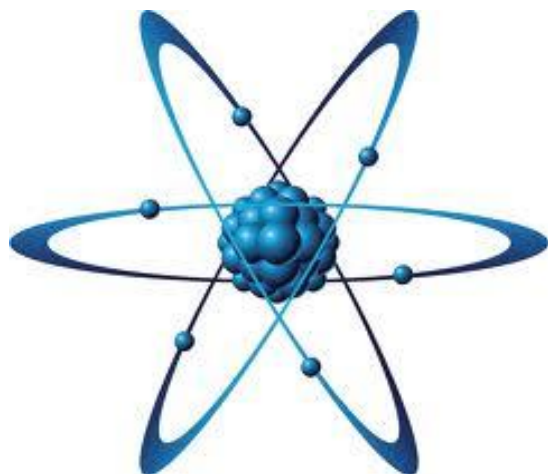


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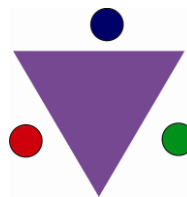
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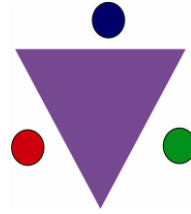
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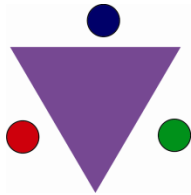
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## A CHARACTERIZATION OF OSCILLATORY MOTIONS FOR ROTATORY CONVECTION IN COUPLE-STRESS FLUID

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### ABSTRACT

The rotatory-thermal instability of a couple-stress fluid heated from below is investigated. Following the linearized perturbation stability theory and normal mode analysis, the paper mathematically established the condition for the onset of oscillatory motions which may be neutral or unstable for rigid boundaries at the top and bottom of the fluid. It is established that all non-decaying slow motions starting from rest, in a couple-stress fluid of infinite horizontal extension and finite vertical depth, which is acted upon by uniform vertical rotation opposite to gravity and a constant vertical adverse temperature gradient, are necessarily oscillatory, if

$$\frac{T_A}{\pi^4 + \pi^8 F^2} > 1,$$

where  $T_A$  is the Taylor number and  $F$  is the couple-stress parameter, the result is also in accordance with corresponding configuration of Newtonian fluid when the couple-stress parameter  $F=0$ , by Gupta et al [1].

**Keywords:** Thermal convection; Couple-Stress Fluid; Rotation; PES; Taylor number.

**MSC 2000 No.:** 76A05, 76E06, 76E15; 76E07.

### INTRODUCTION

In the subject matter like hydrodynamic stability where experiments has led to the theory all along, the main source of arriving at a mathematical breakthrough is to have a feeling for the right result that may have been suggested from nowhere or through the application of intuitive reasoning based on experience and observation. Right from the conceptualizations of turbulence, instability of fluid flows is being regarded at its root. The thermal instability of a fluid layer with maintained adverse temperature gradient by heating the underside plays an important role in Geophysics, interiors of the Earth, Oceanography and

Atmospheric Physics etc. A detailed account of the theoretical and experimental study of the onset of Bénard Convection in Newtonian fluids, under varying assumptions of hydrodynamics and hydromagnetics, has been given by Chandrasekhar [2]. The use of Boussinesq approximation has been made throughout, which states that the density changes are disregarded in all other terms in the equation of motion except the external force term. Sharma et al [3] has considered the effect of suspended particles on the onset of Bénard convection in hydromagnetics. The fluid has been considered to be Newtonian in

all above studies. Scanlon and Segel [1] have considered the effect of suspended particles on the onset of Bénard convection and found that the critical Rayleigh number was reduced solely because the heat capacity of the pure fluid was supplemented by that of the particles.

With the growing importance of non-Newtonian fluids in modern technology and industries, the investigations on such fluids are desirable. Stokes [2] proposed and postulated the theory of couple-stress fluid. One of the applications of couple-stress fluid is its use to the study of the mechanism of lubrication of synovial joints, which has become the object of scientific research. A human joint is a dynamically loaded bearing which has articular cartilage as the bearing and synovial fluid as lubricant. When fluid film is generated, squeeze film action is capable of providing considerable protection to the cartilage surface. The shoulder, knee, hip and ankle joints are the loaded-bearing synovial joints of human body and these joints have low-friction coefficient and negligible wear. Normal synovial fluid is clear or yellowish and is a viscous, non-Newtonian fluid. According to the theory of Stokes [2], couple-stresses are found to appear in noticeable magnitude in fluids very large molecules. Since the long chain hylauronic acid molecules are found as additives in synovial fluid. Walicki and Walicka [3] modeled synovial fluid as couple-stress fluid in human joints. Sharma and Thakur [4] have studied the thermal convection in couple-stress fluid in porous medium in hydromagnetics. Sharma and Sharma [5] have studied the couple-stress fluid heated from below in porous medium. The use of magnetic field is being made for the clinical purposes in detection and cure of certain diseases with the help of magnetic field devices.

Sharma et al. [6] have studied the effect of suspended particles on couple-stress fluid heated from below and found that suspended particles have stabilizing effect on the system. Sharma and Sharma [7] have studied the effect of suspended particles on couple-stress fluid heated from below in the presence of rotation and magnetic field and found that rotation has a stabilizing effect while dust particles have a destabilizing effect on the system. Sunil et al. [8] have studied the effect of suspended particles on couple-stress fluid heated and soluted from below in porous medium and found that suspended particles have stabilizing effect on the system. Thermosolutal convection in a couple-stress fluid in the presence of magnetic field and rotation, separately, has been investigated by Kumar and Singh [9 & 10]. Kumar and Kumar [11] have studied the combined effect of dust particles, magnetic field and rotation on couple-stress fluid heated from below and for the case of stationary convection, found that dust particles have destabilizing effect on the system, where as the rotation is found to have stabilizing effect on the system, however couple-stress and magnetic field are found to have both stabilizing and destabilizing effects under certain conditions. Sunil et al. [12] have studied the global stability for thermal convection in a couple-stress fluid heated from below and found couple-stress fluids are thermally more stable than the ordinary viscous fluids.

Pellow and Southwell [13] proved the validity of PES for for the classical Rayleigh-Bénard convection problem. Banerjee et al [14] gave a new scheme for combining the governing equations of thermohaline convection, which is shown to lead to the bounds for the complex growth rate of the arbitrary oscillatory perturbations, neutral or unstable for all combinations of dynamically rigid or free

boundaries and, Banerjee and Banerjee [8] established a criterion on characterization of non-oscillatory motions in hydrodynamics which was further extended by Gupta et al. [9]. However no such result existed for non-Newtonian fluid configurations, in general and for couple-stress fluid configurations, in particular. Banyal [9] have characterized the non-oscillatory motions in couple-stress fluid in the presence of suspended particles.

Keeping in mind the importance of non-Newtonian fluids, the present paper is an attempt to characterize the onset of instability analytically, in a layer of incompressible couple-stress fluid heated from below in the presence of uniform vertical rotation opposite to force field of gravity, when the bounding surfaces of infinite horizontal extension, at the top and bottom of the fluid are rigid. It is shown that for the configuration under

consideration that, if  $\frac{T_A}{\pi^4 + \pi^8 F^2} \leq 1$ , then an arbitrary neutral or unstable modes of the system

$$\frac{\partial \vec{q}}{\partial t} + (\vec{q} \cdot \nabla) \vec{q} = -\frac{1}{\rho_0} \nabla p + \vec{g} \left( 1 + \frac{\partial \rho}{\rho_0} \right) + \left( \nu - \frac{\mu'}{\rho_0} \nabla^2 \right) \nabla^2 \vec{q} + 2(\vec{q} \times \vec{\Omega}), \quad (1)$$

$$\nabla \cdot \vec{q} = 0, \quad (2)$$

The equation of state

$$\rho = \rho_0 [1 - \alpha (T - T_0)] \quad (3)$$

Where the suffix zero refer to the values at the reference level  $z = 0$ . Here  $\vec{g} = (0, 0, -g)$  is acceleration due to gravity.

Let  $c_v$  denote the heat capacity of the fluid at constant volume, then the equation of heat conduction gives

$$\rho_0 c_v \left( \frac{\partial}{\partial t} + \vec{q} \cdot \nabla \right) T = \kappa \nabla^2 T,$$

Or

$$\frac{\partial T}{\partial t} + (\vec{q} \cdot \nabla) T = \kappa \nabla^2 T, \quad (4)$$

are definitely nonoscillatory and, in particular the PES is valid, where  $T_A$  is the Taylor number.

## FORMULATION OF THE PROBLEM AND PERTURBATION EQUATIONS

Considered an infinite, horizontal, incompressible couple-stress fluid layer, of thickness  $d$ , heated from below so that, the temperature and density at the bottom surface  $z = 0$  are  $T_0, \rho_0$  respectively and at the upper surface  $z = d$  are  $T_d, \rho_d$  and that a uniform adverse temperature

gradient  $\beta \left( = \left| \frac{dT}{dz} \right| \right)$  is maintained. The fluid is

acted upon by a uniform vertical rotation  $\vec{\Omega} = (0, 0, \Omega)$ . Let  $\rho, p, T$  and  $\vec{q} = (u, v, w)$  denote respectively the density, pressure, temperature and velocity of the fluid. Then the momentum balance, mass balance equations of the couple-stress fluid (Stokes [10] (1966), Chandrasekhar [11] (1981) and Scanlon and Segel [12] (1973)) are

The kinematic viscosity  $\nu$ , couple-stress viscosity  $\mu'$ , thermal diffusivity  $\kappa$ , and coefficient of thermal expansion  $\alpha$  are all assumed to be constants.

The basic motionless solution is

$$\vec{q} = (0, 0, 0), T = T_0 - \beta z, \vec{\Omega} = (0, 0, \Omega) \text{ and } \rho = \rho_0 (1 + \alpha \beta z). \quad (5)$$

Assume small perturbations around the basic solution and let  $\delta\rho$ ,  $\delta p$ ,  $\theta$  and  $\vec{q} = (v, w)$  denote respectively the perturbations in density, pressure p, temperature T and couple-stress fluid velocity (0,0,0). The change in density  $\delta\rho$  caused mainly by the perturbation  $\theta$  in temperature is given by

$$\delta\rho = -\alpha\rho_0\theta. \quad (6)$$

Then the linearized perturbation equations of the couple-stress fluid becomes

$$\frac{\partial \vec{q}}{\partial t} = -\frac{1}{\rho_0} \nabla \delta p - g \alpha \theta + \left( \nu - \frac{\mu'}{\rho_0} \nabla^2 \right) \nabla^2 \vec{q} + 2 \left( \vec{q} \times \vec{\Omega} \right), \quad (7)$$

$$\nabla \cdot \vec{q} = 0, \quad (8)$$

$$\frac{\partial \theta}{\partial t} = \beta w + \kappa \nabla^2 \theta, \quad (9)$$

Where

$$\kappa = \frac{q}{\rho_0 c_v}.$$

Within the framework of Boussinesq approximation, equations (7) and (8), give

$$\left[ \frac{\partial}{\partial t} \nabla^2 w - g \alpha \left( \frac{\partial^2 \theta}{\partial x^2} + \frac{\partial^2 \theta}{\partial y^2} \right) + 2 \Omega \frac{\partial \zeta}{\partial z} \right] = \left( \nu - \frac{\mu'}{\rho_0} \nabla^2 \right) \nabla^4 w, \quad (10)$$

$$\left[ \frac{\partial \zeta}{\partial t} - 2 \Omega \frac{\partial w}{\partial z} \right] = \left( \nu - \frac{\mu'}{\rho_0} \nabla^2 \right) \nabla^2 \zeta, \quad (11)$$

Together with (9), where  $\nabla^2 = \frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2} + \frac{\partial^2}{\partial z^2}$  and  $\zeta = \frac{\partial v}{\partial x} - \frac{\partial w}{\partial y}$  denote the z-component of vorticity.

### 3. NORMAL MODE ANALYSIS

Analyzing the disturbances into normal modes, we assume that the Perturbation quantities are of the form

$$[v, \theta, \zeta] = [V, \Theta, Z] \exp(k_x x + i k_y y + n t) \quad (12)$$

Where  $k_x, k_y$  are the wave numbers along the x and y-directions respectively  $k = \sqrt{k_x^2 + k_y^2}$ , is the resultant wave number and n is the growth rate which is, in general, a complex constant.

Using (12), equations (9), (10) and (11), on using (8), in non-dimensional form, become

$$\left( \frac{\partial^2}{\partial z^2} - a^2 \right) \left[ \frac{\partial W}{\partial z} + F \left( \frac{\partial^2}{\partial z^2} - a^2 \right) W - \left( \frac{\partial^2}{\partial z^2} - a^2 \right) \Theta \right] = -\frac{g\alpha d^2 a^2 \Theta}{\nu} - \sqrt{T_A} d D Z, \quad (13)$$

$$\left[ F \left( \frac{\partial^2}{\partial z^2} - a^2 \right) \left( \frac{\partial^2}{\partial z^2} - a^2 \right) \sigma Z - \sqrt{T_A} D W \right] = -\frac{\sqrt{T_A}}{d} D W, \quad (14)$$

$$\left( \frac{\partial^2}{\partial z^2} - a^2 - p_1 \sigma \right) \Theta = -\frac{\beta d^2}{\kappa} W, \quad (15)$$

where

$a = kd, \sigma = \frac{nd^2}{\nu}, p_1 = \frac{\nu}{\kappa}, F = \frac{\mu'}{\rho_0 d^2 \nu}, T_A = \frac{4\Omega^2 d^4}{\nu^2}$   $D = \frac{d}{dz}$  and  $D_{\oplus} = dD$  and dropping  $\Theta$  for convenience. Here  $p_1 = \frac{\nu}{\kappa}$ , is the thermal prandtl number, F is the couple-stress parameter and  $T_A$  is the Taylor number.

Substituting  $W = W_{\oplus}, \Theta = \frac{\beta d^2}{\kappa} \Theta_{\oplus}$  and  $Z = \frac{\sqrt{T_A}}{d} Z_{\oplus}$  in equations (13), (14) and (15) and dropping  $\Theta$  for convenience, in non-dimensional form becomes,

$$\left( \frac{\partial^2}{\partial z^2} - a^2 \right) \left[ \frac{\partial W}{\partial z} + F \left( \frac{\partial^2}{\partial z^2} - a^2 \right) W - \left( \frac{\partial^2}{\partial z^2} - a^2 \right) \Theta \right] = -Ra^2 \Theta - T_A D Z, \quad (16)$$

$$\left[ F \left( \frac{\partial^2}{\partial z^2} - a^2 \right) \left( \frac{\partial^2}{\partial z^2} - a^2 \right) \sigma Z - \sqrt{T_A} D W \right] = -DW, \quad (17)$$

$$\left( \frac{\partial^2}{\partial z^2} - a^2 - p_1 \sigma \right) \Theta = -W, \quad (18)$$

Where  $R = \frac{g\alpha\beta d^4}{\kappa\nu}$ , is the thermal Rayleigh number.

Since both the boundaries rigid and are maintained at constant temperature, the perturbations in the temperature are zero at the boundaries. The appropriate boundary conditions with respect to which equations (16), (17) and (18) must be solved are

$$W = DW = 0, \Theta = 0 \text{ and } Z = 0 \text{ at } z = 0 \text{ and } z = 1. \quad (19)$$

Equations (16)-(18), along with boundary conditions (19), pose an eigenvalue problem for  $\sigma$  and we wish to Characterize  $\sigma_i$  when  $\sigma_r \geq 0$ .

#### 4. MATHEMATICAL ANALYSIS

We prove the following theorem:

**Theorem:** If  $R > 0, F > 0, T_A > 0, \sigma_r \geq 0$  and  $\sigma_i \neq 0$  then the necessary condition for the existence of non-trivial solution  $(W, \Theta, Z)$  of equations (16), (17) and (18) together with boundary conditions (19) is that

$$\frac{T_A}{\pi^4 + \pi^8 F^2} > 1$$

**Proof:** Multiplying equation (16) by  $W^*$  (the complex conjugate of W) throughout and integrating the resulting equation over the vertical range of z, we get

$$\sigma \int_0^1 W^* \left( \frac{\partial^2}{\partial z^2} - a^2 \right) W dz + F \int_0^1 W^* \left( \frac{\partial^2}{\partial z^2} - a^2 \right) W dz - \int_0^1 W^* \left( \frac{\partial^2}{\partial z^2} - a^2 \right) W dz = -Ra^2 \int_0^1 W^* \Theta dz - T_A \int_0^1 W^* D Z dz, \quad (20)$$

Taking complex conjugate on both sides of equation (18), we get

$$\Theta^2 - a^2 - p_1 \sigma^* \bar{\Theta} = -W^*, \quad (21)$$

Therefore, using (21), we get

$$\int_0^1 W^* \Theta dz = - \int_0^1 \Theta \Theta^2 - a^2 - p_1 \sigma^* \bar{\Theta} dz, \quad (22)$$

Also taking complex conjugate on both sides of equation (17), we get

$$F \Theta^2 - a^2 - \sigma^* \bar{Z} = -DW^*, \quad (23)$$

Therefore, using (23), we get

$$\int_0^1 W^* DZ dz = - \int_0^1 DW^* Z dz = \int_0^1 Z \Theta^2 - a^2 - F \Theta^2 - a^2 - \sigma^* \bar{Z} dz, \quad (24)$$

Substituting (22) and (24) in the right hand side of equation (20), we get

$$\begin{aligned} & \sigma \int_0^1 W^* \Theta^2 - a^2 \bar{W} dz + F \int_0^1 W^* \Theta^2 - a^2 \bar{W} dz - \int_0^1 W^* \Theta^2 - a^2 \bar{W} dz \\ & = Ra^2 \int_0^1 \Theta \Theta^2 - a^2 - p_1 \sigma^* \bar{\Theta} dz - T_A \int_0^1 Z \Theta^2 - a^2 - F \Theta^2 - a^2 - \sigma^* \bar{Z} dz, \end{aligned} \quad (25)$$

Integrating the terms on both sides of equation (25) for an appropriate number of times by making use of the appropriate boundary conditions (19), along with (17), we get

$$\begin{aligned} & \sigma \int_0^1 |W|^2 + a^2 |W|^2 dz + F \int_0^1 |W|^2 + 3a^2 |D^2 W|^2 + 3a^4 |DW|^2 + a^6 |W|^2 dz \\ & + \int_0^1 |W|^2 + 2a^2 |DW|^2 + a^4 |W|^2 dz = Ra^2 \int_0^1 |\Theta|^2 + a^2 |\Theta|^2 + p_1 \sigma^* |\Theta|^2 dz - T_A \int_0^1 |Z|^2 + a^2 |Z|^2 dz \\ & - T_A F \int_0^1 |Z|^2 + 2a^2 |DZ|^2 + a^4 |Z|^2 dz - T_A \sigma^* \int_0^1 |Z|^2 dz, \end{aligned} \quad (26)$$

And equating imaginary parts on both sides of equation (26), and cancelling  $\sigma_i (\neq 0)$  throughout from imaginary part, we get

$$\int_0^1 |W|^2 + a^2 |W|^2 dz + Ra^2 p_1 \int_0^1 |\Theta|^2 dz = T_A \int_0^1 |Z|^2 dz, \quad (27)$$

We first note that since  $W$  and  $Z$  satisfy  $W(0) = 0 = W(1)$  and  $Z(0) = 0 = Z(1)$  in addition to satisfying

to governing equations and hence we have from the Rayleigh-Ritz inequality  $\int_0^1 |DW|^2 dz \geq \pi^2 \int_0^1 |W|^2 dz$ ,

(28)

and

$$\int_0^1 |DZ|^2 dz \geq \pi^2 \int_0^1 |Z|^2 dz, \quad (29)$$

Further, for  $W(0) = 0 = W(1)$  and  $Z(0) = 0 = Z(1)$ , Banerjee et al. [1] have show that

$$\int_0^1 |D^2 W|^2 dz \geq \pi^2 \int_0^1 |DW|^2 dz \quad \text{and} \quad \int_0^1 |D^2 Z|^2 dz \geq \pi^2 \int_0^1 |DZ|^2 dz, \quad (30)$$

Further, multiplying equation (17) and its complex conjugate (23), and integrating by parts each term on both sides of the resulting equation for an appropriate number of times and making use of boundary condition on  $Z$  namely  $Z(0) = 0 = Z(1)$  along with (17), we get

$$\begin{aligned} & \int_0^1 \left\{ |D^2 Z|^2 + 2a^2 |DZ|^2 + a^4 |Z|^2 \right\} dz + F^2 \int_0^1 \left\{ |D^4 Z|^2 + 4a^2 |D^3 Z|^2 + 6a^4 \int_0^1 |D^2 Z|^2 + 4a^6 \int_0^1 |DZ|^2 + a^8 |Z|^2 \right\} dz \\ & + 2F \int_0^1 \left\{ |D^3 Z|^2 + 3a^2 |D^2 Z|^2 + 3a^4 \int_0^1 |DZ|^2 + a^6 |Z|^2 \right\} dz + 2\sigma_r \int_0^1 \left\{ |DZ|^2 + a^2 |Z|^2 \right\} dz \\ & + 2\sigma_r F \int_0^1 \left\{ |D^2 Z|^2 + 2a^2 |DZ|^2 + a^4 |Z|^2 \right\} dz + |\sigma|^2 \int_0^1 |Z|^2 dz = \int_0^1 |DW|^2 dz, \end{aligned} \quad (31)$$

Further, by utilizing boundary conditions (19) and equation (17), it follows that

$$\begin{aligned} \int_0^1 |D^2 Z|^2 dz &= \text{Real part of} \left[ - \int_0^1 DZ^* D^3 Z dz \right] \leq \left| - \int_0^1 DZ^* D^3 Z dz \right| \leq \left| \int_0^1 DZ^* D^3 Z dz \right|, \\ &\leq \int_0^1 |DZ^* D^3 Z| dz \leq \int_0^1 |DZ^*| |D^3 Z| dz \leq \int_0^1 |DZ| |D^3 Z| dz \leq \left[ \int_0^1 |DZ|^2 dz \right]^{\frac{1}{2}} \left[ \int_0^1 |D^3 Z|^2 dz \right]^{\frac{1}{2}}, \\ &\hspace{15em} (\text{Utilizing Cauchy- Schwartz-inequality}), \end{aligned}$$

$$\leq \frac{1}{\pi} \left[ \int_0^1 |D^2 Z|^2 dz \right]^{\frac{1}{2}} \left[ \int_0^1 |D^3 Z|^2 dz \right]^{\frac{1}{2}},$$

(Utilizing inequality (30)),

So that we have

$$\left[ \int_0^1 |D^2 Z|^2 dz \right]^{\frac{1}{2}} \leq \frac{1}{\pi} \left[ \int_0^1 |D^3 Z|^2 dz \right]^{\frac{1}{2}},$$

Which yields

$$\int_0^1 |D^3 Z|^2 dz \geq \pi^2 \int_0^1 |D^2 Z|^2 dz, \quad (32)$$

Using inequality (29) and (30), inequality (32) becomes

$$\int_0^1 |D^3 Z|^2 dz \geq \pi^6 \int_0^1 |Z|^2 dz, \quad (33)$$

Also,

$$\int_0^1 |D^3 Z|^2 dz = \text{Real part of} \left[ - \int_0^1 D^2 Z^* D^4 Z dz \right] \leq \left| - \int_0^1 D^2 Z^* D^4 Z dz \right| \leq \left| \int_0^1 D^2 Z^* D^4 Z dz \right|,$$

$$\leq \int_0^1 |D^2 Z^* D^4 Z| dz \leq \int_0^1 |D^2 Z^*| |D^4 Z| dz \leq \int_0^1 |D^2 Z| |D^4 Z| dz, \leq \left[ \int_0^1 |D^2 Z|^2 dz \right]^{\frac{1}{2}} \left[ \int_0^1 |D^4 Z|^2 dz \right]^{\frac{1}{2}},$$

(Utilizing Cauchy- Schwartz-inequality),

$$\leq \frac{1}{\pi} \left[ \int_0^1 |D^3 Z|^2 dz \right]^{\frac{1}{2}} \left[ \int_0^1 |D^4 Z|^2 dz \right]^{\frac{1}{2}},$$

(Utilizing inequality (32)),

So that we have

$$\left[ \int_0^1 |D^3 Z|^2 dz \right]^{\frac{1}{2}} \leq \frac{1}{\pi} \left[ \int_0^1 |D^4 Z|^2 dz \right]^{\frac{1}{2}},$$

Which yields

$$\int_0^1 |D^4 Z|^2 dz \geq \pi^2 \int_0^1 |D^3 Z|^2 dz, \tag{34}$$

Using inequality (33), inequality (34) becomes

$$\int_0^1 |D^4 Z|^2 dz \geq \pi^8 \int_0^1 |Z|^2 dz, \tag{35}$$

Now  $F > 0$  and  $\sigma_r \geq 0$ , therefore the equation (31) gives,

$$\int_0^1 |D^2 Z| dz + F^2 \int_0^1 |D^4 Z| dz < \int_0^1 |DW|^2 dz, \tag{36}$$

And on utilizing the inequalities (29), (30), (33) and (35), inequality (36) gives

$$\int_0^1 |Z|^2 dz < \frac{1}{\pi^4 + \pi^8 F^2} \int_0^1 |DW|^2 dz, \tag{37}$$

Now  $R > 0$  and  $T_A > 0$ , utilizing the inequalities (37), the equation (27) gives,

$$\left[ 1 - \frac{T_A}{\pi^4 + \pi^8 F^2} \right] \int_0^1 |DW|^2 dz + a^2 \int_0^1 |W|^2 dz + Ra^2 p_1 \int_0^1 |\Theta|^2 dz < 0, \tag{38}$$

and therefore, we must have

$$\frac{T_A}{\pi^4 + \pi^8 F^2} > 1. \tag{39}$$

Hence, if

$$\sigma_r \geq 0 \text{ and } \sigma_i \neq 0, \text{ then } \frac{T_A}{\pi^4 + \pi^8 F^2} > 1.$$

And this completes the proof of the theorem.

## RESULTS

Presented otherwise from the point of view of existence of instability as stationary convection, the above theorem can be put in the form as follow:-

**Theorem 2:** The sufficient condition for the validity of the ‘exchange principle’ and the onset of instability as a non-oscillatory motions of non-growing amplitude in a couple-stress fluid, heated from below, in the presence of uniform vertical

rotation is that,  $\frac{T_A}{\zeta^4 + \pi^8 F^2} \leq 1$ , where  $T_A$  is

the Taylor number and  $F$  is the couple-stress parameter, when the boundaries are rigid.

or

The onset of instability in a couple-stress fluid, heated from below, in the presence of uniform vertical rotation, cannot manifest itself as oscillatory motions of growing amplitude if the Taylor number  $T_A$  and the couple-stress parameter  $F$ , satisfy the

inequality  $\frac{T_A}{\zeta^4 + \pi^8 F^2} \leq 1$ , when both the

bounding surfaces are rigid.

In the context of existence of instability in ‘oscillatory modes’ and that of ‘overstability’ in the present configuration, we can state the above theorem as follow:-

**Theorem 3:** The necessary condition for the existence of instability in ‘oscillatory modes’ and that of ‘overstability’ in a couple-stress fluid heated from below, in the presence of uniform vertical rotation is that the Taylor number  $T_A$  and the couple-stress parameter of the fluid  $F$ , must

satisfy the inequality  $\frac{T_A}{\zeta^4 + \pi^8 F^2} > 1$ , when both

the bounding surfaces are rigid

## DISCUSSIONS AND CONCLUSIONS

This theorem mathematically established that the onset of instability in a couple-stress fluid in the presence of uniform vertical rotation, cannot manifest itself as oscillatory motions of growing amplitude if the Taylor number  $T_A$  and the couple-stress parameter of the fluid, satisfy the

inequality  $\frac{T_A}{\zeta^4 + \pi^8 F^2} \leq 1$ , when both the

bounding surfaces are rigid.

The essential content of the theorem, from the point of view of linear stability theory is that for the configuration of couple-stress fluid of infinite horizontal extension heated from below, having rigid boundaries at the top and bottom of the fluid, in the presence of uniform vertical rotation, parallel to the force field of gravity, an arbitrary neutral or unstable modes of the system are definitely non-oscillatory in character

if  $\frac{T_A}{\zeta^4 + \pi^8 F^2} \leq 1$ , and in particular PES is

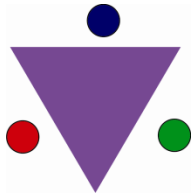
valid and it improved the domain of the result of Banyal and Singh [2]. Further, the result is also in accordance with corresponding configuration of Newtonian fluid when the couple-stress parameter  $F=0$ , by Gupta et al [1].

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## REFERENCES

1. Gupta, J.R., Sood, S.K., and Bhardwaj, U.D., (1986), On the characterization of nonoscillatory motions in rotatory hydromagnetic thermohaline convection, *Indian J. pure appl.Math.*,17(1) pp 100-107.
2. Chandrasekhar, S., (1981), *Hydrodynamic and Hydromagnetic Stability*, Dover Publication,
3. Sharma, R.C., Prakash, K. and Dube, S.N. (1976).Effect of suspended particles on the onset of Bénard convection in hydromagnetics, *J. Math. Anal. Appl.*, USA, Vol. 60 pp. 227-35.
4. Scanlon, J.W. and Segel, L.A., (1973), Some effects of suspended particles on the onset of Bénard convection, *Phys. Fluids*. Vol. 16, pp. 1573-78
5. Stokes, V.K., (1966), Couple-stress in fluids, *Phys. Fluids*, Vol. 9, pp. 1709-15.
6. Walicki, E. and Walicka, A., (1999), Inertial effect in the squeeze film of couple-stress fluids in biological bearings, *Int. J. Appl. Mech. Engg.*, Vol. 4, pp. 363-73
7. Sharma, R.C. and Thakur, K. D., (2000), Couple stress-fluids heated from below in hydromagnetics, *Czech. J. Phys.*, Vol. 50, pp. 753-58
8. Sharma, R.C. and Sharma S., (2001), On couple-stress fluid heated from below in porous medium, *Indian J. Phys*, Vol. 75B, pp.59-61.
9. Sharma, R.C., Sunil, Sharma, Y. D. and Chandel, R.S., (2002), On couple-stress fluid permeated with suspended particles heated from below, *Archives of Mechanics*, 54(4) pp. 287-298.
10. Sharma, R.C. and Sharma, M., (2004), Effect of suspended particles on couple-stress fluid heated from below in the presence of rotation and magnetic field, *Indian J. pure. Appl. Math.*, Vol. 35(8), pp. 973-989
11. Sunil, Sharma, R.C. and Chandel, R.S., (2004), Effect of suspended particles on couple-stress fluid heated and soluted from below in porous medium, *J. of Porous Media*, Vol. 7, No.1 pp. 9-18
12. Kumar, P. and Singh, M. (2008), Magneto thermosolutal convection in a couple-stress fluid, *Ganita Sandesh (india)*, Vol.21(2).
13. Singh, M. and. Kumar, P., (2009), Rotatory thermosolutal convection in a couple-stress fluid, *Z. Naturforsch*, 64a, 7(2009)
14. Kumar, V. and Kumar, S. (2011), On a couple-stress fluid heated from below in hydromagnetics, *Appl. Appl. Math.*, Vol. 05(10),pp. 1529-1542
15. Sunil, Devi, R. and Mahajan, A. (2011), Global stability for thermal convection in a couple stress- fluid, *Int. comm.. Heat and Mass Transfer*, 38,pp. 938-942
16. Pellow, A., and Southwell, R.V., (1940), On the maintained convective motion in a fluid from below. *Proc. Roy. Soc. London A*, 176, 312-43.
17. Banerjee, M.B., Katoch, D.C., Dube,G.S. and Banerjee, K. (1981). Bounds for growth rate of perturbation in thermohaline convection. *Proc. R. Soc. A*378, 301-04
18. Banerjee, M. B., and Banerjee, B. (1984), A characterization of nonoscillatory motions in magnetohydraulics. *Ind. J. Pure & Appl Maths.*, 15(4), 377-382
19. Banyal, A.S., (2011) A characterization of non-oscillatory motions in couple-stress fluid in the presence of suspended particles (2011), *J. Comp. and Math. Scis.(JCMS)*, Vol.2( 3), pp. 537-545.
20. Schultz, M.H. (1973). *Spline Analysis*, Prentice Hall, Englewood Cliffs, New Jersey
21. Banerjee, M.B., Gupta, J.R. and Prakash, J. (1992), On thermohaline convection of Veronis type, *J. Math. Anal. Appl.*, Vol.179, No. 2 pp. 327-334.
22. Banyal, A. S. and Singh, K., (2011) A Characterization of Rotatory Convection in Couple-Stress Fluid, *Int. J. of Fluids Engg.*, Vol. 3, No. 4, pp. 459-468.



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## COMPREHENSIVE ORAL REHABILITATION OF CLEFT LIP AND PALATE PATIENTS

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### ABSTRACT

Cleft lip and palate is one of the most common birth defect with incidence of 1 in 600 births and causes severe facial deformity adversely affecting the self esteem of the child if treatment is not initiated in appropriate time. There has been a robust growth in the treatment of Cleft lip and palate with intricate interconnections of different multi specialities who deliver the treatment in the most seamless way. The purpose of this review article is to illustrate the various dental treatment modalities that can be delivered on a cleft child from birth to adolescence in the overall rehabilitation.

### INTRODUCTION

Cleft of lip and palate are immediately recognizable disruption of normal facial structure accounting approximately one in 600 new born babies<sup>1</sup> and over 300 syndromes are known to have clefting of the lip or palate as an associated feature.<sup>2</sup> It causes considerable morbidity, impose a substantial financial risk for family with a concomitant societal burden. These patients may experience problem with feeding, speaking, hearing, and social integration which can be corrected to various degree by surgery, dental treatment, speech therapy and psychologic intervention.

The treatment protocol of a cleft lip cleft palate patient is unique and needs a smooth delivery of optimum expertise of various specialties in an intricate seamless way, because treatment delivered by one specialty may hamper or interfere in the treatment of other specialty. Team approach to patients with craniofacial anomalies which includes coordination with oral and maxillofacial

surgeons, ENT specialists, obstetricians, speech pathologist, paediatricians, psychologist, ophthalmologist and the nursing staff. Pedodontist role in the multidisciplinary team approach is very important as a specialist being trained in every aspect of child from physiology to psychology their active role in early intervention in overall management is highly recommended. The purpose of this paper is to provide a review of all the different treatment procedures to be delivered to the cleft lip and palate patient from birth to adolescence.

#### Diagnosis and maternal counselling

Intrauterine diagnosis of orofacial clefts is possible by ultrasonography. Clefts are seen easily at 16 weeks of gestation, MRI is used increasingly for evaluation of fetal abnormalities that are difficult to identify on sonography alone.<sup>3, 4</sup> Parental counselling may be required as the family will be under stress. Genetic counselling is also necessary<sup>5</sup>.

**Clinical findings:**

These cases show absent or short columella, shallow gingivolabialsulcus, hypoplastic maxilla, dental problems like congenitally absent primary or permanent lateral incisors or missing premolars adjacent to alveolar cleft, supernumerary teeth, enamel hypoplasia, microdontia/macrodontia, fused teeth aberrations in crown shape and Posterior cross bite with medial collapse of posterior segments. **FIGURE 1**

**Management:** Mainly by multidisciplinary approach with timely and intricate coordination of various specialties

**Feeding Advice:** Cleft children face a lot of problems in feeding like insufficiency in sucking milk from the nipple due to inability to create negative pressure, excessive air intake during feeding, choking, nasal discharge, regurgitation and excessive time required for nourishment make it difficult for the infant to maintain adequate nutrition.<sup>6, 7</sup> Specialized feeding bottles such as the Hagerman feeder and Mead Johnson bottle helps in overcoming some of the feeding problems. The Mead-Johnson cleft palate feeder is a compressible bottle with an elongated cross-cut nipple. With this flow is increased by gently squeezing the bottle in rhythm with the infant's suckling action.. The mothers of cleft child are highly anxious during the feeding process, so counseling the right feeding skills is advisable, cleft babies kept upright at 45° while feeding make gravity aid in the feeding process.<sup>6</sup>

The feeding obturator is a prosthetic aid **FIGURE 2,3** that is designed to obturate the cleft and ensures the separation between the oral and nasal cavities, thereby reducing nasal regurgitation and helps in the development of the jaws and speech. It also prevents the tongue from entering the defect and interfering with spontaneous growth of the palatal shelves hence providing maxillary orthopaedic molding of the cleft segments into approximation before any surgical intervention is done.<sup>7,8</sup>

**Technique of fabrication of Obturators;**

**Impression technique:** is very challenging and There are variety of methods followed for it.

**METHOD I**

Some plastic surgeons prefer light-polymerizing acrylic resin sheets which are moldable to adapt to the oral anatomy after which it is taken out and cured with light to form the primary impression tray for preliminary impression. The impression is poured in Type III dental stone and a custom made tray is fabricated.. Final impression can be recorded with Vinyl polysiloxane materials; the baby is held face toward the floor, in order to prevent aspiration in the event of vomiting and asphyxia.

**Method II**

Primary impression can be made by softened green stick compound and For Wash impression putty consistency addition silicone impression material is used.<sup>6,3,5</sup> Most often used in patients with microstomia and palatal fistula where the patient is unable to open the mouth

**Method III**

A wax sheet of approximate size and shape can be adapted intraorally using the thumb and Index finger. A stone model of the negative wax reproduction is then obtained and a custom acrylic tray with a handle is prepared to be used for final impression.<sup>7</sup>

**The Pre Maxillary Orthopaedics:**

Orthopaedics start within the first week of life and aim at normalizing function and arch form by the most gentle means as possible during the first 18 months, a period of most intensive growth<sup>8</sup>.

**Naso Alveolar Molding [NAM]**

NAM is a non surgical method of reshaping alveolus, lip and nostrils before cleft lip and palate surgery, lessening the severity of cleft.. The modern school of pre surgical orthopaedic treatment in cleft lip and palate was started by McNeil in 1950. Burston, an orthodontist, further developed McNeil's technique and made it

popular. It takes advantage of malleability of immature cartilage which is high in maternal estrogen and hyaluronic acid in the first few weeks of birth and its ability to maintain permanent correction of its form. NAM improves alignment of the alveolar segments and the cleft gap is significantly reduced in size before surgery, making primary repair of the lip, alveolus and the nose an effortless procedure. Narrowing of cleft region reduces tension of the tissues after surgery which would otherwise lead to lip dehiscence in large cleft lip surgery (McNeil 1956). It also improves aesthetic outcome (Gnoinski 1990). It also forces the tongue out of cleft and aids in the development of normal tongue tip behaviour and enhances production of alveolar sounds at 1 yr of age (Dutchcleft trial; Konst et al 1999). Less scar tissue and better lip and nasal form can be achieved so reduces the number of surgical revisions for excessive scar tissue, oronasal fistulas, and nasal and labial deformities. With the alveolar segments in a better position and increased bony bridges across the cleft, the permanent teeth have a better chance of eruption in a good position with adequate periodontal support.<sup>8,9,10</sup> It facilitates feeding, parental support and improved speech the aim of this procedure is Molding the nasal and alveolar segments before surgery to achieve optimum functional and esthetic results. (Oliver 1973, Lubit 1976, Huddart 1990)<sup>8,9,11</sup>

### **Fabrication**

The molding plate is fabricated on the dental stone model with clear self cure acrylic after blocking undercuts and the cleft space with wax. A small opening measuring 6-8 mm in diameter is made on the palatal surface to provide an airway in the event that the palate drops down posteriorly, especially in cases of Pierre Robin syndrome. A retention button is fabricated and positioned anteriorly at an angle of 40° to the plate. In the unilateral cleft only one retention arm is advised.<sup>9,11</sup>

### **Appliance insertion and taping**

The appliance is secured extra orally to the cheeks and bilaterally by surgical tapes that have orthodontic elastic bands at one end. The tapes are a quarter inch in width and about 3-4 inches in length. The elastic on the surgical tape is looped on the retention arm of the molding plate and the tape is secured to the cheeks. The elastics (inner diameter 0.25 inch) are stretched approximately two times their resting diameter for proper activation force of about 100 grams. Parents are instructed to keep the plate in the child's mouth full time and to remove only for cleaning daily the use of skin barrier tapes on the cheeks like DuoDerm or Tegaderm is advocated to reduce irritation on the cheeks. The infant may require time to adjust to feeding with the appliance in the first few days.<sup>11,12,13</sup>

### **Appliance Adjustments**

The baby is seen weekly to make adjustments of the molding plate to bring the alveolar segments together by selectively removing the hard acrylic and adding the soft denture base relining material to the molding plate. No more than 1 mm of modification of the molding plate should be made at one visit.<sup>9</sup> Guidance of maxillary segments moulding plate is adjusted by removing about 1mm soft acrylic along the medial surface of distorted major segment. **FIGURE 4**

After the cleft of the alveolus is reduced to about 5-6 mm the nasal stent is added to improve the alignment of base of the nose and the lip segment. Stent is made up of 0.36 inch, round stainless steel wire in the shape of a 'Swan Neck'. The stent is attached to the labial flange of the molding plate, near the base of the retention arm extends 3-4 mm past the nostril aperture. The hard acrylic component is shaped into a bi-lobed form that resembles a kidney.<sup>9,11</sup>

### **Pre maxillary Retraction**

In cases of cleft lip and palate, premaxillary segment may be positioned severely anterior to the maxillary arch or deviated laterally to one side of

the cleft defect, a straight extra oral force would not place the pre maxilla in the facial midline. In this case, an impression is made of the infant's premaxilla for construction of external acrylic "bulb" prosthesis. This appliance is fitted over the protruding and laterally displaced premaxilla and anchored to the infant's head with a bonnet appliance. After the premaxilla is in the midline, the bulb appliance is replaced by a single elastic strap. In many cases the use of soft, elastic tape (Microfoam Tape) can be used to retract the premaxillary segment in a simpler manner than with the bonnet retraction system.<sup>12, 17</sup> It is worn 24 hours a day and is removed only for feeding. The desired movement can usually be accomplished within 6 to 8 weeks. **FIGURE 5**

**Latham Appliance** (described by Georgiade in 1970). It is an intra oral appliance anchored on the non-cleft maxillary segment that would exert forward force on the cleft maxilla and provide some control over the non-cleft segment. The appliance is designed so that it could be secured to the palatal segments with stainless steel pins. Clockwise turns of the screw move the cleft side of the appliance towards the screw head.<sup>18</sup>

#### **Controversies of Infant Orthopaedics**

Controversies exist against infant orthopedics. Some authors believe that this treatment is expensive and may inhibit maxillary growth (Pruzansky 1964). Bokhout et al (1996) showed that infant orthopedics increases the incidence of dental caries and cause irritation to the oral mucosa, gingival tissue or nasal mucosa.

#### **Complications of NAM**

Complications include intraoral tissue ulceration from excessive pressure applied by the appliance, commonly found in the oral vestibule and on the labial side of the premaxilla. The intranasal lining of the nasal tip can become inflamed if too much force is applied by the upper lobe of the nasal stent. Extreme care should be taken while removing the cheek tape to avoid any irritation to the skin.<sup>9, 13, 15</sup>

#### **GINGIVOPERIOSTEOPLASTY:**

This creates a mucoperiosteal bridge across the alveolar cleft associated with cleft lip and palate. The subperiosteal tunnel allows for bone generation in the absence of bone grafting in young patients. Multiple studies reveal superior facial growth parameters, particularly vertical maxillary growth, when compared with primary bone grafting typically performed within the first year of life and a reduced need for later secondary bone grafting<sup>21</sup>.

#### **CHEILOPLASTY:**

The appearance of an unrepaired wide cleft lip can be distressing. Lip surgery will significantly improve the infant's appearance and thereby relieve parental apprehensions. Surgical closure of the cleft lip may be shortly accomplished after birth, i.e. at 10 weeks of age.

#### **PALATOPLASTY:**

The repair of palate between 1- 1<sup>1/2</sup> years of age gives the best balanced result. Early repair leads to better speech development but severe midfacial growth retardation and dental malocclusion. If palatal repair is done after full growth of the maxilla, midfacial growth retardation and dental malocclusion problems will be less, but speech problem will be very severe.

The soft palate is repaired early to facilitate speech; surgical correction of hard palatal repair is deferred for a later repair at 4 to 5 years.

#### **Hearing problems and Speech disorders**

Paediatric dentist should also be aware of common speech and hearing problem for proper referral and timings of treatment. Speech disorders commonly found in cleft lip and palate patients are hypo nasality, ENT problems, nasal deviation, oronasal fistula and, abnormal growth of oronasal structures.

Hyper nasal speech is corrected by pharyngoplasty and speech therapy.<sup>22</sup> Middle ear disease are commonly seen in cleft lip and palate patients mainly due to short Eustachian tube leading to failure of ventilatory function and

abnormal insertion of Tensor veli palatine muscle into tube. These dysfunctions cause otitis media with effusion commonly known as glue ear. Early palatine surgery improves eustachian tube functions and any hearing problem should be repaired before the child learns to speak. A rehabilitative procedure employing palatal lift prosthesis (PLP) is given to recover diminished speech function<sup>22</sup>.

#### **Oral hygiene and Preventive therapy**

Oral hygiene is of crucial importance after surgery, the patient is anxious about the bleeding caused due to surgery and is nervous to brush.<sup>20</sup> Lip is lifted with the aid of index finger along the labial gingiva without damaging the scar and a baby brush with a small sized head is advised for brushing as there is a lack of sulcus depth and awkward tooth positions in the cleft region. 0.12% chlorhexidine gluconate mouthwash is useful for short periods following surgery to stabilize gingival health in severe cases of gingival inflammation; use of pit and fissure sealants is advisable.<sup>20</sup> Patient-applied topical fluoride in the form of a mouthrinse is worthwhile especially during orthodontic treatment.

#### **Orthodontic problems in mixed dentition**

The midfacial deformities due to primary cleft surgeries include transverse maxillary deficiency with crossbite, midfacial retrusion, reduced antero-posterior development, mandibular prognathism and concave soft tissue profile. A current treatment protocol involves the combined use of Orthodontic treatment, alveolar bone grafting and Implant rehabilitation.<sup>17</sup>

#### **Palatal expansion**

The constricted maxilla as result of the scar tissue following surgery and restricted growth of mandible leads to cross bite. Various expansion appliances that are used are fan shaped maxillary expander, butter fly expander, rapid maxillary expander, quad helix expansion appliance, the banded hyrax appliance, and bonded rapid palatal expander.<sup>16, 18, 23</sup>

They are inefficient because of intermittent nature of force application. Also, they are often soldered to maxillary first molars with pre-existing mesiolingual rotations that the devices are unable to correct. These rotations can distort the appliances and until the rotations are corrected, much of potential expansion time is wasted<sup>25,27</sup>. To overcome disadvantages of rapid maxillary expansion, Nickel Titanium Expander were put forward by Micheal O. Abdoney in 1995. It is temperature activated expander which creates transverse expansion, uprights and rotates the maxillary molars and allows a smooth transition to fixed retention with not much dependence on patient compliance.<sup>27, 30</sup> Bonded rapid palatal expander, an acrylic splint (0.2mm/day) for one month has shown approximately 4.2mm expansion.

