

# On Certain Subclass Of Meromorphic Functions With Positive Coefficients

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**Abstract** In this paper we introduce and study a new subclass of meromorphically uniformly convex functions with positive coefficients defined by a differential operator and obtain coefficient estimates, growth and distortion theorem, radius of convexity, integral transforms, convex linear combinations, convolution properties and  $\delta$ -neighborhoods for the class  $\sigma_p(\varrho, \nu, \varsigma)$ .

## 1 Introduction

Let  $\Sigma$  denote the class of the functions of the form

$$\vartheta(z) = \frac{1}{z} + \sum_{m=1}^{\infty} a_m z^m \quad (1.1)$$

which are regular in domain  $E = \{z \in \mathbb{C} : 0 < |z| < 1\}$  with a simple pole at the origin with residue 1 there. Let  $\Sigma_s$  and  $\Sigma^*(\varrho)$  and  $\Sigma_k(\varrho)$ ,  $0 \leq \varrho < 1$ , denote the subclasses of  $\Sigma$  that are univalent, meromorphically starlike of order  $\varrho$  and meromorphically convex of order  $\varrho$  respectively. Analytically  $\vartheta(z)$  of the form (1.1) is in  $\Sigma^*(\varrho)$  if and only if

$$\operatorname{Re} \left\{ -\frac{z\vartheta'(z)}{\vartheta(z)} \right\} > \varrho, \quad z \in E. \quad (1.2)$$

Similarly,  $\vartheta \in \Sigma_k(\varrho)$  if and only if  $\vartheta(z)$  is of the form (1.1) and satisfies

$$\operatorname{Re} \left\{ -\left( 1 + \frac{z\vartheta''(z)}{\vartheta'(z)} \right) \right\} > \varrho, \quad z \in E. \quad (1.3)$$

It being understood that if  $\varrho = 1$  then  $\vartheta(z) = \frac{1}{z}$  is the only function which is  $\Sigma^*(1)$  and  $\Sigma_k(1)$ . The classes  $\Sigma^*(\varrho)$  and  $\Sigma_k(\varrho)$  have been extensively studied by Pommerenke [9], Clunie [1], Royster [12] and others.

Since, to a certain extent the work in the meromorphic univalent case has paralleled that of regular univalent case, it is natural to search for a subclass of  $\Sigma_s$  that has properties analogous to those of  $T^*(\varrho)$ . Juneja et al. [5] introduced the class  $\Sigma_p$  of functions of the form

$$\vartheta(z) = \frac{1}{z} + \sum_{m=1}^{\infty} a_m z^m, a_m \geq 0, \quad (1.4)$$

$$\Sigma_p^*(\varrho) = \Sigma_p \cap \Sigma^*(\varrho).$$

For functions  $\vartheta(z)$  in the class  $\Sigma_p$ , we define a linear operator  $D_\varsigma^n$  by the following form

$$\begin{aligned} D_\varsigma^0 \vartheta(z) &= \vartheta(z) \\ D_\varsigma^1 \vartheta(z) &= (1 - \varsigma)\vartheta(z) + \varsigma \frac{(z^2 \vartheta(z))'}{z}, \quad \varsigma \geq 0 \\ &= (1 + \varsigma)\vartheta(z) + \varsigma z \vartheta'(z) = D_\varsigma \vartheta(z) \\ D_\varsigma^2 \vartheta(z) &= D_\varsigma(D^1 \vartheta(z)) \\ &\vdots \end{aligned}$$

$$D_\varsigma^n \vartheta(z) = D_\varsigma(D_\varsigma^{n-1} \vartheta(z)) = \frac{1}{z} + \sum_{m=1}^{\infty} [1 + \varsigma(m+1)]^n a_m z^m, \text{ for } n \in \mathbb{N}_0 = 0, 1, 2, \dots \quad (1.5)$$

The classes  $\Sigma_p^*$  and various other subclasses of  $\Sigma$  were studied rather extensively by Clunie [1] and also see [9, 12, 14]. Motivated by works of Madhavi et al. [8], we define the following a new subclass  $\sigma_p(\varrho, v, \varsigma)$  of meromorphically uniformly convex functions in  $\Sigma_p$  by making use of generalized the differential operator.

**Definition 1.1.** For  $-1 \leq \varrho < 1, \varsigma > 0$  and  $v \geq 1$ , we let  $\sigma_p(\varrho, v, \varsigma)$  be the subclass of  $\Sigma_p$  consisting of the form (1.4) and satisfying the analytic criterion

$$-Re \left\{ \frac{z(D_\varsigma^n \vartheta(z))'}{D_\varsigma^n \vartheta(z)} + \varrho \right\} > v \left| \frac{z(D_\varsigma^n \vartheta(z))'}{D_\varsigma^n \vartheta(z)} + 1 \right|, \quad (1.6)$$

$D_\varsigma^n \vartheta(z)$  is given by (1.5).

The function class  $\sigma_p(\varrho, v, \varsigma)$  unifies well known classes of meromorphic uniformly convex function with positive coefficients. To illustrate, we observe that the class  $\sigma_p(\varrho, v, 1) = \sigma_p(\varrho, v)$  was studied by Madhavi et al. [8].

The main object of the paper is to study some usual properties of the geometric function theory such as coefficient bounds, growth and distortion properties, radius of convexity, convex linear combination and convolution properties, integral operators and  $\delta$ -neighbourhoods for the class  $\sigma_p(\varrho, v, \varsigma)$ .

## 2 Coefficient inequality

In this section, we obtain the coefficient bounds of function  $\vartheta(z)$  for the class  $\sigma_p(\varrho, v, \varsigma)$ .

**Theorem 2.1.** A function  $\vartheta(z)$  of the form (1.4) is in  $\sigma_p(\varrho, v, \varsigma)$  if

$$\sum_{m=1}^{\infty} [1 + \varsigma(m+1)]^n [(1+v)(m+1)\varsigma + 1 - \varrho] |a_m| \leq (1 - \varrho), \quad -1 \leq \varrho < 1 \text{ and } v \geq 1. \quad (2.1)$$

*Proof.* It sufficient to show that

$$v \left| \frac{z(D_\varsigma^n \vartheta(z))'}{D_\varsigma^n \vartheta(z)} + 1 \right| + Re \left\{ \frac{z(D_\varsigma^n \vartheta(z))'}{D_\varsigma^n \vartheta(z)} + 1 \right\} \leq (1 - \varrho).$$

$$\begin{aligned}
\text{We have } v \left| \frac{z(D_\zeta^n \vartheta(z))'}{D_\zeta^n \vartheta(z)} + 1 \right| + \operatorname{Re} \left\{ \frac{z(D_\zeta^n \vartheta(z))'}{D_\zeta^n \vartheta(z)} + 1 \right\} \\
\leq (1+v) \left| \frac{z(D_\zeta^n \vartheta(z))'}{D_\zeta^n \vartheta(z)} + 1 \right| \\
\leq \frac{(1+v) \sum_{m=1}^{\infty} [1 + \varsigma(m+1)]^n (m+1) \varsigma |a_m| |z^m|}{\frac{1}{|z|} - \sum_{m=1}^{\infty} [1 + \varsigma(m+1)]^n |a_m| |z^m|}
\end{aligned}$$

Letting  $z \rightarrow 1$  along the real axis, we obtain

$$\leq \frac{(1+v) \sum_{m=1}^{\infty} [1 + \varsigma(m+1)]^n (m+1) \varsigma |a_m|}{\frac{1}{|z|} - \sum_{m=1}^{\infty} [1 + \varsigma(m+1)]^n |a_m|}.$$

The above expression is bounded by  $(1 - \varrho)$  if

$$\sum_{m=1}^{\infty} [1 + \varsigma(m+1)]^n [(1+v)(m+1)\varsigma + 1 - \varrho] |a_m| \leq (1 - \varrho).$$

Hence the theorem is completed.  $\square$

**Corollary 2.2.** Let the function  $\vartheta(z)$  defined by (1.4) be in the class  $\sigma_p(\varrho, v, \varsigma)$ . Then

$$a_m \leq \frac{(1 - \varrho)}{\sum_{m=1}^{\infty} [1 + \varsigma(m+1)]^n [(1+v)(m+1)\varsigma + 1 - \varrho]}, \quad (m \geq 1). \quad (2.2)$$

Equality holds for the function of the form

$$\vartheta_m(z) = \frac{1}{z} + \frac{(1 - \varrho)}{[1 + \varsigma(m+1)]^n [(1+v)(m+1)\varsigma + 1 - \varrho]} z^m. \quad (2.3)$$

**Remark 2.3.**

- (i) For the choice of  $\varsigma = 1$  in Theorem 2.1 and Corollary 2.2, we observed that the coefficient estimates for the functions of the class,

$$|a_m| \leq \frac{(1 - \varrho)}{(m+2)^n [(1+v)(m+1) + 1 - \varrho]}$$

is coincide with Madhavi et al. [8].

### 3 Distortion Theorems

In this section, we obtain the sharp for the distortion theorems of the form (1.4).

**Theorem 3.1.** Let the function  $\vartheta(z)$  defined by (1.4) be in the class  $\sigma_p(\varrho, v, \varsigma)$ . Then for  $0 < |z| = r < 1$ ,

$$\frac{1}{r} - \frac{(1 - \varrho)}{(1 + 2\varsigma)^n [2\varsigma(1+v) + 1 - \varrho]} r \leq |\vartheta(z)| \leq \frac{1}{r} + \frac{(1 - \varrho)}{(1 + 2\varsigma)^n [2\varsigma(1+v) + 1 - \varrho]} r \quad (3.1)$$

with equality for the function

$$\vartheta(z) = \frac{1}{z} + \frac{(1 - \varrho)}{(1 + 2\varsigma)^n [2\varsigma(1+v) + 1 - \varrho]} z, \text{ at } z = r, ir. \quad (3.2)$$

*Proof.* Suppose  $\vartheta(z)$  is in  $\sigma_p(\varrho, v, \varsigma)$ . In view of Theorem 2.1, we have

$$(1 + 2\varsigma)^n [2\varsigma(1 + v) + 1 - \varrho] \sum_{m=1}^{\infty} a_m \leq \sum_{m=1}^{\infty} [1 + \varsigma(m + 1)]^n [(1 + v)(m + 1)\varsigma + 1 - \varrho] \\ \leq (1 - \varrho)$$

which evidently yields  $\sum_{m=1}^{\infty} a_m \leq \frac{1 - \varrho}{(1 + 2\varsigma)^n [2\varsigma(1 + v) + 1 - \varrho]}$ .

Consequently, we obtain

$$|\vartheta(z)| = \left| \frac{1}{z} + \sum_{m=1}^{\infty} a_m z^m \right| \leq \left| \frac{1}{z} \right| + \sum_{m=1}^{\infty} a_m |z|^m \\ \leq \frac{1}{r} + r \sum_{m=1}^{\infty} a_m \\ \leq \frac{1}{r} + \frac{1 - \varrho}{(1 + 2\varsigma)^n [2\varsigma(1 + v) + 1 - \varrho]} r.$$

$$\text{Also, } |\vartheta(z)| = \left| \frac{1}{z} + \sum_{m=1}^{\infty} a_m z^m \right| \geq \left| \frac{1}{z} \right| - \sum_{m=1}^{\infty} a_m |z|^m \\ \geq \frac{1}{r} - r \sum_{m=1}^{\infty} a_m \\ \geq \frac{1}{r} - \frac{1 - \varrho}{(1 + 2\varsigma)^n [2\varsigma(1 + v) + 1 - \varrho]} r.$$

Hence the result (3.1) follows.  $\square$

**Theorem 3.2.** Let the function  $\vartheta(z)$  defined by (1.4) be in the class  $\sigma_p(\varrho, v, \varsigma)$ . Then for  $0 < |z| = r < 1$ ,

$$\frac{1}{r^2} - \frac{1 - \varrho}{(1 + 2\varsigma)^n [2\varsigma(1 + v) + 1 - \varrho]} \leq |\vartheta'(z)| \leq \frac{1}{r^2} + \frac{1 - \varrho}{(1 + 2\varsigma)^n [2\varsigma(1 + v) + 1 - \varrho]}.$$

The result is sharp, the extremal function being of the form (2.3)

*Proof.* From Theorem 2.1, we have

$$(1 + 2\varsigma)^n [2\varsigma(1 + v) + 1 - \varrho] \sum_{m=1}^{\infty} m a_m \\ \leq \sum_{m=1}^{\infty} [1 + \varsigma(m + 1)]^n [(1 + v)(m + 1)\varsigma + 1 - \varrho] \\ \leq (1 - \varrho)$$

which evidently yields  $\sum_{m=1}^{\infty} m a_m \leq \frac{1 - \varrho}{[1 + 2\varsigma]^n [2\varsigma(1 + v) + 1 - \varrho]}$ .