#### **Protraction of mid face**

Protraction is achieved by using a face mask orthopedically. A force of 450 grams per side is initiated and is continued for 1.2 years for a minimum of 12-14 hrs/day. Though the skeletal changes are limited, they produce marked improvements in the soft tissue profile.<sup>33</sup> **Figure 6**

#### **Alveolar bone grafting**

Alveolar bone grafting is typically done between 9 and 11 years of age, when the permanent lateral incisor or the canine tooth roots are approximately one-third developed. It provides bony support to adjacent teeth and provide bony matrix for eruption of teeth in the cleft site. It also eliminates oronasal fistulae, elevate the alar base and provide adequate bone for future dental implant.<sup>26</sup>

#### **Endosseous implant placement**

It is done in case of congenitally missing lateral incisor. Factors influencing implant success are, type of bone used for the graft, developmental stage of the dentition and healing time of the graft. Implant is placed 4-6 months after the grafting procedure. It is not usually placed in young patients for the risk of it becoming ankylosed.<sup>31</sup>

### **Distraction Osteogenesis**

Distraction of maxilla was first proposed by Molina & Oritz-Monasterio(1998). It is a procedure wherein two segments of bone are slowly moved apart in such a way that new bone fills the gap. A device known as distractor is attached to both sides of osteotomed bone, which is gradually adjusted over a period of days or week to stretch the bones so new tissue fills within it which enhances soft tissue adaptation..<sup>28, 29, 30</sup>

### **Alveolar distraction process using dental implants**

An intraosseous, prosthetic device can be used to correct vertical bony defects and serve as the anchor for prosthesis after completion of distraction It is a two-stage procedure in which the implant is placed and permitted to heal for some month .After a latency period of 5 to 12 days, active distraction is started. After completion of distraction process the implant is used to support a dental prosthesis.<sup>31, 32</sup>

### **Complications**

Mechanical problems, such as pin loosening, device failure, Local infections, Ankylosis of zygoma and coronoid process, Damage to teeth and Tooth mobility.

### **Orthognathic surgeries for secondary cleft and craniofacial deformities**

Timing of surgery depends on functional problems, psychological factors and facial growth pattern.<sup>35</sup> generally it is done after completion of growth or when skeleton is mature to achieve predictable results. Lefort I maxillary osteotomy is the basic procedure for the corrections of maxillary deficiency in patients who have cleft .Mid face osteotomies at Lefort II and Lefort III level also have been used depending on the esthetic needs of patients.<sup>34,37</sup>

### **PSYCHOLOGICAL FACTORS:**

Patients with cleft palate have lowered self esteem and difficulties in social interaction. Parents of children with clefts are more likely to spoil their child by being over protective. Communication

disorders are more the result of psychological problems than phonological which influences the entire development of an affected child. Strong parent support networks may help to prevent the development of negative self concept in children with cleft lip and palate.

### **SUMMARY**

There has been a robust growth in the treatment of cleft lip and palate and has come a long way before the total rehabilitation by multi disciplinary approach has helped the cleft patient lead a normal life with almost a face as normal as any other individual and is been possible with excellent surgical results and intricate and seamless multidisciplinary approach by various specialists. The paediatric dentist has a pivotal role restoring esthetics and function and providing continuing high quality, preventive- based dental care through thorough treatment planning and skilful behaviour management.

### **REFERENCES**

1. Batra P,Duggal R Prakash H. Genetics of cleft lip and palate revisited. *J Clin Pediatr Dent*: 27(40): 311-320; 2003
2. Cobourne M T. The Complex genetics of Cleft lip and palate. *European Journal of Orthodontics* 26:7-16; 2004
3. Jianyan L et al. Analysis of interactions between genetic variants of BMP4 and environmental factors with nonsyndromic cleft lip with or without cleft. *Int J Oral Maxillofac Surg*:39: 50-56: 2010
4. Bender PL. Genetics of cleft lip and palate. *J Pediat Nurs*:15; 242-49 2000
5. Jones MC, Prenatal diagnosis of cleft lip and palate: Detection rates, accuracy of ultrasonography and strategies for counselling .*Cleft Palate Craniofac J*; 39; 169-73,2002
6. Bhatia R,Trivedi BD. Role of Pediatric Dentist in Cleft Lip and Cleft palate patients. *Scientific Journal*: 3:2009

7. Pani S C, Hegde A M .Impressions in cleft lip and palate -A novel two stage technique. J Clin Pediatr Dent: 33(2):7-10, 2008
8. Ijaz A, Nasoalveolar moulding of the unilateral cleft of the lip and palate infants with modified stent plate; Pakistan Oral and Dental Journal: 28: 1, 2010
9. Grayson B H, Cutting CB. Presurgical Nasoalveolar Orthopedic Molding in Primary Correction of the Nose, Lip and Alveolus of Infants born with Unilateral and Bilateral clefts. Cleft palate Craniofac. J; 37:528-532, 2000
10. Pfeifer T M, et al Nasoalveolar moulding and gingivoperiosteoplasty versus alveolar bone graft: An outcome analysis of costs in the treatment of unilateral cleft alveolus: Cleft Palate craniofacial journal :39:1,2002
11. Mitsuyoshi L et al Simple modified preoperative nasoalveolar moulding in infants with unilateral cleft lip and palate: British journal of Oral and maxillofacial surgery: 42; 578-580,2004
12. Yang S, Stelnicki EJ, Lee MN. Use of Nasoalveolar molding appliance to direct growth in new born patient with complete unilateral cleft and palate. Pediatr Dent :25; 253-256 , 200
13. Aminpour S, Tollefson TT.Recent advances in Presurgical molding in cleft lip and palate.Plast reconstr surg ;122(4):1131-7 , 2008
14. King NM et al. The management of children born with cleft lip and palate. HKMJ; 2; 153-159, 1996
15. Grayson BH, Shetye PR. Presurgical Nasoalveolar moulding treatment in cleft lip and palate patients.; Review; Indian J Plast Surg; 42(S); 56-61,2009
16. Jaeger, M Braga-Silva. Correction of the Alveolar Gap and Nostril Deformity by Presurgical Passive Orthodontia in the Unilateral Cleft Lip; J Ann Plast Surg; 59: 489-494, 2007
17. Vargervik K. Growth characteristics of the premaxilla and orthodontic treatment principles in bilateral cleft lip and palate. Cleft palate journal:20(4):289-301,1983
18. Spira M, Findlay S, Hardy S, Gerow F ; Early maxillary orthopedics in cleft palate patients: A Clinical Report, Journal of Cranio-Maxillofacial Surgery:24, 45-48, 1992
19. Yukihiro F et al Journal of maxillofacial prosthetics:22(2):86-94,1999
20. Rivkin CJ. Dental care for the patients with a cleft lip and palate. BDJ: 188:2, 2000
21. Losquadro WD, Tatum SA .Direct gingivoperiosteoplasty with palatoplasty.Facial plast surg 2007 may;23(2): 140-5
22. Witzel MA. Speech evaluation and treatment. Oral Maxillofac Surg Clin North Am 3: 501-16, 1991
23. Vasant MR.Menon S, Kannan S.Maxillary Expansion in Cleft lip and Palate using Quad Helix and Rapid Palatal Expansion Screw. MJAFI: 65 :150-153:2009
24. Klempner S Early orthopaedic class III treatment with a modified tandem appliance: JCO:37(4):218-223,2003
25. Isaacson R J .Some effects of Rapid maxillary expansion in cleft lip and palate patients: AJOD: 34;3,1964
26. Kawakami et al .Maxillary Expansion and protraction in cleft lip/palate. Angle orthodontist 2002;72(4):356-361
27. Rygh P .Orthopedic Expansion and Protraction of maxilla in cleft palate patients – A New Treatment rationale Cleft palate journal:19; 2, 1982
28. Watzinger F et al. Computer-aided surgery in distraction osteogenesis of maxilla and mandible .Int J Oral Maxillofac Surg; 28; 171-175, 1999

29. Swennen G et al .Craniofacial distraction osteogenesis:review of literature.Part –I clinical studies.Int J Oral Maxillofac surgery:30:89-103,2001
30. Arndt.WV .Nickel Titanium Palatal Expander .JCO; Mar129-137, 1993
31. Salyer KE, Xu H et al .Skeletal facial balance and harmony in the cleft patient :principles and techniques in orthognathic surgery.Indian journal of plastic surgery;42;149-167,2009
32. Pena WA et al. The Role of Endosseous Implants in the Management of Alveolar Clefts Pediatr Dent; 31; 329-333; 2009
33. Sakamoto T et al. Orthodontic treatment for jaw deformities in cleft lip and palate patients with the combined use of external expansion arch and a facial mask.Bull.Tokyodont coll: 43(4):223-229,2002
34. Oral and maxillofacial Surg Clin N Am:17: 503-517,2005
35. Smith AS et al :Prenatal Diagnosis of Cleft Lip and Cleft Palate Using MRI .American journal of roentgenology:183: 229-235,2004
36. Ravichandra et al: A new technique of impression making for an obturator in cleft lip and palate cases.J Indian Soc Pedod Prev Dent: 4( 28); 311-314,2010
37. Chigurupathi R : Orthognathic surgeries done for secondary cleft and craniofacial deformities. Oral Maxillofacial Surg Clin N Am: 17;503-517 ,2005



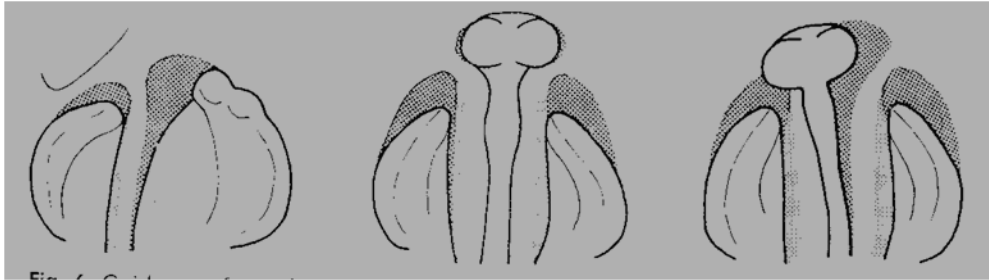
**Figure 1: A child with Unilateral cleft lip & palate**



**Figure 2 : Feeding by nasogastric tube**



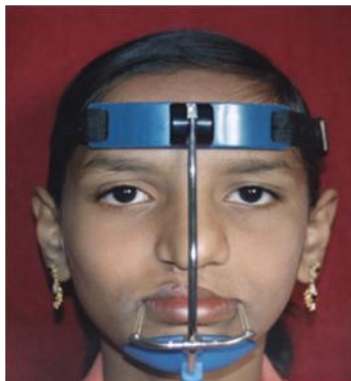
**Figure 3 : The feeding obturator**



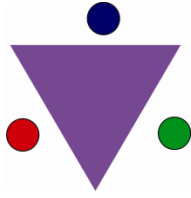
**Figure 4** : Guidance of maxillary segments by NAM plate. Dark stippled areas are gradually ground away; light stippled areas indicate relief of the cleft borders by grinding



**Figure 5** : Acrylic bulb prosthesis



**Figure 6** : protraction by face mask



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## RECENT DEVELOPMENTS IN ENHANCEMENT OF HEAT TRANSFER THROUGH ARTIFICIAL ROUGHNESS IN SOLAR AIR HEATER DUCTS

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### ABSTRACT

The heat transfer between duct plate and air is low, which leads to higher temperature loss to atmosphere in solar air heaters which result in lower performance of system. It is found that the application of artificial roughness breaks the viscous sub layer in ducts, decrease the thermal resistance and increase the turbulence in flow which enhances the heat transfer rate. The roughness geometry with their parameters and correlations developed by various investigators are tabulated in this paper for suitable selection.

**Keywords:** solar air heater, artificial roughness, heat transfer, friction factor

### INTRODUCTION

A solar air heater generally consists of an absorber plate forming a high aspect ratio through which air to be heated. It is more popular because it utilizes both the beam and diffuse radiation and simple in design, requires little maintenance. The absorber plate is a metal sheet about 1mm in thickness, usually made of GI or steel painted black to obtain higher absorbtivity. Transparent glass sheet having higher transmissivity of thickness 4 to 5 mm is the most commonly used cover plate of the top of the solar air heater. To avoid the heat losses, the sides and bottom are insulated with insulating material like mineral wool or glass wool of thickness 5 to 8cm. Since the heat transfer coefficient of air heater is low which can be improved by active/ passive techniques as listed in table 1.

**Artificial Roughness:** Artificial roughness is the passive technique of heat transfer enhancement. Further a general classification of ribs according to modifications is listed in table 2. These are defined by non-dimension parameters as follows:-

- 1) Relative roughness pitch ( $p/e$ ): It is defined as the ratio of distance between two consecutive ribs to the height of the rib.
- 2) Relative roughness height ( $e/D$ ): It is defined as the ratio of rib height to the hydraulic diameter of the duct.
- 3) Angle of attack ( $\alpha$ ): It is defined as the inclination of rib with the direction of flow of air.

**Three main types of artificial roughness are generally found in literature as follows:**

1. Three Dimensional Roughness (Uniform Roughness)
2. Ridge Type Two Dimensional Roughness (Repeated Ribs)

3. Groove Type Two Dimensional Roughness

**Table 1: Methods of Heat Transfer Enhancement**

PASSIVE TECHNIQUES	ACTIVE TECHNIQUES
Treated surfaces	Mechanical aids
Rough surfaces	Surface vibration
Extended surfaces	Fluid vibration
Displaced enhanced devices	Electrostatic fields
Swirl flow devices	Injection

**Table 2: General Classification of Ribs**

1. According to Orientation of ribs
  - i. Transverse ribs
  - ii. Inclined ribs
  - iii. Helical ribs
2. According to Cross sectional views
  - i. Circular
  - ii. Rectangular
  - iii. Square
  - iv. Triangular
  - v. Trapezoidal
3. Discrete ribs or Staggered ribs
  - i. Transverse Discrete ribs
  - ii. Inclined Discrete ribs
  - iii. V – shaped Discrete
  - iv. W shaped Discrete
4. Grooves
5. Combined/ compound ribs
  - i. Transverse & Inclined ribs
  - ii. Rib grooves
  - iii. Special shaped rib & grooves
6. Dimple roughness
7. Special Shaped Ribs
  - i. V- shaped ribs
  - ii. W-shapes ribs
  - iii. Wedge Shaped ribs
  - iv. Chamfered
  - v. Arc shaped wire &
  - vi. Multi V ribs
  - vii. Expanded metal mesh

**Roughness in the form of sand grains**

Nikuradse [1] investigated the effect of roughness on the friction factor and velocity distribution in pipes roughened by sand blasting. Nunner [2] and Dippery and Sebersky [3] developed a friction similarity law and a heat momentum transfer analogy for flow in sand grain roughened tubes.

**Roughness in the form of transverse ribs**

Ravigururajan and Bergles [4] developed general statistical correlations for heat transfer and pressure drop for four types of roughness, namely semicircular, circular, rectangular and

triangular for single-phase turbulent flow in internally ribbed tubes. Han [5] carried out an experimental study in square duct with two opposite rib roughened walls. Son et al. [37] carried out the Particle Image Velocity (PIV) experiments for heat transfer characterization in two-pass square channels with smooth and 90° ribbed walls for high Reynolds number turbulent flow (Re= 30,000). The rib-induced flow turbulence increases the heat transfer mainly because of the enhanced local flow impingement near the rib.

### **Square transverse, Helically Ribbed, Trapezoidal, Three-Dimensional Ribs.**

Firth and Meyer [35] investigated the heat transfer and friction factor performance based on equal pumping power, of four different types of artificially roughened surfaces, namely (i) Square transverse ribbed surface, (ii) Helically ribbed surface. (iii) Trapezoidal ribbed and (iv) Three-dimensional ribs. They found that the helically ribbed surface has a thermal performance which compares closely with the square transverse ribbed surface.

### **Rectangular, Semicircular and Square cross section ribs**

Tanda [11] carried out experimental investigation by using liquid crystal thermography to study of heat transfer from a rectangular channel having width to height ratio of 5 and one surface heated at uniform heat flux and roughened by repeated ribs. The ribs having rectangular or square sections were fixed transverse to the main direction of flow or V-shaped with an angle of 45 or 60 deg relative to flow direction. The results show that for the range of Reynolds number studied, the presence of semicircular, rectangular and square ridges at two walls yield about 4-8 fold, 5-10 fold and 7-15 fold increase in the average friction factor respectively relative to smooth duct. There is about 1.6 to 2.1 fold, 1.7 to 2.2 fold and 1.9 to 2.7 fold increase in the average heat transfer coefficient compared with smooth wall for the semi circular, triangular and square ridge walls respectively.

### **Square, triangular & trapezoidal**

Kamali et al. [18] investigates the effect of square, triangular and trapezoidal ribs with computer code using square duct and the simulation was performed on all four ribs with parameters as relative roughness pitch varies from 8 to 12 and relative roughness height of 0.1

and it was found that the relative roughness pitch of 12 provides the highest heat transfer.

### **Chamfered Ribs**

Layek et al.[14] used chamfered rib groove roughness on one wall of the solar air heater by varying parameters selected and it was found that highest Nusselt number occurs for chamfer angle of 18° but the friction factor increase with chamfer angle. The nusselt number increases 3.24 times and friction increases 3.78 times respectively. The maximum heat transfer enhancement was observed at relative roughness pitch of 6 and relative groove position of 0.4. Again Layek et al.[23] in the next paper investigates the effect of chamfer angle on heat transfer with chamfer angle as 5°, 12°, 15°, 18°, 22° and 30°. It was resulted that the maximum heat transfer occurs at chamfer.

### **90° Broken Transverse Ribs**

Sahu et al.[12] investigated heat transfer on transverse ribs with pitch 10-30mm rib height 1.5mm and it was found that the solar air heater provides maximum efficiency at a pitch of 20mm and heat transfer enhances to 1.4 times as compared to smooth duct.

### **Inclined Ribs**

Han et al. [6] developed a general correlation based on the law of the wall similarity and the application of the heat-momentum analogy for friction and heat transfer to account for rib shape, spacing and angle of attack. In the experimental program, sixteen different geometries were tested for relative roughness pitch of 5, 7.5, 10, 15, and 20, relative roughness height of 0.032, 0.042, 0.056, 0.076, and 0.102 and angle of attack of 20°, 45°, 75°, and 90° and Reynolds number from 3000 to 30000. The main conclusions of the investigation are as : For small value of relative roughness pitch ( $p/e = 5$ ), the flow which separates on each rib does not reattach before it reaches the succeeding rib while a relative roughness pitch value of about

10, the flow does reattach close to the next rib. The maximum value of both the heat transfer coefficient and the friction factor occur at relative roughness pitch ( $p/e$ ) of 10, and ribs at a  $45^\circ$  angle of attack have superior heat transfer performance at given friction power when compared to ribs at a  $90^\circ$  angle of attack or when compared to sand-grain roughness.

### Angled Rib Turbulators

Tanda et al.[27] employed inclined ribs to investigate heat transfer in rectangular channel by using it in one and two walls of the channel. For one ribbed wall the optimum performance was found at relative roughness pitch of 13.33 while for two ribbed wall the optimal performance was observed at relative roughness pitch of 6.66-10 for an angle of attack of  $45^\circ$ .

### Inclined Discrete ribs

Aharwal et al. [21] used inclined discrete ribs on absorber plate and the effect of width and gap position has been investigated under the parameters as Reynolds number from 3000 to 18,000 with the relative roughness pitch ( $P/e$ ) range of 4–10, relative roughness height ( $e/D$ ) range of 0.018–0.037, and angle of attack ( $\alpha$ ) ranges from  $30^\circ$ – $90^\circ$ . Result shows that Nusselt number increases 2.83 times and friction factor 3.60 times under the range of parameters investigated. The maximum heat transfer occurs at the relative gap position of 0.25 with the relative gap width of 1.0 for the relative roughness pitch of 8.0, angle of attack of  $60^\circ$  and relative roughness height of 0.037. The maximum value of friction factor occurs for discrete transverse ribs with relative roughness pitch of 8.0.

### Combined transverse and inclined ribs

Varun et al.[15] investigates the effect of combined transverse and inclined ribs on absorber plate with Reynolds number ( $Re$ ) ranges from 2000 to 14 000, relative roughness pitch ( $p/e$ ) ranges from 3–8 and relative

roughness height  $e/D_h = 0.030$ . Results shows relative roughness pitch of 8 have the maximum thermal efficiency. Again Varun et al [19]. shows the effect of inclined and transverse ribs and optimized the efficiency of solar air heater by taguchi method and the maximum value of effective efficiency has been found for relative roughness pitch ( $p/e$ ) of 8 with parameters as Reynolds number ( $Re$ ) 2000–14,000, relative roughness pitch ( $p/e$ ) 3–8 and a fixed value of relative roughness height ( $e/D$ ) of 0.030.

### V Shaped

Lau et al. [7] observed that the average Stanton number is 60, 45 or 30 deg discrete rib case is about 25 to 35 percent higher than in the 90 deg discrete rib case. In all the above configurations, the crossed ribs were found to perform poorly compared with other configurations. Momin et al. [9] investigated that for relative roughness height of 0.034 and for angle of attack of  $60^\circ$ , the V-shaped ribs enhance the values of Nusselt number by 1.14 and 2.30 times over inclined ribs and smooth plate at Reynolds number of 17034.

### Wedge shaped ribs

Bhagoria et al.[10] used wedge shaped ribs with parameters as  $Re = 3000$ – $18000$ , relative roughness height ( $e/D_h$ ) varies from 0.015–0.033, Relative roughness pitch  $60.17\Phi^{-1.0264} < p/e < 12.12$  rib wedge angle  $\Phi = 8^\circ$ – $15^\circ$ , Aspect ratio of duct  $W/H = 5$  and it was found Nusselt number increases up to 2.4 times while the friction factor rises up to 5.3 times.

### Rib groove

Zhang et al. [38] carried out on experimental investigation on the effect of ribbed-grooved roughness on heat transfer and pressure drop in rectangular channels for Reynolds numbers between 10000 and 50000. They observed that for similar rib height and spacing, the rough side of the ribbed-grooved duct enhances heat transfer 3.4 times while the rough side of the ribbed duct enhances heat transfer 2.4 times. The

turbulence is larger for the ribbed-grooved wall than for the ribbed wall. The additional vortices created by the grooves are responsible for the higher turbulence in the ribbed-grooved wall. Jaurker et al. [13] investigated the characteristics of rib-grooved artificial roughness. The parameters having Reynolds number range from 3000 to 21,000, relative roughness height 0.0181–0.0363, relative roughness pitch 4.5–10.0 and groove position to pitch ratio 0.3–0.7. The effect of important parameters on the heat transfer coefficient and friction factor has been discussed. The results shows nusselt number increases 2.7 times and the friction factor increases up to 3.6 times.

#### **U Shaped ribs**

Bopche et al. [20] used U shaped turbulators on the absorber plate of solar air heater. It was found that the heat transfer increases 2.82 times while friction increases 3.72 times as compared to that of smooth duct.

#### **Multi V ribs**

Hans et al. [26] investigated multiple V ribs and the presence of this rib provides increase in nusselt number and friction factor of 6 and 5 times respectively. The maximum heat transfer occurs at relative roughness width of 6 while maximum friction occurs at relative roughness width of 10 and it was also resulted that the maximum enhancement in nusselt number and friction was found at angle of attack of 60°. Promvonge et al. [24] used multi 60° V baffles on absorber plate to find out the enhancement of heat transfer and it was found that thermal performance with PR=1 and  $e/H=0.10$  results maximum thermal enhancement factor of about 1.87 at lower Reynolds number.

#### **V Discrete**

Gao and Sunden [36] carried out an experimental investigation on heat transfer and pressure drop in the cases of two wide rib roughened walls of rectangular duct with three

rib configurations parallel ribs and V-shaped ribs pointing upstream or downstream of the main flow direction. The system parameters include  $e/D_h$  of 0.06,  $\alpha$  of 60 degree and  $p/e$  of 10 for the Re ranges from 1000 to 6000. The V-ribs pointing downstream produced the highest heat transfer enhancement and friction factors and provided the best thermal performance over the Reynolds number range tested. Parallel ribs provided better performance than that of V-ribs pointing upstream at high Reynolds numbers. Karwa et al. [25] investigated the effect of V down discrete ribs by using a mathematical model. And it was found that at sufficiently lower mass flow rates i.e. less than  $0.04 \text{ kgs}^{-1} \text{ m}^2$  the thermal and effective efficiency differ marginally but at higher mass flow rates i.e. greater than  $0.045 \text{ kgs}^{-1} \text{ m}^2$  the thermal efficiency is higher than effective efficiency. Singh et al. [30] investigated experimentally the effect of V down discrete ribs on one wall of the duct. The maximum heat transfer is 3.04 times and friction factor is 3.11 times higher to that of smooth duct.

#### **W shaped ribs**

Lanjewar et al. [31] used W shaped ribs to increase the performance of air heater and it was resulted that heat transfer increases 2.36 and friction factor increases 2.1 times at an angle of attack of 60°. Kumar et al. [22] employs discrete W ribs on absorber plate having aspect ratio of 8:1. The maximum heat transfer occurs at 30°, 45°, 60° and 75°  $e/D_h$  of 0.0168 but at  $e/D_h$  of 0.0338 the maximum heat transfer was 1.88, 1.99, 2.16 and 2.08 times as compared to smooth duct. It was also resulted that there was decrease in friction with increase in Reynolds number. The effect of orientation of W shaped ribs on heat transfer was observed by lanjewar et al. [28] and it was found that better thermo hydraulic performance is obtained at  $\alpha=60^\circ$ . And it was concluded that W down ribs gives better performance than W up and V ribs.

### **Dimple shape geometry**

Saini et al. [17] used dimple shape geometry as artificial roughness with parameters as Reynolds number 2000 to 12,000, relative roughness height of 0.018 to 0.037 and relative roughness pitch of 8 to 12. The maximum heat transfer was obtained at the relative roughness height of 0.0379 and relative pitch of 10. And the minimum friction was found at relative roughness height of 0.0289 and relative roughness pitch of 10.

### **ARC shaped wire**

Saini et al. [16] investigates the effect of arc shaped wire as artificial roughness on duct and increase in heat transfer is 3.80 time while friction factor increases 1.75 times. The maximum heat transfer occurs at relative arc angle of 0.3333 and relative roughness height of 0.0422.

**Table. 4 Heat Transfer And Friction Factor Correlations**

Author[1]	Optimum value of parameter[2]	Range of parameters[3]	Geometry used[4]	Results on heat transfer and friction/correlations [5]
Han et al. (1978)	p/e=10, α=45°	p=5,7.5,10, 15, 20 e/D <sub>h</sub> =0.032,0.042,0.056, 0.076, and 0.102 α=20°, 45°, 75°, and 90° Re=3000 to 30000	Transverse and inclined	$St_t = \frac{f}{[He^+ - Re^+](2f^{1/2}) + 2}$ $Re^+ = 4.9(e^+/35)^m / [(\Phi/90)^{0.35} (10/(p/e))^n (\alpha/45)^{0.57}]$
Han and Park (1988)	α=45°	Re=10000-60000, α=90°-30°, W/H=1 to 2 and to 4	Inclined and transverse ribs	$R / [(p/e)/10]^{0.35} (W/H)^m = 12.31 - 27.07(\alpha/90^\circ) + 17.86(\alpha/90^\circ)^2$ $G = R + \{[\bar{f} + (H/W)(\bar{f} - f(FD))]/(2St_t) - 1\} / \{[\bar{f} + (H/W)(\bar{f} - \bar{f}(FD))]/2\}^{1/2}$
Han (1984)		Re=7000 to 90000, p/e=10, e/D <sub>h</sub> =0.021 to 0.063	Inclined ribs	$f_r = \left[ \frac{2}{0.95 \frac{p}{e}^{0.58} - 2.5 \ln \frac{2e}{D_e} - 2.5 - 2.5 \ln \frac{2B}{A+B}} \right]^2$ $St_t = \frac{fr/2}{[1 + \sqrt{\frac{fr}{2}} [G_H(\epsilon^+, Pr) - R_m(\epsilon^+) ]}$
Karwa et al. 2001	e/D <sub>h</sub> =0.0441	p/e=4.58-7.09 Ø=15°, e= 0.74-1.68 p=5.25-7.69	integral chamfered rib	$R = \sqrt{\frac{2}{f}} + 2.5 \ln(2e/D_h) + 3.75$ $g = [\{f/(2St) - 1\} \sqrt{2/f} + R]$
[1]	[2]	[3]	[4]	[5]

Malik et al. 2002	$p/e=7.09$ $e/D_h=0.0256$	$Re=2500-18000$ $e/D_h=0.02-0.034$ $\alpha=30^\circ-90^\circ$	V shaped rib	$Nu_r=0.067 \times (Re)^{0.888} \times (e/D_h)^{0.424} \times (\alpha/60)^{-0.077} \times \exp[-0.782 \times \ln(\alpha/60)^2]$ $f=6.266 \times (Re)^{-0.425} \times (e/D_h)^{0.565} \times (\alpha/60)^{-0.093} \times \exp[-0.719 \times (\ln \alpha/60)^2]$
Bhagoria et al. 2002	$p/e=7.57$ $e/D_h=0.033$	$Re$ 3000–18000 $e/D_h$ 0.015–0.033 $\alpha =8^\circ-15^\circ$ $p/e=$ $60.17\Phi^{-1.0264}$ $<p/e<12.12$	Wedge shape rib	$Nu_r=1.89 \times 10^{-4}(Re)^{1.21}(e/D_h)^{0.426}(p/e)^{2.94}[\exp(0.71(\ln(p/e))^2)]$ $(\Phi/10)^{-0.018}[\exp(-1.50(\ln(\Phi/10))^2)]$
Sahu et al. (2005)	$p/e=13.33$	$Re=3000-12000$ W/H 8.0 $e$ (mm) 1.5 $e/D=0.0338$ $p=10, 20$ and 30	90° broken transverse ribs	Efficiency at $p=20$ mm is 83.5%.
Jaurker et al. (2006)	$p/e=6$ $e/D_h=0.036$	$Re$ 3000–21,000 ( $e/D$ ) 0.0181–0.0363 ( $p/e$ ) 4.5–10.0 ( $g/p$ ) 0.3–0.7	Rib grooved	$f = 0.001227(Re)^{-0.199}(e/D)^{0.585}(p/e)^{7.19}(g/p)^{0.645} \times \exp(-1.854\{\ln(p/e)\}^2) \times \exp(1.513\{\ln(g/p)\}^2 + 0.8662\{\ln(g/p)\}^3)$ $Nu = 0.002062 Re^{0.936}(e/D)^{0.349}(p/e)^{3.318} \times \exp[-0.868\{\ln(p/e)\}^2](g/p)^{1.108} \times \exp[2.486\{\ln(g/p)\}^2 + 1.406\{\ln(g/p)\}^3]$
Layek et al. (2007)	$p/e=8$ $e/D_h=0.04$	$Re=3000-21,000$ $p/e=4.5-10$ $e/D_h=0.022-0.04$ $\Phi=5^\circ-30^\circ$ $g/p=0.3-0.6$	transverse chamfered rib-groove	$Nu=0.00225Re^{0.92}(e/D_h)^{0.52}(p/e)^{1.72}(g/p)^{-1.21}\Phi^{1.24} \times [\exp\{-0.22(\ln\Phi)^2\}][\exp\{-0.46(\ln p/e)^2\}] \times \exp\{-0.74(\ln g/p)^2\}]$ $f=0.00245 Re^{-0.124}(e/D_h)^{0.365}(p/e)^{4.32}(g/p)^{-1.124} \times \exp[0.005\Phi]\exp[-1.09(\ln p/e)^2]\exp[0.68(\ln g/p)^2]$
[1]	[2]	[3]	[4]	[5]
Varun et al. (2008)	$p/e=8$	$Re=2000-14000$ $p/e=3-8$ $e/D_h=0.030$	Inclined and transverse ribs	$Nu = 0.0006 \times Re^{1.213} \times (p/e)^{0.0104}$ $f=1.0858 \times Re^{-0.3685} \times (p/e)^{0.0114}$

Saini et al. (2008)	$e/D_h = 0.0422$	W/H= 12 P/e= 10 e/d= 0.0213– 0.0422 ( $\alpha/90$ )= 0.3333– 0.6666 Re=2000–17 000	arc-shaped wire	$Nu = 0.001047 Re^{1.3186} (e/d)^{0.3772} (\alpha/90)^{-0.1198}$ $f = 0.14408 Re^{-0.17103} (e/d)^{0.1765} (\alpha/90)^{0.1185}$
Kamali et al. (2008)	p/e=12	$e/D_h = 0.1$ ,p/e=8-12,	square, triangular & trapezoidal	Trapezoidal ribs have highest value of heat transfer for range of parameters studied.
Saini et al. (2008)	$e/D_h = 0.0379$ p/e=10	Re=2000 to 12,000, $e/D = 0.018$ to 0.037 p/e=8 to 12.	Dimple shape geometry	$Nu = 5.2 \times 10^{-4} Re^{1.27} (p/e)^{3.15} x [\exp(-2.12)(\log(p/e))^2] (e/D)^{0.033} x [\exp(-1.30)(\log(e/D))^2]$ $f = 0.642 Re^{-0.423} (p/e)^{-0.465} [\exp(0.054)(\log(p/e))^2] x (e/D)^{0.0214} [\exp(0.840)(\log(e/D))^2]$
Varun et al. (2009)	p/e=8	Re= 2000–14,000 p/e=3 to 8 $e/D = 0.030$	Transverse and inclined ribs	$Nu = 0.0006 x Re^{1.213} x (p/e)^{0.0104}$ $f = 1.0858 x Re^{-0.3685} x (p/e)^{0.0114}$
Bopche et al. (2009)	$e/D_h = 0.03986$ p/e =8.3	Re=3800 to 18000 $e/D_h = 0.0186$ to 0.03986 p/e = 6.67 to 57.14, $\alpha=90^\circ$	U shaped ribs	$Nu_r = 0.5429 x Re^{0.7054} x (p/e)^{-0.1592} x (e/D_h)^{0.3619}$ $f = 1.2134 x Re^{-0.2076} x (p/e)^{-0.4259} x (e/D_h)^{0.3285}$
[1]	[2]	[3]	[4]	[5]
Aharwal et al (2009)	$e/D_h = 0.037$ p/e=8	W/H= 5.83 d/W=0.16 to 0.5 g/e=0.5to2.0 Re=3000 to 18,000 P/e=4–10; $e/D = 0.018–0.037$	Inclined discrete ribs	$Nu = 0.0102 Re^{1.348} (e/D)^{0.51} \{ [1 - (0.25 - \frac{d}{W})^2 \{ 0.01(1 - \frac{g}{e})^2 \}] \}$ $f = 0.5 Re^{-0.0836} (e/D)^{0.72}$

		$\alpha=30-90^\circ$		
J.L. Bhagoria et al (2009)	$e/D_h=0.038$	Re=3000 to 15,000 $e/D_h=0.0168-0.0338$ p/e= 10 $\alpha=30^\circ$ to $75^\circ$	Discrete W shaped ribs	$Nu_r=0.105xRe^{0.873} x (e/D_h)^{0.453} x (a/60)^{-0.081} x \exp[-0.59 x (\ln(a/60))^2]$ $f=5.68 x Re^{-0.40} x (e/D_h)^{0.59} x (a/60)^{-0.081} x \exp[-0.579 x (\ln(a/60))^2]$
Solanki et al (2009)	$e/D_h=0.03$ p/e=10 chamfer angle= $18^\circ$	Re=3000–21,000 P/e=10 $e/D_h=0.03$ $\Phi=5^\circ, 12^\circ, 15^\circ, 18^\circ, 22^\circ$ and 30 60° V groove	Chamfered rib groove roughness	Nusselt number and friction factor increases 2.6-fold and 3.35-fold in the range of parameters investigated.
Pongjet Promvongee et al. (2010)	p/e=8 $e/D_h=0.043$	$e/H=0.10, 0.20$ and 0.30 Re=5000 to 25,000 AR=10 H=30mm	Multi V 60° baffles	$Nu = 0.147Re^{0.763} Pr^{0.4} (1 - e/H)^{-1.793} (PR + 1)^{-0.42}$ $f=0.48 Re^{-0.038} (1 - e/H)^{-5.428} (PR + 1)^{-0.833}$
Karwa et al (2010)	$e/D_h=0.07$	L= 1–4 m,H=5–20 mm,W= 1 m,L/H 200 $e/D_h 0.02-0.07$ Re =1070–26350	V down discrete ribs	
[1]	[2]	[3]	[4]	[5]
Hans et al. (2010)	$\alpha=60^\circ, W/w=6$	Re=2000 to 20000 $e/D=0.019- 0.043$ P/e=6–12, $\alpha=30^\circ-75^\circ$ W/w=1–10.	Multi V ribs	$Nu=3.35 x 10^{-5} Re^{0.92} (e/D)^{0.77} (W/w)^{0.43} (\alpha/90)^{-0.49} x \exp^{[0.1177(\ln(W/w))^2]} \exp^{[0.61(\ln(\alpha/90))^2]} (p/e)^{8.54} x \exp^{[-2.0407(\ln(p/e))^2]}$ $f=4.47 x 10^{-4} Re^{-0.3188} (e/D)^{0.73} (W/w)^{0.22} (\alpha/90)^{-0.39} x \exp[-0.52(\ln(\alpha/90))^2] (p/e)^{8.9} \exp^{[-2.133(\ln(p/e))^2]}$
Giovanni Tanda (2011)	p/e=13.33	AR = 5 rib turbulators, inclination = $45^\circ$ Re=9000 to 35,500. $e/D=0.09,$ p/e=6.66,10.0,	$45^\circ$ angled rib turbulators	

		13.33, and 20.0		
J.L. Bhagoria et al (2011)	$e/D_h = 0.03375$	W/H=8.0, p/e=10, e/D <sub>h</sub> = 0.03375 $\alpha=30^\circ-75^\circ$ . Re=2300–14,000.	W rib roughness at different angles	$R = \sqrt{(2/f)} + 2.5 \ln(2e/D_h) + 3.75$  $e^+ = \sqrt{f/2} \text{Re}(e/D_h)$
Brij Bhushan et al (2011)	S/e=31.25, d/D=0.294	e/D= 0.03 W/H=10.00 Re=4000–20,000 S/e=18.75–37.50 L/e=25.00–37.50 d/D= 0.147–0.367	Protrusion as artificial roughness	$Nu = 2.1 \times 10^{-88} Re^{1.452} (S/e)^{12.94} (L/e)^{99.2} (d/D)^{-3.9} \times \exp[-10.4 \{\log(S/e)\}^2] \exp[-77.2 \{\log(L/e)\}^2] \times \exp[-7.83 \{\log(d/D)\}^2]$  $f = 2.32 Re^{-0.201} (S/e)^{-0.383} (L/e)^{-0.484} (d/D)^{0.133}$
[1]	[2]	[3]	[4]	[5]
Sukhmeet Singh et al (2011)	$e/D_h = 0.043$ p/e=8	Re=3000-15000 P/e=4-12 $\alpha=30^\circ-75^\circ$ d/w= 0.2-0.8 g/e=0.5-2.0 e/D <sub>h</sub> =0.015-0.043	Discrete V down ribs	$Nu = 2.36 \times 10^{-3} Re^{0.90} (p/e)^{3.50} (\alpha/60)^{-0.023} (d/W)^{-0.043} (g/e)^{-0.014} x (e/D_h)^{0.47} \exp(-0.84(\ln(p/e))^2) \exp(-0.72(\ln(\alpha/60))^2) \times \exp(-0.05(\ln d/w)^2) \exp(-0.15(\ln g/e)^2)$  $f = 4.13 \times 10^{-2} Re^{-0.126} (p/e)^{2.74} (\alpha/60)^{-0.034} (d/w)^{-0.058} (g/e)^{0.031} x (e/D_h)^{0.70} \exp(-0.685(\ln p/e)^2) \exp(-0.93(\ln \alpha/60)^2) \times \exp(-0.058(\ln d/w)^2) \exp(-0.21(\ln g/e)^2)$
Atul Lanjewar et al (2011)	$e/D_h = 0.03375$ , $\alpha = 60^\circ$	p/e = 10 e=0.8 mm, 1.0 mm, 1.3 mm & 1.5 mm e/D <sub>h</sub> =0.018, 0.0225, 0.02925 & 0.03375 W/H=8 Re=2300-14,000 $\alpha=30^\circ, 45^\circ, 60^\circ$ & $75^\circ$	W shaped roughness	$Nu_r = 0.0613 (Re)^{0.9079} (e/D_h)^{0.4487} (\alpha/60)^{-0.1331} \times [\exp(-0.5307(\ln(\alpha/60))^2)]$  $f = 0.6182 (Re)^{-0.2254} (e/D_h)^{0.4622} (\alpha/60)^{0.0817} \times [\exp(-0.28(\ln(\alpha/60))^2)]$

## CONCLUSION

It is found that most of the investigators developed their correlations experimentally for the solar air heaters ducts having different geometries as artificial roughness in order to

### Nomenclature

$D_h$	hydraulic diameter of duct, m
$e$	rib height, mm
$g$	groove position, mm
$h$	heat transfer coefficient, $W/m^2K$
$H$	height of air duct, mm
$P$	pitch, m
$W$	width of duct, m

### Dimensionless Parameters

$d/D$	Relative print diameter
$d/W$	relative gap position
$e^+$	roughness reynolds number
$e/D, e/D_h$	relative roughness height
$e/H$	rib to channel height ratio
$f$	friction factor
$G (e^+)$	Heat transfer function
$G_H$	Heat Transfer Roughness Function

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## REFERENCES

1. Nikuradse, J. Laws of flow in rough pipes. NACA, Technical Memorandum 1292. November 1970.
2. Nunner, W. Heat transfer and pressure drop in rough tubes. VDI Forch 445-B 5-39 (1956); A.E.-R.E. Lib Trans. 786, 1958.
3. Dippery DF, Sabersky RH. Heat and momentum transfer in smooth and rough tubes at various Prandtl number. Int J Heat Mass Transfer 1963; 6:329–53.
4. Ravigururajan TS, Bergles AE. General correlation for pressure drop and heat transfer for single phase turbulent flow in internally ribbed tubes. Augmentation of heat transfer in energy systems. HTD52. New York: ASME, 1985:9-20.
5. Han JC. Heat transfer and Friction in a channel with two opposite rib-roughened walls. Trans J Heat Transfer 1984; 106: 774–81.
6. Han, J.C. L. R. Glicksman and W. M. Rohsenow, “An investigation of heat transfer

enhance the heat transfer. But some researchers have attempted to numerically model the roughness effects. And it was observed that it is the most promising technique to improve the performance of solar air heaters.