Consequently, we obtain

$$\begin{aligned}
 |\vartheta'(z)| &\leq \left| \frac{1}{r^2} + \sum_{m=1}^{\infty} m a_m r^{m-1} \right| \\
 &\leq \frac{1}{r^2} + \sum_{m=1}^{\infty} m a_m \\
 &\leq \frac{1}{r^2} + \frac{(1-\varrho)}{(1+2\varsigma)^n [2\varsigma(1+v) + 1 - \varrho]}.
 \end{aligned}$$

Also,  $|\vartheta'(z)| \geq \left| \frac{1}{r^2} - \sum_{m=1}^{\infty} m a_m r^{m-1} \right|$

$$\begin{aligned}
 &\geq \frac{1}{r^2} - \sum_{m=1}^{\infty} m a_m \\
 &\geq \frac{1}{r^2} + \frac{(1-\varrho)}{(1+2\varsigma)^n [2\varsigma(1+v) + 1 - \varrho]}.
 \end{aligned}$$

This completes the proof.  $\square$

**Remark 3.3.**

- (i) For the choice of  $\varsigma = 1$  in Theorems 3.1 and 3.2, we observed that the sharp for the distortion theorems for the functions of the class are coincide with Madhavi et al. [8].

## 4 Class preserving integral operators

In this section, we consider the class preserving integral operator of the form (1.4).

**Theorem 4.1.** Let the function  $\vartheta(z)$  defined by (1.4) be in the class  $\sigma_p(\varrho, v, \varsigma)$ . Then

$$\vartheta(z) = cz^{-c-1} \int_0^z t^c f(t) dt = \frac{1}{z} + \sum_{m=1}^{\infty} \frac{c}{c+m+1} a_m z^m, \quad c > 0 \quad (4.1)$$

is in  $\sigma_p(\delta, v, \varsigma)$ , where

$$\delta(\varrho, v, c, \varsigma) = \frac{[2\varsigma(1+v) + (1-\varrho)](c+2) - c(1-\varrho)[2\varsigma(1+v) + 1]}{[2\varsigma(1+v)(1-\varrho)](c+2) - (1-\varrho)c}. \quad (4.2)$$

The result is sharp for  $\vartheta(z) = \frac{1}{z} + \frac{(1-\varrho)}{(1+2\varsigma)^n [2\varsigma(1+v) + (1-\varrho)]} z$ .

*Proof.* Suppose  $\vartheta(z) = \frac{1}{z} + \sum_{m=1}^{\infty} a_m z^m$  is in  $\sigma_p(\varrho, v, \varsigma)$ . We have

$$\vartheta(z) = cz^{-c-1} \int_0^z t^c f(t) dt = \frac{1}{z} + \sum_{m=1}^{\infty} \frac{c}{c+m+1} a_m z^m, \quad c > 0.$$

It is sufficient to show that

$$\sum_{m=1}^{\infty} \frac{[1 + \varsigma(m+1)]^n [(1+v)(m+1)\varsigma + 1 - \delta]}{1 - \delta} \frac{c}{c+m+1} a_m \leq 1. \quad (4.3)$$

Since  $\vartheta(z)$  is in  $\sigma_p(\varrho, v, \varsigma)$ , we have

$$\sum_{m=1}^{\infty} \frac{[1 + \varsigma(m+1)]^n [(1+v)(m+1)\varsigma + 1 - \varrho]}{1 - \varrho} |a_m| \leq 1. \quad (4.4)$$

Thus (4.3) will be satisfied if

$$\begin{aligned} & \sum_{m=1}^{\infty} \frac{[1 + \varsigma(m+1)]^n [(1+v)(m+1)\varsigma + 1 - \delta]}{1 - \delta} \frac{c}{c + m + 1} \\ & \leq \sum_{m=1}^{\infty} \frac{[1 + \varsigma(m+1)]^n [(1+v)(m+1)\varsigma + 1 - \varrho]}{1 - \varrho}. \end{aligned}$$

Solving for  $\delta$ , we obtain

$$\delta \leq \frac{[(1+v)(m+1)\varsigma + 1 - \varrho](c + m + 1) - c[(1+v)(m+1)\varsigma + 1](1 - \varrho)}{[(1+v)(m+1)\varsigma + 1 - \varrho](c + m + 1) - c(1 - \varrho)} = G(m) \quad (4.5)$$

A simple computation will show that  $G(m)$  is increasing and  $G(m) \geq G(1)$ . Using this, the result follows.  $\square$

## 5 Convex linear combinations and convolution properties

In this section, we obtain sharp for  $\vartheta(z)$  is meromorphically convex of order  $\delta$  and necessary and sufficient condition for  $\vartheta(z)$  is in the class  $\sigma_p(\varrho, v, \varsigma)$ . And also proved that convolution is in the class  $\sigma_p(\varrho, v, \varsigma)$ .

**Theorem 5.1.** *If the function  $\vartheta(z) = \frac{1}{z} + \sum_{m=1}^{\infty} a_m z^m$  is in  $\sigma_p(\varrho, v, \varsigma)$  then  $\vartheta(z)$  is meromorphically convex of order  $\delta$  ( $0 \leq \delta < 1$ ) in  $|z| < r = r(\varrho, v, \delta)$ , where*

$$r(\varrho, v, \delta) = \inf_{n \geq 1} \left\{ \frac{(1 - \delta)(m+2)^n [(1+v)(1+m)\varsigma + 1 - \varrho]}{(1 - \varrho)m(m+2 - \delta)} \right\}^{\frac{1}{m+1}}.$$

The result is sharp.

*Proof.* Let  $\vartheta(z)$  be in  $\sigma_p(\varrho, v, \varsigma)$ . Then, by Theorem 2.1, we have

$$\sum_{m=1}^{\infty} [1 + \varsigma(m+1)]^n [(1+v)(1+m)\varsigma + 1 - \varrho] |a_m| \leq (1 - \varrho). \quad (5.1)$$

It is sufficient to show that  $\left| 2 + \frac{z\vartheta''(z)}{\vartheta'(z)} \right| \leq (1 - \delta)$  for  $|z| < r = r(\varrho, v, \delta, \varsigma)$ , where  $r(\varrho, v, \delta, \varsigma)$  is specified in the statement of the theorem. Then

$$\left| 2 + \frac{z\vartheta''(z)}{\vartheta'(z)} \right| = \left| \frac{\sum_{m=1}^{\infty} m(m+1)a_m z^{m-1}}{\frac{1}{z^2} + \sum_{m=1}^{\infty} m a_m z^{m-1}} \right| \leq \frac{\sum_{m=1}^{\infty} m(m+1)|a_m| |z|^{m+1}}{1 - \sum_{m=1}^{\infty} m |a_m| |z|^{m+1}}.$$

This will be bounded by  $(1 - \delta)$  if

$$\sum_{m=1}^{\infty} \frac{m(m+2 - \delta)}{1 - \delta} |a_m| |z|^{m+1} \leq 1. \quad (5.2)$$

By (5.1), it follows that (5.2) is true if

$$\begin{aligned} \frac{m(m+2 - \delta)}{1 - \delta} |z|^{m+1} & \leq \frac{[1 + \varsigma(m+1)]^n [(1+v)(m+1)\varsigma + 1 - \varrho]}{1 - \varrho} |a_m|, \quad m \geq 1 \\ \text{or } |z| & \leq \left\{ \frac{(1 - \delta)[1 + \varsigma(m+1)]^n [(1+v)(m+1)\varsigma + 1 - \varrho]}{(1 - \varrho)m(m+2 - \delta)} \right\}^{\frac{1}{m+1}}. \end{aligned} \quad (5.3)$$

Setting  $|z| = r(\varrho, v, \delta, \varsigma)$  in (5.3), the result follows. The result is sharp for the function.

$$\vartheta_m(z) = \frac{1}{z} + \frac{(1 - \varrho)}{[1 + \varsigma(m+1)]^n [(1+v)(m+1)\varsigma + 1 - \varrho]} z^m, \quad m \geq 1.$$

$\square$

**Theorem 5.2.** Let  $\vartheta_0(z) = \frac{1}{z}$  and  $\vartheta_m(z) = \frac{1}{z} + \frac{(1-\varrho)}{[1+\varsigma(m+1)]^n[(1+v)(m+1)\varsigma+1-\varrho]}z^m$ ,  $m \geq 1$ . Then  $\vartheta(z) = \frac{1}{z} + \sum_{m=1}^{\infty} a_m z^m$  is in the class  $\sigma_p(\varrho, v, \varsigma)$  if and only if it can be expressed in the form  $\vartheta(z) = \omega_0 f_0(z) + \sum_{m=1}^{\infty} \omega_m \vartheta_m(z)$ , where  $\omega_0 \geq 0, \omega_m \geq 0, m \geq 1$  and  $\omega_0 + \sum_{m=1}^{\infty} \omega_m = 1$ .

*Proof.* Let  $\vartheta(z) = \omega_0 \vartheta_0(z) + \sum_{m=1}^{\infty} \omega_m \vartheta_m(z)$  with  $\omega_0 \geq 0, \omega_m \geq 0, m \geq 1$  and  $\omega_0 + \sum_{m=1}^{\infty} \omega_m = 1$ . Then

$$\vartheta(z) = \omega_0 \vartheta_0(z) + \sum_{m=1}^{\infty} \omega_m \vartheta_m(z)$$

$$= \frac{1}{z} + \sum_{m=1}^{\infty} \omega_m \frac{(1-\varrho)}{[1+\varsigma(m+1)]^n[(1+v)(m+1)\varsigma+1-\varrho]} z^m$$

$$\begin{aligned} \text{Since } \sum_{m=1}^{\infty} \frac{[1+\varsigma(m+1)]^n[(1+v)(m+1)\varsigma+1-\varrho]}{(1-\varrho)} \omega_m \frac{(1-\varrho)}{[1+\varsigma(m+1)]^n[(1+v)(m+1)\varsigma+1-\varrho]} \\ = \sum_{m=1}^{\infty} \omega_m = 1 - \omega_0 \leq 1. \end{aligned}$$

By Theorem 2.1,  $\vartheta(z)$  is in the class  $\sigma_p(\varrho, v, \varsigma)$ .

Conversely suppose that the function  $\vartheta(z)$  is in the class  $\sigma_p(\varrho, v, \varsigma)$ , since

$$a_m \leq \frac{(1-\varrho)}{[1+\varsigma(m+1)]^n[(1+v)(m+1)\varsigma+1-\varrho]} z^m, m \geq 1.$$

$$\omega_m = \sum_{m=1}^{\infty} \frac{[1+\varsigma(m+1)]^n[(1+v)(m+1)\varsigma+1-\varrho]}{(1-\varrho)} a_m \text{ and } \omega_0 = 1 - \sum_{m=1}^{\infty} \omega_m.$$

It follows that  $\vartheta(z) = \omega_0 \vartheta_0(z) + \sum_{m=1}^{\infty} \omega_m \vartheta_m(z)$ .

This completes the proof of the theorem.  $\square$

For the functions  $\vartheta(z) = \frac{1}{z} + \sum_{m=1}^{\infty} a_m z^m$  and  $g(z) = \frac{1}{z} + \sum_{m=1}^{\infty} b_m z^m$  belongs to  $\Sigma_p$ , we denoted by  $(\vartheta * g)(z)$  the convolution of  $\vartheta(z)$  and  $g(z)$  and defined as

$$(\vartheta * g)(z) = \frac{1}{z} + \sum_{m=1}^{\infty} a_m b_m z^m$$

**Theorem 5.3.** If the function  $\vartheta(z) = \frac{1}{z} + \sum_{m=1}^{\infty} a_m z^m$  and  $g(z) = \frac{1}{z} + \sum_{m=1}^{\infty} b_m z^m$  are in the class  $\sigma_p(\varrho, v, \varsigma)$  then  $(\vartheta * g)(z)$  is in the class  $\sigma_p(\varrho, v, \varsigma)$ .