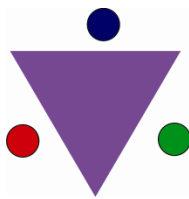
$g/p$	relative groove position
$L/e$	relative long way length of mesh
$p/e$	relative roughness pitch
$Re$	Reynolds number
$R (e^+)$	momentum transfer function
$R$	Roughness function
$St$	Stanton number
$S/e$	relative short way length of mesh
$W/H$	Aspect Ratio

### Greek Symbols

$\alpha$	angle of attack
$\Phi$	wedge angle
$\alpha/90$	arc angle

- and friction for rib-roughened surfaces,” *Int. J. of Heat & Mass Transfer*. Vol. 21, pp.1143-1156, 1978.
7. Lau SC, Kukreja RT, Mc Millin RD. Effects of V shaped rib arrays on turbulent heat transfer and friction of fully developed flow in a square channel. *Int J Heat Mass Transfer* 1991;34: 1605–16
  8. Rajendra Karwa ,S.C. Solanki, J.S. Saini,Thermo-hydraulic performance of solar air heaters having integral chamfered rib roughness on absorber plates,*Energy* 26 (2001) 161–176.
  9. Abdul-Malik Ebrahim Momin, J.S. Saini, S.C. Solanki, Heat transfer and friction in solar air heater duct with V-shaped rib roughness on absorber plate, *International Journal of Heat and Mass Transfer* 45 (2002) 3383–3396.
  10. J.L. Bhagoria, J.S. Saini, S.C. Solanki, Heat transfer coefficient and friction factor correlations for rectangular solar air heater duct having transverse wedge shaped rib roughness on the absorber plate, *Renewable Energy* 25 (2002) 341–369.
  11. Giovanni Tanda, Heat transfer in rectangular channels with transverse and V-shaped broken ribs, *International Journal of Heat and Mass Transfer*, Volume 47, Issue 2, 2004, Pages 229–243.
  12. M.M. Sahu, J.L. Bhagoria, Augmentation of heat transfer coefficient by using 90° broken transverse ribs on absorber plate of solar air heater, *Renewable Energy* 30 (2005) 2057–2073.
  13. A.R. Jaurker, J.S. Saini, B.K. Gandhi, Heat transfer and friction characteristics of rectangular solar air heater duct using rib-grooved artificial roughness, *Solar Energy* 80 (2006) 895–907.
  14. Apurba Layek , J.S. Saini, S.C. Solanki,Heat transfer and friction characteristics for artificially roughened ducts with compound turbulators, *International Journal of Heat and Mass Transfer* 50 (2007) 4845–4854.
  15. Varun, R.P. Saini , S.K. Singal, Investigation of thermal performance of solar air heater having roughness elements as a combination of inclined and transverse ribs on the absorber plate, *Renewable Energy* 33 (2008) 1398–1405.
  16. S.K. Saini, R.P. Saini, Development of correlations for Nusselt number and friction factor for solar air heater with roughened duct having arc-shaped wire as artificial roughness, *Solar Energy* 82 (2008) 1118–1130.
  17. R.P. Saini , Jitendra Verma, Heat transfer and friction factor correlations for a duct having dimple-shape artificial roughness for solar air heaters, *Energy* 33 (2008) 1277– 1287.
  18. R. Kamali, A.R. Binesh, the importance of rib shapes effect on the local heat transfer and friction characteristics of square duct of ribbed internal surfaces, *Heat and Mass Transfer* 35 (2008) 1032–1040.
  19. Varun , Amar Patnaik, R.P. Saini, S.K. Singal , Siddhartha, Performance prediction of solar air heater having roughened duct provided with transverse and inclined ribs as artificial roughness, *Renewable Energy* 34 (2009) 2914–2922.
  20. Santosh B. Bopche , Madhukar S. Tandale, Experimental investigations on heat transfer and frictional characteristics of a turbulator roughened solar air heater duct, *International Journal of Heat and Mass Transfer* 52 (2009) 2834–2848.
  21. K.R. Aharwal , Bhupendra K. Gandhi , J.S. Saini, Heat transfer and friction characteristics of solar air heater ducts having integral inclined discrete ribs on absorber plate, *International Journal of Heat and Mass Transfer* 52 (2009) 5970–5977.
  22. Arvind Kumar , J.L. Bhagoria, R.M. Sarviya, Heat transfer and friction correlations for artificially roughened solar air heater duct

- with discrete W-shaped ribs, *Energy Conversion and Management* 50 (2009) 2106–2117.
23. Apurba Layek, J.S. Saini, S.C. Solanki, Effect of chamfering on heat transfer and friction characteristics of solar air heater having absorber plate roughened with compound turbulators, *Renewable Energy* 34 (2009) 1292–1298.
  24. Pongjet Promvong, Heat transfer and pressure drop in a channel with multiple 60° V-baffles, *International Communications in Heat and Mass Transfer* 37 (2010) 835–840.
  25. Rajendra Karwa, Kalpana Chauhan, Performance evaluation of solar air heaters having v-down discrete rib roughness on the absorber plate, *Energy* 35 (2010) 398–409.
  26. V.S. Hans , R.P. Saini, J.S. Saini, Heat transfer and friction factor correlations for a solar air heater duct roughened artificially with multiple v-ribs, *Solar Energy* 84 (2010) 898–911.
  27. Giovanni Tanda, Effect of rib spacing on heat transfer and friction in a rectangular channel with 45° angled rib turbulators on one/two walls, *International Journal of Heat and Mass Transfer* 54 (2011) 1081–1090
  28. Lanjewar ,J.L. Bhagoria, R.M. Sarviya, Experimental study of augmented heat transfer and friction in solar air heater with different orientations of W-Rib roughness, *Experimental Thermal and Fluid Science* 35 (2011) 986–995.
  29. Brij Bhushan, Ranjit Singh, Nusselt number and friction factor correlations for solar air heater duct having artificially roughened absorber plate, *Solar Energy* 85 (2011) 1109–1118.
  30. Sukhmeet Singh, Subhash Chander, J.S. Saini, Heat transfer and friction factor correlations of solar air heater ducts artificially roughened with discrete V-down ribs, *Energy* 36 (2011) 5053-5064.
  31. Atul Lanjewar, J.L. Bhagoria, R.M. Sarviya, Heat transfer and friction in solar air heater duct with W-shaped rib roughness on absorber plate, *Energy* 36 (2011) 4531-4541.
  32. Brij Bhushan, Ranjit Singh, A review on methodology of artificial roughness used in duct of solar air heaters, *Energy* 35 (2010) 202-212.
  33. R.J. Firth L. Meyer ,A comparison of the heat transfer and friction factor performance of four different types of artificially roughened surface, *International Journal of Heat and Mass Transfer* Volume 26, Issue 2, February 1983,175–18.
  34. Xiufang Gao, Bengt Sunden, PIV measurement of the flow field in rectangular ducts with 60° parallel, crossed and V-shaped ribs *Experimental Thermal and Fluid Science* Volume 28, Issue 6, June 2004, Pages 639–653.
  35. S.Y Son, K.D Kihm, J.C Han, PIV flow measurements for heat transfer characterization in two-pass square channels with smooth and 90° ribbed walls, *International Journal of Heat and Mass Transfer*, volume 45 issue24, 2002,pages 4809-4822
  36. Zhang Y.M., Gu W Z, Han J C. heat transfer and friction in rectangular channels with ribbed or ribbed grooved walls,1994, transactions ASME journal of heat transfer, vol 116,number 1, pages58.
  37. Han, J.C. and Park, J. S., “Developing heat transfer in rectangular channels with rib turbulators,” *Int. J. of Heat and Mass Transfer*, Vol.3/1, pp.183-195, 1988.



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## EVALUATION OF EFFICACY AND SAFETY OF FIXED DOSE COMBINATION OF CEFIXIME AND OFLOXACIN (CO2 TABLET) IN THE MANAGEMENT OF RESPIRATORY TRACT INFECTION

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### ABSTRACT

Acute lower respiratory tract infections (LRTI) range from acute bronchitis and acute exacerbations of chronic bronchitis to pneumonia. Among these, pneumonia represents the most frequent cause of mortality, hospitalisation and medical consultation. **Objective:** To evaluate the safety and tolerability of fixed dose combination of Cefixime and Ofloxacin (CO2 Tablet) in the management of Respiratory tract infection a post marketing surveillance study was carried out among 215 patients of age group 18-72 years suffering from respiratory tract infection. **Materials & Method:** Study drug CO2 (Medley Pharmaceuticals Ltd. Mumbai) containing Cefixime 200 mg + Ofloxacin 200 mg was prescribed to be taken twice daily for a duration of 7-14 days depending upon the severity. Cough intensity, frequency of cough, fever and respiratory rate were recorded during three visit on 3<sup>rd</sup>, 7<sup>th</sup> and 14<sup>th</sup> day of treatment. Safety and efficacy was evaluated based on the global assessment by the investigator based on a three point scale marked as excellent /good/poor. **Result:** 93.95% patients reported fever on the first day of treatment. Body temperature was significantly reduced from baseline mean value  $101 \pm 0.49$  °F to  $99.72 \pm 0.09$ °F,  $98.18 \pm 0.142$  and  $97.95 \pm 0.161$  on 3<sup>rd</sup>, 7<sup>th</sup> and 14<sup>th</sup> day respectively. Similarly the cough intensity was significantly reduced on: 3<sup>rd</sup>, 7<sup>th</sup> and 14<sup>th</sup> day from baseline. On day 3<sup>rd</sup> cough intensity was reduced by 29.4% ( $p < 0.0001$ ), on the day 7<sup>th</sup> cough intensity was reduced by 58.90% ( $p < 0.0001$ ) and on 14<sup>th</sup> day it was further reduced by 79.63% ( $p < 0.001$ ) from the base line. There were repeated bouts of cough at the time of diagnosis; mean  $\pm$  SD value was  $15.59 \pm 11.65$  at base line. On day 3<sup>rd</sup>, number of bouts of cough was reduced to ( $10.6 \pm 8.7$  vs.  $15.5 \pm 11.6$ ) ( $p < 0.05$ ), on 7<sup>th</sup> day it was reduced to ( $5.804 \pm 5.707$  vs.  $15.59 \pm 11.65$ ) ( $p < 0.05$ ) from the base line and on the 14<sup>th</sup> day of treatment it was reduced to ( $2.024 \pm 3.751$  vs.  $15.59 \pm 11.65$ ) ( $p < 0.05$ ). On 14<sup>th</sup> day almost all the patients were devoid of bouts of cough. As per investigators assessment, 98 % of patients reported good to excellent and 2 % reported poor efficacy. As per investigators assessment about safety of CO2 97.9% of patient reported good to excellent and 2.1% reported poor tolerability. Rare incidences of headache and nausea were reported. No serious adverse events were reported which led to withdrawal of patients from the study. **Conclusion:** In conclusion this postmarketing surveillance study of fixed dose combination of cefixime and ofloxacin (CO2 Tablet) antibiotic therapy achieves a better outcome for the empirical management of respiratory tract infection with excellent efficacy, tolerability & safety in the treatment of respiratory tract infection

**Keywords:** LRTI, Pneumonia, Bronchitis, Cefixime, Ofloxacin and CO2

## INTRODUCTION

Acute lower respiratory tract infections (LRTI) range from acute bronchitis and acute exacerbations of chronic bronchitis to pneumonia. Approximately five million people die from acute respiratory tract infections annually. Among these, pneumonia represents the most frequent cause of mortality, hospitalisation and medical consultation<sup>1</sup>. Antimicrobial treatment in LRTI has to be effective, partly because of the need to reduce the cost and also the problem of increasing resistance to the commonly used antibiotics<sup>2</sup>. It has also been suggested that the start of therapy should not be delayed for longer than six hours for diagnostic studies<sup>3</sup>. Compliance is also important, particularly in outpatient patients. A study related to medical compliance for the outpatient management of infectious diseases indicated that there was an inverse relationship between frequency of dose and compliance.

The most common symptom is cough, which is new or changed in character. Other symptoms include sputum production, breathlessness, wheezing, chest pain, fever, sore throat and coryza.

Distinguishing pneumonia from non-pneumonic lower respiratory tract infection in the community is also difficult, particularly without diagnostic radiology. So the empirical therapy is required with the combination of antibiotics with wider range of spectrum.

There is currently no general agreement on the definition of an exacerbation in COPD. A commonly used definition is based on an increase in symptoms of dyspnoea, sputum volume and sputum purulence with or without symptoms of upper respiratory infection. Bacteria are isolated from between 40-60% of acute exacerbations of COPD.

Since RTI involves more than one pathogen, so combination of antibiotic with wider spectrum of activity is suitable option for empirical therapy. As shown in Table 1. Following are the microorganisms that are frequently found in respiratory tract infection<sup>4</sup>.

**Table 1: Common organisms involved in respiratory tract infection & MIC<sub>90</sub> of cefixime and ofloxacin**

ORGANISM	CEFIXIME	OFLOXACIN
	[MIC <sub>90</sub> ( µg per ml)]	[MIC <sub>90</sub> ( µg per ml)]
<b>Organisms involved in respiratory tract infection</b>		
Streptococcus pneumoniae	0.12	2
Staphylococcus aureus	> 128.0	0.5-2 (MSSA)
Staphylococcus epidermidis (MSSE)	—	0.25-1 (MSSA)
Staphylococcus epidermidis (MRSE)	—	0.5 ≥16 (MRSA)
Streptococcus pyogenes	—	2
Clostridium perfringens	—	0.5-2
Haemophilus influenzae	0.04	0.03-0.06
Ampicillin-sensitive		
Klebsiella spp.	0.12	—
Moraxella catarrhalis	—	0.06-0.125
Legionella pneumophila	—	0.03-0.25
Chlamydia pneumoniae	—	1
Mycoplasma pneumoniae	—	1-2

A wide array of organisms may cause acute pneumonia and published reports vary in the organisms isolated due to differences in patient groups, presence of epidemic organisms and diligence of the investigation.

*Streptococcus pneumoniae* is the most frequently identified pathogen in CAP. Other organisms commonly reported include *Mycoplasma pneumoniae*, *Staphylococcus aureus*, *Haemophilus influenzae* and influenza viruses. Common pathogens such as *Streptococcus pneumoniae* may exhibit more resistance to common antibiotics<sup>5</sup>.

### **MATERIALS AND METHOD**

The post marketing surveillance study was a non-randomized, open, non-comparative, multi centric and the drug CO2 tablet (Fixed dose combination of Cefixime 200 mg and Ofloxacin 200 mg, Medley Pharmaceuticals Ltd. Mumbai) was administered to patients suffering from respiratory tract infection for duration of 7-14 days. Informed consent was obtained from the patients & the post marketing surveillance was in accordance with the clinical principles laid down in declaration of Helsinki. 279 subjects were monitored across India.

#### **Inclusion Criteria**

Patients of either gender 18 years or more willing to give informed consent were included. Clinical criteria included cough, sputum volume, and dyspnea. Patients were excluded from entry into the study if they had a known/suspected history of hypersensitivity to any of the antibiotic, hepatic encephalopathy, gastrointestinal bleeding, and known cases of hepatic or renal insufficiency, cardiac disease, pregnant or lactating women.

After informed consent was obtained, patients were prescribed to receive CO2 (cefixime 200 mg and Ofloxacin 200 mg) every 12 hrs for 7-14 days. At the time of entry into the study, base-line data

were recorded. Patients were observed on 3<sup>rd</sup>, 7<sup>th</sup> and 14<sup>th</sup> day after enrollment into the study for assessment of symptoms.

Following parameters were observed:

#### **Assessment of primary outcome measure:**

Following parameters were evaluated at baseline and at the end of the study: a) Body temperature on 3<sup>rd</sup>, 7<sup>th</sup>, and 14<sup>th</sup> day as well as time taken to achieve the normal body temperature b) Evaluation of cough frequency c) Evaluation of cough intensity d) Interference in sleep.

#### **Assessment of secondary outcome measure:**

Global assessment of efficacy and safety; efficacy was evaluated at the end of the study by investigator. The incidences of adverse events were recorded. Tolerability and efficacy was evaluated based on the global assessment by the investigator on a 3 point scale marked as excellent/good/poor.

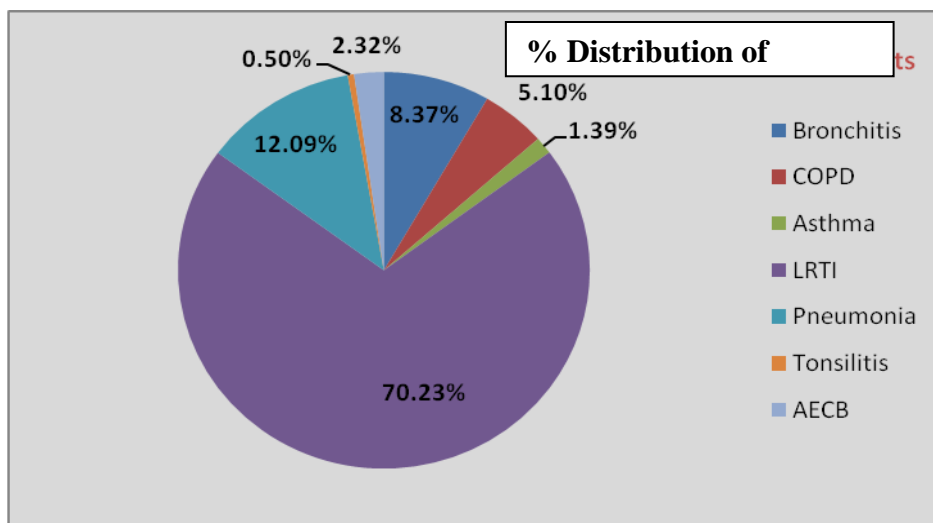
#### **Statistical analysis**

Data analysis on patient demographics and various outcome measures were performed using graph pad prism 5. Comparison between the baseline values with the value on the 3<sup>rd</sup>, 7<sup>th</sup> and 14<sup>th</sup> day of treatment were made, as well as comparison in between these days by applying one way analysis of variance & the post hoc Turkeys multiple comparison test. Value of  $P < 0.05$  were considered significant.

### **OBSERVATIONS**

#### **Patient distribution**

A total of 279 patients were monitored in the study. Two hundred and fifteen patients were included for the final analysis. The patients were in the age range of 18-72 years old with 137 Male and 78 female. Study was conducted in 28 centres across India. Patients had a variety of complaint (Table 2.) including cough, fever and sleep interference.



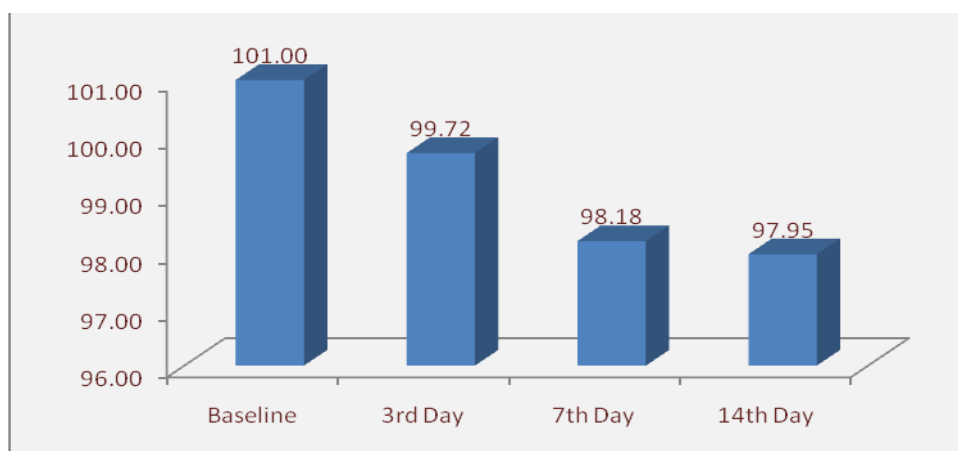
**Table 2: Demographic and clinical characteristics (Baseline)**

Demographic and clinical characteristics (Baseline)	Number of cases
<b>Sex</b>	
Male	137
Female	78
<b>Clinical Characteristics</b>	
Fever	202 (93.95%)
Cough	196 (91.16%)
Sleep disturbances	195 (90.69%)

### Evaluation of Fever

Oral temperature was recorded at the baseline and on subsequent 3<sup>rd</sup>, 7<sup>th</sup> and 14<sup>th</sup> days of treatment. 93.95% patient reported fever on the first day of treatment. Body temperature was significantly reduced from baseline mean value  $101 \pm 0.49$  °F to

$99.72 \pm 0.09$ °F,  $98.18 \pm 0.142$  and  $97.95 \pm 0.161$  on 3<sup>rd</sup>, 7<sup>th</sup> and 14<sup>th</sup> days of treatment respectively. The reduction in body temperature was significantly ( $p < 0.05$ ) lower from baseline to 3<sup>rd</sup> day and onwards (Figure 1)



**Figure 1: Effect of Cefixime-Ofloxacin combination on fever**

Also the time taken to achieve the normal body temperature was  $2.45 \pm 1.68$  days

### Evaluation of Cough Intensity

With regards to cough intensity, there was significant reduction in cough intensity at days: 3<sup>rd</sup>, 7<sup>th</sup> and 14<sup>th</sup> day from baseline. On day 3<sup>rd</sup> cough intensity was reduced by 29.4% ( $1.94 \pm 0.08$  vs.  $2.75 \pm 0.05$ ) ( $p < 0.0001$ ), on the day 7<sup>th</sup> cough intensity was reduced by 58.90% ( $1.13 \pm 0.06$  vs.  $2.75 \pm 0.05$ ) ( $p < 0.0001$ ) and on 14<sup>th</sup> day it was reduced by 79.63% ( $.56 \pm 0.06$  vs.  $2.75 \pm 0.05$ ) ( $p < 0.001$ ) from the base line (Figure 2). On the

basis of turkeys multiple comparison test there was significant lowering ( $p < 0.05$ ) in the cough intensity not only from the baseline but also there was significant lowering in cough intensity in subsequent days of observation i.e. 3<sup>rd</sup>, 7<sup>th</sup> and 14<sup>th</sup> day. Cough intensity was recorded as mild, moderate and severe with numbering as 1, 2 and 3 respectively while no cough or slight cough numbered as 0 or less than 1.

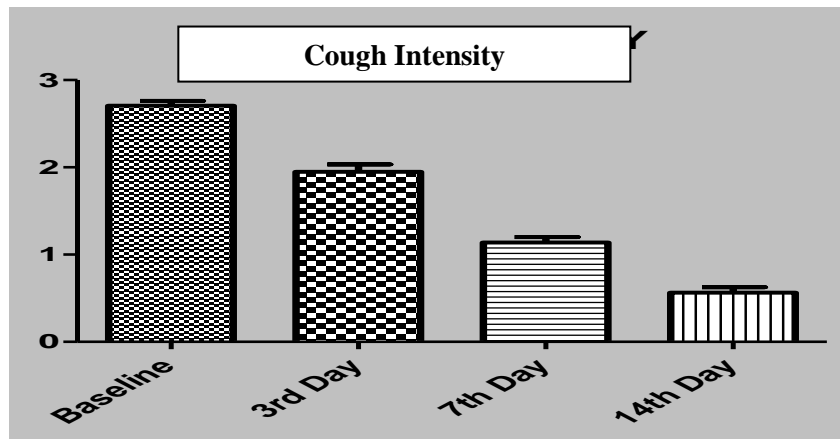


Figure 2. Effect of Cefixime-Ofloxacin combination on cough intensity

### Evaluation of cough frequency

With regards to cough frequency, there were repeated bouts of cough at the time of diagnosis; mean  $\pm$  SD value was  $15.59 \pm 11.65$  at base line. On day 3<sup>rd</sup> and onward the number of bouts of cough was significantly reduced from baseline. On the day 3<sup>rd</sup> number of bouts of cough was reduced by 31.61% ( $10.6 \pm 8.7$  vs.  $15.5 \pm 11.6$ ) ( $p < 0.05$ ), on

7<sup>th</sup> day it was reduced by 62.58% ( $5.804 \pm 5.707$  vs.  $15.59 \pm 11.65$ ) ( $p < 0.05$ ) from the base line and on the 14<sup>th</sup> day of treatment it was reduced by 86.96% ( $2.024 \pm 3.751$  vs.  $15.59 \pm 11.65$ ) ( $p < 0.05$ ). Also the number of bouts of cough was significantly reduced in the subsequent days on 3<sup>rd</sup> vs. 7<sup>th</sup> and 7<sup>th</sup> vs. 14<sup>th</sup> day of the treatment (Figure 3).

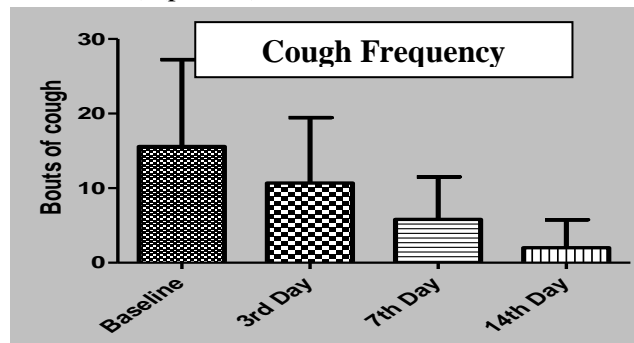


Figure 3: Effect of Cefixime-Ofloxacin combination on cough intensity

### Evaluation of sleep Interference

There was frequent nocturnal awakening at the time of diagnosis; mean±SD value was 4.12± 3.13; this nocturnal awakening was due to coughing interfering with sound sleep. On 3<sup>rd</sup> day nocturnal awakening was reduced to 2.62±2.27 and on 7<sup>th</sup> day it was further reduced to 1.31± 1.7

and on 14<sup>th</sup> day there was no or few cases of nocturnal awakening mean value was 0.581 ± 1.1. There was significant reduction in the nocturnal awakening from the baseline on 3<sup>rd</sup> day of treatment and onward 7<sup>th</sup> and 14<sup>th</sup> day of treatment (P<0.05).

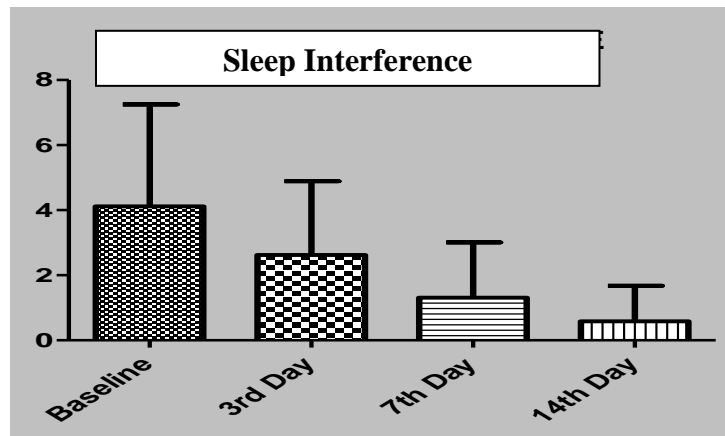


Figure 4: Effect of Cefixime-Ofloxacin combination on sleep interference

### Evaluation of Respiratory rate

There was increased respiratory rate at the baseline; mean value±SD was 27.78± 12.8; there was significant lowering in respiratory rate at days: 7<sup>th</sup> and 14<sup>th</sup> day from baseline. On day 3<sup>rd</sup>

respiratory rate was 25.37± 13.7 (non significant from base line), on the day 7<sup>th</sup> it was reduced to 21.4±4.89 (p<0.05) and on 14<sup>th</sup> day it was further reduced to 19.9±4.31) (p<0.05) from the base line (Figure 5).

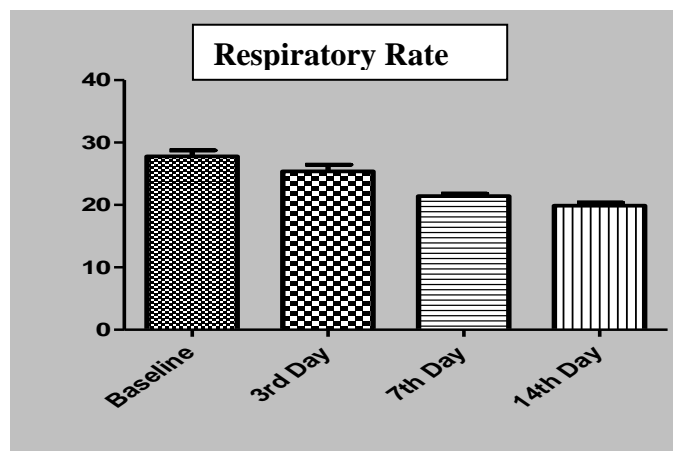


Figure 5: Effect of Cefixime-Ofloxacin combination on sleep interference

### Adverse Event

Concerning the adverse effect; rare cases of nausea (1%), headache (1%) and epigastric pain (2%) were reported which was of mild to moderate intensity & did not require discontinuation of therapy.

### Global efficacy and safety evaluation

As per investigators assessment about efficacy of CO2 tablet (Cefixime 200 + Ofloxacin 200 mg), 98% of patient reported good to excellent and only 2 % of patient reported poor efficacy. As per investigators assessment about tolerability 97.90% of patient reported good to excellent and 2.1 % of patient reported poor tolerability.

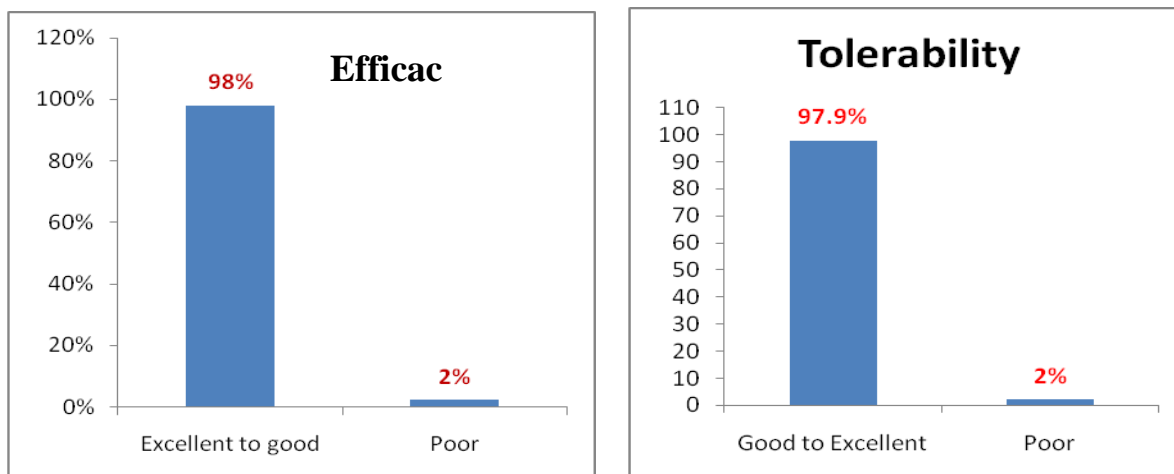


Figure 6: Global assessment on efficacy and safety of the combination of cefixime-ofloxacin

### DISCUSSION

Respiratory tract infections are associated with significant morbidity and mortality. In World Health Report 2004, the World Health Organization estimated that respiratory tract infections were the fourth major cause of mortality, responsible for 4.0 million deaths or 6.9% of the global number of deaths in 2002<sup>6</sup>.

Community-acquired pneumonia (CAP) is a common and potentially serious illness that is associated with morbidity and mortality. Although medical care has improved during the past decades, it is still potentially lethal. Streptococcus pneumoniae is the most frequent microorganism isolated. Treatment includes mandatory antibiotic therapy and organ support as needed<sup>7</sup>.

Nearly 80% of the treatment for this condition is provided in the outpatient setting. Treatment of

CAP for the most part is empirical; therefore, any antibiotic treatment should cover both typical and atypical pathogens. The beta-lactams have historically been considered standard therapy for the treatment of CAP. However, the impact of rising resistance rates is now a primary concern facing physicians<sup>8</sup>.

In one study it has been found that in the management of community acquired pneumonia, mono-therapy was effective in 70% of cases; the combination of two or more antibiotics (cephalosporin + quinolones) was required in 91.2% of patients<sup>9</sup>.

The combination of a fluoroquinolone and a  $\beta$ -lactam, which are directed against different targets (one for DNA gyrase and other cell wall) improve efficacy compared with a fluoroquinolone alone and may reduce the chance of fluoroquinolone-resistant bacteria.<sup>10</sup>

Improved efficacy of the combination compared with a fluoroquinolone alone is considered because of its synergistic effect; Cefixime inhibits bacterial cell wall synthesis & ofloxacin affects bacterial DNA gyrase. As both acts on different target sites, combination provides synergistic effect against most of the pathogens.

In the present study we evaluated the efficacy and safety of fixed dose combination of cefixime and ofloxacin (CO2 tablet) in respiratory tract infection on various objective & subjective parameters like evaluation of fever, cough frequency, cough intensity and interference in sleep.

Fever which is commonly associated in respiratory tract infection (93.95%) was significantly reduced from the baseline on 3<sup>rd</sup>, 7<sup>th</sup> and 14<sup>th</sup> day of the treatment. The mean defervescence time (no fever) was 2.45±1.68 days with combined therapy of cefixime plus ofloxacin. This result was comparable to the previous study on the use of combination of cefixime and ofloxacin in the treatment of typhoid fever, where the mean defervescence time was 3.2 days<sup>11</sup>.

With regard to cough intensity, there was significant reduction in cough intensity at days: 3<sup>rd</sup>, 7<sup>th</sup> and 14<sup>th</sup> day from baseline. On day 3<sup>rd</sup> cough intensity was reduced by 29.4% (1.94±0.08 vs. 2.75±0.05) (p<0.0001), and reduced by 58.90% (1.13±0.06 vs. 2.75±0.05) (p<0.0001) and 79.63% (.56±0.06 vs. 2.75±0.05) (p<0.001) respectively on 7<sup>th</sup> and 14<sup>th</sup> day of treatment from the base line. Regarding the cough frequency, there were repeated bouts of cough at the time of diagnosis; mean ± SD value was 15.59 ± 11.65 at base line. On day 3<sup>rd</sup> and onward the number of bouts of cough was significantly reduced from baseline. Similarly there was increased respiratory rate which was lowered down to normal on 7<sup>th</sup> and 14<sup>th</sup> day of treatment. Regarding the evaluation of global efficacy and tolerability by the investigator, the combination showed very good efficacy and excellent tolerability & safety. Concerning the

adverse effect; rare cases of nausea (1%), headache (1%) and epigastric pain (2%) has been found which was of mild to moderate intensity & did not require discontinuation of therapy.

## CONCLUSION

In conclusion this fixed dose combination of cefixime and ofloxacin (CO2 Tablet) antibiotic therapy achieves a better outcome for the empirical management of respiratory tract infection with excellent efficacy, tolerability & safety in the treatment of respiratory tract infection.

## ACKNOWLEDGEMENT

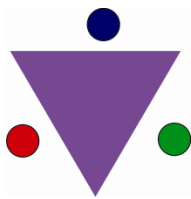
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## REFERENCES

1. Laopaiboon M, Panpanich R, Lerttrakarnnon P. Azithromycin for acute lower respiratory infection. The Cochrane Library 2011; Issue 11: Page No. 1
2. Legnani D. Role of oral antibiotics in treatment of community-acquired lower respiratory tract infections. Diagnostic Microbiology and Infectious Disease 1997; 27: 41-7
3. Brown PD, Lerner SA. Community-acquired pneumonia Lancet 1998; 352:1295-302
4. A. Kucers, S.Crowe, M.L. Grayson, J. Hoy The use of antibiotics 1997; 5<sup>th</sup> edition: Page No. 409-12, 986
5. Scottish Intercollegiate Guidelines Network; Community Management of Lower Respiratory Tract Infection in Adults, June 2002; 59: Page No.8
6. World Health Organization. The World Health Report changing history. Geneva, Austria 2004: Page No. 120, 126.
7. Caballero and Rello Combination antibiotic therapy for community acquired pneumonia; Annals of Intensive Care 2011, 1:48: Page No. 1-7
8. Segreti J, House HR, Siegel RE. Principles of antibiotic treatment of community-acquired pneumonia in the outpatient setting Jul 2005 Am J Med.;118 Suppl 7A:21S-28S
9. Sanguinetti CM, De Benedetto F, Donner CF; ISOCAP Study Group. GP management of community-acquired pneumonia in Italy: the ISOCAP study. Monaldi Arch Chest Dis. 2005 Mar;63(1):23-9
10. National Nosocomial Infections Surveillance (NNIS) system report, data summary from January 1992-April 2000, Am J Infect Control. 2000 Dec; 28(6):429-48.
11. Indian Medical Gazette August 2010, Vol.CXLIV, No. 8, Page No. 290-94



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## AUTOMOTIVE EMISSION OF BIO FUEL - A REVIEW

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### ABSTRACT

Among several alternative for conventional automotive fuels, bio fuel is catching lot of attention due to its availability and emission characteristics. This review paper discussed about the comparative engine performance and emission characteristics of bio fuel and conventional fuel assist by several researchers. The bio fuel used in the form of various bio fuel such as ethanol, Jatropha, Mahua oil, Biodiesel, pongamia pinnata methyl ester (PPME), vegetable oil. Several bio fuel used as bio diesel.

**Keyword:** Eco friendly, low cost and easily availability of bio fuel.

### INTRODUCTION

The world is presently confronted with the twin crises of fossil fuel depletion and environmental degradation. Indiscriminate and lavish consumption of fossil fuels have led to reduction in underground-based carbon resources. The search for alternative fuels, which promise a harmonious correlation with sustainable development, energy conservation, efficiency and environmental preservation, has become highly pronounced in the present context. [4]. Emissions from combustion engines have a considerable impact on the environment and human health In order to reduce emissions, a wide range of alternative fuels are being developed [12]. Diesel engines are the most efficient prime movers. From the point of view of protecting global environment and concerns for long-term energy security, it becomes necessary to develop alternative fuels [5] Global air-pollution is a serious problem. Much of this pollution is caused by the use of fossil fuels for transportation [13].

The fuel of bio-origin can provide a feasible solution to this world wide petroleum crisis. Gasoline and diesel driven automobiles are the major sources of greenhouse gases (GHG) emission. Scientists around the world have explored several alternative energy resources, which have the potential to quench the ever-increasing energy thirst of today's population. Various bio fuels energy resources explored including biomass, biogas, primary alcohols, vegetable oils, biodiesel etc. These alternative energy resources are largely environment-friendly but they need to be evaluated on case to case basis for their advantages, disadvantages and specific applications. Some of these fuels can be used directly while other needs to be formulated to bring the relevant properties closer to conventional fuels [4]. Biodiesel is 100% renewable only when the alcohol used in the transesterification process is also renewable, but this proportion is reduced to around 90% (if the balance is made in mass) or 95 % ( if the balance is made in carbon

mass) when fossil alcohol (usually methanol) is used [11]. It is important for an alternative diesel fuels to be technically acceptable, economically competitive, environmentally acceptable and easily available. Among these alternative fuels, biodiesel and its derivatives, have received much attention in recent years for diesel engines. Biodiesel is an oxygenated diesel engine fuel that can be obtained from vegetable oils or animal fats by conversion of the triglycerides to esters via transesterification. [8]

### Energy Scenario

The present energy scenario has simulated active research interest in non-petroleum, renewable and non-pollutant fuels. The world reserves of primary energy and raw materials are very limited. According to an estimate, the reserves will last for 218 years for coal, 41 year for oil, and 63 year for

natural gas. The enormous growth of world population, increased technical development and standard of living in the industrial nations has led to this intricate situation in the field of energy supply and demand. The prices of crude oil increasing and fluctuating on a daily basis. This necessitates developing and commercializing fossil fuel alternatives from bio origin.

Use of fossil fuels such as petroleum product and coal lead to several environmental problems such as reduction in underground-based carbon energy sources, serious modifications in earth's surface layer. Usage of these fossil fuels has led to increase in CO<sub>2</sub> level in atmosphere from 280PPM in pre industrial era to 350 PPM now. These CO<sub>2</sub> level are still climbing as a function of fuel burnt leading to green house effect, acid rains, smoke and change of climate world over [4]

Projected demand for diesel, and bio fuels requirements				
Year	Diesel demand Mt	Biodiesel blending requirement (in metric tons)		
		@ 5 per cent	@ 10 per cent	@ 20 per cent
2006-2007	52.32	2.62	5.23	10.46
2011-2012	66.91	3.35	6.69	13.38
2016-2017	83.58	4.18	8.36	16.72

[9]

It has been reported by the results of many studies that biodiesel can be used in diesel engines with little or no modifications and with almost the same performance. Besides it reduces carbon monoxide (CO), unburned hydrocarbons (HC), and smoke emissions. [8]

### Alternative of Diesel (Petroleum Product)

#### Ethanol

India is the fourth largest ethanol producer after Brazil, the United States and China, its average annual ethanol output amounting to 1,900 million litres with a distillation capacity of 2,900 million litres per year. For a 5 percent ethanol blend in

petrol nationally, the ethanol required would be 640 million litres of ethanol in 2006-2007 and 810 million litres in 2011-2012. Current capacity can potentially satisfy this demand.

The cost of ethanol production can be decreased by using improved agricultural practices to increase sugarcane yield and deploying energy-efficient ethanol dehydration methods like pressure-swing adsorption and membrane separation. Restrictive government policies need to be reformed to loosen constraints on ethanol production.

India is now the world's largest sugar consumer and this has put added pressure on the ethanol industry. As agricultural research has amply demonstrated, sweet sorghum and tropical sugar beet are cost-effective feedstock crops that may substitute for sugarcane. Furthermore, exciting new biotechnology involving enzymatic saccharification and fermentation has made it possible to use readily available cellulosic material like wood and crop residue for ethanol production. Also, trade in ethanol can play an important part in helping meet India's ethanol requirements. India's trade policies do not have to be protectionist, but should rather be aimed at spurring domestic growth [9]. Commercial diesel fuel, 20% biodiesel and 80% diesel fuel, called B20, and 80% biodiesel and 20% ethanol, called BE20, were used in a single cylinder, four strokes direct injection diesel engine. The effect of test fuels on engine torque, power, BSFC, brake thermal efficiency, exhaust gas temperature, and CO, CO<sub>2</sub>, NO<sub>x</sub> and SO<sub>2</sub> emissions was investigated. The experimental results showed that the performance of CI engine was improved with the use of the BE20 especially in comparison to B20. Besides, the exhaust emissions for BE20 were fairly reduced [8]. Biodiesel and petroleum diesel have similar properties, hence, nearly all conventional diesel engines is able to work fueled without any modification with blends from pure diesel up to B20 [14].

### **Jatropha**

The Government of India has developed an ambitious National Biodiesel Mission to meet 20 per cent of the country's diesel requirements by 2011-2012. Since the demand for edible vegetable oil exceeds supply, the Government decided to use non-edible oil from *Jatropha Curcas* oilseeds as biodiesel feedstock [9]. The effect of reducing *Jatropha* oil's viscosity by increasing the fuel temperature (using waste heat of the exhaust gases) and thereby eliminating its effect on combustion and emission characteristics of the

engine [5]. The performance and emissions tests were conducted with diesel, preheated *Jatropha* oil, unheated *Jatropha* oil and blends of *Jatropha* oil at different loads and constant speed (1500 rpm). From the experimental results obtained, *Jatropha* oil is found to be a promising alternative fuel for compression ignition engines [5]. Compared to neat diesel operation, methyl esters of Honge oil, *Jatropha* and sesame oils result in poor performance associated with higher emissions [15].

### **Mahua Oil**

Mahua oil (crude) is widely available in India and neighboring countries. Furthermore, the use of non-edible vegetable oils such as Mahua oil is of significance because of the great need for edible oil as food. It is well established that for alkali hydrolysis, the raw vegetable oil has to meet certain specifications. In experimental investigation, Mahua Oil Ethyl Ester (MOEE) was prepared by transesterification using H<sub>2</sub>SO<sub>4</sub> as a catalyst and tested in a 4-stroke direct injection natural aspirated diesel engine. It was observed that properties of MOEE were similar to standard diesel. [16]. Transesterification, or alcoholysis, is the reaction of a fat or oil with an alcohol to form esters and glycerol. The literature clearly shows that transesterification is the best way to use vegetable oil as a fuel in existing diesel engine [7].

### **Biodiesel**

Global air-pollution is a serious problem. Much of this pollution is caused by the use of fossil fuels for transportation. Therefore, engine manufacturers have designed alternatively fueled engines and fuel systems, which provide sufficient power while staying within regulatory emission-limits. At the same time, a great deal of research and development on internal-combustion engines has taken place not only in the design area but also in finding an appropriate fuel. Many researchers have concluded that biodiesel holds promise as an alternative fuel for diesel engines. Diesel-fuel blends with biodiesel have superior lubricity,

which reduces wear and tear on the diesel engine and makes the engine components last longer. Biodiesel mixes well with diesel fuel and stays blended. These characteristics of biodiesel reduce the emissions of carbon monoxide (CO), hydrocarbons (HC), and particulate matter (PM) in the exhaust gas compared with diesel fuel [1, 2, 9]. **Exhaust gas recirculation (EGR)** is effective to reduce NO<sub>x</sub> from diesel engines because it lowers the flame temperature and the oxygen concentration in the combustion chamber. However, EGR results in higher particulate matter (PM) emissions. Thus, the drawback of higher NO<sub>x</sub> emissions while using biodiesel may be overcome by employing EGR [6].

#### **Pongamia Pinnata Methyl Ester (PPME)**

Pongamia pinnata is a non-edible species capable of growing in almost all types of land (sandy, rocky including oolitic limestone). It grows even in salt water and can withstand extreme weather conditions with a temperature range of 0–50<sup>0</sup>C and annual rainfall of 5–25 dm. Transesterification of pongamia oil was carried out by heating of oil, addition of KOH and methyl alcohol, stirring of mixture, separation of glycerol, washing with distilled water and heating for removal of water. The PPME so produced was mixed with diesel in varying proportions from 20% to 100% by volume (B20, B40, B60, B80 and B100) with the help of a magnetic stirrer. The blends were stirred continuously to achieve stable property values. Fuel properties such as flash point, fire point, kinematic viscosity and calorific value were determined for PPME and are compared with the other biodiesel. From the experimental investigation, it is concluded that blends of PPME with diesel up to 40% by volume (B40) could replace the diesel for diesel engine applications for getting less emissions and better performance and will thus help in achieving energy economy, environmental protection and rural economic development. In the near future conventional fuels will be fully replaced by biodiesel and will provide

a viable solution for the much threatening environmental pollution problems [10].

#### **Vegetable Oil**

Bio-diesel, which can be used as an alternative diesel fuel, is made from renewable biological sources such as vegetable oil and animal fats. It is biodegradable, non-toxic and possesses low emission profiles. Also, the uses of bio-fuels are environmentally beneficial [3].

### **LITERATURE REVIEW**

**Huseyin Aydin, Cumali Ilklic (2010)** has used higher percentage of bio diesel in unmodified diesel engine, 20% bio diesel and 80% diesel fuel called as B20, and 80% bio diesel and 20% ethanol is called BE20. On investigation they found that performance increases as well as the Percentage level of CO<sub>2</sub>, CO, HC, NO<sub>x</sub>, SO<sub>x</sub> get decreased.

**K. Sureshkumar, R. Velraj R. Ganasan (2008)** has used Pongamia pinnata methyl ester and its blend with diesel in the proportion of B20, B40, B60, B80, B100. The Brake Specific Fuel Consumption (BSFC) is lower than diesel and for B40, BSFC is less as well as the Percentage level of CO<sub>2</sub>, CO, HC, NO<sub>x</sub>, SO<sub>x</sub> get decreased. And also said that B40 can replace diesel for better performance and less emission.

**Deepak Agarwal, Avinash Kumar Agarwal (2007)** has used JATROPHA oil in the proportion as J10, J20, J50, J75 and J100, in which J20 is having the better result than diesel in terms of thermal efficiency, BSFC and less emission.

**Avinash Kumar Agarwal (2006)** has used alcohol and biodiesel in CI engine. On experimental investigation the results are better for biodiesel in comparisons to diesel in terms of performance and exhaust emission.

**Deepak Agarwal, Shailendra Sinha, Avinash Kumar Agarwal (2006)** has done experimental investigation of control of NO<sub>x</sub> emission in bio diesel fueled CI Engine, and with the help of Exhaust gas recirculator (EGR) . by using

biodiesel in various proportion give the good result then diesel.

**Mustafa Canakei, Ahmet Erdil, Erol Areaklioglu (2005)** has compared the performance and emission, then get the results in the favour of biodiesel.

**Sukumar Puhan, N. Vedaraman, G. Sankarayanan, Bopanna V. Bharat Ram(2004)** performance and emission study is based on Mahua oil the performance level in terms of thermal efficiency increases as well as BSFC and exhaust emission was less.

**Joseph B. Gonsalves (2006).** On the basis of Emission, various alternative fuels which are easily available in India studied.

### Benefits from the use of biofuels in india

#### Reduced emission of harmful pollutant

Ethanol and biodiesel are both oxygenated compounds containing no sulphur. These fuels do not produce sulphur oxides, which lead to acid rain formation. Sulphur is removed from petrol and diesel by a process called hydro-desulphurization. The hydro-desulphurization of diesel causes a loss in lubricity, which has to be rectified by introducing an additive. Biodiesel has

natural lubricity, and thus no lubricity-enhancing additive is required [6,8,9].

Since ethanol and biodiesel contain oxygen, the amount of carbon monoxide (CO) and unburnt hydrocarbons in the exhaust is reduced. With the introduction of ethanol in Brazil, CO emission from automobiles decreased from 50 g/km in 1980 to 5.8 g/km in 1995. The emission of nitrogen oxides (No<sub>x</sub>) from bio fuels is slightly greater when compared to petroleum, but this problem can be ameliorated by using de-No<sub>x</sub> catalysts which work well with biofuels due to the absence of sulphur [6,9].