*Proof.* Suppose  $\vartheta(z)$  and  $g(z)$  are in  $\sigma_p(\varrho, v, \varsigma)$ . By Theorem 2.1, we have

$$\sum_{m=1}^{\infty} \frac{[1+\varsigma(m+1)]^n[(1+v)(m+1)\varsigma+1-\varrho]}{(1-\varrho)} a_m \leq 1$$

$$\text{and } \sum_{m=1}^{\infty} \frac{[1+\varsigma(m+1)]^n[(1+v)(m+1)\varsigma+1-\varrho]}{(1-\varrho)} b_m \leq 1.$$

Since  $\vartheta(z)$  and  $g(z)$  are regular in  $E$ , so is  $(\vartheta * g)(z)$ . Furthermore

$$\begin{aligned} & \sum_{m=1}^{\infty} \frac{[1 + \varsigma(m+1)]^n [(1+v)(m+1)\varsigma + 1 - \varrho]}{(1-\varrho)} a_m b_m \\ & \leq \sum_{m=1}^{\infty} \left\{ \frac{[1 + \varsigma(m+1)]^n [(1+v)(m+1)\varsigma + 1 - \varrho]}{(1-\varrho)} \right\}^2 a_m b_m \\ & \leq \left( \sum_{m=1}^{\infty} \frac{[1 + \varsigma(m+1)]^n [(1+v)(m+1)\varsigma + 1 - \varrho]}{(1-\varrho)} a_m \right) \\ & \quad \left( \sum_{m=1}^{\infty} \frac{[1 + \varsigma(m+1)]^n [(1+v)(m+1)\varsigma + 1 - \varrho]}{(1-\varrho)} b_m \right) \\ & \leq 1. \end{aligned}$$

Hence, by Theorem 2.1,  $(\vartheta * g)(z)$  is in the class  $\sigma_p(\varrho, v, \varsigma)$ .  $\square$

**Remark 5.4.**

- (i) For the choice of  $\varsigma = 1$  in Theorems 5.1, 5.2 and 5.3, we observed that the results coincide with Madhavi et al. [8].

## 6 Neighborhoods for the class $\sigma_p(\varrho, v, \gamma, \varsigma)$

In this section, we define the  $\delta$ -neighborhood of a function  $\vartheta(z)$  and establish a relation between  $\delta$ -neighborhood and  $\sigma_p(\varrho, v, \gamma, \varsigma)$  class of a function.

**Definition 6.1.** A function  $\vartheta \in \Sigma_p$  is said to be in the class  $\sigma_p(\varrho, v, \gamma, \varsigma)$  if there exists a function  $g \in \sigma_p(\varrho, v, \varsigma)$  such that

$$\left| \frac{\vartheta(z)}{g(z)} - 1 \right| < (1 - \gamma), \quad z \in E, \quad 0 \leq \gamma < 1. \quad (6.1)$$

Following the earlier works on neighborhoods of analytic functions by Goodman [2] and Ruschweyh [13]. We defined the  $\delta$ -neighborhood of a function  $\vartheta \in \Sigma_p$  by

$$N_\delta(\vartheta) = \left\{ g \in \Sigma_p : g(z) = \frac{1}{z} + \sum_{m=1}^{\infty} b_m z^m \text{ and } \sum_{m=1}^{\infty} m |a_m - b_m| \leq \delta \right\} \quad (6.2)$$

**Theorem 6.2.** If  $g \in \sigma_p(\varrho, v, \varsigma)$  and

$$\gamma = 1 - \frac{\delta[2\varsigma(1+v) + 1 - \varrho]}{2\varsigma(1+v)} \quad (6.3)$$

then  $N_\delta(g) \subset \sigma_p(\varrho, v, \gamma, \varsigma)$ .

*Proof.* Let  $\vartheta \in N_\delta(g)$ . Then we find from (6.2) that

$$\sum_{m=1}^{\infty} m |a_m - b_m| \leq \delta \quad (6.4)$$

which implies the coefficient of inequality  $\sum_{m=1}^{\infty} |a_m - b_m| \leq \frac{\delta}{m}$ ,  $m \in \mathbb{N}$ .

Since  $g \in \sigma_p(\varrho, v, \varsigma)$ , we have  $\sum_{m=1}^{\infty} b_m = \frac{1-\varrho}{2\varsigma(1+v)+1-\varrho}$ .

So that  $\left| \frac{\vartheta(z)}{g(z)} - 1 \right| < \frac{\sum_{m=1}^{\infty} |a_m - b_m|}{1 - \sum_{m=1}^{\infty} b_m} \leq \frac{\delta[2\varsigma(1+v)+1-\varrho]}{2\varsigma(1+v)} = 1 - \gamma$ , provided  $\gamma$  is given by (6.3).

Hence, by Definition 6.1,  $\vartheta \in \sigma_p(\varrho, v, \gamma)$  for  $\gamma$  given by (6.3), which completes the proof of theorem.  $\square$



**Remark 6.3.**

- (i) For the choice of  $\varsigma = 1$  in Theorem 6.2, we observed that the result is coincide with Madhavi et al. [8] .

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# On new subclasses of meromorphically convex functions with positive coefficients

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## Abstract

In this paper we introduce and study a new subclass of meromorphically uniformly convex functions with positive coefficients defined by a Bessel operator and obtain

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coefficient estimates, growth and distortion theorem, radius of convexity, integral transforms, convex linear combinations, convolution properties and  $\delta$ -neighborhoods for the class  $\Sigma_p(\alpha, \tau, c)$ .

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## **Online LIS Education in the New Normal Maharashtra State**

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### **Abstract :**

The study was conducted to examine the perspectives of LIS teachers regarding their preparedness for the online education learning system in Maharashtra. It focused on the resources, platforms, assessment methods used during online LIS education. Google Meet, Zoom, online quizzes, E-PGPathashala, E-Gyankosh, Shodhaganga, Google Classroom, Whatsapp, and E-mail helped to sustain the teaching during the lockdown. The study identified few gender differences. Few suggestions from the respondents on improvements in online education are also mentioned.

### **Keywords :**

Learning Resources, LIS Education, New Normal, Online Learning, Online Learning Tools

### **1. Introduction :**

Information technology has made a drastic change in every field. The teaching field is no exception to this. The chalk and talk method is the most popular method, but we need to adopt new learning methods in our teaching process with this new technology. Hybrid things have different impacts; thus, if we use multiple methods, it will be helpful for a teacher to interact more with the students.

Intelligent gadgets for different tasks like teaching, designing question papers, assessment of students, feedback, and research methodology are required. Innovative teaching and learning methodologies such as short

lectures, simulation, role-playing, and problem-based learning (PBL) are very useful in addressing the rapid technological advances and developing workplaces required in the foreseeable future (Naga Subramani and Iyappan, 2018). Higher education plays an integral part in every country existence as it provides highly trained experts for future growth and prosperity (Kannadhasan et al., 2020)

## 2. Literature review :

Mahalakshmi and Rangaswamy (2019) presented the overview of required skills, i.e., communication, technical, and domain skills. They discussed innovativeness in teaching methods such as Problem based teaching, simulation, role-play, project-based teaching (PBT), etc., in education. Farooq and Matteson (2016) pointed out the similarities and differences between traditional and online seminars. While developing the LIS curriculum, the skills of faculty members should also be developed. The Government should also take the initiative in providing funds for creating the infrastructure in LIS schools (Edegbo, 2011). Islam and Karim (2020) conducted a literature review to investigate research studies on the use of e-resources by students in developing countries. Literature found that e-resources are a time-demand material for all education institutions. Slow internet speed reported one of the obstacles to getting their required information.

Aslam et al. (2021) believed the positive side of online learning is an excellent opportunity to enhance skills and importance in self-development. Callo and Yazon (2020) studied Indian higher education during lockdown that found that lack of access to laptops or desktops was the main difficulty amongst a significant ratio of teachers and students to complete the teaching-learning task. They believed that the institution could take some measurement for the fundamental infrastructure problem. Okuonghae et al. (2021) conducted a study on technological development and self-efficacy. They depicted a substantial relationship between e-learning adoption and technological readiness, computer self-efficacy in Library and Information Science students in Nigeria. Most participants suffered from disturbances during online classes because of internet connectivity (Mohanani et al., 2020). Rafique et al., (2021) explored the significant differences in Online Learning Readiness (OLR) of students in Pakistan concerning students' readiness towards their computer, internet, and online communication self-efficacy and learning motivation depending on



the level of their program of study.

Rajkoomar and Raju (2016) have explored the educational and pedagogical issues in blended learning to develop a framework for designing and implementing blended learning in the delivery of LIS curricula in South African universities. Islam et al. (2011) explored how EL tools and technologies support the LIS education process and measure the Weights of factors constraining the use of EL in LIS education. Wójcik (2016) observed that AR technology is a helpful teaching tool that enables students to achieve improved learning outcomes in the practical skills needed by librarians and the personal and social competencies relevant to labor market needs.

### **3. Need and significance of the study :**

Due to the COVID19 pandemic, there were restrictions on everyone in India as well as abroad. No one was prepared for this. After the declaration of lockdown in India, immediately after few days, it was directed by the officialsto begin with online education. Many were aware of technology but had not used it 100%; however, all education sectors accepted the challenge happily, and online environment education started.

It was essential to find out How LIS teaching during Online Environment is taking place? Therefore, the present study will explore the preparedness of LIS teachers for online education.

### **4. Objectives :**

1. To study different platforms used by LIS teachers for online education.
2. To find out the type of e-resources used by the LIS teachers.
3. To explore the assessment methods used during online LIS education.
4. To study the opinion of LIS teachers about the readiness at the university level for online teaching.

### **5. Scope, methodology and population :**

Quantitative data was collected through the questionnaire using Google forms. This study covered the 10 Universities in Maharashtra (India) having full-time Library and Information Science Courses. From the University websites and earlier research, the researcher found the number of faculty members. Simple descriptive





statistics are used to analyze the data.

## 6. Findings and discussion :

**Table 1: University wise responses**

Sl. No	Name of University	Questionnaire Sent	Response Received			
			Male	Female	Total	%
1	University of Mumbai, Mumbai	8	4	3	7	87.5
2	SNDT Women's University, Mumbai	5	1	4	5	100
3	Tata Institute of Social Sciences (TISS), Mumbai	4	2	-	2	50
4	Savitribai Phule Pune University (SPPU), Pune	5	1	1	2	40
5	Shivaji University, Kolhapur	6	5	-	5	83.33
6	Dr Babasaheb Ambedkar Marathwada University (BAMU)	4	1	1	2	50
7	Swami RamanandTeerth Marathwada University, Nanded SRT Marathwada University, Nagpur	3	-	1	1	33.33
8	SantGadge baba Amravati University, Amravati	3	1	1	2	66.66
9	Solapur University, Solapur	2	2	-	2	100
10	Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur	3	1	1	2	66.66
		<b>43</b>	<b>18</b>	<b>12</b>	<b>30</b>	



The questionnaire was sent to 43 LIS faculty members through e-mail and Whatsapp, and total 30 responses (69.77%) received that includes 40% female teachers and 60 % male teachers. The responses received from the age group of 26-35(6.66%), 36-45(36.66%), 46-55(46.66%) and 56& above (10%). The study includes Assistant professor (40%), Associate professor (16.66 %), Head (23.33%), and visiting faculty (20%).

### 6.1 Teaching platforms used by LIS teachers :

Nowadays, there are various online platforms available for interaction. Comparatively, Zoom is considered easy because of its features in the main display that are easy to operate (Fuady et al., 2021).

**Table 2 : University-wise response about teaching platform**

Name of University (responded)	Google Meet		Zoom		Webex		Microsoft Team		Skype		TedEd / Jamboard	
	M	F	M	F	M	F	M	F	M	F	M	F
Mumbai-(4,3)	4	3	4	3	2	2	4	3	1	2	0	2
SNDT-(1,4)	1	4	1	2	0	1	0	0	0	0	0	2
TISS-(2,0)	0	0	2	0	1	0	0	0	0	0	0	0
SPPU-(1,1)	1	0	1	0	1	0	1	0	0	0	0	0
Shivaji-(5,0)	5	0	5	0	4	0	0	0	0	0	0	0
BAMU-(1,1)	1	1	0	1	0	1	1	1	1	1		1
SRT-(0,1)	0	0	0	0	0	0	0	0	0	0	0	0
Nagpur-(1,1)	1	1	1	1	1	0	0	0	0	0	0	0
Amravati-(1,1)	1	1	0	1	1	0	0	0	0	0	0	0
Solapur-(2,0)	2	0	2	0	1	0	0	0	0	0	0	0
<b>Total</b>	16	10	16	8	11	4	6	4	2	3	0	5
<b>Gender-wise %</b>	88.88	88.88	88.88	68.33	61.11	33.33	33.33	33.33	11.11	25	-	41.66
<b>Grand Total</b>	26		24		15		10		5		5	
<b>Total %</b>	86.66%		80.00		50.00		33.33		16.66		16.66	



Similarly, the present study also found that the LIS teachers used different combinations of platforms. Google Meet was the preferable teaching delivery platform (86.66% LIS teachers), followed by Zoom (80%) and Webex (50%). Skype and Tedex were the most minor preferred platforms for teaching. About 20-23% of teachers were using a combination of media such as Zoom, Google Meet, and Webex.