One of the disadvantages in using pure ethanol is that aldehyde emissions are higher than those of gasoline, but it must be observed that these aldehyde emissions are predominantly acetaldehydes. Acetaldehydes emissions generate less adverse health effects when compared to formaldehydes emitted from gasoline engines.

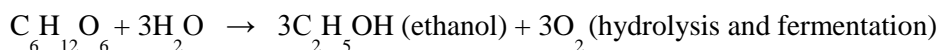
Table below shows the results of the emission tests for pure biodiesel (B100) and 20 per cent biodiesel blend (B20) compared to conventional diesel [9].

Biodiesel emissions compared to conventional diesel		
Emissions	B100 (100 per cent biodiesel)	B20 (20 per cent biodiesel)
<b>Regulated Emissions</b>		
Total Unburned Hydrocarbons	-93 per cent	-30 per cent
Carbon Monoxide	-50 per cent	-20 per cent
Particulate Matter	-30 per cent	-22 per cent
No <sub>x</sub>	+13 per cent	+2 per cent
<b>Non regulated emissions</b>		
	B100 (100 per cent biodiesel)	B20 (20 per cent biodiesel)
Polycyclic Aromatic Hydrocarbons (PAH)	-80 per cent	-13 per cent
NPAH (Nitrated PAH)	-90 per cent	-50 per cent
<b>Life cycle emissions</b>		
Carbon Dioxide (LCA)		-80 per cent
Sulphur Dioxide (LCA)		-100 per cent

The NOx emissions were slightly increased with the use of both biodiesel–ethanol blend and standard diesel fuel with respect to those of the biodiesel–diesel blend [8].

### Reduction in greenhouse gas emissions

The net CO<sub>2</sub> emission of burning a biofuel like ethanol is zero since the CO<sub>2</sub> emitted on combustion is equal to that absorbed from the atmosphere by photosynthesis during the growth of the plant (sugarcane) used to manufacture ethanol. This is illustrated by the following equations:



### Increased Employment

At the beginning of the new millennium, 260 million people in India did not have access to a consumption basket which defines the poverty line. India is home to 22 per cent of the world's poor. A programme that generates employment is therefore particularly welcome. The bio fuels sector has the potential to serve as a source of substantial employment. The investment in the ethanol industry per job created is \$11,000, which is significantly less than the \$220,000 per job in the petroleum field. In India, the sugar industry, which is the backbone of ethanol production, is the biggest agro industry in the country. The sugar

industry is the source of the livelihood of 45 million farmers and their dependants, comprising 7.5 per cent of the rural population. Another half a million people are employed as skilled or semi-skilled labourers in sugarcane cultivation.

The first phase of the National Biodiesel Mission demonstration project will generate employment of 127.6 million person days in plantation by 2007. On a sustained basis, the program will create 36.8 million person days in seed collection and 3,680 person years for running the seed collection and oil-extraction centers'. Table shows the estimated cumulative achievements of the project in terms of output and employment[9].

Yearly and cumulative achievements of demonstration project							
Year	Cumulative area (thousand hectares)	Availability of seed (million tons)	Expellers (number)	Plantation employment (million person days)	Seed collection employment (million person days)	Seed centre employment (person years)	Availability of oil (million tons)
2003	80	0	0	21	0	0	0
2004	240	0.200	20	45.9	1.6	160	0.048
2005	400	0.800	80	53	6.4	640	0.192
2006	400	1.600	160	7.68	12.8	1280	0.384
2007	400	2.000	200	0	16	1600	0.480
Cumulative Total				127.6	36.8	3,680	1.1104

### **Improved social well-being**

A large part of India's population, mostly in rural areas, does not have access to energy services. The enhanced use of renewable (mainly bio fuels) in rural areas is closely linked to poverty reductions because greater access to energy services can:

- Improve access to pumped drinking water. Potable water can reduce hunger by allowing for cooked food (95 per cent of food needs cooking);
- Reduce the time spent by women and children on basic survival activities (gathering firewood, fetching water, cooking, etc.);
- Allow lighting which increases security and enables the night time use of educational media and communication at school and home; and
- Reduce indoor pollution caused by firewood use, together with a reduction in deforestation.

Lack of access to affordable energy services among the rural poor seriously affects their chances of benefiting from economic development and improved living standards. Women, older people and children suffer disproportionately because of their relative dependence on traditional fuels and their exposure to smoke from cooking, the main cause of respiratory diseases. Electricity through transmission lines to many rural areas is unlikely to happen in the near future, so access to modern decentralized small-scale energy technologies, particularly renewable (including bio fuels), are an important element for effective poverty alleviation policies. A programme that develops energy from raw material grown in rural areas will go a long way in providing energy security to the rural people.

### **CONCLUSION**

The above discussed bio fuels, will play an extremely important role in meeting India's energy needs. Today the favorable position is this that petroleum products are costly as compare to the

bio fuel. Bio fuels offer several significant benefits including:-

- Reduced emission of pollutants such as carbon monoxide, unburnt hydrocarbons, and particulate matter. Bio fuels contain virtually no sulphur.
- Reduced emission of the greenhouse gas carbon dioxide, which contributes to global warming.
- Increased employment. Because for the production of bio fuels several plants to be placed which require labor work.
- Energy security and decreased dependence on oil imports by diversification energy supply.
- Improved social well-being.

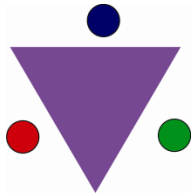
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### **REFERENCES**

1. Agarwal AK, Bijwe J, Das LM. Effect of biodiesel utilization on wear of vital parts in compression ignition engine. *J Eng Gas Turb Power* 2003;125:604–11.
2. Agarwal AK, Das LM. Biodiesel development and characterization for use as a fuel in compression ignition engines. *J Eng Gas Turb Power* 2001;123:440–7.
3. A.S. Ramadhas, S. Jayaraj, C. Muraleedharan Use of vegetable oils as I.C. engine fuels—A review *Renewable Energy* 29 (2004) 727–742
4. Avinash kumar Agareal. Bio fuels (alcohols and biodiesel) applications as fuels for Internal combustion engines. *progress in Energy and Combustion science* 33 (2007) 233-271.

5. Deepak Agarwal , Avinash Kumar Agarwal. Performance and emissions characteristics of Jatropha oil (preheated and blend) in a direct injection compression ignition engine *Applied Thermal Engineering* 27 (2007) 2314–2323.
6. Deepak Agarwal, Shailendra Sinha, Avinash Kumar Agarwal Experimental investigation of control of NOx Emissions in biodiesel-fueled compression ignition engine *Renewable Energy* 31 (2006) 2356–2369.
7. Freedman B, Pryde EH, Mounts TL. Variables affecting the yields of fatty esters from transesterified vegetable oils. *JAOCs* 1984;61(10):1638–43.
8. Huseyin Aydin, Cumali Lilkilic. Effect of ethanol blending with biodiesel on engine performance and exhaust emissions in a CI engine. *Applied Thermal Engineering* 30 (2010) 1199–1204.
9. Joseph B. Gonsalves. An Assessment of the Bio fuels Industry in India United Nations Conference on Trade and Development 18 October 2006.
10. K. Sureshkumar, R. Velraj, R. Ganesan Performance and exhaust emission characteristics of a CI engine fueled with Pongamia pinnata methyl ester (PPME) and its blends with diesel *Renewable Energy* 33 (2008) 2294–2302.
11. Magrín Lapuerta\_, Octavio Armas, Jose´ Rodri´guez-Ferna´ ndez Effect of biodiesel fuels on diesel engine emissions *Progress in Energy and Combustion Science* 34 (2008) 198–223.
12. M. Lindgren, G. Larsson, P.-A. Hansson. Evaluation of factors influencing emissions from tractors and construction equipment during realistic work operations using diesel fuel and bio-fuels as substitute journal homepage: [www.elsevier.com/locate/issn/15375110](http://www.elsevier.com/locate/issn/15375110)
13. Mustafa Canakci, Ahmet Erdil, Erol Arcakliog˘lu Performance and exhaust emissions of a biodiesel engine *Applied Energy* 83 (2006) 594–605.
14. N.Janardhana rao, M.R.CH.Sastry, Dr. P.Nageswara Reddy Comparative Analysis Of Performance And Emissions Of An Engine With Palm Oil Biodiesel Blends With Diesel. N.Janardhana Rao et al. / *International Journal of Engineering Science and Technology (IJEST)*.
15. N.R. Banapurmath, P.G. Tewari, R.S. Hosmath. Performance and emission characteristics of a DI compression ignition engine operated on Honge, Jatropha and sesame oil methyl esters *Renewable Energy* 33 (2008) 1982–1988.
16. Sukumar Puhan, N. Vedaraman, G. Sankaranarayanan, Boppana V. Bharat Ram. Performance and emission study of Mahua oil (madhuca indica oil) ethyl ester in a 4-stroke natural aspirated direct injection diesel engine *Renewable Energy* 30 (2005) 1269–1278.



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## ULNAR HEAD OF FLEXOR CARPI ULNARIS SEPARATING ULNAR NERVE AND ULNAR ARTERY

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### ABSTRACT

During routine dissection, of the right upper limb of a 70 years old donated embalmed male cadaver in the Department of Anatomy, K.J. Somaiya Medical College, Sion, Mumbai, India, we observed a separate humeral and ulnar heads of flexor carpi ulnaris muscle. To recognise Anatomical variations it is necessary to know the normal Anatomy. Normally the flexor carpi ulnaris muscle arises by two heads, humeral and ulnar, connected by a tendinous arch. The humeral head arises from the medial epicondyle via the common flexor tendon. The ulnar head arises from the medial margin of the olecranon process and an aponeurosis attached to the posterior sub cutaneous border of the ulna. The tendon of flexor carpi ulnaris inserted into the hamate and the fifth metacarpal bone through pisohamate and pisometacarpal ligaments. In the present case the ulnar head of flexor carpi ulnaris muscle was more bulky. It separated ulnar nerve and artery. The humeral and ulnar heads were separated from each other by ulnar nerve. These two heads fused with each other just before their insertion, where the ulnar artery came in contact with ulnar nerve. The further course and distribution of ulnar artery and ulnar nerve were normal. The knowledge of such unusual ulnar head separating ulnar artery and ulnar nerve may be clinically important for plastic surgeons doing flap surgeries and for the surgeon dealing with cubital tunnel syndrome.

**Keywords:** Flexor carpi ulnaris, Ulnar artery, Ulnar Head, Ulnar nerve, Humeral head, plastic surgeons, cubital tunnel syndrome.

### INTRODUCTION

Flexor carpi ulnaris muscle is the medial most muscle of the superficial flexor group. It arises by two heads, humeral and ulnar, connected by a tendinous arch. The small humeral head arises from the medial epicondyle via the common flexor tendon. The ulnar head has an extensive origin from the medial margin of the olecranon process and proximal two-thirds of the posterior border of the ulna, an aponeurosis (along with flexor digitorum profundus and extensor carpi ulnaris) and from the intermuscular septum between it and

flexor digitorum superficialis. A thick tendon forms along its anterolateral border in its distal half. The tendon is attached to the pisiform, and thence prolonged to the hamate and the fifth metacarpal bone by pisohamate and pisometacarpal ligaments (pisiform is the sesamoid bone developing in the tendon of flexor carpi ulnaris). Acting with the flexor carpi radialis, it flexes the wrist and acting with the extensor carpi ulnaris it adducts the wrist (1). Flexor carpi ulnaris muscle is innervated by the ulnar nerve (C7, C8 and T1). The line between the medial

humeral epicondyle and the pisiform, along the anterior palmar margin of the muscle, is used as a reference point for locating the ulnar neurovascular bundle. The ulnar artery reaches the muscle in its middle third, whereas the ulnar nerve is covered by the muscle throughout its entire course running under the tendon in the wrist region. The ulnar artery, the larger of the two terminal branches of the brachial, begins a little below the bend of the elbow, and, passing obliquely downward, reaches the ulnar side of the forearm at a point about midway between the elbow and the wrist. It then runs along the ulnar border to the wrist, crosses the transverse carpal ligament on the radial side of the pisiform bone, and immediately beyond this bone divides into two branches, which enter into the formation of the superficial and deep palmar arches. The ulnar nerve, after descending in the forearm between the flexor digitorum profundus and flexor carpi ulnaris muscles, pierces the deep fascia and enters the wrist through the Guyon's canal. In the distal part of the canal, the ulnar nerve divides into a superficial sensory branch and a deep motor branch, which supplies the hypothenar muscles and then passes across the palm, distributing to other intrinsic hand muscles.

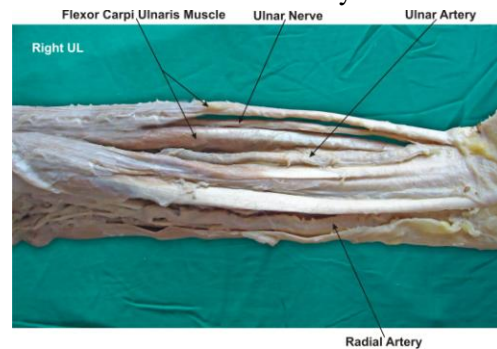
### MATERIALS AND METHODS

The right upper limb of a donated embalmed 70 years old male cadaver was dissected during routine dissection in the department of Anatomy at K.J. Somaiya Medical College, Sion, Mumbai. All the superficial flexor muscles were exposed. The humeral and ulnar heads of flexor carpi ulnaris muscle was dissected carefully to observe the arrangement of ulnar artery, ulnar head, ulnar nerve and humeral head. The course of ulnar artery and ulnar nerve were also dissected.

The photographs of the variations were taken for proper documentation.

### RESULTS

The variation was observed in the forearm of right upper limb. However, the left upper limb was normal. The right forearm showed separate ulnar and humeral heads of flexor carpi ulnaris muscle. The ulnar head of flexor carpi ulnaris muscle separated ulnar artery and nerve. The humeral and ulnar heads were separated from each other by ulnar nerve. The tendons of both the heads of flexor carpi ulnaris fused with each other just before their insertion. The ulnar artery comes in contact with ulnar nerve in the lower part of the forearm near the wrist where the two heads of flexor carpi ulnaris fused with each other. The ulnar artery in the hand takes part in the formation of superficial and deep palmar arches. The ulnar nerve in the hand bifurcates into superficial sensory branch and a deep motor branch. The course and distribution of the terminal branches of both ulnar nerve and ulnar artery were normal.



### DISCUSSION

The variations of flexor carpi ulnaris muscle have been reported previously by many authors. These variations include: (i) an additional slip of flexor carpi ulnaris (2). (ii) variations in musculotendinous junction of the flexor carpi ulnaris muscle (3), (iii) variant flexor carpi ulnaris causing ulnar nerve compression (4). In the present case the two heads of flexor carpi ulnaris muscle remain separate. The ulnar head separated ulnar artery and nerve. The ulnar nerve runs in between the two heads of the flexor carpi ulnaris muscle in the forearm. Such variation is not yet reported in literature. The flexor carpi ulnaris

muscle acts as an anatomical guideline for finding the neurovascular bundle (ulnar nerve, ulnar artery and accompanying venae comitantes), it can be easily palpated in its distal course if the wrist is flexed and adducted. The present variation need to be taken into account when interpreting ultrasound and MR images, as well as during dissection of the ulnar neurovascular bundle when using flexor carpi ulnaris as a guideline. The flexor carpi ulnaris is a useful local muscle flap in the forearm and elbow. It is, however, an important palmar flexor and ulnar deviator of the wrist, and functional loss may arise from the use of this muscle in its entirety. The flexor carpi ulnaris is made up of two distinct neuromuscular compartments. This arrangement allows for splitting of the muscle and the potential use of the larger ulnar compartment as a local muscle flap while maintaining the humeral compartment as an ulnar deviator and palmar flexor of the wrist (5). After multiple efforts to heal an infected nonunion of the proximal ulna, a flexor carpi ulnaris muscle pedicle flap was used to improve blood supply and softtissue coverage at the nonunion site. It was observed that it promoted bone healing and restoration of useful elbow function (6). The course and distribution of ulnar nerve and ulnar artery can assist the surgeon in the diagnosis and effective management of the more common pain syndromes conditions associated with the ulnar aspect of the hand (7). As the two heads of flexor carpi ulnaris muscles were separate the tendinous arch between them was absent. The possibility of entrapment of ulnar nerve in cubital tunnel in such cases is rare.

### CONCLUSION

The knowledge of such unusual variations of flexor carpi ulnaris is a must before any operative procedures of the forearm and hand. The ulnar head of flexor carpi ulnaris separating ulnar artery and ulnar nerve seen in present case is important for Anatomists. It may be clinically important for plastic

surgeons doing flap surgeries and for the surgeons dealing with cubital tunnel syndrome. Orthopaedicians have used this muscle flap for treating non union of proximal ulna and hence knowledge of this variable head is important.

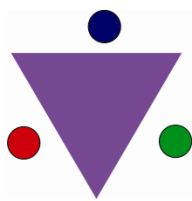
**Competing Interests:** The authors declare that they have no competing interest.

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### REFERENCES

1. Susan, Standring, Gray's Anatomy, 39<sup>th</sup> Edition Elsevier Churchill Livingstone, 2005. pg: 877.
2. Bergman, R. A.; Thomson, S. A.; Afifi, A. K. & Saadesh, F. A. Compendium of human anatomic variations. Urban & Schwarzenberg, Baltimore – Munich, 13, 1988.
3. Grechenig, W.; Clement, H.; Egner, S.; Tesch, N. P.; Weiglein, A. & Peicha, G. Musculo-tendinous junction of the flexor carpi ulnaris muscle. An anatomical study. *Surg. Radiol. Anat.*, 22:255-60, 2000.
4. Al-Qattan, M. M. & Duerksen, F. A variant of flexor carpi ulnaris causing ulnar nerve compression. *J. Anat.*, 180:189-190, 1992.
5. Lingaraj, K.; Lim, A. Y.; Puhaindran, M. E. & Kumar, P. V. The split flexor carpi ulnaris as a local muscle flap. *Clin. Orthop. Relat. Res.*, 455:262-6, 2007.
6. Meals, R. A. The use of a flexor carpi ulnaris muscle flap in the treatment of an infected nonunion of the proximal ulna. A case report. *Clin. Orthop. Relat. Res.*, 240:168- 72, 1989.
7. Kleinert, H. and Hayes, J. The ulnar tunnel syndrome. *Plastic Reconstructive Surgery*, 1971, Vol.47, pg. 21-24.



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## PHYTO-SOCIOLOGICAL STUDY OF FOREST ECOSYSTEM IN YUSMARG FOREST: A HILL RESORT OF KASHMIR VALLEY, INDIA

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### ABSTRACT

The increasing anthropogenic pressure especially increasing influx of tourists at health resorts in mountainous regions decreases the distribution of trees in the given area, which ultimately affects the variety, variability, uniqueness and distribution pattern in Forest Ecosystem. The area belongs to temperate region of Pir Panjal mountain range. In order to cope up with this situation a phyto-sociological study was carried out during the month of May to December 2010. The main objective of the study was to determine the distribution pattern of trees and impact of tourist on forest ecosystem. The study was based on three sites with marked differences in their physical and biotic features. The composition and the number of tree species were recorded by quadrat method. Quadrates of size (10m×10m) were randomly laid. During the study period, the only tree family observed was Pinaceae. The total IVI was observed highest (135.7) for *Abies pindrow* at site3 and lowest (74.7) total IVI was observed for *Pinus wallichiana* at site1. The total relative density was observed highest (51.1) for *Abies pindrow* at site3 and lowest (21.2) was observed for *Pinus wallichiana* at site1. Shannon Weiner diversity Index having small variation during the study period. Dominance index (Simpson Index) was less than 1 which showed that the sites were not dominated by single species. The distribution pattern of trees was random. The primary conclusion is, there is a moderate anthropogenic impact on normal distribution of tree community which may cause decrease in tree line within next few decades in the forest ecosystem.

**Keywords:** Yusmarg, *Abies pindrow*, Pinaceae, Tourists, Anthropogenic

### INTRODUCTION

The structural property of a community is the quantitative relationship between the species growing around. The earth's vegetation includes all plant forms wherever and what they may be, and most have yielded to a phyto-sociological approach of one type or another. Phyto-sociology aims to characterize and classify communities in terms of their composition and structure, and therefore has a place under plant ecology. The quantitative study of vegetation is called phyto-

sociology and its principle aim is to describe the vegetation, explain or predict its pattern and classify it in a meaningful way (Ilorkar and Khatri, 2003). A sound understanding of the richness of species is necessary for appropriate conservation and restoration of the biological diversity. Forests are important landscape units in any region because they consist of both flood-resistant species and immigrants from the adjacent uplands, thereby comprising most of the regional floristic biodiversity and protect natural beauty by holding

soil firmly which in turn supports other living activities directly to flora and indirectly to the fauna life. Forest floor vegetation plays an important role in nutrient cycling, habitat conservation and regeneration of trees shrubs. Trees subjected to periodic flooding often compensate anaerobic soil conditions by developing morpho-anatomical adaptations and by reducing metabolism during the waterlogged period, resulting in decreased photosynthetic rates, leaf shedding, and reduced wood growth and cambial dormancy (Fernandez *et al.*, 1999; Parolin *et al.*, 2004; Worbes 1997). Inundation is thus a powerful factor selecting the occurrence and distribution of tree species (Jackson and Colmer 2005), which in turn influences structure and biomass of seasonally flooded tree species communities. Nunes da Cunha and Junk (2001) investigated the distribution of woody plant communities in the northern part of the Pantanal near the city of Poconé in terms of habitat preference and found approximately 40 flood-resistant tree species, most of them showing a wide distribution range on the topographic gradient, from areas with prolonged flooding to dry habitats that become flooded only during extreme flood events. It is a well known fact that the altitude represents a complex gradient along which many environmental variables change concomitantly. Rahbek (1997) explain the patterns in species richness decrease with altitude. Besides the ecosystem functions the distribution and occurrence of species had been affected by human interventions (Singh *et al.*, 1987). The vegetation diversity of forest ecosystems is influenced by topography, soil, climate and geographical location of the region. There is a great diversity in the floristic pattern due to altitudinal variation, and rainfall (Arora 1995). Jammu & Kashmir possesses vast forests stretching from the lower valleys high up into mountain passes right to the edge of massive glaciers and vary according to both altitude and climatic conditions. They range

from the tropical deciduous forests to temperate forests. Jammu & Kashmir's forests include a wide variety of species including evergreens, Pine, Laurel, Sal, Oak, Magnolia, Cedar, Birch, Spruce and Juniper.

## MATERIAL AND METHODS

### Study Area

Yusmarg health resort situated at 33°49' 42"N latitude and 74° 39' 59"E longitudes, 2712 m above sea level (a.s.l) and is approximately 47 km to the southwest of Srinagar and lies in the Budgam district of Jammu and Kashmir . It is a cluster of meadows bounded by magnificent trees in the lap of Pir Panjal mountain range. Grassy pastures are stretching to acres of land, the dense forests full of pine trees and snow capped mountains presents a splendid look. A river, known by the name of Doodh Ganga (Doodh=milk and Ganga= from river Ganga) frothing and crashing on its way over the rocks makes a little white foam, which gives it this name. The hills comprise of a number of several peaks, namely Tatta Kutti, Sang Safed etc. It is reputed for having some unique spring flowers. It also has some of the highest peaks in Pir-Panjal range like Tatakoli 4725m, Romesh Thong 5000m and Sunset peak 4746m. The town of Yusmarg enjoys a temperate climate. Precipitation in Yusmarg is normally in the form of mild snowfall during the winters. Summers are mild and warm, and winters are very cold. The average temperature in summers ranges between 20-25°C, while temperatures start coming down from September, winters are very cold and temperatures dips in sub-zeros.

### Study Sites

#### Site1: Near the edge of Meadows

This site is situated at 33°50'00.6"N latitudes, 74°40'08.6"E longitudes at an elevation of 2436 m on way to Nilnag Coniferous forest. This site was located opposite to JK TDC HUTS and near to the

grazing area, dominated with Coniferous tree species and having rough and sloppy topography.

### **Site2: In Between Upper and lower Reaches of Forest Beat**

This site is situated at 33° 50' 08.3" N latitudes, 74° 40' 57.2" E longitudes and at an elevation of 2445m above mean sea-level and having sharp steepness compared to site1.

### **Site 3: Bushy Forest area**

This site is situated at 33° 50' 16.2" N latitudes, 74° 39' 43.9" E longitudes and at an elevation of 2400m above mean sea-level, with less diverse of herbs but dominated with shrubs. Study sites and study area shown in figure1.

### **Sampling and Collection**

Information was gathered using a variety of methods to gain a better understanding of the present condition of Yusmarg forests, perspectives and priorities. Site survey and sampling for three representative sites was carried out during May to December (2010). The composition and number of tree species at each site was recorded by quadrat method. Quadrates were laid out randomly throughout the selected forest stands by taking quadrates of size 10m × 10 m. The size and the number of quadrates were determined following (Misra, 1968; Kershaw, 1973). In each quadrates, trees were recorded with >31.5 cm Circumference at breast height (cbh) i.e. 1.37m above the ground) individually measured and quantitatively analyzed for abundance, density and frequency according to the formulae given by Curtis and Mc Intosh (1950) and Mishra (1968). The relative values were summed up to represent Importance Value Index (IVI) Curtis (1959). The diversity index (H') was computed by using Shannon-Wiener information Index (Shannon and Wiener, 1963). The concentration of dominance (CD) was computed by Simpson's Index (Simpson, 1949).

## **RESULTS**

Plant species that were found during study period include trees as *Abies pindrow*, *picea smithiana*

and *Pinus wallichiana*. The research analysis of data as presented in table 1 revealed that at site1, the density and IVI was highest in the month of May for *Picea smithiana* as 3 and 142.2, followed by *Pinus wallichiana* 1.8 and 99.6 respectively. In the month of June *Abies pindrow* have 2.0 and 122.2 density and IVI followed by *Picea smithiana* as 1.8 and 111.9 (Table 1). In November and December *Abies pindrow* was having highest density and IVI as 2.3 and 123.0, 3.3 and 142.1, followed by *Picea smithiana* 1.5 and 94.1, 2.0 and 101.4 respectively. Overall density and IVI values were obtained highest for *Abies pindrow* as 2.1 and 111.5, and for *Picea smithiana* 2.1 and 111.3, table4. At site2, the density and IVI was highest in the month of May for *Picea smithiana* 3.5 and 166.9 followed by *Abies pindrow* 1.3 and 85.3. In the month of June density and IVI was highest for *Picea smithiana* 2.5 and 128.2, followed by *Pinus wallichiana* 1.8 and 101.3 respectively. In November and December *Pinus wallichiana* was having highest density and IVI as 2.8 and 139, 5.5 and 143.6 respectively. But in the month of November second highest values were obtained for *Picea smithiana* with density and IVI 1.5 and 94 and in December *Abies pindrow* with density and IVI was 3.3 and 101.7, depicted in table2. The overall values of density and IVI was highest for *Pinus wallichiana* 2.6 and 113.9, followed by *Picea smithiana* 2.2 and 100.4 respectively (Table 4). At site3, the density and IVI was highest in the month of May for *Abies pindrow* 1.3 and 112.5 followed by *Picea smithiana* 1 and 97.5. In the month of June *Abies pindrow* again having highest density and IVI 1.8 and 123.2 followed by *Pinus wallichiana* 1.3 and 97.9 Table 3. Similar trend was followed in the November and December with highest density and IVI of *Abies pindrow* followed by *Pinus wallichiana* 2.8, 120.8; 3.3, 177.2 and 2.0, 97.7; 0.8 and 67.4 respectively (Table 3). Overall density and IVI values were highest for

*Abies pindrow* 2.3 and 135.7 followed by *Pinus wallichiana* 1.2 and 88.4 (Table 4).

### Diversity Indices

Index of dominance also called Simpson index observed 0.32 at site1 and at site2, and 0.34 at site3, depicted in table5. The mean value of Shannon-Weiner index observed 1.06 at site1, 1.05 at site2 and 1.04 at site3 respectively during the study period. Evenness Index observed 0.97, 0.96 and 0.95 at site1, site2 and at site3 respectively, presented in table5. Abundance/Frequency (A/F) ratio observed 0.02 at site1, 0.03 at site 2 and 0.02 at site 3. These results showed random spatial distribution in case of tree species, (Table 6).

### DISCUSSION

Phyto-sociological studies incorporate mainly the description of plant composition, floristic communities and the functional aspects. Plants in nature occur in repeating groups of associated plants called communities. The structure of a community is determined mainly by the dominating plant species and not by other characteristics (Odum, 1971). All these species are not equally important but there are only a few overtopping species which by their bulk and growth modify the habitat and control the growth of other species of the community as these species are called dominants (K. J. Gaston, 2000). Total 3 tree species belonging to Pinaceae family were recorded on the three sampling sites. Total density/m<sup>2</sup> varied for trees from 2.6 to 0.9 at site2 and site3 respectively. For a particular species, higher frequency indicates its more frequent distribution at sites due to optimum soil and environmental conditions. *Picea smithiana* showed 100% frequency at site1 and near values was obtained at site 2 while 93.8% frequency was reported in case of *Abies pindrow* at site 3. The higher value of IVI indicates that all the available resources are being utilized by *Abies pindrow* and *Picea smithiana* species and left over are being

trapped by specie at site1, at site2 *Pinus wallichiana* having highest IVI followed by *Picea smithiana*. *Abies pindrow* having highest IVI at site3. Moreover, each species of a community plays specific role and there is a definite quantitative relationship between abundant and rare species (Bhandari et al., 1999). The high IVI of a species indicated its dominance and ecological success, its good power of regeneration and greater ecological amplitude. *Abies pindrow* showed maximum IVI values at two sites and therefore emerged as a dominant species of the ecosystem. A/F ratio was used to assess the distribution pattern of the species. Distribution pattern indicated that most of plots species are distributed contagiously (clumped) followed by randomly. The distribution of tree species was mainly random at all sites. Similar findings have been reported for Central Himalayan forests by different workers (Saxena and Singh, 1982; Bhandari and Tiwari, 1997), Kershaw, (1973) and Singh and Yadava, (1974). Odum (1971) described that in natural conditions; contagious (clumped) distribution is the most common type of distribution and is performed due to small but significant variations in the environmental conditions. Preponderance of random distribution in tree as compared to shrub layer reflects the dimension of biotic interferences in these strata. Diversity is a combination of two factors, the number of species present, referred to as species richness and the distribution of individuals among the species, referred to as evenness or equitability. Single species populations are defined as having a diversity of zero, regardless of the index used. Species diversity therefore, refers to the variations that exist among the different forms. In the present study Shannon - Wiener index of diversity has been used. The Shannon index (H') of diversity for trees was maximum (1.06) at site 1 followed by (1.05) at site 2 and (1.04) at site 3. Simpson's index (Cd) was maximum (0.34) at site 3 followed by (0.32) at site 1 and site 2 for trees.

### CONCLUSION

The primary conclusion is, there is a moderate anthropogenic impact on normal distribution of tree community which may cause decrease in tree line within next few decades in the forest ecosystem. Priority should be given to protect tree line especially saplings so that large gaps in forest area would be replaced with healthy forest ecosystem in future.

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### REFERENCES

1. Arora, R.K. 1995. Himalayan Resources, Diversity and Conservation. In: U.Dhar (ed.), *Himalayan Biodiversity*. Gyanodaya Prakashan, Nainital 2: 39-55.
2. Bhandari, B.S. and Tiwari, S.C. 1997. Dominance and diversity along an altitudinal gradient in a montane forest of Garhwal Himalaya. *Proc. Indian National SciencAcademy*. B 64: 437-446.
3. Bhandari, B.S.,D.C. Nautiyal and R. D. Gaur, 1999. Structural attributes and Productivity potential of an alpine Pasture of Garhwal Himalaya. *J.Ind. Bot. Soc.*, 78:321-329.
4. Curtis, J.T., 1959. The Vegetation of Wisconsin. *An Ordination of Plant Communities*. Univ. Wisconsin press, Madison, Wisconsin, pp:657.
5. Curtis JT , McIntosh RP (1950). The interrelations of certain analytic and synthetic phytosociological characters. *Ecology*, 31: 438-455.
6. Fernandez MD, Pieters A, Donoso C, Herrera C, Tezara W, Rengifo E, Herrera A (1999) Seasonal changes in photosynthesis of trees in the flooded forest of the Mapiro River. *Tree Physiol* 19:79-85.
7. Ilorkar, V.M. and Khatri, P.K. 2003. Phytosociological study of Navegaon National Park (Maharashtra). *Indian For.*, 129: 377-387.
8. Jackson MB, Colmer TD (2005) Response and adaptation by plants to flooding stress. *Ann Bot (Oxford)*96:501-505.
9. Kershaw KK. 1973. *Quantitative and Dynamic Plant Ecology*. (2<sup>nd</sup> edition). London: FLBS and Edwards Arnold (Publ.) Ltd., p. 308.
10. K. J. Gaston, 2000. "Global palterns in biodiversity," *Nature*; 405 : 220-227.
11. Misra, R. 1968. *Ecology Work Book*. Oxford and IBH Publishing, New Delhi.
12. Nunes da Cunha C, Junk WJ (2001) Distribution of woody plant communities along the flood gradient in the Pantanal of Poconé, Mato Grosso, Brazil. *International Journal of Ecology and Environmental Science* 27:63-70.
13. Odum E.P. 1971. *Fundamentals of Ecology*, 3rd edition.
14. Parolin P, De Simone O, Haase K, Waldhoff D, Rottenberger S, Kuhn U, Kesselmeier J,

- Kleiss B, Schmidt W, Piedade MTF, Junk WJ (2004) Central Amazon floodplain forests: tree adaptation in a pulsing system. *The Bot Rev* 70:357–380.
15. Rahbek, C., 1997. The relationship among area, elevation and regional species richness in Neotropical birds. *Am. Nat.*, 149, 875-902.
  16. Singh, J. S and Singh ,S. P. 1987. Forest vegetation of the Himalaya; *Bot. Rev.* 52 80-192.
  17. Saxena, A.K. and Singh, J.S. 1982. A phytosociological analysis of woody species in forest communities of a part of Kumaun Himalaya. *Vegetatio*, 50: 3-32.
  18. Singh, J.S and Yadav, P.S. 1974. Seasonal variation in composition of plant biomass and net primary productivity of tropical grassland of Kurukshetra, India. *Ecological Monograph*, 44: 351-375.
  19. Shannon, C. E. and Wiener, W. 1963. *The Mathematical Theory of communication*. University of Illinois press, Urbana. 117p.
  20. Simpson, E. H. 1949. The Measurement of Diversity. *Nature*. 163-688.
  21. Worbes M (1997) The forest ecosystem of the floodplains. In Junk WJ (ed) *The Central Amazon floodplains. Ecology of a pulsing system*. Springer Verlag Berlin, Heidelberg, New York, pp 223–266.

**Table1: List of tree species and other data recorded by quadrat laid randomly at site1.**

Species	May							June							November							December						
	F %	RF	D m <sup>-2</sup>	RD	A	RA	IVI	F %	RF	D m <sup>-2</sup>	R D	A	R A	IV I	F %	R F	D m <sup>-2</sup>	R D	A	R A	IV I	F %	R F	D m <sup>-2</sup>	RD	A	RA	IVI
<i>Abies pindrow</i>	50.0	20.0	0.8	13.6	1.5	23.8	57.4	100.0	40.0	2.0	44.4	2.00	37.7	12.2	10.0	36.4	2.3	45.0	2.25	41.7	12.3	10.0	36.4	3.3	54.2	3.25	51.6	142.1
<i>Picea smithiana</i>	100.0	40.0	3.0	54.5	3.0	47.6	142.2	100.0	40.0	1.8	38.9	1.75	33.0	11.9	10.0	36.4	1.5	30.0	1.50	27.8	94.1	10.0	36.4	2.0	33.3	2.00	31.7	101.4
<i>Pinus wallichiana</i>	100.0	40.0	1.8	31.8	1.7	27.8	99.6	50.0	20.0	0.8	16.7	1.50	28.3	65.0	75.0	27.3	1.3	25.0	1.67	30.9	83.1	75.0	27.3	0.8	12.5	1	15.9	55.6

F =Frequency (%), RF = Relative Frequency, D (m<sup>-2</sup>) =Density, RD = Relative Density, A = Abundance, RA = Relative Abundance and IVI =Importance Value Index

**Table2: List of tree species and other data recorded by quadrat laid randomly at site2.**

Species	May							June							November							December						
	F %	RF	D m <sup>-2</sup>	RD	A	RA	IVI	F %	RF	D m <sup>-2</sup>	R D	A	R A	IV I	F %	R F	D m <sup>-2</sup>	R D	A	R A	IV I	F %	R F	D m <sup>-2</sup>	R D	A	R A	IVI
<i>Abies pindrow</i>	100.0	40.0	1.3	23.6	1.25	21.7	85.3	75.0	30.0	1.0	18.9	1.3	21.9	70.7	50.0	20.0	0.8	14.7	1.5	24.6	59.3	10.0	40.0	3.3	32.5	3.3	29.2	101.7
<i>Picea smithiana</i>	100.0	40.0	3.5	66.0	3.50	60.9	166.9	100.0	40.0	2.5	47.2	2.5	41.0	12.2	10.0	40.0	1.5	29.4	1.5	24.6	94.0	50.0	20.0	1.3	12.5	2.5	22.1	54.6
<i>Pinus wallichiana</i>	50.0	20.0	0.5	9.4	1.00	17.4	46.8	75.0	30.0	1.8	33.0	2.3	38.3	10.3	10.0	40.0	2.8	53.9	2.8	45.1	13.9	10.0	40.0	5.5	55.0	5.5	48.6	143.6

F =Frequency (%), RF = Relative Frequency, D (m<sup>-2</sup>) =Density, RD = Relative Density, A = Abundance, RA = Relative Abundance and IVI =Importance Value Index

**Table3: List of tree species and other data recorded by quadrat laid randomly at site3.**

Species	May							June							November							December						
	F %	RF	D m <sup>-2</sup>	RD	A	RA	IVI	F %	RF	D m <sup>-2</sup>	R D	A	R A	IV I	F %	R F	D m <sup>-2</sup>	R D	A	R A	IV I	F %	R F	D m <sup>-2</sup>	R D	A	R A	IVI
<i>Abies pindrow</i>	75.0	37.5	1.3	41.7	1.67	33.3	112.5	100.0	44.4	1.8	43.8	1.75	35.0	12.2	10.0	36.4	2.8	43.7	2.75	40.7	12.8	10.0	50.0	3.0	70.7	3.25	56.5	177.2
<i>Picea smithiana</i>	75.0	37.5	1.0	33.3	1.33	26.7	97.5	50.0	22.2	0.8	18.8	1.50	30.0	71.0	75.0	27.3	1.5	23.8	2.00	29.6	80.7	50.0	25.0	0.5	10.9	1.00	17.4	53.3
<i>Pinus wallichiana</i>	50.0	25.0	0.8	25.0	1.50	30.0	80.0	75.0	33.3	1.3	31.3	1.67	33.3	97.9	10.0	36.4	2.0	31.7	2.00	29.6	97.7	50.0	25.0	0.8	16.3	1.50	26.1	67.4

F =Frequency (%), RF = Relative Frequency, D (m<sup>-2</sup>) =Density, RD = Relative Density, A = Abundance, RA = Relative Abundance and IVI =Importance Value Index.

**TABLE4: Comparison of Total Frequency, Total Relative Frequency, Total Density, Total Relative Density, Total Abundance, Total Relative abundance and Total Importance Value Indices of three tree species observed at three different sites.**

Species	SITE 1							SITE2							SITE3						
	TF %	TRF	TD m <sup>-2</sup>	TRD	TA	TRA	TIVI	TF %	TRF	TD m <sup>-2</sup>	TR D	TA	TR A	TIV I	TF %	TR F	TD m <sup>-2</sup>	TR D	TA	TR A	TIV I
<i>Abies pindrow</i>	87.5	33.3	2.1	38.9	2.36	39.3	111.5	81.3	32.5	1.6	24.4	1.92	24.0	81.0	93.8	41.7	2.3	51.1	2.40	42.9	135.7
<i>Picea smithiana</i>	100.0	38.0	2.1	38.9	2.06	34.4	111.3	87.5	35.0	2.2	34.2	2.50	31.3	100.4	62.5	27.8	0.9	21.3	1.50	26.8	75.9
<i>Pinus wallichiana</i>	75.0	28.5	1.1	21.2	1.50	25.0	74.7	81.3	32.5	2.6	41.0	3.23	40.4	113.9	68.8	30.6	1.2	27.0	1.73	30.8	88.4

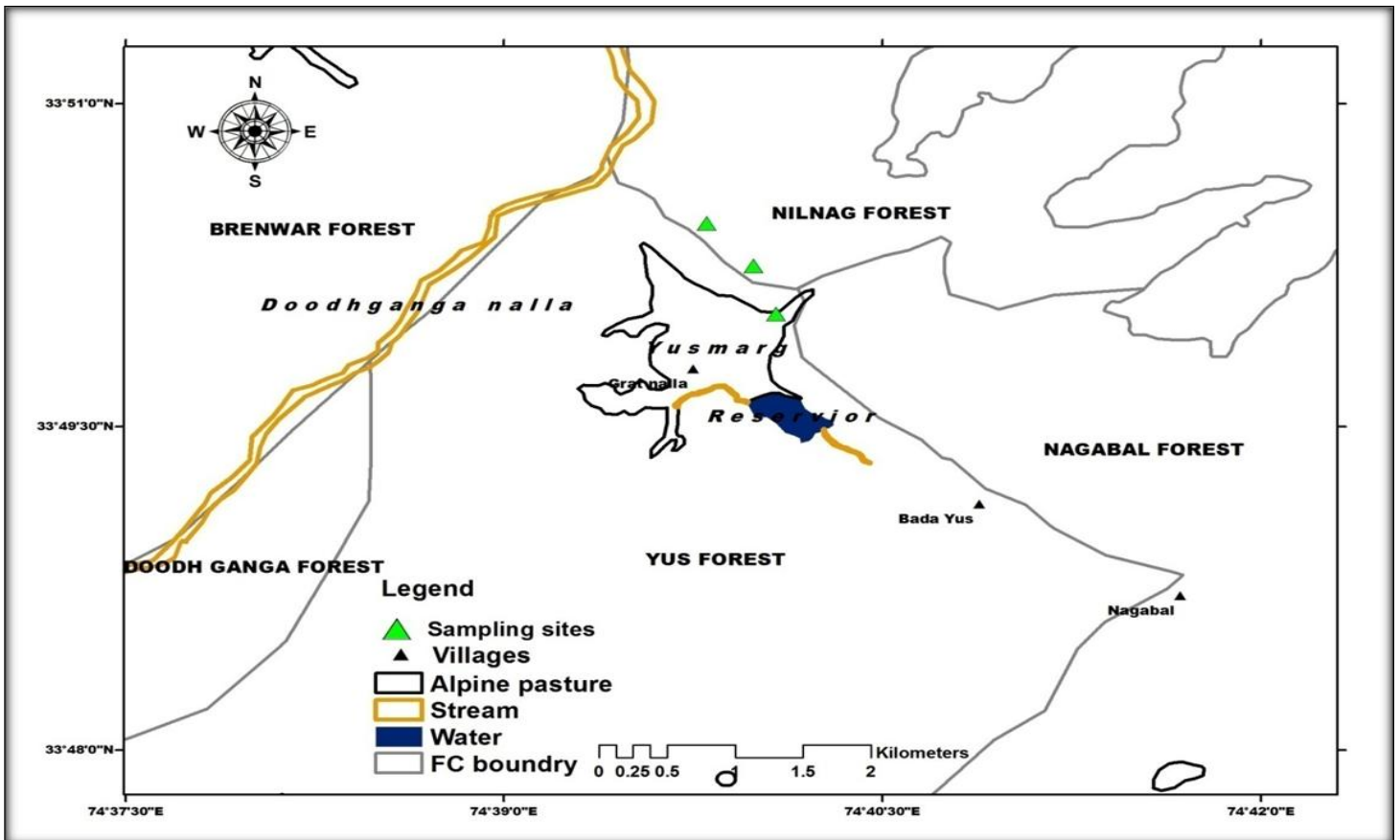
TF = Total Frequency (%), TRF = Total Relative Frequency, TD (m<sup>-2</sup>) =Total Density, TRD = Total Relative Density, TA =Total Abundance, TRA = Total Relative Abundance and TIVI =Total importance value indices

**Table 5: Diversity Indices.**

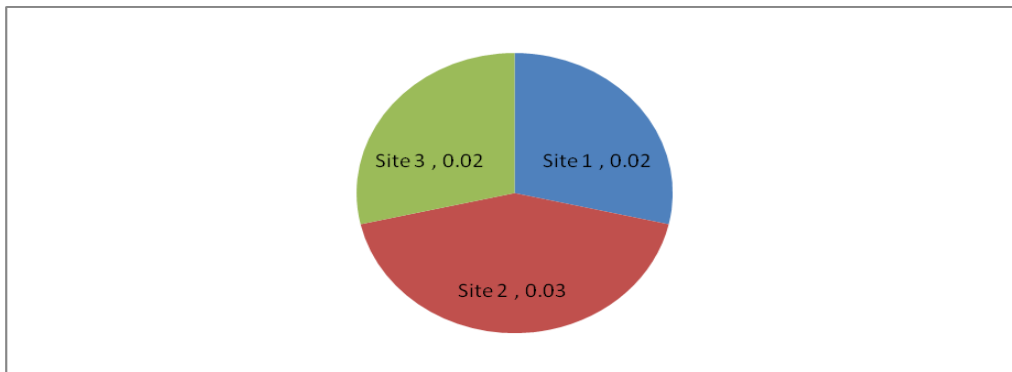
Sites	Simpson's Index	Shannon-Weiner Index	Evenness Index
Site 1	0.32	1.06	0.97
Site 2	0.32	1.05	0.96
Site 3	0.34	1.04	0.95

**Table 6: Spatial Distribution of species**

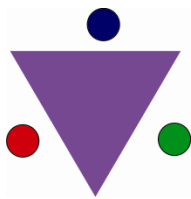
Sites	Frequency	Abundance	A/F
Site 1	262.5	5.92	0.02
Site 2	250.1	7.65	0.03
Site 3	225.1	5.63	0.02



**Fig1. Map of Study sites and study area**



**Fig 2. A/F Ratio**



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## PHYTOCHEMICAL SCREENING AND ANTIOXIDANT ACTIVITY OF MALVA SYLVESTRIS

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### ABSTRACT

Assortment of medicinal plants which are conventionally used for thousands of years, are present in a assemblage of herbal provision of the Indian traditional health care system (Ayurveda) named Rasayana which was projected for their appealing antioxidant activities. Along with the medicinal plants used in Ayurvedic Rasayana for their restorative action, medicinal plants have been scrupulously investigated. The developing countries predominantly rely on the conventional medicines. The long-established medicine involves the use of dissimilar plant extracts or the bioactive constituents. This nature of study provides the healthiness relevance at reasonable cost. The hit such as ethnomedicine actively represents one of the unsurpassed avenues in penetrating new profitable plants for medicine. In observance with this view in mind that the current investigation is carried out in *Malva sylvestris*, known as common mallow, which is native to Europe, North Africa and Asia. In the Mediterranean region, this genus has a elongated history and used as food, and outstanding to its therapeutic significance, several parts of this plant have been engaged in conventional as well as ethnoveterinary medicines. The Antioxidant evaluation of *Malva sylvestris*, was carried out using the free radical scavenging activity of the 1, 1-diphenyl-2-picrylhydrazyl radical (DPPH), total phenolics content and reducing power assay on the methanolic extract. Qualitative phytochemical investigation of this plant confirms the presence of various phytochemicals like saponins, alkaloids and flavonoids. The results suggest that the phytochemical properties of this plant were used for curing various ailments and possess potential antioxidant properties.