Table 2 depicts the University wise platform used for the teaching process. Teachers from the University of Mumbai have used all the media, followed by Babasaheb Ambedkar Marathwada University, Shivaji University, and SNDT University. Google Meet platform was easy and effectively used by all the teachers (86.66%) except teachers from TISS who used the Zoom platform mainly and SRT University who used their developed virtual platform.

It was found that male (88.88%) and female (88.88%) teachers used Google Meet equally, whereas Zoom, Webex, Microsoft teams were used more by male teachers than female teachers.

All the LIS teachers from the age group of 26-35 preferred Google meet, zoom and Webex platforms; 72.72% of teachers from 36-45 age group preferred Google meet and Zoom, followed by Webex (54.54%); 85.71% teachers from 46-55 age group, preferred Google meet, followed by Zoom (78.57%), Webex (57.14%). All the teachers from the age group of 56 and above used only Google Meet and Zoom platforms.

## 6.2 Content delivery and distribution of study material :

Naga Subramani & Iyappan (2018) mentioned that Technological Pedagogical Content Knowledge captures the qualities of these new hybrid educators who find their place between the intersections of these qualities.

Shaharane et al. (2016) studied the effectiveness of Google Classroom's active learning activities for data mining subjects through the survey. The present study reflects that 50% of teachers of the 26-35 age group, 81.81% of 36-45, 57.14% of 46-55, and 33.33% of teachers from the 56 and above age group choose the Google Classroom platform.

Figure 1 shows that female teachers found e-mail (75%) as the best method to distribute the content, followed by WhatsApp (66.66%) and Google Classroom (58.33%), whereas male teachers preferred Google classroom, WhatsApp

(66.66%), e-mail (55.55%) and Moodle (33.33%). However, overall, WhatsApp was the preferred medium for content delivery (66.66% teachers), followed by e-mail (63.33%), Google Classroom, and Moodle (36.66% each). Digital repository is a good platform for content delivery, but only 20% of teachers chose the option. Therefore, more awareness should be made about the usage of Digital repositories.

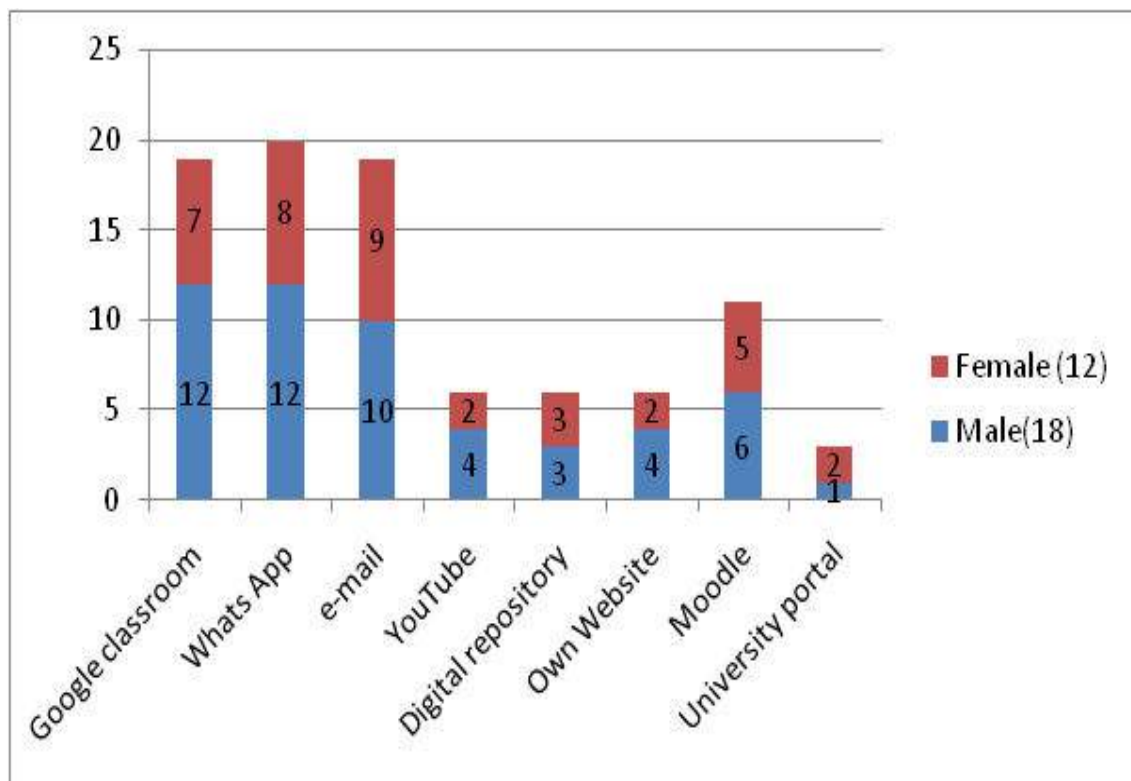


Figure 1: Distribution of material

### 6.3 Assessment methods :

During the lockdown, the change to the method from offline to online in all sectors started. For the education sector, conducting the examination is a big challenge. Due to the lack of high-speed internet connectivity attending lectures and submitting assignments on time would be challenging. Therefore, flexibility in submitting assignments can be provided to the students (Mahmood, 2021).

Assessments done on different platforms would encourage the students towards active participation. Teachers from the Mumbai region and Shivaji Univer-

sity, Kolhapurused multiple strategies for assessment like online quiz, short online answer, Text-based assignments, open-book test, presentations, Debate and Webinars. The online quiz was the most popular method used by teachers (77.41%), followed by the short answer (54.83%), text-based assignments & online PowerPoint presentation (48.38%), content creation and webinar (46.66%), open-book test (40%) and debate (36.66%).

LIS Teachers who were older than 35 years having more experience had used different types of assessment that wouldbe appropriate for the professional course.

#### 6.4 University preparedness towards online education :

ICT is the most fundamental factor in providing online education. The teachers' opinions were collected using the Likert Scale (Excellent = 5, Very Good = 4, Good = 3, Ok = 2, and Poor = 1) to find University preparedness towards online education. Gender-wise differences of opinions were found on the perspectives about the role of their universities. Male teachers gave a high score for ICT, followed by communication and policy matters (refer to Table 4). In contrast, female teachers gave the highest score for proactiveness of their university, followed by ICT and communication process(refer to Table 5). According to both genders, their universities were lagging in framing the rules concerning online education.