**Keywords:** Antioxidants, Free radicals, DPPH, *Malva sylvestris*, Phytochemical Screening.

### INTRODUCTION

The conventional drug all over the world is currently revalue by an widespread activity of study on dissimilar plant species and their remedial principles. Investigational evidence suggests that free radicals as well as reactive oxygen species be able to involved in a high numeral of diseases<sup>1,2</sup>. As plant life produce a lot of antioxidants to manage the oxidative stress caused by sunbeams along with oxygen, they can

correspond to a resource of new-fangled compounds with antioxidant activity. The Indian traditional health care system, Ayurveda is the oldest medical organization in the world and is being rejuvenated in its inclusive form beneath the name of Maharishi Ayurveda<sup>3</sup>. One of the scientific specialty of Ayurveda is Rasayana. Rasayana is not merely a drug rehabilitation but is a particular procedure accomplished in the form of rejuvenating recipe, dietary regimen promoting

high-quality habit. The function of rasayana is two-fold: avoidance of disease along with counteraction of aging processes which result from optimization of homeostasis. The denotation of the word Rasayana fundamentally refers to nutrition and its gaining, association, circulation and perfusion in the body tissues<sup>4</sup>.

World Plant Biodiversity is the prevalent resource of herbal remedy also still concerning 60-80% World Population rely on plant based medicines which are being used in view of the fact that the ages as long-established health care systems. It is nowadays clear, that the medicinal ethics of these plants lie in the bioactive phytochemical constituents that manufacture definite physiological belongings on human body. Although the conventional Indian system of medicine has a elongated history of use, they are deficient in enough documentation, predominantly in light modern methodical knowledge<sup>5</sup>. These innate compounds formed the pedestal of modern drugs as we use these days<sup>6,7,8</sup>.

‘Phyto’ is the Greek phrase for plant. There are readily available several families of phytochemicals and they assist the human body in a diversity of ways. Phytochemicals might defend human from an assortment of diseases. Phytochemicals are non-nutritive plant chemicals to facilitate defensive or disease anticipatory properties. Phytochemicals are fundamentally alienated into two groups i.e. primary in addition to secondary metabolites; according to their functions in plant metabolism. Primary metabolites encompass common sugars, amino acids, proteins and chlorophyll even as Secondary metabolites encompass of alkaloids, flavonoids, tannins and saponins and terpenoids<sup>9,10</sup>. Accordingly, the current study intended to reflect on 2,2-Diphenyl-1-picryl-hydraxyl radical (DPPH) which will be used to resolve their free radical scavenging behavior and phytochemical screening of the frequently used medicinal plant i.e. *Malva sylvestris*.

*Malva sylvestris* is a species of the Mallow genus, Malva which belongs to the family of Malvaceae in addition to is recognized as common mallow<sup>11,12,13</sup>. It originates from southern Europe along with Asia although has widen all above the world as a common weed. The dehydrated or fresh flowers moreover leaves of high mallow are used as food and medicine. It have been worn as food and medicine in Europe ever since the time of ancient Greece and Rome. Conventional herbal medicine continues to observe the plant as a valuable anti-inflammatory mediator for the respiratory tract, the skin, and the gastrointestinal tract<sup>14</sup>. *Malva sylvestris* is an herbaceous plant used in phototherapy and broadly dispersed in Italy<sup>15</sup>, the leaves are used as emollient, laxative as well as cough medicine<sup>16</sup>.

## MATERIALS AND METHODS

### Collection:

Authentic samples: Various market samples of *Malva sylvestris* were procured from Chunnihal Attar Ayurvedic Store, Ghat Gate, Jaipur in the month of March, 2010.

### Identification:

All the samples were authenticated and were given identification number. The identification was as follows:

These samples were authenticated and submitted in Ethnomedicinal Herbarium, Centre of Excellence funded by DST, MGiaS, Jaipur (Rajasthan).

### Processing of plant materials:

During the course of the study each sample was screened for its foreign matter and milled, before use.

### Experimental details:

Present studies were performed on *Malva sylvestris* for the following studies-

1. Phytochemical test of plant extract
2. Antioxidant Potentials of Methanolic extract of plant

## 1. PHYTOCHEMICAL SCREENING

Phytochemical screening was performed using standard procedure:

### TEST FOR REDUCING SUGARS (FEHLINGS TEST)

The aqueous ethanol extract (0.5gm in 5 ml of water) was added to boiling fehling's solution (A and B) in a test tube. The solution was observed for a colour reaction.

### TEST FOR TERPENOIDS (SALKOWSKI TEST)

To 0.5 gm each of the extract was added to 2ml of chloroform. Concentrated sulphuric acid (3ml) was carefully added to form a layer. Reddish brown coloration of the interface indicates the presence of terpenoids.

### TEST FOR FLAVONOIDES

4ml of extract solution was treated with 1.5ml of 50% methanol solution. The solution was warmed and metal magnesium was added. To this solution, 5-6 drops of concentrated Hydrochloride acid was added and red colour was observed for flavonoids and orange color for flavons.

### TEST FOR TANNINS

About 0.5 g of the extract was boiled in 10ml of water in a test tube and then filtered. A few drops of 0.1% ferric chloride was added and observed for brownish green or a blue-black coloration.

### TEST FOR SAPONINS

To 0.5 g of extract was added 5 ml of distilled water in a test tube. The solution was shaken vigorously. And observed for a stable persistent froth. The frothing was mixed with 3 drops of olive oil and shaken vigorously after which it was observed for the formation of an emulsion.

### TEST FOR ALKALOIDS

Alkaloids solutions produce white yellowish precipitate when a few drops of Mayer's reagents are added. Most alkaloids are precipitated from neutral or slightly acidic solution by Mayer's regent.

The alcoholic extract was heated on a boiling water bath with 2% hydrochloric acid. After cooling, the mixture was filtered and treated with a few drops of mayer's reagent. The sample was then observed for the turbidity or yellow precipitation.

## 2. ANTIOXIDANT ACTIVITY

### Preparation of test extracts

All the test plant sample and their adulterants were milled and refluxed in ethanol for 36 h, filtered, concentrated to dryness *in vacuo*. A portion of ethanolic extract was further successively extracted in pet. ether, benzene, chloroform, alcohol and water, concentrated and stored at minimum temperature, until used.

### Preparation of DPPH

DPPH (2, 2'-diphenyl-1-picrylhydrazyl,  $C_{18}H_{12}N_5O_6$ ; Hi media) 0.8 mg was dissolved in 10 ml methanol to obtain a concentration of 0.08 mg/ml for antioxidative (qualitative and quantitative) assay.

### Qualitative assay

Each successive extract (10 mg) was dissolved in 10 ml of its suitable solvent to get a concentration of 1 mg/ml and from this, 0.25 $\mu$ l was taken with the help of micropipette, applied on silica gel G coated plates. These circular spots were sprayed with DPPH solution, allowed to stand for 30 min. When DPPH reacts with an antioxidant compound, which can donate hydrogen, it is reduced, and the changes in colour (from deep-violet to light- yellow on white) were recorded at 517 nm on a UV spectrophotometer (Varian Cary PCB 150, Water Peltier System).

### Quantitative assay

A concentration of 1 mg/ml of ethanolic extract of each test sample was prepared to obtain different concentrations ( $10^2\mu$ g to  $10^{-3}\mu$ g/ml). Each diluted solution (2.5 ml each) was mixed with DPPH (2.5ml). The samples were kept in the dark for 15 min at room temperature and then the decrease in absorption was measured. Absorption of blank sample containing the same amount of methanol

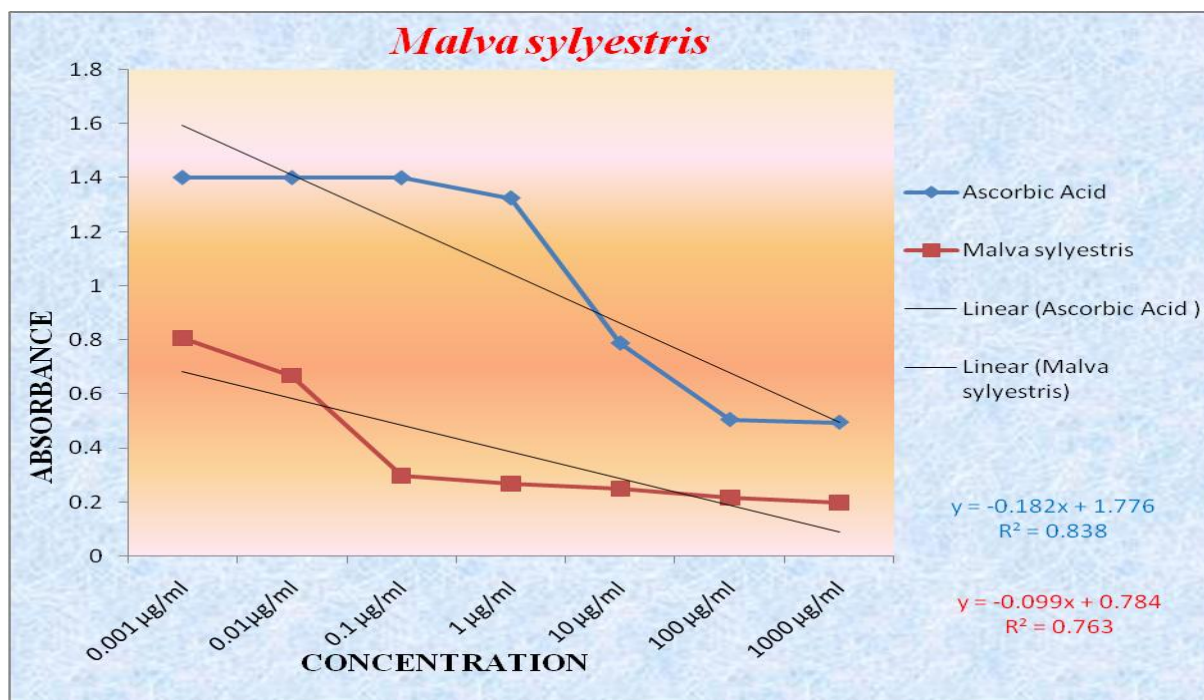
and DPPH solution was prepared and measured. The UV absorbance was recorded at 517 nm. The experiment was done in triplicate and the average absorption was noted for each concentration. Data were processed using EXCEL and concentration

that cause 50% reduction in absorbance (RC<sub>50</sub>) was calculated. The same procedure was also followed for the standards- quercetin and ascorbic acid.

## RESULTS

**Table 1: Showing Optical density of *Malva sylvestris* on different concentrations**

CONCENTRATION (µg/ml)	O.D (nm)
0.001	0.808
0.01	0.669
0.1	0.298
1	0.269
10	0.251
100	0.218
1000	0.198



**Fig 1: Graph showing Antioxidant Activity of *Malva sylvestris* at different concentration**

**Table 2: Showing phytochemical screening results of *Malva sylvestris***

<i>Malva sylvestris</i>						
TEST	Reducing Sugar	Saponin	Tannin	Terpenoides	Flavonoides	Alkaloides
	-	+	-ve	-ve	+	+

### DISCUSSION

In the present investigation, Table 1 shows the optical density of *Malva sylvestris* at different concentrations and it was showed that the maximum optical density comes out to be 0.808 nm which is at the concentration  $10^{-3}$   $\mu\text{g/ml}$  and the smallest optical density is 0.198 nm which is at the concentration  $10^3$   $\mu\text{g/ml}$  where as the other shows comparable O.D at different concentrations i.e. 0.669 nm at  $10^{-2}$   $\mu\text{g/ml}$ , 0.298 nm at  $10^{-1}$   $\mu\text{g/ml}$ , 0.269 nm at 1  $\mu\text{g/ml}$ , 0.251 nm at  $10^1$   $\mu\text{g/ml}$ , 0.218 nm at  $10^2$   $\mu\text{g/ml}$ .

The DPPH radical scavenging activity of *Malva sylvestris* is given in the Fig.1. In the present investigations antioxidant activity of *Malva sylvestris* showed appreciable activity against the DPPH assay method where the regression line clear cut showed the effectiveness of it as it's have potentials which are comparable to ascorbic acid. The antioxidant activity of *Malva sylvestris* in methanolic extract using DPPH assay method shows appreciable activity comparable to standard ascorbic acid. The straight line showed  $Y = -0.182x + 1.776$  & regression = 0.838 whereas, in above drug the straight line is  $Y = -0.099x + 0.784$  & regression = 0.763.

The Phytochemical screening of the plants bare a few differences in the constituent of the tested plants in table 2. The phytochemical screening of *Malva sylvestris* shows the occurrence of alkaloids, flavonoids and saponin, whereas it shows the absence of tannin, terpenoids respectively. The screening of the *Malva sylvestris* shows only a miniature amount of differences in the component of the hard-bitten plants. This drug

shows the substantiation of broad-shouldered antioxidant activity equivalent or in a less important amount. The prolongation of alkaloids, flavonoids and saponin in this plant is persuasive to be painstaking for the free radical scavenging effects hardheaded.

### CONCLUSION

Numerous studies have been performed to categorize antioxidant compounds with pharmacologically activity and a restricted toxicity. The Phytochemical screening and qualitative estimation of *Malva sylvestris* shows a small amount of differences in the ingredients, Where it possess a large amount of alkaloids, flavonoids and saponins. The incidence of quercetin in enormous capacity is rationally proportional to the antioxidant activity so it is manifestly shows that the occurrence of flavonoids will provide evidence of the antioxidant activity and also it promotes a drug for treatment of various infectious diseases. *Malva sylvestris* exhibit strapping antioxidant activity in added or a smaller amount. The presence of flavonoids in the plant is expected to be conscientious for the free radical scavenging effects pragmatic. The plant phenolic compound i.e. flavonoids are a chief assemblage of compounds that execute as primary antioxidants or free radical scavengers. The DPPH analysis provides in progression on the reactivity of the test compounds through stable free radical along with it gives a strapping absorption band at 517nm in visible region. Accordingly, these types of studies suggest that these plants acquire

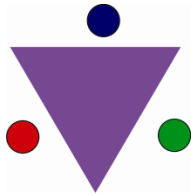
antioxidant activities which can counteract the oxidative damage caused by infectious disease.

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#### REFERENCES

1. Richards, R.T., Sharma, H.M., 1991. Free radicals in health and disease. *Indian Journal of Clinical Practice* 2 (7), 15–26.
2. Niwa, Y., 1991. Effect of Maharishi 4 and Maharishi 5 on inflammatory mediators with special reference to their free radical scavenging effect. *Indian Journal of Clinical Practice* 1 (8), 23–27.
3. Glaser, J.L., 1988. Maharishi Ayurveda: an introduction to recent research. *Modern Science and Vedic Science*.
4. Singh, R.H., 1992. Rasayana and Vajikarana. In: Sharma, P.V. (Ed.), *History of Medicine in India*. Indian National Science Academy, New Delhi.
5. Shrivastava Surabhi and Leelavathi S. Preliminary Phytochemical Evaluation of Leaf Extracts of *Catunaregum spinosa* Thunb. *International Journal of Pharmaceutical Sciences Review and Research* 2010; 3 (2) : 114-118.
6. Edeoga HA, Okwu DE, and Mbaebie BO. Phytochemical constituent of some Nigerian Medicinal Plants, *African Journal of Biotechnology academic journals* 2005; 4:685-688.
7. Akinmo-laudn, Ibukun, EO, afor, E, Obuotor, EM and Farombi, EO Phytochemical constituents and Antioxidant Activity of Extracts from leaves of *O>Gratissimum*, *Sci. Res. Essay* 2:163-166.
8. Rout SP, Choudhary KA, Kar DM, Das L and Jain A. Plants in Traditional Medicinal System- Future Source of New Drugs, *Internl. J. Pharmacy and Pharmaceurical Sci* 1(1) : 1-23.
9. Parekh Jigna, Chanda V Sumitra. In vitro Antimicrobial Activity and Phytochemical Analysis of Some Indian Medicinal Plants. *Turk J Biol* 2007; 31: 53-58.
10. Kumar A, Ilavarasn R, Jayachandran T, Decaraman M, Aravindham P, Padmanaban N and Krishnan M RV. Phytochemical investigation on a tropical plant. *Pakistan Journal of Nutrition* 2009; 8(1): 83-85.
11. Chevallier, A . (1996): *The Encyclopedia of Medicinal Plants* . New York: DK Publishing.
12. Blumenthal, M.; Goldberg, A. and Brinckmann, J. (2000): *Herbal Medicine: Expanded Commission E Monographs* . Marshmallow leaf . Austin, TX: American Botanical Council; Newton, MA: Integrative Medicine Communications.
13. Milin, V. and Kustrak, D. (2003): Officinal and unofficinal polysaccharide containing drugs (Mucilagenous drugs) . *Farm Glas* . 59: 57-67.
14. Lust, J. (1974): *The Herb Book*. Toronto, Bantam Books, 262–3.
15. Guarrera, P.M. (2005) : Traditional phytotherapy in central Italy (Marche, Abruzzo, and Latium). *Fitoterapia* 76: 1-25.
16. Gonda, R., Tomoda, M. and Shimizu, N., 1990: Structure and anticomplementary activity of an acidic polysaccharide from the leaves of *Malva sylvestris* var. *mauritiana*. *Carbohydrate Research*, 198: 323- 9.



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## SYRINGOCYSTADENOMA PAPILLIFERUM IN NEVUS SEBACEOUS AT UNUSUAL SITE

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### ABSTRACT

Nevus sebaceous is a benign, congenital hamartoma of the skin, with a predilection for the scalp and less commonly occurs on the face, around the ears, neck or on the trunk. In late childhood and early adulthood, there is a significant risk of developing secondary tumors, the most common of which are syringocystadenoma papilliferum and basal cell carcinoma. A case of syringocystadenoma papilliferum associated with nevus sebaceous in a 26 year old female patient in the nipple areolar region. A rare site of occurrence of syringocystadenoma papilliferum arising in nevus sebaceous is described. To the best of our knowledge, this appears to be the first case reported in the nipple areolar complex.

**Keywords:** Nevus sebaceous, Syringocystadenoma papilliferum, nipple areola

### INTRODUCTION

Nevus sebaceous is a congenital skin lesion commonly seen by pediatricians, dermatologists, and plastic surgeons.<sup>[1]</sup> It has a predilection for the scalp and less commonly occurs on the face, around the ears, neck, or on the trunk. The most common benign and malignant neoplasms arising in this disorder include trichilemmoma, syringocystadenoma papilliferum, keratoacanthoma, apocrine cystadenoma and basal cell carcinoma.

Syringocystadenoma papilliferum is a benign adnexal tumor of the skin,<sup>[2]</sup> which can occur either de novo or on some organoid nevus such as nevus sebaceous. This tumor presents generally over the scalp and forehead. The clinical presentation of nevus sebaceous and syringocystadenoma papilliferum varies widely

but the histological appearance is uniform and characteristic, forming the basis of diagnosis.<sup>[3]</sup>

### CASE REPORT

A 26 year old female patient presented with history of pigmented papules in bilateral nipple and areola region, since birth. Lesion formed an irregular nodule during puberty and progressed to a verrucous plaque, on right side, since one month.

On examination, her general condition was good. Local examination showed a pigmented, non tender, verrucous nodule in right nipple areolar complex, measuring 3.5x2.5x2cm. (Fig. 1)

Excision biopsy of the lesion was done on the right side and sent for histopathological examination. Grossly, the specimen was a single, irregular, warty mass measuring

3.5x2.5x2cm. Cut surface was grey white with tiny cysts.

Microscopy showed dilated, keratin filled infundibulum surrounded by numerous mature and immature sebaceous glands. (Fig.2) There were cystic invaginations from the surface, lined by stratified squamous epithelium transforming into a double layered epithelium. (Fig.3) Outer layer of epithelium was lined by cuboidal cells and the inner layer by columnar cells, a few of which showed decapitation secretion. Papillary projections into the cystic invagination were evident. Dense mononuclear inflammatory infiltrate, predominantly plasma cells were seen in the papillary core and around the cyst wall. (Fig.4) A good number of apocrine cysts were also seen. These classical histological features favored a diagnosis of Syringocystadenoma Papilliferum associated with Nevus Sebaceous.

### DISCUSSION

Nevus sebaceous is a congenital hamartoma of the skin, first described by Jadassohn. It is defined by hyperplasia of the epidermis, hair follicles, sebaceous and apocrine glands. Nevus sebaceous often presents at birth, is quiescent in childhood and grows during puberty, probably due to increased levels of serum androgens present in neonatal period and at puberty.<sup>[4]</sup> It is sporadic and occurs with equal frequency in males and females of all races.<sup>[1]</sup> In a study by Rosen et al,<sup>[1]</sup> out of 631 cases, most common locations of nevus sebaceous were scalp, face or neck [Scalp (62.8%), Forehead (10.3%), Cheek (9.8%), Neck (3.7%), Eyebrow (1.7%), Back (1.5%), Eyelid (0.8%), Chest (0.5%), Abdomen (0.2%) and Breast (0.2%)]. In late childhood and early adulthood, there is a significant risk of developing secondary tumors, mainly syringocystadenoma papilliferum and basal cell carcinoma.<sup>[4]</sup>

Syringocystadenoma papilliferum, formerly known as nevus syringocystadenomatous papilliferus, is a proliferating tumor with mostly apocrine differentiation but eccrine differentiation can also be seen. The histogenesis of this rare neoplasm is still unclear. It is theorized that syringocystadenoma papilliferum arises from the pluripotent cells of apocrine lineage.<sup>[5]</sup> In about 75% of cases, syringocystadenoma papilliferum arises within a preexistent naevus sebaceous of Jadassohn according to a large series of 100 cases by Helwig and Hackney.<sup>[6]</sup> In their series,<sup>[6]</sup> 55 lesions were on the scalp, 11 on the forehead and temple, 5 on the face and 3 on the upper lip, but none was reported on the nipple areolar complex. Less frequently reported sites are chest, abdomen, arm, eyelid and thigh.<sup>[2][7][8]</sup>

Clinically, the differential diagnoses of these lesions include linear epidermal nevus, nevus comedonicus, basaloid follicular hamartoma, cylindroma and eccrine nevus.<sup>[9]</sup> However, in our case, histopathological features were unmistakable and had no differential diagnosis. The only treatment for syringocystadenoma papilliferum is excisional biopsy, which also confirms the diagnosis. CO2 laser excision of syringocystadenoma papilliferum of the head and neck is a clinical treatment option in anatomic areas unfavorable to excision and grafting.<sup>[10]</sup>

### CONCLUSION

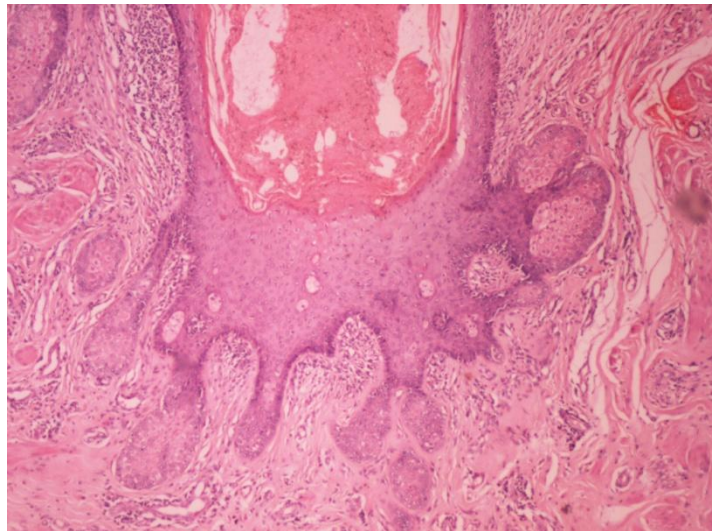
Syringocystadenoma papilliferum in nevus sebaceous is well described, but a relatively rare tumor, diagnosed only by histopathological examination. We report a case of syringocystadenoma papilliferum associated with nevus sebaceous in the right nipple areolar region, an exceptional site of presentation.

## REFERENCES

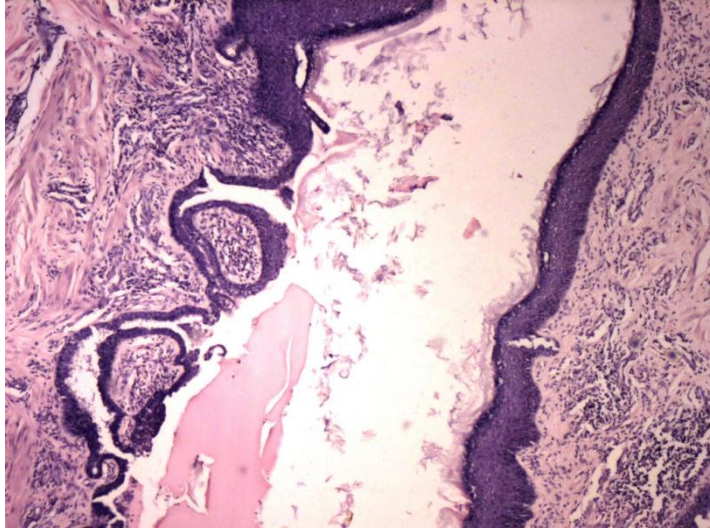
1. Rosen H, Schmidt B, Lam H.P, Meara J.G, Labow B.I. Management of Nevus Sebaceous and the Risk of Basal Cell Carcinoma: An 18-Year Review. *Pediatric Dermatology* Vol. 26 No. 6 676–681, 2009
2. Rao VA, Kamath GG, Kumar A. An unusual case of syringocystadenoma papilliferum of the eyelid. *Indian J Ophthalmol* 1996;44:168-9
3. Karg E, Korom I, Varga E et al. Congenital syringocystadenoma papilliferum. *Pediatr Dermatol* 2008;25:132–133
4. Hamilton K.S, Johnson S, Smoller B.R. The Role of Androgen Receptors in the Clinical Course of Nevus Sebaceous of Jadassohn. *Mod Pathol* 2001;14(6):539–542
5. Stokes JH. A clinico-pathologic study of an unusual cutaneous neoplasm combining nevus syringadenomatosus papilliferus and a granuloma. *J Cutan Dis.* 1917; 35: 411-9.
6. Helwig EB, Hackney VC. Syringoadenoma papilliferum. *Arch Dermatol* 1995; 71: 361-372.
7. Premalatha S, Rao NR, Yesudian P, Razack A, Zahra A. Syringocystadenoma Papilliferum in an unusual location. *Int J Dermaatol* 1985;24:520-1
8. Malhotra P, Singh A, Ramesh V. Syringocystadenoma papilliferum on the thigh: An unusual location. *Indian J Dermatol Veneral Leprol* 2009;75:170-2
9. Philipone E, Chen S. Unique case: syringocystadenoma papilliferum associated with an eccrine nevus. *Am J Dermatopathol.* 2009; 31(8): 806-7.
10. Fz Elfatoiki, K Khadir, A Ouakadi, S Azzouzi, N Bahechar, H Benchikhi. Syringocystadenoma papilliferum: Unusual location. *Dermatology Online Journal* 2011; 17(6):7



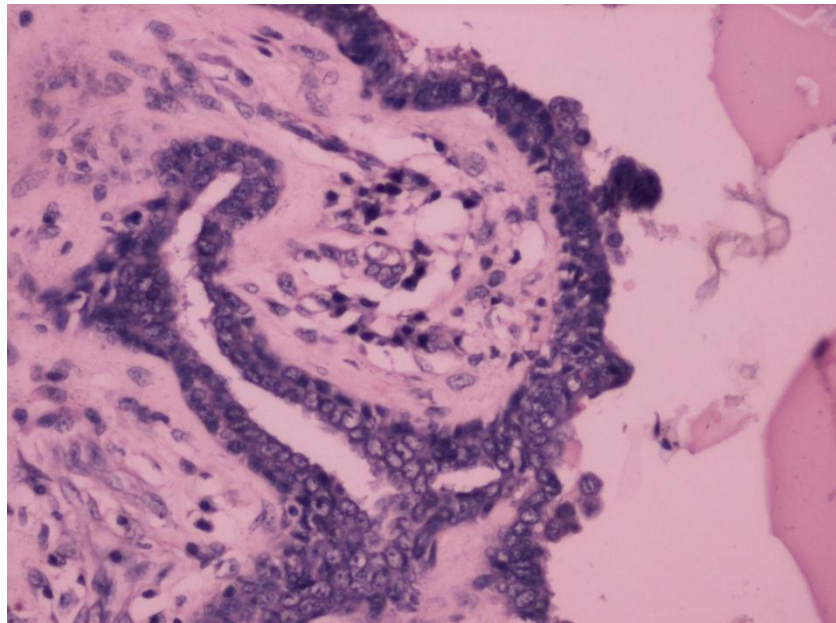
**Fig.1: Clinical photograph showing bilateral verrucous lesion with nodule on right side**



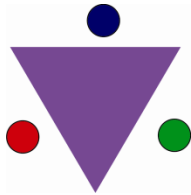
**Fig.2: Photomicrograph of tissue section showing dilated keratin filled infundibulum with numerous mature and immature sebaceous glands. [H&E, 4x]**



**Fig.3. Photomicrograph of tissue section showing papillary projection with plasma cells [HnE,20x]**



**Fig.4: Photomicrograph of tissue section showing cystic invagination and transformation of stratified squamous lining to double layered epithelium.[HnE,10x]**



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## A COMPARATIVE STUDY OF LUNG FUNCTIONS TEST BETWEEN ATHLETES AND NON-ATHLETES

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### ABSTRACT

The purpose of the study was to compare the lung volumes and capacities between athletes and non-athletes. Sixty college going young male subjects (athletes: N=30 and non-athletes: N=30) of 18-25 years were randomly selected from different colleges affiliated to Guru Nanak Dev University, Amritsar, Punjab, India. All the participants were assessed for height, weight and body mass index. Lung functions test was performed with a computerized spirometer following the procedures and predicted values recommended by the American Thoracic Society. Lung functions parameters i.e. forced vital capacity, expiratory reserve volume, inspiratory reserve volume, vital capacity, inspiratory capacity and tidal volume were measured. The independent samples t-test used for data analysis. The level of  $p \leq 0.05$  was considered significant. Statistical analysis showed significant differences between athletes and non-athletes of all the lungs function variables. It was observed that all lung function parameters of athletes were higher than non-athletes ( $p < 0.05$ ). It was concluded that athletes have greater lungs functions in comparison with non-athletes. Results of the present study therefore suggest that sporting activity, sports training and exercise may cause an increase in the lungs function which could be due to increased development of respiratory musculature incidental to physical training. This study provides evidence that sporting activity has an influence on the lungs function test.

**Keywords:** Lungs Function Test, Athlete, Non-athlete, Spirometer.

### INTRODUCTION

Respiratory system is an important system of a human body where gaseous exchange takes place with diffusion of enormous amounts of oxygen into the blood during physical activity (Khurana, 2005). The lung function tests, like other physiological tests must be of the utmost importance for measuring the fitness of an individual from a physiological point of view (Astrand and Rodahl, 1970). Lungs function parameters tend to have a relationship with lifestyle such as regular exercise and non-exercise

(Wasserman et al., 1995; Twisk et al., 1998). The apparently simple function of the lung is to deliver  $O_2$  to gas exchanges surface and exhaust  $CO_2$  to atmosphere. Lungs functions test is a powerful tool to measure volumes and capacities of an athlete in physiology lab. In addition to measuring volumes and capacities, it provides information regarding response to training or exercise and monitors the response following respiratory problems including exercise induced broncho spasm (McGraw-Hill's 2001). Due to regular exercise, athletes tend to have an increase in

respiratory capacity when compared to non-exercising individuals. Exercise is stressful condition which produces a marked change in body functions and lungs are no exception. Sedentary life styles could be associated with less efficient pulmonary functions. There are several studies that have shown significant improvement in pulmonary functions as a result of the effect of exercise (Chandran et al., 2000; Shivesh et al., 2007). However, there are studies which show non-significant change in pulmonary functions as an effect of exercise (Hamilton and Andrew 1976; Kuppu and Vijayan 1988). In athletes lung volumes and capacities alters during resting state and intense exercise. Lung function tests provide qualitative and quantitative evaluation of pulmonary function and are therefore of definitive value in the diagnosis and therapy of patients with cardio-pulmonary disorders as well as those with obstructive and restrictive lung disease (Belman and Mittman, 1980; Robinson and Kjeldgaard, 1982). The parameters used to describe lung function are the lung volumes and lung capacities. The pulmonary functional capacities of normal sedentary individuals have been studied extensively in India (Singh, 1959; Rao et al., 1961; Singh, 1967; Jain and Ramiah, 1969; Gupta et al., 1979). Therefore, the purpose of the study was to compare the lung function parameters between athletes and non athletes.

#### **MATERIAL AND METHODS**

The present study was conducted on Sixty college going young male subjects (athletes: N=30 and non-athletes: N= 30) of 18-25 years age. The subjects were selected as athletes who have been

participated in inter-university championships and subjects selected as non-athletes who have been not participated any sporting activity. All subjects randomly selected from the different colleges affiliated to Guru Nanak Dev University, Amritsar, Punjab, India. The age of each subject was calculated from the date of birth as recorded in his institute. The height of the subjects was measured with anthropometric rod to the nearest 0.5 cm. The weight of subjects was measured by using portable weighing machine to the nearest 0.5 kg. Body mass index was calculated as body weight adjusted for stature. Lung functions testing were performed with a computerized spirometer following the procedures and predicted values recommended by the American Thoracic Society. All Spirometric measurements were performed under standard conditions of body temperature and ambient pressure and with water vapor saturation with the subjects sitting down and wearing a nose clip. The forced vital capacity, expiratory reserve volume, inspiratory reserve volume, vital capacity inspiratory capacity and tidal volume were measured in each subject and recorded in absolute values. Each subject performed 3 acceptable maneuvers according to the American Thoracic Society recommendations.

#### **Statistical analysis:**

The lung functions test were compared in both the athletes and non-athletes groups by the 'Independent samples t' test. Data were expressed as Mean value and SD. Statistical significance was indicated by 'P' value <0.05. Data was analyzed using SPSS Version 16.0 (Statistical Package for the Social Sciences, version 16.0, SPSS Inc, Chicago, IL, USA).

## RESULTS

**Table 1: Mean, standard deviation and 't' value with statistical significance of age, height, weight and body mass index variables in athletes and non-athletes.**

Variables	Athletes (N -30)		Non-Athletes (N-30)		t-value
	Mean	SD	Mean	SD	
Age (years)	21.033	2.747	20.633	1.973	0.64
Height (cm)	181.833	4.259	172.733	6.096	6.70*
Weight (kg)	73.066	3.423	73.033	4.230	0.03
Body Mass Index (BMI)	22.104	0.887	24.503	1.344	8.15*

(Significant; \*p < 0.05)\*indicates significance of the difference between athletes and non-athletes values at p<0.05

The mean and standard deviation of age, height, weight and body mass index variables between athletes and non-athletes are shown in table -1. Athletes significantly possess greater stature and body mass index value than non-athletes. In case of age and body weight difference between athletes and non-athletes group were found to be

non significant. The values presented in table-1 shown the average age value was 21.033 and 20.633, height value was 181.833 and 172.733, weight value was 73.066 and 73.033 and body mass index value was 22.104 and 24.503 of athletes and non-athletes group respectively.

**Table 2: Mean, standard deviation and 't' value with statistical significance of forced vital capacity, expiratory reserve volume and inspiratory reserve volume variables in athletes and non-athletes.**

Variables	Athletes (N -30)		Non-Athletes (N-30)		t-value
	Mean	SD	Mean	SD	
Forced Vital Capacity (liters)	4.940	0.093	3.796	0.394	15.45*
Expiratory Reserve Volume (liters)	1.336	0.080	1.046	0.089	13.13*
Inspiratory Reserve Volume (liters)	3.336	0.171	2.780	0.195	11.73*

(Significant; \*p < 0.05)\*indicates significance of the difference between athletes and non-athletes values at p<0.05

The mean and standard deviation of forced vital capacity, expiratory reserve volume and inspiratory reserve volume between athletes and non-athletes are shown in table -2. The mean value of forced vital capacity of athletes and non-athletes was 4.940 and 3.796 and the mean value of expiratory reserve volume of athletes and non-athletes group was 1.336 and 1.046 respectively, whereas the mean value of inspiratory reserves

volume of athletes and non-athletes group was 3.336 and 2.780 respectively. The "t" value in case of forced vital capacity was 15.45, expiratory reserve volume was 13.13 for inspiratory reserves volume, it was 11.73. Results indicated that athletes have significantly greater values in forced vital capacity, expiratory reserve volume and inspiratory reserves volume variables than the non-athletes group.

**Table 3: Mean, standard deviation and ‘t’ value with statistical significance of vital capacity, inspiratory capacity and tidal volume variables in athletes and non-athletes.**

Variables	Athletes (N -30)		Non-Athletes (N-30)		t-value
	Mean	SD	Mean	SD	
Vital capacity (liters)	4.726	0.086	3.790	0.286	17.11*
Inspiratory Capacity (liters)	3.580	0.106	2.990	0.263	11.38*
Tidal Volume (mili-litres)	571.000	30.211	479.000	14.936	14.95*

(Significant; \*p < 0.05)\*indicates significance of the difference between athletes and non- athletes values at p<0.05

Table-3 indicated that the mean value of vital capacity of athletes and non-athletes was 4.726 and 3.790 and the mean value of inspiratory capacity of athletes and non-athletes group was 3.580 and 2.990 respectively, whereas the mean value of tidal volume of athletes and non-athletes group was 571.000 and 479.000 respectively. The “t” value in case of vital capacity was 17.11, inspiratory capacity was 11.38 for tidal volume, it was 14.95. Results indicated that athletes have significantly greater values in vital capacity, inspiratory capacity and tidal volume variables than the non-athletes group.

### DISCUSSION

Results obtained from the present study indicated that athletes had a significantly higher forced vital capacity, expiratory reserve volume, inspiratory reserve volume, vital capacity, inspiratory capacity and tidal volume than the non-athletes. These findings are in line with those of reported by many researchers (Adegoke and Arogundade, 2002; Cordian, 1990; Newman et al., 1961, Bloomfield et al., 1985). Adegoke and Arogundade (2002) reported greater lung functions in footballers, volleyball and basketball players when compared to non-athletes. Greater values among the athletes could be explained due to better strengthening of respiratory muscles as a result of strenuous

physical training. Cordain (1990) also reported larger lung volumes in swimmers and divers when compared to normal non-athletes. Many other previous studies (Onadeko et al., 1976; Bjorstrom, 1987) also showed a significantly greater vital capacity in athletes when compared with non-athletes. However, the findings of the present study are in contrast to the findings of the other studies (Hagberg, 1988) which reported no significant differences between athletes and non-athletes. Results from the present study strongly suggest that the intensity or severity of the sports engaged in by the athletes probably determines the extent of strengthening of the respiratory muscles which result in the increase in the lung volumes. There might be increase in the maximal shortening of the inspiratory muscles as an effect of training, which has been shown to improve the lungs function parameters (Fanta et al., 1983). In the Amsterdam Growth and Heart study, physical activity was observed to be positively correlated to changes in forced vital capacity between ages 13-27 years over a period of 15 years (Twisk et al., 1998). This is supported by many other previous studies as well (Armour et al., 1993; Mehrotra et al., 1998; Birkel and Edgren 2000). All pulmonary function variables of athletes measured in this study were above normal limits for the 18-25 year age group. The forced vital capacity of athletes in

the present study is 4.940 liters which is greater than the Nigerian athletes studied by the Adegoke and Arogundade (2002) but lower than that of elite European road cyclists (5.91L) studied by the Vrijens et al. (1982) and top South African squash players (6.32L) studied by the Rensburg et al. (1982). The lung function parameters were found to vary in the different countries and these may be due to the genetic, ethnic and nutritional factors as suggested by Lakhera et al. (1994).

### CONCLUSION

The result obtained from the study indicated that there were significant differences in the lung function parameters between athletes and non-athletes. Means of all parameters were significantly higher in athletes than non-athletes. Hence, Conclusion made in this study that, athletes had greater lung capacities in comparison with non-athletes. Results of the present study therefore suggest that sports activity, sports training and exercise may cause an increase in the lungs functions which could be due to increased development of respiratory musculature incidental to physical training or exercise.

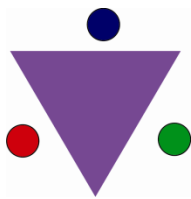
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### REFERENCES

1. Adegoke, O A and Arogundade, O. 2002. The effect of chronic exercise on lung function and basal metabolic rate in Nigerian athletes. *African Journal of Biomedical Research*, 5: 9-11.
2. Armour, J, Donnelly, P.M. and Bye, P.T. 1993. The Large Lungs of Elite Swimmers: An Increased Alveolar No. *Eur Respir J*, 6(7): 237-247.
3. American Thoracic Society. 1995. Standardization of spirometry, 1994update. *Am J Respir Crit Care Med.*, 152(3):1107-1136.
4. Astrand, P.O. and Rodahl, K.1970. *Textbook of Work Physiology*. McGraw- Hill Kogakusa Ltd.
5. Belman, M.J. and Mittman, C. 1980. Ventilatory muscle training improves exercise capacity in chronic obstructive pulmonary disease patients *Am Resp Dis.*, 121. 273-279.
6. Birkel, D.A. and Edgren, L. 2000. Hatha Yoga improved vital capacity of college students. *Altern Ther Health Med*, 6: 55-63.
7. Bjourstrom, R. L. and Schocne, R.B. 1987. Control of ventilation in elite synchronized swimmers, 63, 1091-1095
8. Bloomfield, J., Blansby, B.A., Ackland, T.R. and Elliot, B.C. 1985. The anatomical and physiological characteristics of pre-pubertal adolescent swimmers, tennis players and non competitors. *Austr Sci Med Sport*, 17:19-23.
9. Chandran, C.K., Nair, H.K. and Shashidhar, S. 2000. Respiratory functions in kalaripayattu practitioners. *India J Physiol Pharmacol*, 48(2): 235-240.
10. Cordain, L., Tucker, A., Moon, D. and Stager, J. 1990. Lung volumes and maximal respiratory pressures in collegiate swimmers and runners. *Res Q Exerc Sport* 61: 76-80.

11. Fanta, C.H., Leith, D.E. and Brown, R. 1983. Maximal shortening of inspiratory muscles: effect of training. *J Appl Physiol*, 54: 1618-1623.
12. Gupta, P., Gupta, L. and Ajmer, R. L., 1979. Lung functions in Rajasthan subjects. *Ind.J.Physiol.Pharmacol.* 23 (1): 9-14.
13. Haberg, J.M. 1988. Palmonary function in young and older athletes and untrained men. *J Appl Physiol.*, 65(1): 101-105.
14. Hamilton, P., Andrew, G.M. 1976. Influence of growth and athletic training on heart and lung functions. *Eur J Appl Physiol*, 36: 27-38.
15. Jain, S. K. and Ramiah, T. J., 1969. Normal standards of pulmonary function tests for healthy Indians 15-40 yrs old, comparison of different prediction equations. *Ind.J.Med.Res.* 57: 1433-1466.
16. Khurana, I. 2005. Textbook of Medical Physiology, Elsevier Health Sciences in: Physiology of Exercise and Sports, 1221-1230.
17. Kuppu, R.K.V. and Vijayan, V.K. 1988. Maximum expiratory flow volume loop in Southern Indian College Sportsmen. *Ind J Physiol Pharm*, 32(2): 93-99.
18. Lakhera, S.C., Kain, T.C. and Bandopadhyay, P. 1994. Changes in lung functions during adolescence in athletes and non athletes. *J Sports Med Phys Fitness*, 34(3): 258- 264.
19. Mc Graw-Hill's 2001. Ordering and Interpretation of the Lung Function Test. *Pocket Guide to Lung Function Tests*, 3rd ed.
20. Mehrotra, P.K., Verma, N.S., Tiwari, S. and Kumar, P. 1998. Pulmonary functions in Indian sportsmen playing different sports. *Ind J Physiol Pharmacol*, 42(3):412-416.
21. Newman, F., Smalley, B.F. and Thomson, M.L. 1961. A comparison between body size and lung function of swimmers and normal school children. *J Physiol (Lond)* 156:9-14.
22. Onadeko, B.O., Falase, A.O. and Ayeni, O. 1976. Pulmonary function studies in Nigerian sportsmen. *Afr. J. Med. Sci.* 5,291- 295.
23. Rao, M. N., Sengupta, A., Saha, P. N. and Devi, S.A., 1961. Physiological norms in Indians. Indian Council of Medical Research Spl., report series no. 38.
24. Rensburg, J.P., Linde, V.D., Ackerman, P.C., Kieblock, A.J. and Strydom, N.B. 1982. Physiological profile of squash players. *S Afr Med J.* 62:721-723.
25. Robinson, E.P. and Kjeldqard, J.M.1982. Improvement Inventilatory muscle function with running. *J. Appl. Physiol*, 52:1400-1405.
26. Shivesh, P., Sushant, M. and Ujjwal, R. 2007. Athletes, yogis and individuals with sedentary lifestyles. do their lung functions differ? *Ind J Physiol Pharmacol*, 51(1):9-14.
27. Singh, H. D. 1959. Ventilatory function tests, normal standards in male adults. *J.Ind.Med.Prof.* 5: 2483-2486.
28. Singh, H. D., 1967. Peak flow rate in Indians. *Ind.J.Physiol.Pharmacol.* 11:129-130.
29. Twisk, W., Staal, B.J., Brinknian, M.N., Kemper, H.C. and Van Mechelen, W. 1998. Tracking of lung function parameters and the longitudinal relationship with lifestyle. *Eur, Resp. J.* 12 (3), 627-34.
30. Vrijens, J., Pannier, J.L. and Bouckaert, J. 1982. Physiological profile of competitive road cyclists. *J Sports Med*, 22: 207-16.
31. Wassreman, K, Gitt, A., Weyde, I. and Eckel, H.E. 1995. Lung function changes and exercise-induced ventilatory responses to external restive loads in normal subjects. *Respiration* ,62 (4), 177-84.
32. Wilmore, J.H., and Costill, D.L. 1999. *Physiology of Sports and Exercise*. 2nd ed. Human Kinetics, Champaign, 490-507.



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## EFFECT OF FERMENTATION ON THE ANTI NUTRITIONAL FACTORS, ANTIRADICAL ACTIVITY AND *IN VITRO* PROTEIN DIGESTIBILITY OF *CICER ARIETINUM* L.

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### ABSTRACT

**Objective:** The aim of the present study was to find out the effect of fermentation on the physico-chemical properties (pH, total titratable acidity and protein content), antinutritional factors (phytate, total polyphenolic content (TPC) and tannin), antiradical activity and *in vitro* protein digestibility of desi *Cicer arietinum* seeds. **Methods:** Physicochemical parameters were assessed by using pH meter and titrimetric method. Antinutritional factors such as phytate, TPC and tannin were determined by spectrophotometric, Folin-ciocalteu and Folin–denis method respectively and protein content and digestibility by Lowry’s method and Pepsin-HCl method respectively. **Results:** Results showed that fermentation significantly reduced the pH from 6% to 4% and total titratable acidity from 1% to 4%. TPC in raw lentil was found to be 1011.4 mg/100g which was reduced to 150.5 mg/100g after 40 h of fermentation. There was 99% and 93% reduction in phytate and tannin content respectively after fermentation. Antiradical activity was reduced from 90% to 65% at different intervals of fermentation. Fermentation significantly increased the *in vitro* protein digestibility from 43% to 75%. **Conclusion:** The study revealed that fermentation significantly improved the nutritive value of desi chickpea.

**Keywords:** Fermentation, Antinutritional, Polyphenols, Protein digestibility, *Cicer arietinum*.

### INTRODUCTION

Fermentation is regarded as one of the oldest and most economical methods of processing and preserving foods aimed at prolonging shelf-life and improving palatability. It may also improve digestibility and nutritional value of food. Fermentation consists of modifying food by microorganisms that grow and reproduce and consume part of the substrate and enrich it with the products of their metabolism. It is an ancient technology that remains one of the most practical methods for preserving foods and enhancing their nutritional and organoleptic qualities. It is a desirable method for processing and preserving

food because of its low cost, low energy requirements, and high yield, with acceptable and diversified flavors for human consumption <sup>(1)</sup>. Today, a variety of food products are derived from this technology in households, small-scale food industries as well as in large enterprises. Furthermore, fermentation is an affordable food preservation technology and of economic importance to developing countries. It enhances the nutritional quality of foods and contributes to food safety particularly under conditions where refrigeration or other foods processing facilities are not available <sup>(2)</sup>.

Fermentation has been reported to cause a general improvement in the nutritional value of legumes. Whole or ground seeds, either raw or cooked, can act as substrate for fermentation. The fermented legumes are popular due to improved sensory characteristics, protein quality and digestibility and contents of some minerals and vitamins, as well as partial or complete elimination of antinutritional factors <sup>(3)</sup>.

Chickpea (*Cicer arietinum*) is a crop of economic importance and also an important source of protein in the diet of people in India as well as other. It is the third most important pulse crop in the world and is mainly grown in the semi-arid regions particularly in the Indian subcontinent and dry areas of the Middle East. The chickpea seeds are relatively higher in protein content (25 to 30 %), carbohydrate and calories than other legumes. Its seeds are also a good source of essential minerals like calcium, phosphorus, iron and vitamin B <sup>(4)</sup>. Grain legumes or pulses, although are rich and low-cost sources of dietary proteins and nutrients for a large part of the world's population, their nutritive value is limited by the presence of several antinutritional and toxic substances and poor digestibility <sup>(5)</sup>. Fermentation is a method that seems to enhance the nutritive value of legumes by increasing the levels of essential nutrients and reducing the level of antinutrients in foods. It ultimately contributes towards the improvement in the *in-vitro* digestibility of legumes <sup>(6)</sup>. The aim of this work was to study the efficiency of fermentation on the reduction or elimination of antinutritional factors, improvement in the protein digestibility and changes in the physico-chemical properties of desi *cicer arietinum* seeds.

## MATERIAL AND METHODS

### Procurement of Raw Materials

Chickpea (*Cicer arietinum*) used for this investigation has been purchased from the local market of Allahabad city. All required chemicals and apparatus have been obtained from Centre of

Food Technology, University of Allahabad. All the chemicals used in analysis were of AR (Analytical Reagent) grade.

### Fermentation

The standard fermentation procedure was followed <sup>(7)</sup>. The sample flour was mixed with distilled water (1:2 w/v) and incubated at 37°C for 16, 24, 32 and 40 hours time intervals. The fermented samples were dried in hot air oven at 70°C for 4 to 6 hours and the dried samples were grounded and stored in polyethylene bags at 4°C for subsequent analysis.

### Proximate, vitamin and mineral content

The AOAC methods <sup>(8)</sup> were used to determine proximate composition: drying at 105 °C for 24 h for moisture (method 925.098); incineration at 550 °C for ash (method 923.03); defatting in a Soxhlet apparatus with petroleum ether for lipids (method 920.39C with minor modifications). Carbohydrate content was estimated by difference method and the calorific value was estimated as given in Swaminathan <sup>(9)</sup>.

### pH and Total titratable acidity

The pH of the samples was determined according to the method of AOAC **(10)**. The titratable acidity was estimated by titrating against 0.1 N NaOH to phenolphthalein end-point and the acidity was calculated as g lactic acid/100g <sup>(11)</sup>.

### Protein

Protein estimation was estimated by Lowry's method <sup>(12)</sup>. The blue colour developed by the reduction of the phosphomolybdic-phosphotungstic components in the Folin-Ciocalteu reagent by the amino acids tyrosine and tryptophan present in the protein plus the colour developed by the biuret reaction of the protein with the alkaline cupric tartrate was measured.

### *In vitro* protein digestibility

The *in vitro* protein digestibility of the samples was determined by enzymatic method **(13)**. A known weight of the sample containing 16 mg nitrogen was taken in triplicate and digested with 1 mg pepsin in 15 ml of 0.1 M HCl at 37°C for 2

hours. The reaction was stopped by the addition of 15 ml 10% trichloro-acetic acid (TCA). The mixture was then filtered quantitatively through Whatman No. 1 filter paper. The TCA soluble

fraction was assayed for nitrogen using the micro-kjeldahl method. Protein digestibility of the sample was calculated by the following formula:

$$\text{Protein digestibility (\%)} = \frac{\text{N in supernatant} - \text{blank N}}{\text{N in sample}} \times 100$$

### **Total polyphenolic content**

Polyphenols are extracted with 70% methanol from a test portion of finely ground sample at 70° C. The polyphenols in the extract was determined colorimetrically using Folin-Ciocalteu phenol reagent and gallic acid was used as a calibration standard <sup>(14)</sup>.

### **Phytate**

The phytate was extracted with trichloroacetic acid and precipitated as ferric salt. The iron content of the precipitate is determined colorimetrically and the phytate phosphorus content calculated from this value assuming a constant 4 Fe: 6 P molecular ratio in the precipitate <sup>(15)</sup>.

### **Tannin**

Estimation of tannins was done by Schanderel et al., <sup>(16)</sup> Tannin-like compounds reduce phosphotungstomolybdic acid in alkaline solution to produce a highly colored blue solution, the intensity of which is proportional to the amount of tannins. The intensity is measured in a spectrophotometer at 700 nm.

### **Percent antiradical activity**

DPPH is a stable free radical that accepts an electron or hydrogen radical to become a stable diamagnetic molecule. The reduction capability of the DPPH radical is determined by the decrease in its absorbance at 516 nm induced by antioxidants. The absorption maximum of a stable DPPH radical in ethanol was at 516 nm <sup>(17)</sup>.

### **Statistical Analysis**

The results of fermentation at different hours are given as means  $\pm$  standard error. Statistical analysis

of variance (One-Way ANOVA) was done by using SPSS software 12 version, to determine differences among means. The statistically significant difference was defined as  $p \leq 0.01$ .

## **RESULTS**

### **Proximate, Vitamin and Mineral Composition of chickpea**

**Table 1** shows the proximate, vitamin C and mineral composition of chickpea. These values were compared with the values given by Gopalan <sup>(18)</sup> in Food Composition table.

### **Effect of fermentation on the pH and total titratable acidity of chickpea**

Unfermented flour of chickpea had a pH value of 6.6 (**Table 2**). Fermentation gradually reduced the pH with time. Fermentation of the flour for 16, 24, 32 and 40 hours had significantly ( $p \leq 0.05$ ) dropped the pH to 5.2. Unfermented flour of chickpea had a Total Titratable Acidity (TTA) of 1.4% (Table 2). Fermentation gradually increased the TTA with time. Fermentation of the flour for 16, 24, 32 and 48 hours had significantly ( $p \leq 0.01$ ) increased the TTA to 3.8%.

### **Effect of fermentation on the phytate content of chickpea**

Phytate (mg/100g) content of chickpea is shown in **Table 3** as affected by different periods of fermentation (16, 24, 32, 40 hours). Phytate content of the unfermented flour was 667 mg/100g. Fermentation of the chickpea significantly ( $p \leq 0.01$ ) reduced the phytate content to about 98%.

### **Effect of fermentation on the total polyphenolic content of chickpea**

The mean values for the effect of fermentation on total polyphenolic content are presented in Table 4.2. There is significant difference ( $p < 0.01$ ) among means. Fermentation at 16, 24, 32 and 40 h increased TPC by 27%, 22%, 16% and 17%, respectively (Table 3).

### **Effect of fermentation on the tannin content of chickpea**

The tannin content of unfermented flour was 0.35%. Fermentation significantly ( $p \leq 0.05$ ) reduced the tannin content by about 57% at the end of 40 hours. The values for tannin at different fermentation time periods are given in Table 3.

### **Effect of fermentation on the percent (%) antiradical activity of chickpea**

The mean values for the effect of fermentation on antiradical activity are presented in Table 3. The analysis of variance of the data showed significant differences ( $p < 0.05$ ) among different time intervals. The percent antiradical activity of raw chickpea was 88%. During fermentation for 16, 24, 32 and 40 hr of chickpea, antiradical activity decreased by 3.4%, 2%, 3.6 % and 3.4% respectively.

### **Effect of fermentation on the protein content of chickpea**

The protein content of raw chickpea was 18.2g/100g (Table 2). After 32 hours of fermentation period, the protein content was found to be 25.4g/100g. However, at the end of 40 hours of fermentation the protein content was observed to be 27.5g/100g. During fermentation for 16, 24, 32 and 40 hr of chickpea, protein increased by 15.3%, 9.5%, 8.6 % and 8%, respectively.

### **Effect of fermentation on the in vitro protein digestibility of chickpea**

The in vitro protein digestibility (IVPD) of unfermented chickpea flour was 54.3%. At the end of 40 hours of fermentation, the IVPD was found to be 77%. This increased value was observed to be significant ( $p \leq 0.01$ ).

## **DISCUSSION**

This decline in pH indicates the production of lactic acid. The pH drop was probably the result of microbial activity on the flour converting some of the carbohydrates into organic acids such as lactic acid, citric acid and acetic acids<sup>(19)</sup>. According to these authors, the production of lactic acid bacteria during fermentation has attributed to the decrease in pH. Organic acids produced during fermentation also can potentially enhance Fe and Zn absorption via the formation of soluble ligands<sup>(20)</sup>. The increased acidity and low pH as a result of fermentation enhances the keeping quality of fermented foods, by inhibiting microbial growth and also contributing to the flavor of the processed food<sup>(21)</sup>.

The decrease in phytate content during fermentation might be due to activity of enzyme phytase naturally present in legumes and microorganisms in the dough. It has been suggested that the loss of phytate during fermentation could be a result of the activity of native phytase and/or the fermentative microflora by different workers<sup>(21; 19)</sup>. Reduction in phytic acid contents of cereal and legume seeds with such processing treatments has been frequently reported<sup>(22)</sup>. This has been attributed to an increase of phytase activities in fact; this enzyme makes the phytates soluble and released soluble protein and minerals. Fermentation also provides optimum pH conditions for enzymatic degradation of phytic acid which is present in cereals in the form of complexes with polyvalent cations such as iron, zinc, calcium, magnesium and proteins.

With regard to the TPC content after fermentation, our results are in agreement with those reported in fermented *Lens culinaris*, *V. sinensis* and *Glycine max*<sup>(23)</sup> and others<sup>(24)</sup>. Studies suggested that the fermentation process is an adequate and effective process for increasing the concentration of phenolic compounds and, hence, their nutritional and biological quality<sup>(25)</sup>. Few workers have also reported an increase in polyphenol content of

fermented flour with increase in temperature in pearl millet <sup>(26)</sup>. Some authors have reported that polyphenols increase significantly or remained constant in the fermented food also natural fermentation was found to increase certain phenolic monomer like catechin <sup>(23)</sup>. An increase in the concentration of total phenolic content during fermentation of millet and explained this by the hydrolytic activity of microorganism that degrade tannin phenolic compounds of low molecular weight <sup>(27)</sup>.

The decrease in tannin content after certain processing treatments in legumes was also observed by various authors <sup>(28)</sup>. The decreases in the tannin content were attributed to the hydrolysis of polyphenolic compounds or tannin complexes during fermentation. It may also be due to the activities of microorganisms during fermentation which decreases the tannin content in the fermented product because microorganisms play a vital role in the reduction of tannins. These results were in agreement with earlier findings <sup>(29)</sup> who observed that optimum fermentation time is quite essential to obtain maximum tannin reduction in chickpea. Tannin reduction during fermentation might have been caused by the activity of enzyme tannase of fermenting microflora on tannin. This enzyme hydrolyses the deep side ester bond of hydroxylable tannin releasing gallic acid and glucose <sup>(5)</sup>.

Some studies have been also witnessed a decrease in percentage DPPH radical inhibition, amount of total phenolic compounds and super oxide anion radical inhibition as a result of fermentation <sup>(30)</sup>. Few authors also stated that the presence of phytase produces flours with lower antioxidant activity might be due to the phytase acting on phytic acid, decreasing its concentration and liberating into the medium the phosphate groups and cations. Phytic acid is considered to be an antioxidant compound because it is a potent inhibitor of iron-catalyzed hydroxyl radical formation by chelating free iron <sup>(24)</sup>. On the other

hand, the liberated cations might favor the oxidation of different components of the medium. These two facts could be the cause of lower antioxidant activity.

The increment in the per cent protein content during fermentation is also quantitative increment attributed to the utilization of carbohydrates by microorganisms <sup>(31;32)</sup>. It can also be due to microbial synthesis from metabolic intermediates during fermentation an increment of raw protein during the fermentative process of 'Tape Ketan' and *Pentaclethra macrophylla* Benth variety <sup>(30)</sup>. Increment of raw protein in the fermented product could be due to the protein hydrolysis product by extra cellular enzyme of fermented microorganism, such as proteases, promoting an increase in the total nitrogen content caused by the release of amino acid and short chain peptides. On the other side in cowpea no change in protein level has been reported <sup>(33)</sup>. Antinutrients have the capacity of decreasing the content and increasing the palatability of the product because they form insoluble complexes with them <sup>(34)</sup>. The antinutrients level are decreased in the fermented product and thereby increasing the protein content. The fermentation significantly improves the protein quality as well as the level of lysine in millet and other cereals <sup>(35)</sup>. In the same way, during the fermentation of corn meal the concentrations of available lysine, methionine and tryptophan increase had been found to be increased <sup>(35)</sup>.

The poor protein digestibility of legumes is caused by phytic acid and polyphenols that bind to enzymes in the digestive tract and thus inhibit utilization of proteins <sup>(36)</sup>. This adverse effect can be overcome by fermentation. In vitro protein digestibility is increased after fermentation because of partial degradation of complex storage proteins by endogenous and microbial proteolytic enzymes into soluble products <sup>(37)</sup>. The increment in in vitro protein digestibility (IVPD) could be attributed to antinutrients degradation by

microorganisms and to partial degradation of complex storage proteins into more simple and soluble products. It was suggested that fermentation causes structural changes in the storage proteins (prolamins and glutelins) making them more accessible to enzymatic attack. Studies have been also demonstrated that during fermentation, insoluble protein (prolamine and glutelin) under structural changes which makes them more accessible to pepsin attack, rather than being broken down into smaller sub-units. These changes are likely to have a marked effect on protein digestibility of seed protein and may be responsible for the increased protein digestibility. As a result of lactic acid fermentation, the protein digestibility can be elevated. Fermentation of food grains is known to be an effective method of improving the starch and protein digestibility and bioavailability of minerals.

### CONCLUSION

On the basis of the above findings it is concluded that Fermented legumes are an integral and significant part of the diet of many people in developing countries, being one of the oldest and most economical methods of processing and preserving foods. Fermentation led to desirable changes in the legume, including an improvement in protein digestibility and enhancing of storage quality of the product, providing adequate amounts of food energy and a partial or complete elimination of anti-nutritional compounds (tannins, phytates and polyphenolc etc.). Therefore, natural fermentation of legumes has been a very effective process for increasing functionality of *Cicer arietinum*. Within the studied fermentation processes, whole grain fermentation is very promising, due to the obtained results as well as its lower cost.

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### REFERENCES

1. Deshpande SS and Salunkhe DK. (2000). Grain legumes, seeds and nuts: rationale for fermentation. Fermented grains legumes, seeds and nuts: a global perspective. FAO Agricultural Services Bulletin. 142:1-32.
2. Motarjemi Y. (2002). Impact of small scale fermentation technology on food safety in developing countries. International Journal of Food Microbiology. 75:213-229.
3. Tarar OM. (2009). Development, Characterization and Shelf Life Optimization of a Prototype Nutrient Dense Food Bar. M.Sc. thesis, University of Agriculture, Faisalabad, Pakistan.
4. Muehlbauer FJ, Cubero JI and Summerfield RJ. (1985). pp 266-311. Grain Legume Crops. pp 266-311. Collins, 8 Grafton Street, London, U.K.
5. Adewumi GA and Odunfa SA. (2009). Effect of controlled fermentation on the oligosaccharides content of two common Nigerian *Vigna unguiculata* beans (drum and oloyin). African Journal of Biotechnology. 8(11):2626-2630.
6. Granito MA, Torres JF, Guerra M and Vidal-Valverde C. (2005). Influence of fermentation on the nutritional value of two varieties of *Vigna sinensis*. Journal of European Food Research Technology. 220:176-181.
7. Omima EF, Abdullahi HET and Elfadil EB. (2010). Effect of fermentation on Biochemical Characteristics of Sorghum

- Flour Supplemented with Chickpea Flour. *Journal of Applied Sciences Research*. 6(7):860-865.
8. A.O.A.C. (1990). In Helrich K. (Ed.), *Official methods of analysis*. (15th ed.). Arlington, VA, USA.
  9. Swaminathan (2003) *Essentials of food and nutrition*. Vol, I, 2<sup>nd</sup> Ed. Bangalore Printing and Publ Co. Ltd., Bangalore, p 101.
  10. AOAC (1998) *Official methods of Analysis*. (16<sup>th</sup> ed.) Arlington, VA: Association of Official Analytical Chemists.
  11. Mbata TI, Ikenebomeh MJ and Alaneme JC. (2009) Studies on the microbiological, nutrient composition and antinutritional contents of fermented maize flour fortified with bambara groundnut (*Vigna subterranean* L). *African Journal of Food Science*. 3(6):165-171
  12. Lowry OH, Rosebrough NJ, Farr AL and Randall RJ. (1951) Protein measurement with Folin phenol reagent. *Journal of Biological Chemistry*. 103:265-275.
  13. Monjula S and John E. (1991) Biochemical changes and in vitro protein digestibility of endosperm of germinating *Dolichos lablab*. *Journal of the Science of Food and Agriculture*. 55: 429-438.
  14. ISO 14502-1:2005. Determination of substances characteristic of green and black tea -- Part 1: Content of total polyphenols in tea.
  15. Wheeler EI and Ferrel RE. (1971). Methods for phytic acid determination in wheat and wheat fractions. *Journal of Cereal Chemistry*. 48:312-320.
  16. Schanderl SH. (1970). *Method in Food Analysis* pp 709. Academic Press, New York.
  17. Sanjha SD, Sheth NR, Patel NK, Patel D and Patel B. (2009). Characterization and evaluation of antioxidant activity of *Portulaca oleracea*. *International Journal of Pharmacy and Pharmaceutical Sciences*. 1:74-84.
  18. Gopalan C, Sastri BVR and Balasubramanian SC (1989). Nutritive value of Indian foods, National Institute of Nutrition, Indian Council for Medical Research, Hyderabad, India.
  19. Shimelis EA and Rakshit SK. (2008). Influence of natural and controlled fermentations on-galactosides, antinutrients and protein digestibility of beans (*Phaseolus vulgaris* L.) *International Journal of Food Science and Technology*. 43:658–665.
  20. Gibson RS, Perlas L and Hotz C. (2006) Improving the bioavailability of nutrients in plant foods at the household level. *Proceedings of the Nutrition Society*. 65:160–168. Ibrahim, S. S., Habiba, R. A., Shatta, A. A., and Embaby, H. E. (2002). Effect of soaking, germination, cooking and fermentation on antinutritional factors in Cowpeas. *Nahrung*, 46; 92–95.
  21. Elyas HAS, Tinay HA, Yousif EN and Sheikh AEE. (2002). Effect of natural fermentation on nutritive value and in vitro protein digestibility of pearl millet. *Food Chemistry*. 78:75-79.
  22. Ibrahim, S. S., Habiba, R. A., Shatta, A. A., and Embaby, H. E. (2002). Effect of soaking, germination, cooking and fermentation on antinutritional factors in Cowpeas. *Nahrung*, 46; 92–95.
  23. Bartolome B, Estrella I and Hernaandez T. (1997). Changes in phenolic compounds in lentils (*Lens culinaris*) during germination and fermentation. *Z. Lebensmittelel Unters*. 205:290-294.
  24. Dueñas M, Hernández T and Estrella I. (2007). Changes in the content of bioactive polyphenolic compounds of lentils by the action of exogenous enzymes. Effect on

- their antioxidant activity. *Food Chemistry*. 101:90-97.
25. Sullivan, T. W., Douglass, J. H., Andrews, D. J., Bond, P. L., Hemcock J. O., Bramelcox, P. J., Stegmeir, W. D., & Brethour, X. (1990). Nutritional value of pearl millet for food and feed. *Proc. Int. Conf. on Sorghum Nutritional Quality*, pp. 83–94.
  26. Khetarpaul, N., & Chauhan, B. M. (1991). Effect of natural fermentation on phytate and polyphenolic content and in vitro digestibility of starch and protein of pearl millet (*Pennisetum typhoideum*). *Journal of the Science of Food and Agriculture*, 55(2), 189–195.
  27. Hadimani, N. A., Ali, S. Z., & Malleshi, N. G. (1995). Physicochemical composition and processing characteristics of millet varieties. *Journal of Food Science and Technology. Mysore*, 32(3), 193–198.
  28. Saxena, A. K., Sharma, A. K., Sehgal, K. L., & Bakhshi, A. K. (1992). Proximate composition and fatty acid make-up of some improved varieties of pearl millet in Punjab. *Indian Journal of Nutrition and Dietetics*, 29(5), 177–180.
  29. Moreno, C.R., E.O.C. Rodríguez, J.M. Carrillo, O.G.C. Valenzuela and J.B. Hoyos. (2004). Solid state fermentation process for producing chickpea (*Cicer arietinum* L.) tempeh flour. Physicochemical and nutritional characteristics of the product. *Journal of Science Food Agricultural* 84(3):271-278.
  30. Oseni OA and Akindahunsi AA. (2010). Phytochemical Properties and Effect of Fermentation on the Seed of *Jatropha curcas*. *American Journal of Food Technology*. 6:158-165.
  31. Awada SH, Hady A, Hassan AB, Ali MI and Babiker EE. (2005). Antinutritional factors content and availability of protein, starch and mineral of maize and lentil as influenced by domestic processing. *Journal of Food Technology*. 3(4):523-528.
  32. Fadlallah E, Abdullahi H, Tinay E1 and Babiker E. (2010). Effect of Fermentation on Biochemical Characteristics of Sorghum Flour Supplemented with Chickpea Flour. *Journal of Applied Sciences and Research*. 6(7):860-865.
  33. Akinyele IO and Akinlosotu A. (1999). Effect of soaking, dehulling and fermentation on the oligosaccharides and nutrient content of frijol (*Vigna unguiculata*). *Food Chemistry* 41:43-53.
  34. Usha, A., Sripriya, G., & Chandra, T. S. (1996). Effect of fermentation on primary nutrients in finger millet (*Eleusine coracane*). *Journal of Agricultural and Food Chemistry*, 44, 2616–2818.
  35. Hamad, A. M. and M. L. Fields (1979). Evaluation of the protein quality and available lysine of germinated and fermented cereal. *Journal of Food Science*. 44: 456.
  36. Abdelhaleem WH, Tinay AH, Mustafa AI and Babiker EE. (2008). Effect of fermentation, malt-pretreatment and cooking on antinutritional factors and protein digestibility of sorghum cultivars. *Pakistan Journal of Nutrition*. 7:335-341.
  37. Calvin O, Noetzold H, Bley T and Henle T. (2004). Proximate composition and digestibility of fermented and extruded uji from maize–finger millet blend. *Journal of the Swiss Society of Food Science and Technology*. 8:827-832.

**Table 1: Nutritional composition of *Cicer arietinum***

Proximate	Reference range (g/100g), (Gopalan, 2004)	Whole (desi) chickpea
Moisture (%)	12.4	8.0±0.05
Protein (g)	25.1	18.2 ±0.15
Fat (g)	3.3	5.2± 0.09
Ash (%)	2.1	2.84 ±0.09
Fibre (g)	0.7	4.0± 0.14
Carbohydrate (g)	59.0	65.8± 0.12
Energy (Kcal)	343	382.5± 0.58

**Table 2: Effect of fermentation on physico-chemical properties and *in vitro* protein digestibility of *Cicer arietinum***

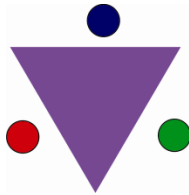
Treatments	pH	Total titratable acidity	Protein content	IVPD (%)
0 h Fermentation	6.6±0.62 <sup>c</sup>	1.4±0.03 <sup>a</sup>	18.2±0.18 <sup>a</sup>	54.3±0.29 <sup>a</sup>
16h Fermentation	6.3±0.00 <sup>d</sup>	2.1±0.03 <sup>b</sup>	21±0.20 <sup>b</sup>	57.7±0.50 <sup>b</sup>
24h Fermentation	6.0±0.03 <sup>c</sup>	2.7±0.57 <sup>c</sup>	23±0.23 <sup>c</sup>	60.8±0.20 <sup>c</sup>
32h Fermentation	5.4±0.03 <sup>b</sup>	3.2±0.57 <sup>d</sup>	25±0.30 <sup>d</sup>	64.2±0.25 <sup>d</sup>
40h Fermentation	5.1±0.03 <sup>a</sup>	3.8±0.03 <sup>e</sup>	27±0.29 <sup>e</sup>	77.1± 0.34 <sup>e</sup>

\* Values are means ± (S.D.). Means in a column, within processing condition, not followed by a common letter are significantly different at P < 0.05 as assessed by Duncan's multiple range test. \*\*Means in a column, within processing condition, not followed by a common letter are significantly different at P < 0.01

**Table 3: Effect of fermentation on antinutritional factors and antiradical activity of *Cicer arietinum***

Treatments	Phytate (mg/100g)	TPC (mg/100g)	Tannin (mg/100g)	Antiradical activity (%)
0 h Fermentation	667±1.20 <sup>e</sup>	145±1.73 <sup>a</sup>	0.35±0.02 <sup>c</sup>	88.1±0.15 <sup>c</sup>
16h Fermentation	350±2.08 <sup>d</sup>	185±2.88 <sup>b</sup>	0.13±0.035 <sup>b</sup>	85.3±0.33 <sup>d</sup>
24h Fermentation	107±1.15 <sup>c</sup>	226±1.73 <sup>c</sup>	0.10±0.03 <sup>b</sup>	83.6±0.33 <sup>c</sup>
32h Fermentation	32±1.20 <sup>b</sup>	264±2.30 <sup>d</sup>	0.16±0.03 <sup>b</sup>	80.2±0.57 <sup>b</sup>
40h Fermentation	12±1.52 <sup>a</sup>	309±1.22 <sup>e</sup>	0.33±0.03 <sup>a</sup>	77.5±0.87 <sup>a</sup>

\* Values are means ± (S.D.). Means in a column, within processing condition, not followed by a common letter are significantly different at P < 0.05 as assessed by Duncan's multiple range test. \*\* Means in a column, within processing condition, not followed by a common letter are significantly different at P < 0.01



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## TO ASSESS THE FUNCTIONAL CAPACITY AND HEALTH STATUS OF THE STABLE CHRONIC OBSTRUCTIVE PULMONARY DISEASE PATIENTS

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### ABSTRACT

**Background of objectives:** There are various studies in western countries suggesting that there is significant reduction in functional capacity and health status of stable Chronic Obstructive Pulmonary disease(COPD) patients. However, no such studies were found in Indian population to the best of our knowledge therefore, the present study was undertaken to assess the functional capacity and health status of stable COPD patients. **Materials & Methods:** This was a cross-sectional, observational study. 30 stable COPD participants attending outpatient department of chest medicine were compared with age matched normals with regards to demographic status, BMI, functional capacity & health status using Six minute walk test and Medical Outcome Study Short Form-36 Item Questionnaire(MOS SF-36).

**Results:** All the participants were chronic smokers. All of them had dyspnea related to physical activities with increased work of breathing. Although 63.33% reported to have normal dietary intake with only 33.6% complaining of reduced appetite, the overall weight of the COPD participants was significantly reduced when compared to normal's. There was marked decrease in distance walked by COPD participants (mean 258.53+/-18.31 m) compared to normal's (mean 421.37+/-14.76 m). The Respiratory rate and Rate of perceived exertion of COPD group were markedly increased at p-value <0.01 compared to normal's, both in pre and post six minute walk test. The mean score of total health of COPD subjects (55.83+/-3.11) was markedly lower compared to normal's (95.17 ± 0.71). Also, there was significant positive correlation between six minute walk distance and MOS SF-36(r=0.499, p<0.01) score in stable COPD participants.

**Conclusion:** Stable COPD subjects showed impaired functional capacity & health status compared to age matched healthy population. Strategies aiming at modifying these factors could be implemented to improve the well being of stable COPD subjects.

**Keywords:** Stable COPD, Functional capacity, Six minute walk test, Health status

### INTRODUCTION

The COPD is progressive and irreversible disorder of the airway with widespread involvement of pulmonary as well as extra pulmonary systems. It is commonly associated with varying degree of dyspnea related to activities of daily living.

Dyspnea having greater impact on functional capacity which is described as the ability to perform predominantly aerobic activity, a fundamental requirement for many activities of daily living that renders an individual physically inactive and sedentary. The reduction of functional

capacity in turn additionally affects health status of the sufferers<sup>1</sup>.

Various studies have indicated that irreversible airway narrowing, reduced FEV1 does not improve with any medications but the functional capacity and health status have been found to show significant improvement with implementation of pulmonary rehabilitation program. Till date, to the best of our knowledge there are no studies that assess the functional capacity and health status of stable COPD patients in Indian population. Therefore the present study aimed to identify and study the problems of stable COPD patients of our area. This would help us to device and establish the strategies that would improve their quality of life.

#### **MATERIALS AND METHODS**

The study proposal was approved by the Human Research Ethical Committee of H M Patel Center for Medical Care and Education, Karamsad. The study design was hospital based, cross sectional study. Two groups of population were recruited into the study. One group consisted of participants with stable COPD diagnosed by chest physician & second group consisted of age matched normal healthy individuals (healthy as self reported & not on any medications) from the local population. In both groups, male population has been selected as no female COPD patients reported during study period in our set up. The participants with acute exacerbations of COPD, pulmonary tuberculosis, asthma, restrictive lung disease, neuromuscular dysfunctions, muscle problems of spine or lower extremities, metabolic disease, hypertension, heart failure, unstable angina, peripheral vascular disease were excluded from the study.

All the participants were assessed through general format. The height was measured using wall mounted height measuring scale without footwear. The body weight (wt) was measured using weighing scale with Standard deviation of  $\pm 0.5$  kg. Body mass index (BMI) was calculated as the

weight (in kg) divided by square of height (in M<sup>2</sup>). The Six minute walk test and MOS SF-36 questionnaire were used as an outcome measures to assess the functional capacity and health status of both the groups.

#### **Functional capacity assessment**

The 6MWT was performed using standard guidelines laid down by American Thoracic Society, 2002 on a flat, straight, 30 meter long corridor of our Hospital.<sup>2,3,4</sup>

**Pre test:** Pulse rate, Respiratory rate, Blood pressure and Borg's rate of perceived exertion were recorded. The Borg's RPE scale was translated from English to Gujarati and showed to participants.

**Post test:** Six minute walk distance, Borg's RPE, Pulse rate, Respiratory rate and Blood pressure was recorded. The measurement of these parameters was taken at an interval of every two minutes till the parameters returned to the baseline value.

#### **Medical Outcomes Study Short Form-36 Item Questionnaire**

The MOS SF-36 questionnaire has been used to assess self reported domain of health status. It contains major 2 components- physical health and mental health to assess quality of life. The score ranges from 0-100 with higher score representing the better health status. This questionnaire was available in English language and therefore translated into vernacular version (i.e. Gujarati).the participants were interviewed personally by the investigator and information was gathered. Approximately 10 minute duration was required to answer the questionnaire<sup>5,6,7</sup>.

**Statistical analysis:** The data obtained were fed into the computer in microsoft excel sheet for statistical analysis, SPSS (statistical package for social sciences)package has been used. The dependent variables of the two groups were compared using Unpaired Student's t-test at 95% confidence limit. The correlation was found

between the variable of the two groups using Pearson's correlation.

## RESULTS

I. **Table 1 and 2** indicates that the COPD participants had significant weight loss when compared to the normal's, although only 36.66% had complain of reduced appetite while rest of the 63.33% had normal dietary intake. **Table 3:** The mean value of resting PR, RR, BP and Borg's RPE of the study group was much higher than control group which was statistically significant at p-value <0.01. Post-test, RR and RPE showed statistically significant rise at p-value <0.01. With regards to recovery time following 6MWT, it was found that COPD subjects took longer time as compared to control group that was statistically significant at p-value <0.05. The 6MWD was markedly reduced in COPD subjects (258.53±18.31) as compared to control group (421.37±14.76) with statistical significance at p-value<0.05. **Table 4:** The mean score of total health of COPD and normal subjects was 55.83 ± 3.11 and 95.17 ± 0.71 respectively . The difference between both the group was statistically highly significant at p-value<0.01. **Table 5:** In Pearson's Correlation analysis, post-test RR (r=-0.39, p<0.05) and post-test RPE (r=0.377, p<0.05) showed statistically significant negative correlation with 6MWD in COPD group. When SF-36 score was analysed, strong correlation was seen with 6MWD in COPD group (r=0.45, p=0.005) as compared to control group(r=0.410, p<0.05).

## DISCUSSION

All the study participant were males as no female participants reported during the study period this could also possibly be explained by low prevalence of the disease in women or undiagnosed in women, also less exposure to health care services due to less dominating in gender, negligence of the disease and lastly greater occurrence in lower socioeconomic class where

least importance is given to the women and women's health<sup>8</sup>. The participants also were chronic smokers with duration exceeding 30 years which has been reported to be the approximate period to result into substantial loss of lung function to experience symptoms. All the participants in study group had dyspnea (MRC grade II-IV) as a primary symptom related to activities of daily living, barrel shaped chest, use of accessory muscles of respiration at rest. These signs are consequences of path mechanical changes of thorax in an attempt to compensate for a compromised respiratory function. When the lungs become inflated, the diaphragm gets displaced downwards, result into reduction in efficiency of contraction. These changes contribute o shortness of breath which is commonly encountered more often by COPD subjects this becomes more apparent when person with COPD performs any activity<sup>2</sup>.

Fabio Pitta et al 2005 concluded that 6MWD (< 400 mt) is the best surrogate marker of inactivity during daily life in patients with COPD<sup>9</sup>. In the present study, 6MWD covered by the study group was 40% lesser than the normal's. Inactivity in COPD is not a surprising finding in itself, possibly the existence of dyspnea limit their level of physical activity. The baseline parameters were found to be higher in study group compared to control group probably due to higher BMR in patients with COPD. Immediately after 6MWT, they showed greater rise in RR and RPE, whereas no significant change occurred in circulatory response that is PR and BP. It has been agreed by various authors that mainly dyspnea which gets precipitated on walking influences RR and RPE in order to meet excessive energy requirement of body compensated by greater demand on respiratory system<sup>10</sup>. In addition to that M Decramer et al explained the peripheral muscle weakness, de conditioning and impaired gas exchange as important contributors to exercise intolerance<sup>11</sup>.

The advancement in age is often associated with change in health status due to physical limitations and limited ability to engage in leisure time activities to some extent (Mayou et al 1990). The MOS SF-36 score of COPD group was quite lower than that of their healthy counterparts. Similar findings have been reported in various studies suggesting that it's a reflection of impaired functional capacity as dyspnea limit ADLs, therefore COPD subjects do not favor to socialize with people or they prefer to stay home and more often remain confined to bed<sup>12,13,14</sup>. Moreover, anxiety, depression and other factors like frequent physician visits, emergency room visits and hospitalizations for COPD have been seen to affect the health status<sup>15</sup>. Therefore, the factors contributing to dyspnea, weight loss, decreased endurance, peripheral muscle dysfunction and raised BMR should be considered to improve functional outcomes.

Weight loss is an important predictor of performance of COPD subjects<sup>16</sup>. In the present study, 33% of COPD population had a reduced dietary intake and rest of them had an adequate dietary intake. Although on the whole had a drastic weight loss compared to normal subjects may be due to dyspnea related to ADL, increased resting energy expenditure, systemic inflammation, and tissue hypoxia. These patients may become short of breath in the very act of eating and so may not eat enough to replace the calories they used<sup>17</sup>, therefore, imbalance in energy ultimately reflects through weight loss significantly. Secondly, the increased resting energy expenditure may be due to an increased oxygen consumption of the respiratory muscles secondary to the increased resistive load and impaired efficiency of respiratory muscles. The poor nutritional status also has an adverse effect on the outcome irrespective of the lung functions, therefore, nutritional assessment should be made an important part of regular assessment of patients with COPD.

The Cochrane database systemic reviews 2008(Y Lacasse et al) showed that an increase in 6MWD, reduction in MRC dyspnea score, enhancement of emotional function, patient's sense of control over their condition and improvement in health status occurs following pulmonary rehabilitation. The pulmonary rehabilitation targeting therapy with exercise training and nutritional intervention is found to be beneficial. It has been shown to increase functional performance independent of degree of airflow limitations. Importantly it appears that much of the improvement with exercise training is due to its effect on skeletal muscle function as well<sup>18</sup>.

The results of this study shows significant reduction in functional capacity and health status compared to control group, this should not be overlooked as although COPD is irreversible condition, there is convincing evidence that improvement in well-being of stable COPD patients occur with a structured, well planned pulmonary rehabilitation program.

### CONCLUSION

The present study indicates that the functional capacity and the health status are significantly compromised in stable COPD subjects compared to age matched healthy individuals. Reduction in functional capacity is attributed to alteration of pulmonary functions based on significant increase in post test RR and RPE along with baseline reduction in PEFR and chest expansion. There was no significant rise in post test PR and BP suggestive of no affection of circulatory system. The nutritional status, indicated by weight and BMI was significantly lower in COPD patients compared to normal despite the dietary intake of 66% subjects with COPD being normal.

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No Conflict of Interest

### REFERENCES

1. Elisabeth Stahl, et al., Health-related quality of life is related to COPD disease severity. *Health and Quality of life outcomes* 2005; 3:56
2. Jerome L Fleg, Gary Balady et al., Assessment of functional capacity in clinical and research applications. *American heart association*, 2000; 102:1591.
3. ATS statement: Guidelines for 6 MWT. ATS Board of Directors, *American journal of respiratory critical care medicine*, vol 16; 111-117, 2002
4. Wise RA, et al., Minimal clinically important differences in the 6MWT and the incremental shuttle walking test. *COPD*.2005; 2:125-9
5. Soyuyigit S, Erk M, Guler N et al., The value of SF-36 Questionnaire for the measurement of life quality in COPD, 2006,259-266
6. Mahler DA, Mackowiak JI et al., Evaluation of the short term 36 item questionnaire to measure HRQOL in patients with COPD. *Chest J*, 1995; 1585-9.
7. Molfino NA, et al., Current thinking on genetics of COPD. *Current Opinion Pulm Med*. 2007; 13:107-13
8. Anita B Varkey, et al., chronic Obstructive Pulmonary Disease in Women: exploring gender differences. *Current opinion in Pulmonary Medicine*, 2004.
9. Fabio Pitta, et al., Characteristics of physical activities in daily life in COPD. *AM J Crit Care Med*. 2005; Vol 171; 972-977
10. Gallego MC, et al., Dyspnea in COPD: relation to the MRC scale with dyspnea induced by walking and cardiopulmonary stress testing. *Arch Bronconeumol*. 2002; 38: 112-6
11. M Decramer, R Gosselink, Muscle weakness is related to utilization of health care resources in COPD patients. *ERJ* February 1, 1997 vol. 10 no. 2 417-423
12. Hutter BO, et al., functional capacity and Quality of life in patients with COPD: instruments of assessment and methodological aspects. *Pneumologie*. 1999; 53:133-42.
13. Marc Miravittles et al., Factors determining the Quality of life of patients with COPD in primary care. *Therapeutic advances in Respiratory Medicine*, 2007; Vol.1, No.2, 85-92
14. Larson JL, et al., Functional performance and physical activity in COPD: theoretical perspectives. *COPD*. 2007; 4:237-42
15. H. Florence Seung Kim, et al., Functional impairment in COPD patients: the impact of anxiety and depression. *Psychosomatics* 2000; 41:465-471
16. Deveci F, et al., Nutritional status, pulmonary functions, and exercise performance in COPD cases. *Tuberk Toraks* 2005; 53:330-9
17. Consensus on why dyspnea occur? *Am J Resp Crit C Med*, 2008
18. Y Lacasse et al., Pulmonary rehabilitation for COPD. *Cochrane Database of Systemic Reviews* 2008 Issue 4.

**Table 1 Demographic data of COPD and Normal Subjects (n=30)**

Characteristics	COPD Subjects	Normal Subjects
Age(In years)	63.06 ± 7.74	59.40 ± 7.95
Sex		
Male	100%	100%
Female	-	-
Height(cms)	161.53 ± 6.59	163.57 ± 5.92
Weight(kg)	47.66 ± 7.88	60.60 ± 10.74
BMI(kg/m <sup>2</sup> )	18.31 ± 3.06	22.44 ± 3.68
Smoking	100% Smoker	Not Applicable
Duration(years)	36.40	-
Packs/day	Apporx. 1	-
Duration of disease(years)	5.75	-

**Table.2 Clinical presentation of COPD subjects**

	Yes	No
Breathlessness/cough with expectoration	100%	0%
Allergy/History	3.30%	96.70%
Family History	23.33%	76.66%
Appetite	63.33% (Normal)	36.66% (Decreased)
Barrel shaped chest*	100%	0%
Use of accessory muscles	100%	0%

**Note:** \*Ratio of Antero-posterior Vs Transverse diameter of chest >0.7 is considered as Barrel shaped chest

**Table 3.Comparison of Pre & Post Six Minute Walk Test parameters between normal & COPD subjects**

Pulse Rate (beats per minute)						
	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test
	Mean ± SE		t-value		p-value	
Normal	82.03 ± 2.22	94.40 ± 2.22	3.062	1.885	<0.01	>0.05
COPD	91.77 ± 2.27	101.07 ± 2.75				

Respiratory Rate (breaths per minute)						
	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test
	Mean ± SE		t-value		p-value	
Normal	19.10 ± 0.40	25.07 ± 0.82	8.443	4.767	<0.01	<0.01
COPD	24.63 ± 0.52	30.20 ± 0.69				

Rate of Perceived Exertion (score)						
	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test
	Mean ± SE		t-value		p-value	
Normal	6.00 ± 0.00	6.13 ± 0.06	4.253	11.122	<0.01	<0.01
COPD	6.73 ± 0.17	10.63 ± 0.40				

<b>Recovery Time (in minutes)</b>			
	Mean ± SE	t-value	p-value
<b>Normal</b>	3.80 ± 0.11	2.386	<0.05
<b>COPD</b>	4.33 ± 0.19		

<b>6 Minute Walk Distance (meters)</b>			
	Mean ± SE	t-value	p-value
<b>Normal</b>	421.37 ± 14.76	-6.923	<0.01
<b>COPD</b>	258.53 ± 18.31		

**Table 4: The comparison of total health between normal and COPD subjects**

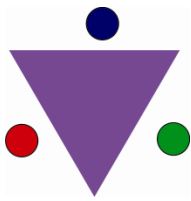
<b>SF-36 Total score (%)</b>			
	Mean ± SE	t-value	p-value
<b>Normal</b>	95.17 ± 0.71	-12.313	<0.01
<b>COPD</b>	55.83 ± 3.11		

**Table 5: Pearson's Correlation between 6MWD and Post test RR, Post test RPE, Total Health Score in Normal and COPD subjects**

	Mean ± SE		R	p-value
	6 MWD (meter)	Post-RR (per minute)		
<b>Normal</b>	421.37 ± 14.76	25.07 ± 0.82	-0.033	>0.05
<b>COPD</b>	258.53 ± 18.31	30.20 ± 0.69	-0.389	<0.05

	Mean ± SE		R	p-value
	6 MWD (meter)	Post-test RPE (score)		
<b>Normal</b>	421.37 ± 14.76	6.13 ± 0.06	0.062	>0.05
<b>COPD</b>	258.53 ± 18.31	10.63 ± 0.40	-0.377	<0.05

	Mean ± SE		R	p-value
	6 MWD (meter)	SF-36 Total Score (%)		
<b>Normal</b>	421.37 ± 14.76	95.17 ± 0.71	0.410	<0.05



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## A SEROEPIDEMIOLOGICAL STUDY OF HERPES SIMPLEX VIRUS TYPE 2 IN HIV POSITIVE INDIVIDUALS IN RAJAHMUNDRY, ANDHRA PRADESH, INDIA

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### ABSTRACT

**Objectives :** This study was done to find out the seroprevalence of herpes simplex virus type 2 (HSV-2) and its association with certain factors like age , gender as well as other demographic and behavioural factors in 166 human immunodeficiency virus ( HIV ) positive adults . **Methods :** This is a cross sectional study . 166 HIV positive adults were selected , informed consent was obtained and detailed history was taken. Serum samples were then screened for HSV-2 type specific IgG antibodies by ELISA . **Results :** HSV-2 seroprevalence was 42.1 % and it was higher among women ( 56.3% ) than among men ( 31.6 % ) . HSV-2 seroprevalence increased along with advancement of age and it was associated with high promiscuous behaviour . **Conclusions :** Only 14.2 % of the HSV-2 seropositive group gave history of symptoms suggestive of genital herpes . This demonstrates the need for regular HSV-2 seroprevalence surveys particularly in high risk groups. HSV-2 infected individuals can therefore be identified and institution of proper counselling and treatment not only reduces the rate of transmission of HSV-2 infection but also decreases the incidence of HIV infection.

**Key words:** Human immunodeficiency virus , seroprevalence , Herpes simplex virus type 2

### INTRODUCTION

Herpes simplex virus type 2 ( HSV-2 ) infection is a common cause of genital ulcer disease <sup>(1)</sup> . It is a lifelong infection which is highly infectious and often transmitted sexually in the absence of symptoms. HSV-2 prevalence is increasing worldwide and has become a prominent public health issue over recent years in relation to its potential role in facilitating HIV transmission <sup>(2)</sup> . There is an epidemiological synergy between HSV-2 and HIV-1. HSV-2 infection is associated with a 2 - 4 fold increase in HIV-1 acquisition . In addition , HSV-2 is reactivated and transmitted more frequently in persons co-infected with HIV-1 and HSV-2 than in persons not infected with HIV-1 .

HSV - 2 infection is an independent risk factor for the acquisition and transmission of infection with HIV-1. Among co-infected persons, HIV-1 virions can be shed from herpetic lesions of the genital region . This shedding may facilitate the spread of HIV through sexual contact <sup>(3)</sup> .

The majority of the HSV-2 infections are unrecognised and represent the major reservoir for HSV-2 transmission . Antibody prevalence rates correlate with past sexual activity and vary greatly among different population groups<sup>(3)</sup> . Therefore seroepidemiological studies are critical to understanding the pattern and distribution of infection within populations <sup>(4)</sup> . Data on the prevalence of HSV-2 infection among HIV

positive adults are scarce<sup>(5)</sup>. The potential role of HSV-2 infection in facilitating HIV transmission highlights the need for including anti-HSV-2 testing and therapy in the management of HIV positive patients, especially for reducing the risk of transmission of HIV through herpetic lesions<sup>(6)</sup>.

This study was done to find out the seroprevalence of HSV-2 and its association with certain factors like age, sex as well as other demographic and behavioural factors among HIV positive adults.

### **MATERIALS AND METHODS**

It is a hospital based cross sectional study. The study was conducted in GSL General Hospital, a tertiary care hospital located in Rajahmundry, Andhra Pradesh. The study group consisted of 166 HIV positive adults with age ranging from 15 to 60 years, diagnosed at the hospital between January, 2010 and November, 2011. Written informed consent was obtained and detailed history was taken on age, gender, education, socio-economic status, address, marital status, occupation, condom usage, sexual orientation, number of sexual partners in the preceding years, years of sexual activity, history of genital herpes and history of any other STDs in past or present.

Serum samples were collected from each patient and screened for HSV-2 type specific IgG antibodies by enzyme linked immunosorbent assay [ELISA]. Test procedure was done and results interpreted as per manufacturer's guidelines [Manufacturer: EUROIMMUN]. This ELISA test specifically detects IgG class antibodies directed against HSV-2 specific glycoprotein G2. Cross reactivity with antibodies against HSV-1 leading to false positive results does not occur with this type of ELISA<sup>(7,8)</sup>. The specificity of this ELISA with respect to the gold standard western blot test is 98% and the sensitivity is 100%<sup>(7)</sup>.

Statistical Methods: All statistical analysis were performed by using SPSS software, version 16 and data have been summarised as counts and percentages. Unpaired proportions have been compared using Chi Square test or Fisher's Exact Probability test, as appropriate. All analysis was two tailed and  $p < 0.05$  was considered statistically significant.

### **RESULTS**

Data obtained from history was analysed and shown in Table - I. All were heterosexuals. The overall HSV-2 sero-prevalence was 42.1% and it was higher among women than among men (Table - II). HSV-2 seropositivity increased along with advancement of age (Table - III). Sero-prevalence of HSV-2 was higher among those with high promiscuous behaviour (Table - IV). These associations were found significant statistically. Only 14.2% of individuals with antibody to HSV-2 gave history of symptoms suggestive of genital herpes.

### **DISCUSSION**

Few surveys describing the seroepidemiology of HSV-2 using type-specific tests in HIV sero-positive adults from Andhra Pradesh have been published. In our study HSV-2 seroprevalence among HIV seropositive adults was 42.1%. A similar study on HIV positive adults done at Visakhapatnam, a nearby city in Andhra Pradesh, reported HSV-2 seroprevalence of 49%<sup>(9)</sup>. A larger study on general population done at Guntur district of Andhra Pradesh, reported HSV-2 seroprevalence of 5.87%<sup>(10)</sup>. A community based study in New Delhi found that the seroprevalence of HSV-2 was 7% and 8.6% in men and women respectively<sup>(11)</sup>. These findings support that there is a strong association between HSV-2 and HIV infections. The higher rate of HSV-2 seen in HIV seropositive individuals may indicate that individuals who are infected by HSV-2 are

more likely to acquire HIV infection , and vice-versa <sup>(1,5,12,13)</sup> .

HSV-2 sero-prevalence was high among women ( 56.3 % ) than among men ( 31.5 % ) . This difference between men and women may be due to the difference in the nature of promiscuous behaviour by gender ( 62.5 % of women had high promiscuous behaviour compared to 37.5 % of men ) . HSV-2 sero-prevalence increased along with advancement of age. Prevalence rates of 34.6%, 37.7% and 57.8% were found among the groups aged 15 - 30 , 31 - 45 and 46 – 60 years respectively . The increase in prevalence of each higher level of age may be related to increasing years of sexual activity along with advancement of age . HSV-2 sero-prevalence was high among those with sexual partners more than 3 in the preceding years than among those with less than 3 ( 52.1% versus 28.6% ) . These findings were found significant statistically and were in tandem to observations reported in various studies <sup>(14,15,16,17)</sup> .

Only 14.2% ( 10/70 ) of individuals with antibody to HSV-2 gave history of symptoms suggestive of genital herpes . This indicates that only a low proportion of the patients were aware of the HSV-2 infection. Similar observation was also made in other studies <sup>(5,14,15,17)</sup> . This emphasizes the importance of studying the disease by serological methods .

### CONCLUSION

HSV-2 prevalence is more common in HIV positive individuals compared to those of general population . This shows a strong association between HSV-2 and HIV infections. HSV-2 positive individuals are more likely to acquire HIV infection . There is a need for regular HSV-2 screening particularly in high risk groups . HSV-2 infected individuals can therefore be identified and institution of proper counselling and treatment not only reduces the rate of transmission of HSV-2 infection but also decreases the incidence of HIV infection.

However, more rigorous study designs are needed to confirm these possibilities.

### ACKNOWLEDGEMENT

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### REFERENCES

1. Corey Lawrence, Wald Anna, Celum, Connie L, Quinn, Thomas C . “The effects of Herpes Simplex virus 2 on HIV – I Acquisition and Transmission : A review of two overlapping epidemics“. JAIDS Journal of Acquired Immunodeficiency Syndromes : volume 35 ( 5 ) 15 April 2004 .
2. Herpes Simplex virus type 2 : Programmatic and research priorities in developing countries . Report of A WHO / UNAIDS / LSHTM workshop . London , 14-16 , February .WHO HIV AIDS /2001.05.2001 .
3. Fausi, Braunwald, Kasper, Houser, Longo, Jameson, Loscalzo . Harrison’s principles of internal medicine .17<sup>th</sup> edition .2008 .volume I :p. No. 1097 .
4. Cowan FM, French RS, Mayaud P, Gopal R, Robinson NJ, Artimos De Oliveira, S Faillace T, Vuscula A, Nigard-Kibur M, Ramalingam S, Srdharan G, L Aouad R, Alami K, Rbai M, Sunil Chandra N, Brown DW 2003 . Seroepidemiological study of Herpes Simplex virus type 1 and 2 in Brazil, Estonia, India, Morocco and Srilanka .Sex Trans Infect 79 : 286-290
5. Flavia Cunha Santos, Solange Artimos De Oliveira, Sergio Setubal, Luiz Antonio Bostos Canacho, Tereza Faillace, Jose Paulo, Gagliardi Leite, Luis Guillermo Coca Velarde, The HSV

- International study group. Seroepidemiological study of Herpes Simplex virus type 2 in patients with the acquired immune deficiency syndrome in the city of Niteroi, Rio De Geneiro , Brazil . Mem Inst Oswaldo Cruz ,Rio De Geneiro , vol 101 ( 3 ) : 315-319 , May 2006 .
6. Suligo B, Dorrucchi M, Volpi A, Andreoni M, Zerboni R, Rezza G and the Italian Seroconversion study group 2002, Prevalence and determinants of Herpes Simplex virus type 2 infection in a cohort of HIV positive individuals in Italy . Sex Trans Dis Is : 665-667 .
  7. EUROIMMUN – Anti HSV – 2 – ( gG 2 ) – ELISA ( IgG ) . EUROIMMUN AG . D – 23560 Lubeck ( Deutschland ) . Seekamp 31 .
  8. Haliona B, JE Malkin . Epidemiology of Genital Herpes : Recent advances . European Journal of Dermatology 1999 : 9 : 177-84 .
  9. K Anuradha, H Maan Singh, KVT Gopal, R Raghu Rama Rao, T V Ramani, Jyothi Padmaja . Herpes Simplex virus type 2 infection : A risk factor for HIV infection in heterosexuals . Indian J Dermatol Venerol Leprol. 2008 ; 74 : 230 - 3 .
  10. John A Schneider, Venu Lakshmi, Rakhi Dandona, G Anil Kumar, Talasila Sudha, Lalit Dandona, Population - based seroprevalence of HSV – 2 and Syphilis in Andhra Pradesh state of India . BMC Infectious diseases 2010
  11. R Chawla, P Bhalla, K Bhalla, M Meghachandra Singh, S Gorg . Community - based study on seroprevalence of Herpes Simplex virus type 2 infection in New Delhi Indian Journal of Medical Microbiology ,(2008 ) 26 (1) : 34 – 9 .
  12. Russel DB, Tabrizi SN, Russel JM, Garland SM 2001 . Seroprevalence of Herpes Simplex virus type 1 and 2 in HIV infected and uninfected homosexual men in a primary care setting . J Clin Virol 22 : 305 - 313 .
  13. Genital herpes and human immunodeficiency virus : double trouble . Connie Celum , Ruth Levine , Maria Weaver , Anna Wald , . Bulletin of the World Health Organization / June 2004 , 82 ( 6 ) .
  14. Varela JA, Gorgia Corbeira P, Aguanell MV, Boceta R , Ballesteros J, Aguilar L. et al,. Herpes Simplex virus type 2 seroepidemiology in Spain . Sexually Transmitted Diseases 2001 ; 28 : 47 – 50.
  15. Gottlieb SL, Douglas JM, Schmid S . Seroprevalence and correlates of Herpes Simplex virus type 2 infection in 5 STD clinics . Journal of Infectious Diseases 2002 : 186 : 1381 – 1389 .
  16. Cowan FM, Johnson AM Ashley R, Corey L, Mindel A . Antibody to Herpes Simplex virus type 2 as serological marker of sexual lifestyle in populations. BMJ 1994 ; 309 :1325 – 1329 .
  17. Janier M, Lassau F, Bloch J . Seroprevalence of HSV 2 antibodies in an STD clinics in Paris. Int J STD AIDS 1999 ; 10 : 522 .

**Table 1 . Analysis of Data Obtained From History, Study group no. 166**

<b>Parameter-wise Distribution</b>		<b><u>Number of adults ( % )</u></b>
<b>Age - wise Distribution</b>	<b>15 – 30 years</b>	<b>52 ( 31.3 )</b>
	<b>31 – 45 years</b>	<b>69 ( 41.5 )</b>
	<b>46 – 60 years</b>	<b>45 ( 27.1 )</b>
<b>Gender - wise Distribution</b>	<b>Men</b>	<b>95 ( 57.2 )</b>
	<b>Women</b>	<b>71 ( 42.7 )</b>
<b>Marital Status</b>	<b>Married</b>	<b>136 ( 81.9 )</b>
	<b>Single</b>	<b>30 ( 18.0 )</b>
<b>Socio-Economic Status</b>	<b>Low</b>	<b>130 ( 78.3 )</b>
	<b>Medium</b>	<b>36 ( 21.6 )</b>
<b>Condom Usage</b>	<b>No</b>	<b>42 ( 25.3 )</b>
	<b>Yes</b>	<b>124 ( 74.6 )</b>
<b>Promiscuous Behaviour</b>	<b><u>High ( &gt; 3 lifetime sexual partners )</u></b>	<b>96 ( 57.8 )</b>
	<b>Men</b>	<b>36 ( 37.5 )</b>
	<b>Women</b>	<b>60 ( 62.5 )</b>
	<b><u>Low ( &lt; 3 lifetime sexual partners )</u></b>	<b>70 ( 42.1 )</b>
	<b>Men</b>	<b>55 ( 78.5 )</b>
	<b>Women</b>	<b>15 ( 21.4 )</b>
<b>Past History of STDs</b>	<b>Present</b>	<b>128 ( 77.1 )</b>
	<b>Absent</b>	<b>38 ( 22.8 )</b>

**Table 2 : HSV-2 sero-prevalence in relation to Gender ( n = 166 )**

Gender	HSV-2 Antibody		Total	P Value
	Positive	Negative		
Men	30 ( 31.6 % )	65 ( 68.4 % )	95	0.0014 < 0.01
Women	40 ( 56.3% )*	31 ( 43.7 % )	71	
Total	70	96	166	

**\* HSV-2 sero-prevalence was significantly higher among women than among men**

**Table 3 : HSV-2 sero-prevalence in relation to Age ( n = 166 )**

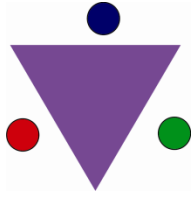
Age ( Years )	HSV-2 Antibody		Total	P Value
	Positive	Negative		
15 - 30	18 ( 34.6 % )	34 ( 65.4 % )	52	0.043 < 0.05
31 - 45	26 ( 37.7% )	43 ( 62.3 % )	69	
46 - 60	26 ( 57.8 % )*	19 ( 42.2 % )	45	
Total	70	96	166	

**\* HSV-2 sero-positivity increased significantly with advancement of age**

**Table 4: HSV-2 sero-prevalence in relation to number of sexual partners ( n = 166 )**

<b>No. of Sexual partners in the preceding years</b>	<b>HSV-2 Antibody</b>		<b>Total</b>	<b>P Value</b>
	<b>Positive</b>	<b>Negative</b>		
<b>Less than 3</b>	20 ( 28.6 % )	50 ( 71.4 % )	70	0.0025
<b>More than 3</b>	50 ( 52.1.% )*	46 ( 47.9 % )	96	< 0.01
<b>Total</b>	70	96	166	

**\* Sero-prevalence of HSV-2 was significantly higher among those with high promiscuous behaviour**



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## BICORNUATE UTERUS WITH UNILATERAL AGENESIS OF RIGHT KIDNEY-A CASE REPORT

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### ABSTRACT

**Objective:** To present a rare case anomaly of bicornuate uterus along with agenesis of right kidney in nulliparous women. **Background:** The revolution in the field of Radio diagnostics has helped a lot in understanding and establishing the developmental anomalies of female reproductive organs; they not only threaten to cause Infertility or Miscarriages, the life of the mother and child as well. It is essential to establish the condition or the probable causes for any unusual presentations which helps us to take measures during antenatal care and its management. The structural Anomalies also plays an important role in the successful and contented marital life of the couple, but quite often these problems are much highlighted with the above said complaints. One such suspected case where 19 years old female with the main complaints of lower abdominal pain and burning micturition was thoroughly examined and she was subjected to through radiological investigation to confirm and rule any out structural anomalies.

**Methods:** Patient was subjected to radiological investigations like MRI (magnetic resonance imaging) urography, USG (ultrasonography) and HSG (Hysterosalpingography) to confirm or to rule out suspected structural anomalies. **Results:** The abnormal structural presentation of the uterus showing bicornuate appearance was accompanied with untraced right kidney was suggestive of uterine anomaly along with the agenesis of right kidney. **Conclusion:** Timely justified usage of the Radio diagnostic Equipment's certainly will help to go in the direction of finding the solutions by taking necessary action on the right time to save the lives. In our case a Bicornuate Uterus was associated with agenesis of the right kidney was found during the investigations, these combined defects in individual drags attention of close differentiation of reproductive and urinary system development during the fetal life, it is one such uncommon anomaly quite obviously drags its attention in every aspects of clinical examination.

**Key words-** CT scan, HSG, MRI, Urography and USG.

### INTRODUCTION

Every individual has the rights to take birth normal which obviously demands structurally and functionally viable organ systems. The female genital or reproductive organs poses a greater risk as they are involved from the time of conception to till labor, Most often birth anomalies are not

recognized until the person attains a certain age due to its time dependent physiological limitations. Among the female reproductive organs uterus play an important role to produce a healthy off spring, its developmental defects are commonly seen in the clinical practice and they can be better diagnosed with the help of

equipments with advanced and sophisticated technology. The commonly seen threats include placenta previa, cephalopelvic disproportion (CPD), uni or bicornuate uterus, Still birth and so on.

Bicornuate uterus is one such anomaly where the uterus is having two Cervices with separate uterine cavities resembling horns, it has a wall inside and partial split outside. Bicornuate uterus is the common congenital uterine anomaly that can affect woman's reproductive capabilities, Incidence of congenital uterine anomalies occur in general population at a rate of 6.7% and the same in infertile population is around 7.3%.<sup>1</sup> Uterus develop from successfully formed urogenital ridge, the medial part of the ridge forms the Genital or Gonadal ridge which develops from the intermediate mesoderm which moves along with the body wall of the developing embryo. The mullerian duct or Wolffian duct plays an important role in the formation and differentiation of the female genitourinary system. The Paramesonephric ducts arise as a longitudinal invagination of the epithelium on the surface of the urogenital ridge. These ducts fuse proximally with the regression of the septum to produce the uterus and vagina in female. The proximal and lateral part remains as a Fallopian tube which is also an important structural component for the successful fertilization and pregnancy.<sup>2</sup> The mullerian duct can have a complete or partial duplication or improper septate regression can lead to conditions like Bicornuate or septate Uterus, the early establishment of structural viability of an individual can prepare a person to face or to overcome from the probable anticipated problems like bicornuate uterus is one among them. The other anomalies include the duplication of uterus, septate uterus, fallopian tube duplication or block etc. was recognized when the person undergoes radiological examination for any relevant complaints. In obstruct and gynaec practice the Investigations like USG (ultra sonography), MRI

(Magnetic resonance imaging), CT scan (Computer axial tomography) etc. are routinely used to confirm the normal or abnormal structural and developmental defects in mother and the fetus<sup>3</sup>. Developmentally Genital and Urinary systems are closely interwoven which can be realized by seeing the number closely related reproductive anomalies were associated with anomalies of Kidney.

### **MATERIALS AND METHODS**

A 19 years old female with 6 months married life came with the chief complaints of intermittent lower abdominal pain which was associated with the symptoms of burning micturition and there was no history of recent complaints like fever, vomiting, diarrhea, and her menstrual history and her Physical examination was found normal. On vaginal Speculum examination midline longitudinal septum was seen in upper 2/3<sup>rd</sup> of vagina and two Cervices were visualized on either side of the septum. The HSG (Figure 1) showed a single endometrial cavity filled with contrast that is deviated to the left side and drains into left fallopian tube indicting the partition. The right uterine horn and fallopian tubes were not visualized and the tissue separating the 2 horns demonstrates signal intensity identical to myometrium on all pulse sequences. The lower portion of the septum is seen to be extending inferiorly up to external os and there was a minimum endometrial collection in the right horn and the ovaries were found normal. On fluoroscopic study angiograffin was injected and radiographs were taken, was showing the normal flow in the left uterine cornua but the right cornua was not visible. Later it was confirmed through MRI (Figure 3) and also through Chrompercubation examination was showing the filling defect of dye in the left fallopian tube. The excretory Urography ( Figure 2) showed normal functioning left kidney with excretion of contrast dye into the left ureter and simultaneously there

was complete non visualization of right kidney and right ureter was later confirmed through Radiological (MRI) investigations. Though the uterine defects are common, initially they were recognized through the physical examination of the patient showing the septum, subsequently it was confirmed through the HSG (hysterosalphyngography) was showing the endometrial cavity communicating with the left fallopian tube only, later it was confirmed through the fluoroscopic examination.

### RESULTS

The diagnosis of a case of bicornuate uterus associated with the agenesis of right kidney was established.

### DISCUSSION

Timely justified usage of radio diagnostics especially with the long term complaints of unsuccessful attempts to conceive or repeated miscarriages associated with infertility plays an important role in establishing its tentative cause. The anomalies are reported from simple to most complex sequences. Mayer – rokintansky – kuster - hauser syndrome (MRKH) is such one case syndrome where the mullerian agenesis is seen which results in non development of uterus. The MRKH syndrome is characterized by various pattern of its expressions like congenital aplasia of the uterus where the mullerian agenesis is seen which results in non development of uterus where the upper part 2/3 of vagina in women was showing the normal development along with normal secondary sexual characteristics. The phenotypic manifestations of MRKH syndrome overlap with various other syndromes and its associations will require an accurate delineation, It affects 1 in 4500 women it may be may be found more frequently with renal, vertebral, and also to some extent with cardiac defects. The keen physical examination is however it is a basic necessity to diagnose any suspected case at the

earliest with at most care, especially where the medical facilities are limited .<sup>4,5</sup> A rare case of Bicornuate uterus having the single cervix and two narrow individual uterine cavities were appreciated radio logically, was associated with fibroid mass bilaterally in its Horn; such anomalies are recognized with the long term complications with unsuccessful attempts to achieve pregnancy which may often lead to a false sense of pregnancy in an individual <sup>6</sup>.

The Bicornuate uterus can even cause the rupture of the uterus and foetal death, which is a life threatening condition, needs its identification very early for the proper care and management to avoid undue complications. Most importantly ignored or undiagnosed case of Bicornuate uterus can lead to life threatening complications in primigravida during the first or second trimester of pregnancy without any significant gynecological history, this also shows the limitation of the physical examination..<sup>7</sup> Often Uterine anomalies were found to be associated with renal anomalies and there were cases reported in the literature, such associated findings were established through radio Diagnostics. Interestingly the pancake kidney was showing that the entire renal substance which was fused to form a single mass lying in the pelvis, 20% to 66% of women with renal ectopica are associated with the abnormalities of Uterus or Vagina or both <sup>8</sup>. Anomalies of female reproductive tract was found to occur one in 4000 to 20,000 in women, molecular studies shows that LIM gene which encodes a transcriptional factors plays an important role in the development of head and kidney, which is also involved in the differentiation of wolffian duct, mesonephros, metanephros and fetal gonads. The Lim expressions are prerequisite for the proper development of female reproductive tract; its thin expression in the intermediate mesoderm of gastrula of developing fetus could be one of the causative factors for female reproductive system

anomalies, which were studied in some of the animal experimental model like Mice<sup>9</sup>.

There is a clear developmental association between the uterine anomaly with the urinary system development which is more genetically dominated, where the identical twins were showing the common uterine anomaly associated with bilateral duplex kidney<sup>10</sup>. Though a specific gene is not yet certain to establish the developmental defects but more familiar tendency shows its genetic link in 1<sup>st</sup> degree relatives where they are more prone for such developmental anomalies with variable phenotypic expressions like agenesis of kidney, duplex kidney, pancake kidney etc. with or without uterine anomalies, such early finding have the clinical implication in the management of antenatal care. Grievous structural and functional presentations with expected and unexpected clinical consequences certainly can be handled effectively by the timely confirmation of the condition and its possible underlying causes, for which the recent advancement in the radio diagnostics is really a boon in the field of clinical medicine. In our case there was no history of any birth defects in the patient's family which was showing an unknown dominant cause for its clinical presentation. Our case draws more attention when the further radiological investigations were shown the agenesis of the right kidney. It is anatomically an important correlation probably indicating a close molecular association during the development of Genital and urinary systems.

### CONCLUSION

The advancement in the science and technology and its utility in the clinical practice are complimentary to each other. The ultimate benefit of this cohort certainly can save the people of two generations by its timely and justified usage by experts. In comparison with the cost and benefit ratio, experience of pain and agony, time consumption and the accuracy of noninvasive

radiological procedures are really fascinating and plays an important role in saving many lives and sufferings well in advance. Bicornuate uterus anomaly associated with agenesis of right kidney shows their developmental and structural intimacy, any such suspected and associated signs and symptoms needs an early clinical and diagnostic evaluation to plan and execute proper medical surgical procedures to prevent or to overcome from the anticipated complications well in advance.

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### REFERENCES

- 1 Saravelos SH, Cocksedge KA and Tin –Chiu Li, Prevalence and diagnosis of congenital uterine anomalies in women with reproductive factor a critical appraisal. Articles citing this article Experimental uterus transplantation Human reproduction update. 2008; 14 (5): 415-429.
2. Singh I and Pal GP, Human embryology, chapter Urogenital system Jaypee publishers, New Delhi, 2008, 8<sup>th</sup> edition, 237.
3. Scarsbrook AF, Moore NR, MRI appearances of mullerian duct abnormalities, Clinical radiology. 2003; 58(10):747-754.
4. Morcel K, Camborieux L. Programme de Recherches sur les Aplasies Müllériennes (PRAM), and Daniel Guerrier Mayer-Rokitansky Küster-Hauser (MRKH) syndrome Orphanet journal of rare diseases, 2007; 2: 13.

5. Gupta NP, Mayer-Rokitansky-Kuster-Hauser (MRKH) syndrome, Indian journal of urology. 2002;18 (2):111-116
6. Ly J Q. Rare bicornuate uterus with fibroid tumors Hysterosalphyngography SG – MR imaging Correlation.American journal of Roentgenology. 2002; 179(2):537-538.
7. Kore S, Pandole A, Akolekar R, Vaidya N, Ambiyee VR. Rupture of left horn of bicornuate uterus at twenty weeks of gestation.Journal of post graduate Medicine. 2000;46 (1); 39-40.
8. Kenan I, Birsen C. Cake kidney associated with uterine anomaly. The internet journal of urology 2007 (5) Internet scientific publications, [www.ispub.com/journal/...internet\\_journal\\_of\\_urology/volume\\_5](http://www.ispub.com/journal/...internet_journal_of_urology/volume_5). (Date of access 18-2-2012).
9. Koblishhi A, Shawlot W, Kania A, Behringer RR. Requirement of Lim 1 for female reproductive tract development. Development 2004; 131: 539-549.
10. Daw E and Toon P. Identical twins with uterus didelphys and duplex kidneys, Post graduate journal.1985; 6(10):269-270.



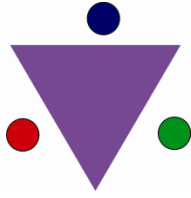
**Fig: 1** The HSG - showing a single endometrial cavity filled with contrast that is deviated to the left side and drains into one fallopian tube. The right uterine horn and fallopian tubes are not visualized.



**Fig: 2** The excretory Urography- showed normal functioning left kidney with excretion of contrast into the left ureter and simultaneously the non visualization of right kidney.



**Fig: 3** MRI investigation. Two uterine cavities were seen with separate endometrial cavities with concave fundus. The tissue separating the 2 horns demonstrates signal intensity identical to myometrium on all pulse sequences.



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## **AUTOMATIC MEDICAL IMAGE SEGMENTATION USING SPATIAL FUZZY CLUSTERING METHOD**

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### **ABSTRACT**

The performance of the set segmentation is subject to appropriate initialization and optimal configuration of controlling parameters, which requires substantial manual intervention. A new fuzzy level set algorithm is proposed in this paper to facilitate medical image segmentation. Moreover fuzzy level set algorithm is enhanced with locally regularized evolution. Such improvements facilitate level set manipulation and lead to more robust segmentation. Performance evaluation of the proposed algorithm was carried on medical images from different modalities .the results confirm its effectiveness for medical image segmentation.

**Keywords:** Fuzzy logic, Clustering, Image segmentation, Level set method.

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### **INTRODUCTION**

Segmentation is defined as partitioning portions of an image. It adds structure to a raw image. In the case of medicine, this can involve identifying which portions of an image is the tumor, or separating white matter from grey matter in a brain scan. Segmentation is a vital aspect of medical imaging. It aids in the visualization of medical data and diagnostics of various diseases.

The result of image segmentation is a set of segments that collectively cover the entire image, or a set of contours extracted from the image (see edge detection). Each of the pixels in a region are similar with respect to some characteristic or computed property, such as color, intensity, or texture. Adjacent regions are significantly different with respect to the same characteristic(s). When applied to a stack of images, typical in Medical imaging, the resulting

contours after image segmentation can be used to create 3D reconstructions with the help of interpolation algorithms like marching cubes.

we will restrict most of our discussion to approaches that generalize the statistical inference beyond first and second moments to entire probability density functions (pdf). From this, segmentation can be reinterpreted as measuring the “distance” between two distributions via a similarity metric.

we relax the assumption of *a-priori* knowledge, and focus on the accurate segmentation of biological structures or pathologies found in medical imagery. A qualitative comparison between the Bhattacharyya distance and our newly proposed metric is then done to highlight the notion that similarity measures can not be applied equally for image segmentation. In particular situations, one distribution metric may prevail while another measure may be highly

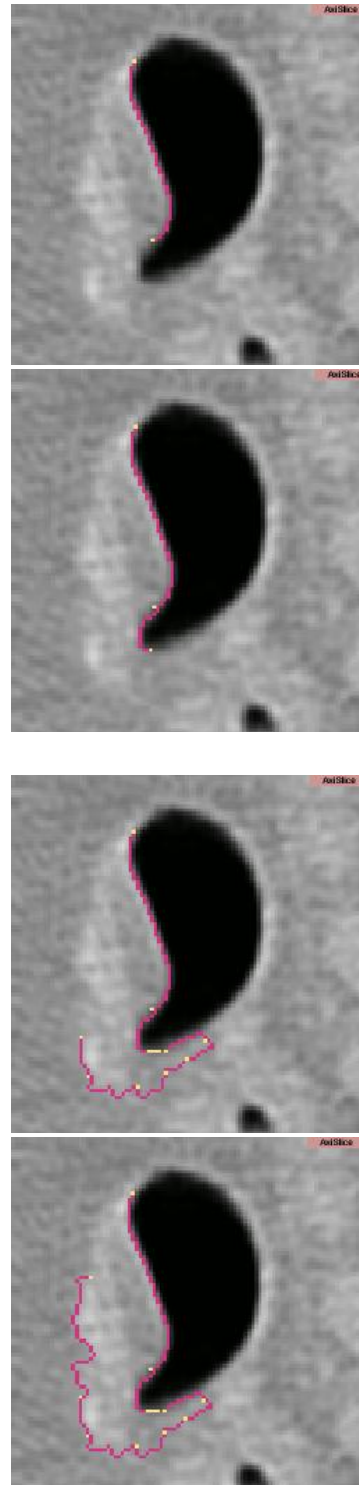
dependent on the initialization or statistical information. To the best of our knowledge, a qualitative comparison of segmentation results has not been made.

### **Digital Image Segmentation**

Image segmentation plays an important role in image analysis and computer vision. The goal of image segmentation is partitioning of an image into a set of disjoint regions with uniform and homogeneous attributes such as intensity, color, tone etc. The image segmentation approaches can be divided into four categories; thresholding, clustering, edge detection, and region extraction. In color images, the boundaries between objects are blurred and distorted due to the imaging acquisition process. Furthermore, object definitions are not always crisp and knowledge about the objects in a scene may be vague.

Segmentation is a vital aspect of medical imaging. It aids in the visualization of medical data and diagnostics of various diseases. This report presents an implementation of a level set approach for active contour image segmentation. This method is originally developed by Osher and Sethian and then applied to image segmentation by Malladi. No requirements about objects' shape and allowance for very flexible topology change are key advantages for this method. Partitional clustering essentially deals with the task of partitioning a set of entities into a number of homogeneous clusters, with respect to a suitable similarity measure. Due to the fuzzy nature of many practical problems, a number of fuzzy clustering methods have been developed following the general fuzzy set theory strategies outlined by Zadeh,

The main difference between the traditional hard clustering and fuzzy clustering can be stated as follows. While in hard clustering an entity belongs only to one cluster, in fuzzy clustering entities are allowed to belong to many clusters with different degrees of membership.



Partitional clustering essentially deals with the task of partitioning a set of entities into a number of homogeneous clusters, with respect to the fuzzy cluster structure relates to the data from which it is derived, from this different clusters and shapes can be identified. The data is generated from a cluster structure identified.

Image segmentation plays an important role in image analysis and computer vision. The goal of image segmentation is partitioning of an image into a set of disjoint regions with uniform and homogeneous attributes such as intensity, color, tone etc. The image segmentation approaches can be divided into four categories; thresholding, clustering, edge detection, and region extraction. In color images, the boundaries between objects are blurred and distorted due to the imaging acquisition process. Furthermore, object definitions are not always crisp and knowledge about the objects in a scene may be vague. Fuzzy set theory and Fuzzy logic are ideally suited to deal with such uncertainties. Fuzzy clustering models have proved a particularly promising solution to the color clustering problem. Such unsupervised models can be used with any number of features and clusters. The Fuzzy C means (FCM) algorithm, proposed by Bezdek (1981), is the first and most widely used algorithm in image segmentation because it has robust characteristics for ambiguity and can retain much more information than hard segmentation methods.

### **Clustering**

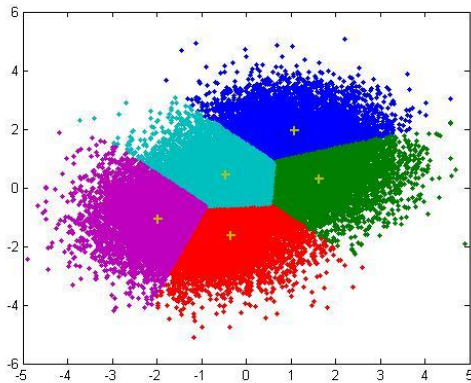
The notion of a **cluster** varies between algorithms and is one of the many decisions to take when choosing the appropriate algorithm for a particular problem. A **clustering** is essentially a set of such clusters, usually containing all objects in the data set. Additionally, it may specify the relationship of the clusters to each other, At first the terminology of a cluster seems obvious: a group of data objects. However, the clusters found by different algorithms vary significantly in their properties, and understanding these **cluster models** is key to

understanding the differences between the various algorithms. Typical cluster models include:

- **Connectivity models:** for example hierarchical clustering builds models based on distance connectivity.
- **Centroid models:** for example the k-means algorithm represents each cluster by a single mean vector.
- **Distribution models:** clusters are modeled using statistic distributions, such as multivariate normal distributions used by the Expectation-maximization algorithm.
- **Density models:** for example DBSCAN and OPTICS defines clusters as connected dense regions in the data space.
- **Subspace models:** in Biclustering (also known as Co-clustering or two-mode-clustering), clusters are modeled with both cluster members and relevant attributes.
- **Group models:** some algorithms (unfortunately) do not provide a refined model for their results and just provide the grouping information.

A hierarchy of clusters embedded in each other. Clusterings can be roughly distinguished in:

- **hard clustering:** each object belongs to a cluster or not
- **soft clustering (also: fuzzy clustering):** each object belongs to each cluster to a certain degree (e.g. a likelihood of belonging to the cluster)



**Fig:1 Efficient K-means Clustering**

### Fuzzy Clustering

Clustering is the process of dividing the data into homogenous regions based on the similarity of objects; information that is logically similar physically is stored together, in order to increase the efficiency in the database system and to minimize the number of disk access. The process of clustering is to assign the  $q$  feature vectors into  $K$  clusters, for each  $k$ th cluster  $C_k$  is its center. Fuzzy Clustering has been used in many fields like pattern recognition and Fuzzy identification. A variety of Fuzzy clustering methods have been proposed and most of them are based upon distance criteria. The most widely used algorithm is the Fuzzy C-Mean algorithm (FCM), it uses reciprocal distance to compute fuzzy weights. This algorithm has as input a predefined number of clusters, which is the  $k$  from its name. Means stands for an average location of all the members of particular cluster and the output is a partitioning of  $k$  cluster on a set of objects. The objective of the FCM cluster is to minimize the total weighted mean square error:

The FCM allows each feature vector to belong to multiple clusters with various fuzzy membership values. Then the final classification will be

according to the maximum weight of the feature vector over all clusters. The detailed

algorithm: Input: Vectors of objects, each object represent  $s$  dimensions, where  $v = \{v_1, v_2, \dots, v_n\}$  in our case it will be an image pixels, each pixel has three dimensions RGB,  $K =$  number of clusters.

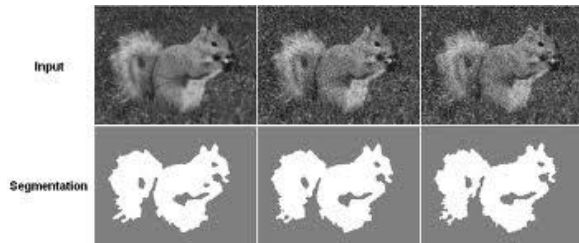
Output = a set of  $K$  clusters which minimize the sum of distance error.

Algorithm steps:

- (1) Initialize random weight for each pixel, it uses fuzzy weighting with positive weights  $\{W_{qk}\}$  between  $[0, 1]$ .
- (2) Standardize the initial weights for each  $q$ th feature vector over all  $K$  clusters via
- (3) Standardize the weights over  $k = 1, \dots, K$  for each  $q$  to obtain  $W_{qk}$

### SIMULATION RESULTS

We test our region-based segmentation model on several images, which further demonstrates the viability and possible advantage of our distribution metric for image segmentation. A common example that is often tested with energy models that discriminate on probability distributions is the zebra image. The goal here is to capture the entire zebra by separating the distributions so as to obtain a bimodal "Object" with a unimodal background. We note that several segmentation methods have been able to capture this image. However, for the sake of completeness, we show results in Figure 4. Stages of the segmentation are shown along with the corresponding plots of the probability distributions. Segmenting biological structures from medical images is often a challenging task. This is due to the inherent inhomogeneous distribution of a photometric variable as well as the low contrast and noise (as seen in the Kaposi Sarcoma). In the remaining examples, we segment both the corpus callosum and an MRI image of a heart.



**Fig: 2 Segmentation**

### CONCLUSION

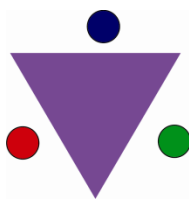
We introduce a new metric for image segmentation that quantifies the “distance” between two distributions as the standard deviation of the difference between logarithms of those densities. While several metrics and measures have been proposed for image segmentation, results often vary drastically. Specifically, although separating distributions using the Bhattacharyya distance as a measure has resulted in the successful segmentation on some challenging imagery, in other cases such as the Kaposi Sarcoma, the Bhattacharyya - based algorithm fails to capture the infected portion of the skin while the energy model proposed in this paper results in a successful segmentation. The differing segmentation results can be traced to how the respective metrics penalize perturbations on a manifold of distributions. Thus, a subject of future work is to investigate and clarify how differences in metrics affect segmentation.

### REFERENCES

1. X. Han, C. Xu and J. Prince, “A topology preserving level set method for geometric deformable models”, *IEEE Trans. Patt. Anal. Mach. Intell.*, vol. 25, pp. 755-768, 2003.
2. J. Gomes and O. Faugeras, “Reconciling distance functions and Level Sets”, *J. Visual*

*Communic. and Imag. Representation*, vol. 11, pp. 209-223, 2000.

3. R. Malladi, J. A. Sethian, and B. C. Vemuri, “Shape modeling with front propagation: a level set approach”, *IEEE Trans. Patt. Anal. Mach. Intell.*, vol. 17, pp. 158-175, 1995.
4. T. Georgiou, “Distances and riemannian metrics for spectral density functions,” *IEEE Trans. on Signal Processing* (8), pp. 3395–4003, 2007.
5. B. Vemuri and Y. Chen, “Joint image registration and segmentation”, *Geometric Level Set Methods in Imaging, Vision, and Graphics*, Springer, pp. 251-269, 2003.
6. Chen Zhang and Shixiong Xia, “ K-means Clustering Algorithm with Improved Initial center,” in *Second International Workshop on Knowledge Discovery and Data Mining (WKDD)*, pp. 790-792, 2009.
7. P. Bradley, U. Fayyad, Refining initial points for k-means clustering, *Proceedings 15th International Conf, on Machine Learning*, San Francisco, CA, 1998, pp. 91-99.
8. J. Pena, J. Lozano and P. Larranaga, An Empirical comparison of four initialization methods for the k-means algorithm, *Pattern Recognition Letters* Vol. 20, 1999.
9. S.L.Chiu, Fuzzy model identification based on cluster estimation, *Journal of Intelligent and Fuzzy Systems*.
10. Kiyotaka Mizutani and Sadaaki Miyamoto, Possibilistic Approach to Kernel- Based Fuzzy c-Means Clustering .



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## EVALUATION OF *IN-VIVO* ANTI-RHEUMATIC ACTIVITY OF *ANISOMELES MALABARICA* R.BR.

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### ABSTRACT

The present study was carried out to investigate the anti-rheumatic properties of methanolic extracts of the aerial parts of the plant *Anisomeles malabarica* R.Br., (Lamiaceae) using experimental animal models. The anti-rheumatic activity of the methanolic extracts was studied based on the effects on carrageenan-induced rat paw oedema. The preliminary phytochemicals were screened for the presence and absence of alkaloids, steroids, proteins, flavonoids, saponins, carbohydrates, tannins, fats and oils. The extracts in dose level 2000 mg/kg orally were used in anti-rheumatic studies. The methanolic extracts of leaves of *Anisomeles malabarica* R.Br., produced significant anti-rheumatic activity in a dose-dependent manner (200 mg/Kg and 400 mg/Kg body weight) to that of standard drug indomethacin (10 mg/Kg). The extract exhibited inhibitory effect in carrageenan induced hind paw oedema in rats with all the doses used when compared to the control group. The data obtained indicate that the crude extracts of the aerial parts of the plant *Anisomeles malabarica* R.Br., possess potential anti-rheumatic activity by supporting the folkloric usage of the plant to treat various inflammatory conditions.

**Keywords:** *Anisomeles malabarica* R.Br., Anti-rheumatic, Carrageenan, Rat paw oedema

### INTRODUCTION

Inflammation is a normal protective response to tissue injury that is caused by physical trauma, noxious chemicals or microbiological agents. Inflammation is the result of concerted participation of a large number of vasoactive, chemotactic and proliferative factors at different stages and there are many targets for anti-inflammatory action<sup>1</sup>.

Rheumatoid arthritis is a systemic autoimmune disorder characterized by polyarticular symmetrical arthritis. Various inflammatory mediators produce joint inflammation with pain function loss, joint destruction and permanent deformity after certain time if remained

untreated. This disease has a worldwide distribution but its pathogenesis is not clearly understood<sup>2</sup> although there are few anti-rheumatic drugs showing effectiveness in the treatment of rheumatoid arthritis, the side effect and toxicity call for new and more effective natural drugs<sup>3</sup>.

There are many herbs which have been enlisted to have the potential in the symptomatic treatment of rheumatoid arthritis, hence the present study has been carried out to evaluate the anti-rheumatic potential. The tools of biotechnology provides vast potential for the development of new inventions, particularly in the field of pharmaceuticals which are environmentally safe and do not require heavy

investments. In this context, the herbal medicines have been proved to have tremendous scope<sup>4</sup>.

*Anisomeles malabarica* R.Br. (Lamiaceae) is distributed in major parts of India and especially in South India as a traditional medicinal plant commonly known as Peymarutti (Tamil), Gouzaban (Hindi), Chodhara (Marathi), Karithumbi (Kannada) and Malabar catmint (English)<sup>5</sup>. The herb is reported to possess anti-spasmodic, anti-periodic properties and used in rheumatoid arthritis<sup>6</sup>. It is used for the traditional treatment of snakebite as antidote<sup>7</sup> and plant leaves are used as carminative, astringent, stomachic, rheumatism and diaphoretic in Coimbatore district<sup>8</sup> and also used as dentifrice to cure various problems<sup>9</sup>. Preliminary phytochemical tests were carried out by Brindha et al., (1977)<sup>10</sup> and used for the treatment of various infections.

## MATERIALS AND METHODS

### Chemicals

Extraction was carried out using methanol in soxhlet apparatus. Chemicals & reagents for the present analysis were purchased from Karnataka fine chemicals, Bangalore and E. Merck Ltd., Mumbai, India.

### Plant material

*Anisomeles malabarica* was collected from Mysore, Nanjangud and surrounding areas and also from medicinal garden of Indian Institute of Horticultural Research, Hesaraghatta, Bangalore where they were growing profusely. The plants have been identified and authenticated by experts from National Ayurveda Dietetics Research Institute, Bangalore (Ref. No. SMPU/NADRI/BNG/2010-11/550).

### Extraction of plant material

The plant materials were extracted with methanol using soxhlet extraction apparatus continuously for 16 hours<sup>11</sup>. For extraction, the dried plant material was used. Initially 400gms of material was packed in filter paper and loaded into the thimble of soxhlet apparatus. 2.5 liter of methanol

was poured into the flask (distilling pot) and the whole apparatus was set. The soxhlet extraction was performed for 12- 16 hours until the collected solvent in siphon tube appears to be clear. Later the extracted solvent was evaporated under reduced pressure to get solid/ semi solid extract. The extract was weighed, physical characters were noted. The percentage yield was calculated to be 10.62.

### Phytochemical screening

All the extracts were screened for the presence of various active plant metabolites like steroids, alkaloids, carbohydrates, flavanoids, glycosides and tannins according to standard phytochemical methods<sup>12</sup>. Briefly, Dragendorff reaction was used to confirm the presence of alkaloids, alkaline reagent test for tannins, frothing test for saponins, legal's test for glycosides, Xanthoproteic test for proteins and Shinoda test for flavanoids respectively.

#### 1. Acute toxicity study in rats with test drugs<sup>13, 14</sup>

Two groups, each of three female rats, were treated with the extracts of the aerial parts of the plant namely *Anisomeles malabarica* (abbreviated as AmA/Test drug) by Oral administration at a dosage of 2000 mg/kg body weight. The test drug was formulated in vehicle (distilled water) at a concentration of 2000 mg/mL and administered at the dose volume of 10 mL/kg. The animals were observed daily during the acclimatization period and mortality/viability and clinical signs were recorded. All animals were observed for clinical signs during first 30 minutes and at approximately 1, 2, 3 and 4 hours after administration on test day 0 and once daily during test days 1-14. Mortality/viability was recorded twice daily during days 1-14 (at least once on day of sacrifice). Body weights were recorded on test day 0 (prior to administration), test days 7 and 14 (Table 1). All animals were necropsied and examined macroscopically (Table 2).

## Treatment

The animals received a single dose of the test item by oral administration at 2000 mg/kg body weight after being fasted for approximately 18.0 hours but with free access to water. Food was provided again at approximately 3.0 hours after dosing. The administration volume was 10 mL/kg body weight. The animals were dosed using 18 G oral Stainless steel feeding tubes.

## Necroscopy

All animals were sacrificed at the end of the observation period by carbon dioxide in euthanasia chamber and discarded after the gross/macrosopic pathological changes were observed and recorded. No organs or tissues were retained.

## 2. Anti-inflammatory studies<sup>15</sup>

This model is based on the principle of release of various inflammatory mediators by carrageenan. Oedema formation due to carrageenan in the rat paw is biphasic event. The initial phase is attributed to the release of histamine and serotonin. The second phase of oedema is due to the release of prostaglandins, protease and lysosome. Subcutaneous injection of carrageenan into the rat paw produces inflammation resulting from plasma extravasations, increased tissue water and plasma protein exudation along with neutrophil extravasations, all due to the metabolism of arachidonic acid.

The pharmacological screening of the AmA was carried out using standard protocols. The crude extract was suspended in 1% carboxy methyl cellulose (CMC) for administration to albino rats. Albino rats of 150-200g were used for present investigation. They were kept in polypropylene cages in an air-conditioned area at 25 ± 2°C in 10-

14 h light dark cycle. They were provided with Amrut brand balanced feed and tap water ad libitum.

## 3. Carrageenan induced rat paw oedema<sup>16</sup>

Thirty rats were divided into five groups (n=6) starved overnight with water ad libitum prior to the day of experiment. The group I kept as control group, group II kept as carrageenan control, groups III and IV received test drug at different doses and group V kept as standard drug control, respectively. Left paw was marked with ink at the level of lateral malleolus; basal paw volume was measured plethysmographically by volume displacement method using Plethysmometer (UGO Basile 7140) by immersing the paw till the level of lateral malleolus.

In the experiment, animals from the control group were given vehicle control (CMC) and animals from standard drug were treated with Indomethacin as shown in Table 3. Other groups were treated with different doses of test drugs as shown in Table 3. After 30 min. of drug treatment the rats are challenged by a subcutaneous injection of 0.1ml of 1% solution of carrageenan into the sub-plantar side of the left hind paw. The paw volume is measured again at 1, 2, 3, 4 & 5 hours after challenge. The increase in paw volume is calculated as percentage compared with the basal volume. The difference of average values between treated animals and control group is calculated for each time interval and evaluated statistically. The percent Inhibition is calculated using the formula as follows.

$$\% \text{ oedema inhibition} = [1 - (V_t / V_c)] \times 100$$

V<sub>t</sub> and V<sub>c</sub> are oedema volume in the drug treated and control groups respectively.

**Table1: Body weight analysis of test drug treated rats in acute toxicity studies**

Sl. No	Test drug	Group	Dose (mg/kg body weight)	Animal Numbers	Sex	Test day 0 (treatment) (g)	Test day 7 (g)	Test day 14 (g)
1	AmA	I	2000	002001	Female	220.23	241.22	252.38
				002002	Female	221.24	241.89	252.13
				002003	Female	202.28	240.92	251.68
		II	2000	002004	Female	222.41	243.11	263.61
				002005	Female	223.12	243.68	253.84
				002006	Female	222.51	243.00	253.38

Key: mg/kg = miligram/kilogram, g = gram, AmA=*Anisomeles malabarica* Aerial parts

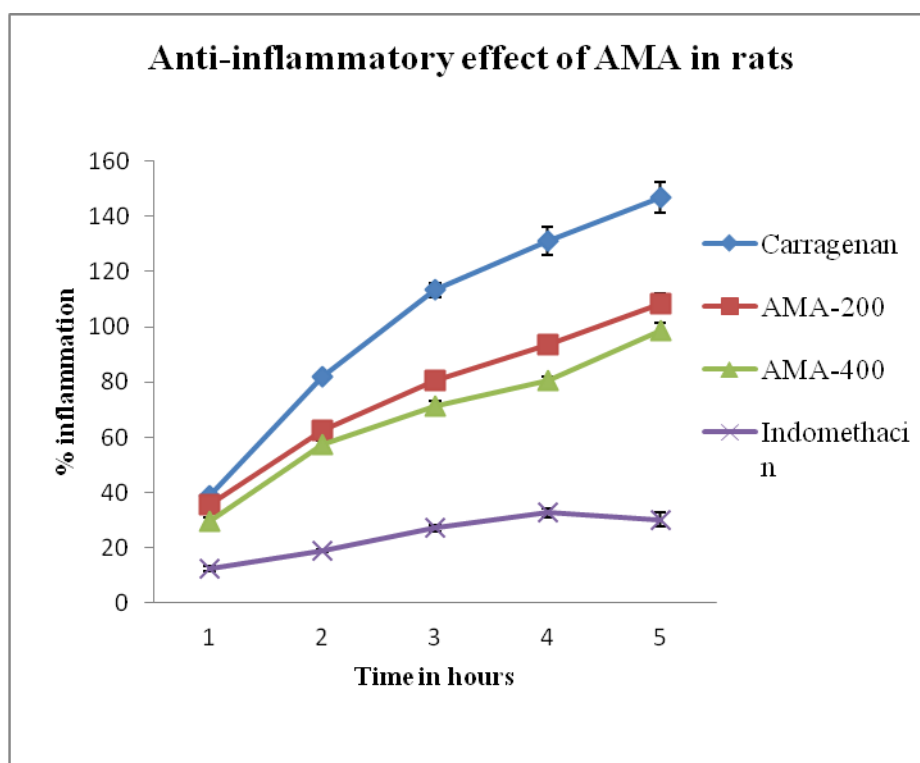
**Table 2: Macroscopic findings of animals from test drug treated groups in acute toxicity study.**

Sl. No	Test drug	Group	Dose (mg/kg bw)	Animal Numbers	Sex	Mode of death	Macroscopic findings
1	AmA	I	2000	002001	Female	Terminal Sacrifice	No abnormalities Detected
				002002	Female	Terminal Sacrifice	No abnormalities Detected
				002003	Female	Terminal Sacrifice	No abnormalities Detected
		II	2000	002004	Female	Terminal Sacrifice	No abnormalities Detected
				002005	Female	Terminal Sacrifice	No abnormalities Detected
				002006	Female	Terminal Sacrifice	No abnormalities Detected

Key: mg/kg bw = miligram/kilogram body weight, AmA=*Anisomeles malabarica* Aerial parts

**Table 3. Anti-inflammatory activity of test drugs on carrageenan induced rat paw oedema.**

Groups	Drug Doses	Percentage of inflammation at time (h)				
		1	2	3	4	5
II	Carrageenan Control	38.83±1.03	81.83±1.16	113.3±2.39	131.00± 4.98	146.72 ± 5.46
III	AmA 200 mg/kg	35.83±1.97	62.57 ± 1.74	80.63±3.33	93.37 ± 2.84	108.56 ± 3.46
IV	AmA 400 mg/kg	29.52±1.63	57.22 ± 1.62	71.35±1.91	80.55 ± 1.42	98.64 ± 2.68
V	Indomethacin 10 mg/kg	12.55 ± 0.86 0.86	19.1 ± 0.48 0.48	27.17 ± 1.07	32.65 ± 1.52	30.15 ± 2.50



**Figure 1. Anti-inflammatory activity of test drugs on carrageenan induced rat paw oedema**

## RESULTS

### 1. Acute toxicity study

All animals survived until the end of the experimental period. All the animals were dosed at 2000 mg/kg body weight did not show evident toxicity throughout the experimental period. The animals which were survived throughout the experiment increased their body weight by day 14 as compared to day 0. No abnormalities were detected in animals at necropsy. Based on the results, the median lethal doses (LD<sub>50</sub>) of AmA was greater than 2000mg/kg body weight and is classified as category 4.

### 2. Anti-inflammatory activity

In the control group, carrageenan induced significant inflammation over the normal untreated animals. AmA inhibited the inflammation significantly at the doses, 200 and 400 mg/kg at time 2, 3, 4 and 5 h. AmA dosed at 400mg/kg exhibited potent anti-inflammatory activity in dose dependant manner. Standard drug, indomethacin at 10 mg/kg inhibited the inflammation significantly at all time intervals (Figure 1). From these above findings it is evident that the aerial parts of the plant namely *Anisomeles malabarica* R.Br. possesses potent anti-rheumatic properties and it is further envisaged to carry out the purification of the bio-active compounds using column chromatography and elucidate the structure of the purified compounds using specialized spectral techniques like IR, MASS, C<sup>13</sup> NMR & <sup>1</sup>H NMR .

## DISCUSSION

The carrageenan-induced paw oedema model in rats is known to be sensitive to cyclooxygenase inhibitors and has been used to evaluate the effect of non-steroidal antiinflammatory agents, which primarily inhibit the cyclooxygenase involved in prostaglandin synthesis<sup>17</sup>. Carrageenan-induced hind paw oedema is the standard experimental model of acute-inflammation. The time course of oedema development in carrageenan-induced paw

oedema model in rats is generally represented by a biphasic curve<sup>18</sup>. The first phase of inflammation occurs within an hour of carrageenan injection and is partly attributed to trauma of injection and also to histamine, and serotonin components<sup>19</sup>. The second phase is associated with the production of bradykinin, protease, prostaglandin, and lysosome<sup>19</sup>. Prostaglandins (PGs) play a major role in the development of the second phase of inflammatory reaction which is measured at +3 h<sup>20</sup>.

The dose 400 mg/kg of methanolic extract of *Anisomeles malabarica* R.Br. produced a significant inhibition of carrageenan induced paw oedema at +2, +3, +4, +5 and +6h. Therefore, it can be inferred that the inhibitory effect of methanolic extract of *Anisomeles malabarica* R.Br. on carrageenan induced inflammation could be due to inhibition of the enzyme cyclooxygenase and subsequent inhibition of prostaglandin synthesis. Significant inhibition of paw oedema in the early hours of study by *Anisomeles malabarica* R.Br. could be attributed to the inhibition of histamine<sup>21</sup> and/or serotonin. The decrease in paw oedema inhibition at +6h may be attributed to the termination of test drug action.

## CONCLUSION

It is evident from the above findings that the aerial parts of the plant namely *Anisomeles malabarica* R.Br. possess bio-active principles which are responsible in reducing the inflammation in carrageenan induced paw oedema in rats in dosed dependent manner. These findings also support the folkloric usage of the plant in treating rheumatoid arthritis and it becomes imperative to purify these bio-active principles using various purification methods like column chromatography and also repeat the same set of in-vivo studies in experimental models and also elucidate the structure of the purified compound and if found potent, chemically synthesize the compound.

On the basis of these findings, it may be inferred that methanolic extract of *Anisomeles malabarica* R.Br. has anti-inflammatory activities. These activities were related to the dose and these results corroborate the potential traditional use of the plant in folk medicine. At present, there are no reports on investigation to identify the active components present in methanolic extract of *Anisomeles malabarica* R.Br.. Further investigations are anticipated to identify the active components and lead to their further clinical use.

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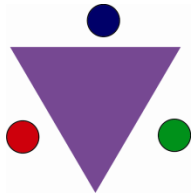
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#### REFERENCES

1. Tripathi KD. Essentials of medical pharmacology. Jaypee brothers medical publishers (p) ltd. Vth Ed. New Delhi; 2004. p. 167-181, 257-259
2. Harris EDJR (1990). Rheumatoid arthritis: pathophysiology and implications for therapy. N.Engl. J. Med. 322: 1277-1289.
3. Scott DL, Shipley M, Dawson A, Edwards S, Symmons DP, Woolf AD (1998). The clinical management of rheumatoid arthritis and osteoarthritis: strategies for improving

- clinical effectiveness. Br. J. Rheumatol. 37: 546-554.
4. CSIR. 1997. MEDICINAL PLANTS. Their bioactivity, screening and evaluation. Proceedings of the international workshop, held at Lucknow (India), organized by Center for Science and Technology of the non-aligned and other developing countries with the support of UNIDO and CSIR.
5. Kritkar KR and Basu BD. Indian Medicinal plants. 2<sup>nd</sup> Edition, International Book distributor, Dehradun, India. 1935. pp 2011-2012.
6. Nadkarni KM. Indian materia medica. 3rd Edition, Popular Prakashan Pvt Ltd, Mumbai. 1996. pp 114-115.
7. Perumalsamy R, Maung Thwin M, Gopalakrishnakone P and Ignacimuthu S, Ethno-botanical survey of folk plants for the treatment of snakebites in southern part of Tamilnadu, India. Journal of Ethnopharmacology. 115 (2): 2008. 302-312.
8. Kalyani K, Lakshmanan KK and Viswanathan MB, Medico-botanical Survey of plants in Marudhamalai Hills of Coimbatore district, Tamilnadu. Journal of the Swamy Botanical Club. 6 (3 & 4): 1989. 89-96.
9. Ganesan S. Traditional oral care medicinal plants survey of Tamilnadu. Natural Product Radiance. 7 (2) : 2008. 166-172.
10. Brindha P, Rukmani B and Purushothaman KK. Pharmacognostic studies on *Anisomeles malabarica* R. Br. Bulletin of Medico-ethno-Botanical Research. 4: 1977. 74-84.
11. Mukherjee PK. Quality Control of Herbal Drugs, Business Horizons Pharmaceutical Publishers, New Delhi, 2010, pp. 184-191.
12. Kokate CK, Khandelwal KR, Pawar AP and Gohale SB. Practical Pharmacognosy, Nirali Prakashan, Pune, India. c1995. pp 137-139.

13. Turner RA. Screening methods in pharmacology, Academic Press, London, 61, 1965.
14. Kulkarni SK. Handbook of Experimental Pharmacology, 2nd edition, 78-81, 1993
15. Ravi V, Saleem TSM, Patel SS, Raamamurthy J, Gauthaman K, Anti-Inflammatory Effect of Methanolic Extract of *Solanum nigrum* Linn Berries. International Journal of Applied Research in Natural Products, 2(2), pp. 33-36, 2009.
16. Winter CA., Risley EA and Nuss GW. Carrageenan induced oedema in hind paw of the rats as an assay for anti-inflammatory drugs. Proceedings of the Society for Experimental Biology and Medicine. 11: 1962. 544-547.
17. Seibert K, Zhang Y, Leahy K and et al. Pharmacological and biochemical demonstration of the role of cyclooxygenase 2 in inflammation and pain. Proc Natl Acad Sci 1994; 91: 12013–12017.
18. Vinegar R, Schreiber W, Hugo R. Biphasic development of carrageenan edema in rats. J Pharmacol Exp Ther 1969; 166: 96–103.
19. Crunkhorn P, Meacock SC. Mediators of the inflammation induced in the rat paw by carrageenan. Br J Pharmacol 1971; 42: 392–402.
20. Di Rosa M, Willoughby DA, Screens for anti-inflammatory drugs. J Pharm Pharmacol 1971; 23: 297–298.
21. Hirasawa N, Watanabe M, Mue S, Tsurufuji S, Ohuchi K. Downward regulation of neutrophil infiltration by endogenous histamine without affecting vascular permeability responses in air pouch type carrageenan inflammation in rats. J Inflammation 1991; 15: 117– 126.



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## DSP BASED START –UP TECHNIQUE FOR BRUSHLESS DC MOTOR

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### ABSTRACT

Three phase BLDC motor used in automotive application have good efficiency and good controllability over wide range of speed and to align the rotor position of BLDC motor by suitable starting method. Based on electromotive force the position is sensed by without current sensor. Stator current and time period alignment of rotor position is adjusted by pulse width of switching device. The additional current sensor and any information of motor parameter not necessary at start up operation. The fundamental principle of technique is to determine the initial position of permanent magnet by the time period of discharge of stator winding, which are excited before discharge. For this purpose, an approach a new flux linkage function is defined, that is speed independent. Experiment are implemented on a single chip DSP controller to demonstrate the suggested starting up technique. A starting procedure of the motor is also discussed to detect the rotor position at a standstill. The position sensorless drive is proposed in this paper based on the detection of back emf technique especially at a lower speed. Moreover the complex phase shift circuit eliminated. Due to low cost, the proposed control algorithm is particularly suitable for cost sensitive products. The output of the proposed system is verified by matlab simulink.

**Keywords-** bldc- brushless direct current motor, emf –electromagnetic force, dsp-digital signal processor, ASD- adjustable speed drive.

### INTRODUCTION

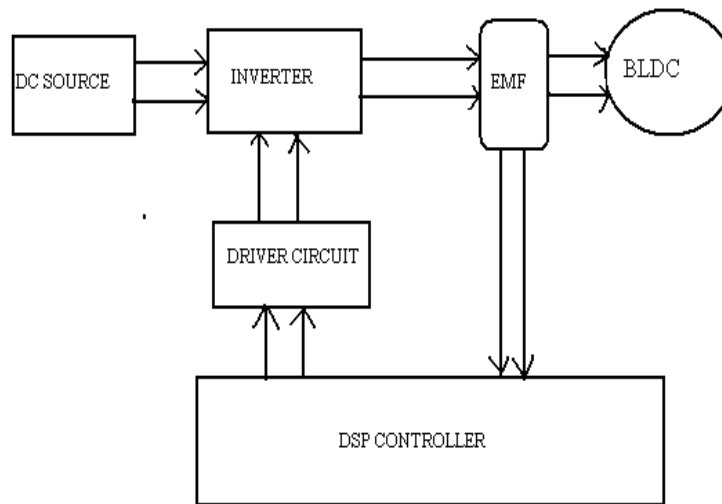
Brushless dc motor have been put into practical use because of high efficiency and good controllability. A brushless dc motor require an inverter and a position sensor to perform ‘commutation’ because a permanent magnet synchronous motor takes the place of dc motor with brushes and commutator. Unfortunately, there are several practical implementation problems when using the phase to neutral zero crossing detection method. Firstly, the neutral

voltage is required for comparison with the non-conducted back EMF or the average terminal voltage, in which it will introduce high common-mode noise. The other problem is the requirement of the phase shift (delay time) circuit. Since the zero crossing points of the conventional back EMF method are inherently leading 30 electric degrees of the ideal commutation points, a precise velocity estimator and a phase shift circuit (algorithm) are needed to process the zero crossing signals so that accurate commutation points can be determined.

The additional open loop starting process and a complex phase shift circuit accompanied with a precise velocity estimator make the sensorless commutation much more complex than the Hall effect sensor based commutation. As a result, it is not surprising that the cost of the commercial sensorless commutation ICs is usually several times higher than that of the Hall effect sensor based commutation ICs. In order to cope with the aforementioned problems, a new cost effective sensorless commutation method is proposed.

Instead of detecting the motor terminal to neutral voltage, the estimated commutation signals are extracted directly from the specific average

line to line voltage of a BLDCM using simple single-stage low pass filters and low cost comparators. The output signals of the new detection circuit can be directly applied to the conventional commutation table, as if they were obtained from the real Hall effect sensors. That is, the estimated commutation signals are well in phase with the ideal commutation points. Unlike conventional solutions, the proposed method does not require additional virtual motor neutral voltage, complex phase shift circuits, or precise speed estimators. Therefore, in terms of cost and reliability, the proposed approach has obvious advantages over conventional solutions.



**Fig 1: Block Diagram with DSP Controller**

Instead of detecting the motor terminal to neutral voltage, the estimated commutation signals are extracted directly from the specific average line to line voltage of a BLDCM using simple single-stage low pass filters and low cost comparators. The output signals of the new detection circuit can be directly applied to the conventional commutation table, as if they were obtained from

the real Hall effect sensors. That is, the estimated commutation signals are well in phase with the ideal commutation points.

Unlike conventional solutions, the proposed method does not require additional virtual motor neutral voltage, complex phase shift circuits, or precise speed estimators. Therefore, in terms of

cost and reliability, the proposed approach has obvious advantages over conventional solutions. Several experiments have been conducted to demonstrate the feasibility of the proposed approach. The output signals of the new detection circuit can be directly applied to the conventional commutation table. The results indicate that the proposed method exhibits satisfactory

performance over a wide speed range under varying load conditions and different back EMF waveforms.

These characteristics suggest that the proposed method is very suitable for cost sensitive applications such as home appliances, computer peripherals, automotive components, etc.

### THREE PHASE INVERTER WITH BLDC MOTOR

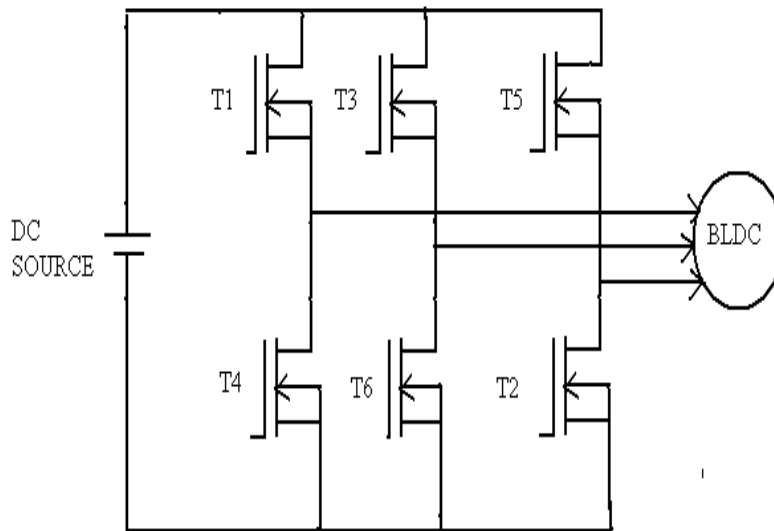


Fig 2: 3 Phase Inverter with BLDC Motor

### MOTOR PARAMETERS

TYPE	Y CONNECTED FOUR POLE
RATED VOLTAGE	12V
STATOR RESISTANCE	0.115(OHM)
STATOR INDUCTANCE	0.195(mH)
BACK EMF CONSTANT	0.01238303(V/rad)
TORQUE CONSTANT	0.0127726(Nm/A)
ROTOR MOMENT OF INERTIA	1.9959e-006(Kg^2)

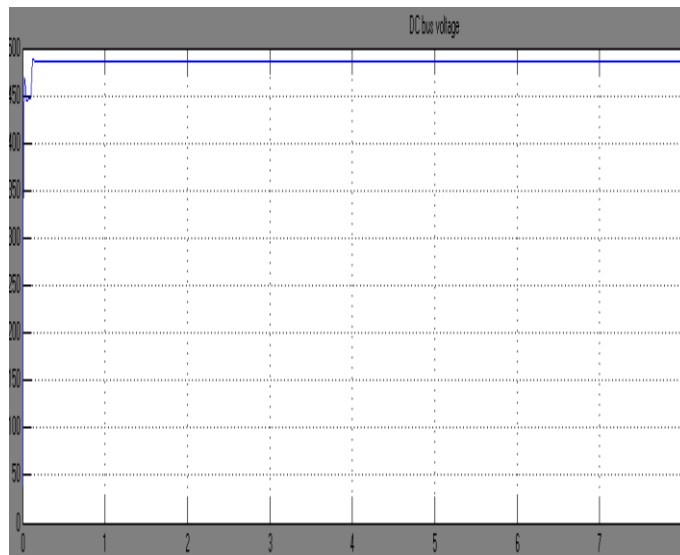
## SIMULATION WAVE FORM

### Line to Line Voltage

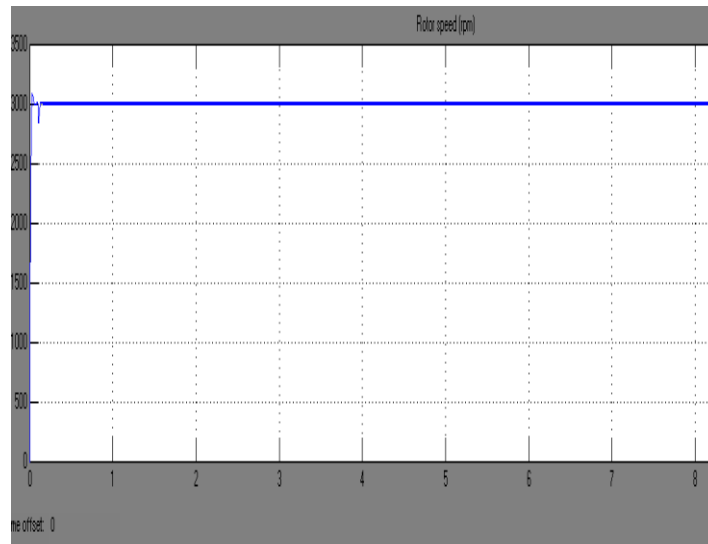
Simulation has become a very powerful tool on the industry application as well as in academics, nowadays. It is now essential for an electrical engineer to understand the concept of simulation and learn its use in various applications. Simulation is one of the best ways to study the system or circuit behavior without damaging it. The tools for doing the simulation in various fields are available in the market for engineering professionals. Many industries are spending a considerable amount of time and money in doing

simulation before manufacturing their product. In most of the research and development (R&D) work, the simulation plays a very important role. Without simulation it is quiet impossible to proceed further. It should be noted that in power electronics, computer simulation and a proof of concept hardware prototype in the laboratory are complimentary to each other. However computer simulation must not be considered as a substitute for hardware prototype. The objective of this chapter is to describe simulation of impedance source inverter with R, R-L and RLE loads using MATLAB tool.

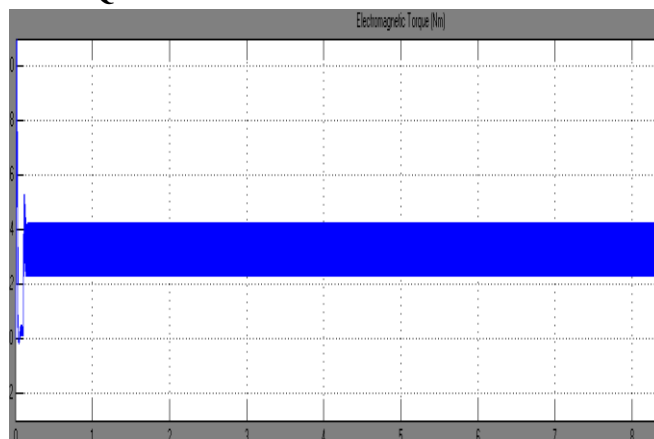
### DC BUS VOLTAGE



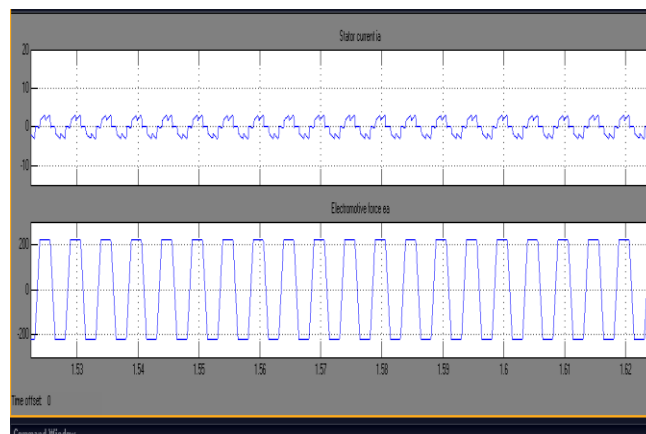
## ROTOR SPEED



## ELECTROMAGNETIC TORQUE



## STATOR CURRENT AND BACK EMF

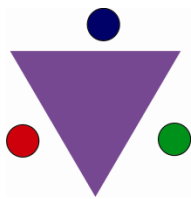


## CONCLUSION

This method proposed start-up technique without the additional current sensor to align the rotor position of BLDC motor and accelerate the motor from stand still upto a desired speed where the position sensorless control algorithm based on the back emf could work properly. Both stator current and time period for aligning the rotor position can be easily controlled by modulating the pulse width of specific switching device. The neutral voltage is not required in the proposed method , only three motor terminal voltage need to be detected. The experimental results have revealed that the phase relationship is sensitive to operating speed and load condition. The amplitude of line to line voltage is significantly larger than the phase voltage , even a small back emf effectively detected. The proposed method can be used for BLDC motor with non ideally trapezoidal waveform. Since most BLDC motor do not have ideal back emf waveform. Speed estimation algorithm and complex phase shift are not required. Consequently the proposed method is particularly suitable for cost sensitive application such as home appliances and related computer peripherals.

## REFERENCES

1. N.Matsui, "sensorless PM brushless dc motor drives" IEEE Tran.
2. S. Ogaswara and H. Akai , "an approach to position sensorless drive for brushless DC motor" , IEEE trans .
3. G.H Jang, J.H park and J.H. Chang. "position detection and start up algorithm of a rotor in a sensorless "BLDC motor utilizing inductance variation .
4. Y.S Lai, R.F.S. Shyu and S.S.Tseng, "new initial position detection technique for three phase brushless dc motor without position and current sensors" ,IEEE trans.
5. W.J Lee, and S. K. sul "a new starting method of BLDC motors without position sensor", IEEE trans .
6. T.H. Kim and M.Ehsani, "senseless control the BLDC motors from near zero to high speeds", IEEE trans.
7. Cheng Hu and Ming Yong Cheng, 'a new sensorless control scheme for brushless dc motor without phase shift circuit", IEEE Trans.
8. M.Tursini, "initial rotor position estimation method for PM motor", IEEE Trans.



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## COMPARATIVE ANALYSIS OF TWO VARIETIES OF *CYPERUS ESCULENTUS* TUBERS

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### ABSTRACT

This study reports on the comparative analysis of two (large and small) varieties of *Cyperus esculentus* tubers and the utilization of the By-product. Proximate analysis of the tubers using standard methods showed that the large variety contains: 54.74% carbohydrate, 30% fat, 7.01% protein, 6.30% fiber and 1.95% ash while the small variety contains : 41.76% carbohydrate, 40% fat, 9.19% protein, 6.80% fiber and 2.25% ash. The mineral elements, Ca, Mg, K, Na, Fe, Zn and Cu were determined by atomic absorption spectrophotometric method. Phosphorus was assayed colourimetrically as the phosphomolybdovanate complex at 450nm. The reducing sugar as D-glucose was also determined colorimetrically at 540nm and it was found to be 362.50 and 372.50 mg/ml for the large and small varieties respectively. Starch and oil were extracted from the tubers and physicochemical properties assessed. The amylase content of the starches were 22.60 and 28.27% for the large and small varieties respectively. The small variety is richer in mg, K, Zn and phosphorus while the large variety is richer in Fe, Na and Ca. Commercial lecithin obtained as a by-product of starch extraction was utilized as an emulsifier in the body cream.

**Keywords:** *Cyperus esculentus*, proximate analysis, colourimetry

### INTRODUCTION

*Cyperus esculentus* is sedge of the family Cyperaceae, order Cyperales or Graminales, and gene, Carex produces rhizomes from the base and bears two varieties of subterraneous spheroid tubers: large and small (with sitting diameters ranging up to 9-17mm and 4-10mm respectively), whose yellow kernels are surrounded by a brown fibrous sheath (Umerie et al. 1997). It is popularly known as “chufa sedge”, “yellow nut sedge”, tiger nut” and “earth almond”.(Ade-Omowaye, et al, 2008). The tubers are edible and rich in stored carbohydrates and fats and are available in different parts of the world such as Senegal,

Ghana (Lowe and Stanfield, 1974; Gronquist, 1977; Swift, 1989) and Northern part of Nigeria (Anon 1992). In Spain, it is extensively used for human consumption (Mason, 2008). The plant itself is merely a weed and the sweet tasting tubers serve only as casual masticator and no other industrial uses (Umerie and Enebeli, 1996). In complementary and traditional systems of Asian medicine, the tubers (seeds) are used as an aphrodisiac and as stimulant (Evans, 2002).

The large variety is light brown in colour while the small variety which has a darker brown colour tastes sweeter. The oil is a stable, non-drying oil and requires only degumming for purification. It is

also known to share the common features of remaining liquid at room temperature with coconut oil (Berger, 1994) the oil has a low solidification point (titre of oil) and will require no mintering to remain uniformly liquid at refrigeration temperatures, hence good for salad and cooking oils (Black, 1991, Umerie et al, 1997).

*C. esculentus* qualifies to be considered as an economically important crop and no more a mere weed since it can serve as a cheap source of raw material for the food and oleochemical and allied industries. There is still a dearth of studies on the full economic potentials of *C. esculentus* tubers, and even on the varieties to ascertain the advantages of one over the other. Therefore, the work investigates the variations of properties between the two varieties of *C. esculentus* tubers.

## **EXPERIMENTAL**

### **Materials**

Samples of *Cyperus esculentus* tubers from the local market in Awka, Anambra State, Nigeria. All other chemicals were of analytical grade.

## **METHODS**

### **Preparation of Samples**

Dried samples of the tubers were purchased from the local market in Awka, Anambra State Nigeria. The samples were sorted to eliminate the bad ones, milled to fine state using a Moulinex Type 276 mill and stored in a well-stopper container in a refrigerator prior to subsequent analyses.

### **Proximate analysis and Determination of mineral contents of Tubers**

The standard procedures described by the Egan et al (1981) and AOAC methods (1975) were used for the determination of moisture, ash, fiber, fat and crude protein contents. The carbohydrate content was calculated by difference. The gross energy value of tigernut was calculated using the Atwater formula: gross energy value ( kcal/100g) = (4×%carbohydrate)+ (9×%fat/oil) + (4×%crude protein). The minerals, Ca, Mg, K, Na, Fe, Zn and

Cu were determined by the atomic absorption spectrophotometric methods. Phosphorous was determined by vanado-molybdate colourimetric method as phosphomolybdate complex at 450nm. Reducing sugar as D-glucose was equally assayed at 540nm using a colourimeter (Bohz 1958).

### **Extraction of Oil**

The tubers were kilned at 50°C for 24 hours after which they were milled. The granulated sample was weighed out into an extraction thimble and extracted with petroleum ether (60-80) in a soxhlet apparatus. After the extraction, the solvent was distilled off at 80°C and the oil content calculated from the weight of oil and weight of the milled tuber sample from which the oil was extracted

### **Physic-chemical properties of oil**

The acid, saponification and iodine values of the oil were determined by standard procedure described by Plummer (1987), AOCS (1960) and Glasser (2008). The free fatty acid (FFA) was calculated from the relationship given by Norris (1965): 1 unit of Acid value = 0.503% × FFA (calculated as oleic acid). The ester value was obtained by subtracting the acid value from the saponification value (Baltes, 1964).

### **Extraction of *C. esculentus* starch**

The starch was extracted using wet milling method. 200g of *C. esculentus* tubers was weighed and steeped in a solution of potassium metabisulphite(1.22g/l of Na<sub>2</sub>S<sub>2</sub>O<sub>5</sub>) which served as a preservative to prevent fermentation, and left over night after which the water was decanted and the tubers washed with clean water. The tubers were milled to slurry and then separated using tiny-pored sieve cloth after which the chaff was discarded and the liquor allowed standing overnight in order to settle. The floating lipid emulsion containing oil and phospholipid was carefully skimmed off into a separating funnel.

Water was then decanted and the starch deposit washed severally with water and passed through a 260-mesh sieve (fine sieving) and the suspension allowed to settle for 8h. The water was decanted

leaving behind pure starch cake, which was the sun-dried for about 24hrs and finally oven-dried at 50°C for 3h and stored.

#### **Extraction of commercial lecithin**

The floating lipid emulsion containing oil and phospholipid obtained as a by-product of starch extraction was carefully skimmed off into a separating funnel where the oil fraction was removed from the phospholipid using petroleum ether (60-80°C boiling range). The extraction was repeated until the solvent gave a clear solution. The phospholipid (commercial lecithin) was then transferred to a beaker, washed and dried using acetone.

#### **Analysis of starch**

Granule size was measured in iodine-stained suspensions of the starch granules at 10× and 100× magnification under an optical microscope and using a Neubauer counting chamber. The method of Chrastil (1987) was employed for the determination of the amylase content.

#### **Cream Formulation**

A body cream was formulated using commercial lecithin as an emulsifier and the result compared favourably with that of the standard in which a combination of lanolin and triethanolamine was used as the emulsifying agent.

### **RESULTS AND DISCUSSION**

The result of comparative analysis of the varieties of *C. esculentus* tubers and utilization of the by-product (commercial lecithin) in the body cream formulation.

#### **Levels of nutrients in large and small varieties of *C. esculentus* tubers**

The low moisture levels of the two varieties of *C. esculentus* tubers (Table 1) remain an asset in storage and preservation of the nutrients. The tubers contain reasonable amounts of carbohydrate. They were also found to very rich in sugar reserves. This means that the tubers can conveniently serve as carbohydrate sources in brewing. Their low protein content qualifies them

for use as brewing adjuncts (Umerie et al.1997). The fiber content which is a measure of cellulose and lignin content of food is high in both sources of dietary fiber whose high consumption reduces the incidence of large intestine, e.g. diverticulosis and neoplasm. The quality of food and its content of mineral elements like K, Na, Ca, P, Fe, in the varieties of *C. esculentus* tubers were found to be moderate. However the small variety is richer in mg, K, Zn and phosphorus, while the large variety is richer in Fe, Na, Ca and Cu

#### **Characteristics of Oils of varieties of *C. esculentus***

From the result of oil analysis, (Table 2) it is obvious that the yield of oil from both species were quite high and comparable with the recorded values from some oil seeds e.g. soyabeans, cotton seed, rubber seed etc (Nerris, 1965) that are extracted industrially. This implies that extraction of the oil from the tubers especially the small variety is a viable worthwhile venture. The oils from the varieties can be classed as stable, non – drying oil as implicated by low iodine value (< 100) and low saturation. The saponification values of the oils are very high as can be seen in the Table 2 and so can be used in the formulation of soap, shampoo, polish, resin etc. the low acid values are indicative of the absence of oxidative rancidity, which prove that the oils have high shelf life.

#### **Analysis of Starch from varieties of *C. esculentus***

Table 3 shows that the starch obtained from varieties of *C. esculentus* tubers are white in colour. The starch yield percentage of the large specie is more than that of the small specie; though both are quite high and thus profitable. From the result of the granule size determination, it is very clear that the starches are of premium quality. The high amylase contents of the starches show that they can easily complex and form strong gel.

### Body cream formulation

The body cream formulated using commercial lecithin obtained from the tubers as an emulsifier in Table 4, was found to compare quite favourably with 'oil of ulay' cream in which a combination of lanolin and triethanolamine was used as the emulsifying agent in terms of consistency and pH value (Echeta 1997).

### CONCLUSION

Finally, having established the fact that commercial lecithin from these tubers can give a good quality cream, cosmetologists are therefore enjoined to make use of it in body cream formulations. It was also confirmed that the small variety of *C. esculentus* are richer in oil content while the large variety are richer in starch content. However, both varieties can serve as a cheap source of raw materials for the food, oleochemical and allied industries.

### REFERENCES

1. Ade-Omowaye, B.I.O., Akinwande, B.A., Bolarinwa, I.F and Adebisi, A.O. 2008. Evaluation of tigernut (*Cyperus esculentus*) - wheat composite flour and bread. African journal of food science. Vol (2), 087-091.
2. A.O.C.S. Official method. 1960. Sampling and Analysis of commercial fats and oils. 801-855.
3. Anon. 1992. Cyperales in the Encyclopedia Britanica, Micropedia, 15<sup>th</sup> Ed. Encyclopedia Inc. Chicago. 3, 185.
4. AOAC.1975. Association of Official Analytical Chemists. Official methods of Analyst. 13<sup>th</sup> Ed. Washington D.C.
5. AOAC.1980. Association of Official Analytical Chemists. Official methods of Analyst. 13<sup>th</sup> Ed. Washington D.C.
6. Baltes, J. 1964. Classical methods in fat analysis. In: Analysis and characterization of oils, fats and fat products, ed. H.A. Boekenoogen, interscience publishers, London, 1-58.
7. Berger, K. 1994. Oils from under-utilized palm and forest products, In: technological advances in improve and alternative sources of lipids, ed., B.S. Kamel and Y.Kakuda, 1<sup>st</sup> edn. Blackie Academic and professional, Glasgow, 172-173.
8. Black, H.C. 1991. Fats and oils. In Collier Encyclopedia, ed., B. Johnson, vol 9, Macmillan Educational and Educational company, New York, 610-613.
9. Bohz D.F.1958. Colourimetric determination of non metal. Willey Van Nostrand Scientific Encyclopedia Inc. New York.5<sup>th</sup> Ed 616.
10. Chrastil, J., 1987. Improved colorimetric determination of amylase in starches or flours. Carbohydrate Res. 159: 154-158
11. Cronquist, A. 1977. Cyperales. In : McGraw-Hill Encyclopedia of science and technology, 4<sup>th</sup>edn, vol 3. McGraw-Hill, New York, 698.
12. Davidson S., Passmore R., Brock J.F and Truswell A.S. 1975. Energy content of food in Human Nutrition and dietetics. 6<sup>th</sup> Ed. Churchill living stone, Edinburgh. 17-20, 47.
13. Dutta, A.C. 1995. General description and Economic Plants In: Botany for degree students, 6<sup>th</sup> Ed. Oxford University Press 1995. 627, 225.
14. Echeta, C.I. 1997. Analysis and reconstitution of 'oil of Ulay'. A B.Sc thesis. Nnamdi Azikiwe University Awka nigerai. 23.
15. Egan, H., Kirk, R.S. and Sawyer, R., 1981. General chemical analysis of food. In: Pearson's chemical analysis of food, 8<sup>th</sup>edn, Churchill Livingstone, New York, 8-26.
16. Glasser, A.C., 2008. Analysis of fixed oils, fats and waxes. In : Pharmaceutical chemistry, theory and applications, vol1, Lieslie G. chatten (ed), CBS publishers and distributors. New Delhi, India, 405-437.

17. Lowe, J. and Stanfield D.P. 1974. The flora of Nigeria Sedge (Family; Cyperaceae). Ibadan University Press, Ibadan.40-41.
18. Norris, F.A., 1964. Fats and fatty acids. In : Kirk-Othmer Encyclopedia of chemical technology 2<sup>nd</sup>edn., vol 8, John Miley, New York, 770-881.
19. Parmerter S.M. 1969. Starches in Kirk-Othmer Encyclopedia of Chemical Technology, John Wiley and Sons Inc, New York.2<sup>nd</sup> Ed. 18, 672.
20. Plummer, D.T., 1987. Quantitative and analysis of lipids. In : An introduction to practical Biochemistry, 3<sup>rd</sup>edn., McGraw-Hill Book Company (UK) Ltd., England, 195-197.
21. Swift, H.W., 1989. Sedge. In : The Encyclopedia Americana, International edn., vol 24, Grolier Incorporated, Danbury, Connecticut, 513.
22. Umerie S.C, Okafor E.O and Uka A.S. 1997. Evaluation of the tubers and oil of *Cyperus esculentus*. Bioresource technology 61, 171-173.

**Table 1 Level of nutrients in large and small varieties of *C. esculentus* tubers**

Proximate composition (%)	Large		Small	
Moisture	0.68		2.68	
Ash	1.95		2.25	
Crude protein	7.01		9.19	
Crude fat	30.0		40.0	
Crude fiber	6.30		6.80	
Carbohydrate	54.74		41.76	
Reducing sugar as D-glucose (mg/ml)	362.50		372.50	
Gross energy (kcal/100g)	517.00		563.80	
Minerals	(mg/l)	(mg/100g)	(mg/l)	mg/100g
Cu	0.33	0.99	0.28	0.84
Mg	18.39	55.17	24.61	73.83
Mg	1.34	4.02	1.50	4.50
Ca	12.51	37.53	8.67	26.01
Na	5.77	17.31	4.96	14.88
Fe	86.85	260.55	117.52	352.56
K	6.11	18.33	9.09	27.27
Zn	1300	778.44	2200	1317.37
P				

**Table 2 Characteristics of oils from large and small varieties of C. esculentus tubers**

Parameters	Large	Small
Oil content (%)	30	40
Iodine value (g/100g)	30.46	30.52
Saponification value (mgKOH/g)	210.53	215.32
Acid value (mgKOH/g)	1.96	9.53
Free fatty acid (% as oleic acid)	0.99	4.79
Lecithin content (%)	11	13
Ester value (mgKOH/g)	208.57	205.79

**Table 3 Analysis of starch from large and small varieties of C. esculentus tubers**

Parameters	Large	Small
Colour	White	White
Starch yield (%)	26.79	17.61
Granule size ( $\mu\text{m}$ ) :		
Small	3-5	3-5
Medium	6-8	6-8
Large	8-12	8-12
Amylose content (%)	22.60	28.27

**Table 4 pH Values of Body creams formulated using the Emulsifiers below**

Emulsifiers	pH value of cream
Lanolin + Triethanolamine	7.0
Commercial Lecithin	7.5
Commercial Lecithin + Lanolin	8.0
Commercial Lecithin + Triethanolamine	8.3
Triethanolamine	9.0
lanolin	8.5