Table 4: Male response on University preparedness

Factors	Male Respondents
ICT	71
Communication	69
Policy	65
Rules	64
Proactiveness	60

Table 5: Female response on University preparedness

Factors	Female Respondents
Proactiveness	43
ICT	38
Communication	32
Rules	31
Policy	30

### 6.5 Use of e-resources :

The study found that many e-resources were known to the respondents; further, they learned new resources to face the e-learning education of new normal. All the respondents knew about e-resources like e-Journals, E-PGPATHSHALA, Gyankosh, Shodhganga, Gutenberg, Free books, free journals and DOAJ.

Figure 2 represents how proficient LIS teachers make use of various e-resources. Overall, 26.66% of the teachers regularly practiced Shodhganga, 23.33% of the teachers were practicing e-journals, e-PG Pathshala, and e-GyanKosh; and 16.66% of teachers were practicing NDLI and DOAJ, and only 10% of LIS teachers were using Project Gutenberg.

About 6.67% of teachers learned about NDLI and Gutenberg during the lockdown, and about 3.33% of teachers learned about the E-PG Pathshala, Gyankosh, and DOAJ.

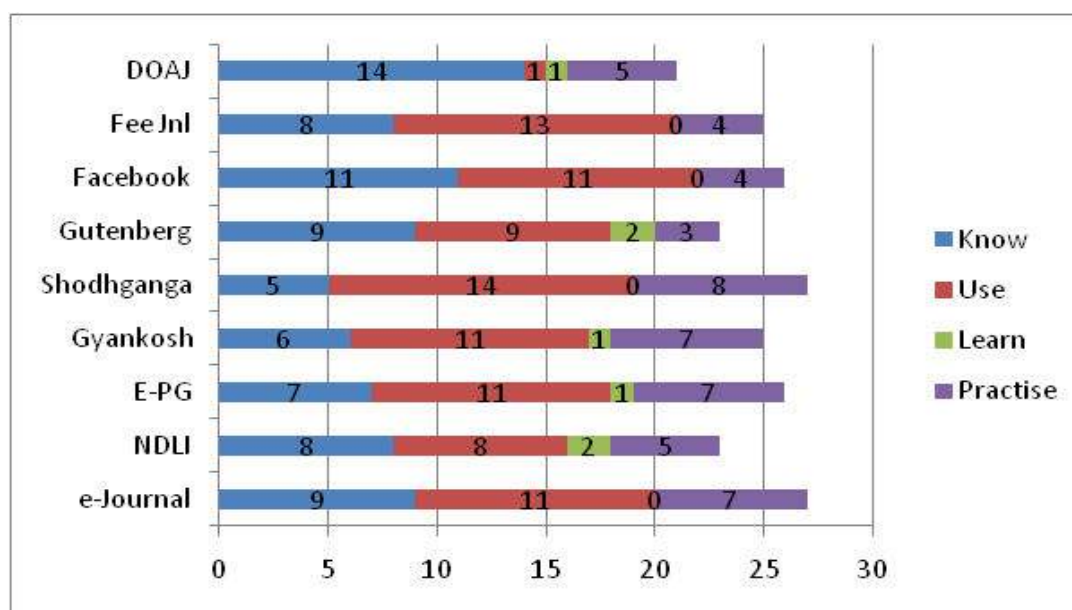


Figure 2: LIS Teachers' Knowledge E-resources

### 6.6 Suggestions from LIS teachers :

86.66% of the teachers expressed their views to an open-ended question about the suggestion to bring change in LIS education for the forthcoming year.



### **Syllabus revision**

University should be flexible about syllabus completion. In addition, LIS education should enable students to prepare for online library services platforms, etiquettes, and required skills.

### **LIS departments**

Should focus on ICT, E-Resources, ICT infrastructure, which mainly includes laptop and internet connectivity for students 24\*7 access to e-resources. Universities should make availability of infrastructure regarding online teaching tools. Universities might try out innovative practices, such as loaning computers to needy students and teachers. Libraries need to develop a good collection of e-books and other e-resources in LIS.

### **UGC and Government initiative**

UGC and Government should take the initiative towards regular training on new platforms available for online teaching and learning. Furthermore, they should be proactive to ensure the safety and security of the health of students and faculty members. Gender Studies concerning online LIS education might help to frame policies and schemes.

### **Students and Teachers Perspectives**

Faculty should get more freedom to teach online on any available platform for online teaching. Study and teaching should be more of a fun activity yet academic for students and teachers. They need to keep updating themselves with new pedagogies themselves.

## **7. Conclusion :**

The study comes out with a positive side that the teachers have taken the efforts to go with this online education. From various platforms of teaching, Zoom, Google Meet, Webex is the most popular combination choose by LIS teachers. Teachers knew few resources, tools, but they took an extra effort to learn a few more which will help them during their teaching process. DOAJ and Shodhganga were two popular e-resources among the LIS teachers. MOOC, MOODLE, Google Classroom, and Google Tools used by maximum LIS teachers. Most male teachers believed that university is prepared with ICT, whereas most female teachers thought that the university is pro-active for online education. The study comes out



with a good suggestion that the curriculum may include practical sessions for students on communication and etiquettes in online settings in LIS education. Policymakers or university authorities might use the result of the study to bring infrastructural and pedagogical changes in professional courses. Further, some studies need to be continued with students' perspectives on online LIS education. Further research in this area can frame a model for LIS online learning to bring uniformity.

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# ACUTE HYPOGLYCAEMIC STUDIES OF CRUDE DRUG OF CASSIA ALATA LEAVES

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**Abstract:** In recent years, the phyto-therapy is gathering remarkable appreciation in treatment of chronic disorders. The herbal formulations with hepatoprotective, anticancer, antidiabetic, immunomodulatory and lipid lowering effects have widespread acceptability. At present, 'Diabetes mellitus' is one of the serious chronic disorders and has become a global health problem. The present investigation intended to confirm antidiabetic claim of *Cassia alata* Linn. (Family – Leguminosae). The hypoglycaemic activity had been assessed on normal and streptozotocin (STZ) induced diabetic Wistar albino rats using oral test drug. Drug was given in form of dried powder of leaf at the dose of 0.5 g/kg b.w. Prior to the study; the safe dose of drug was selected on the basis of acute oral toxicity testing. In case of normal rats, the test drug showed insignificant hypoglycaemic action but it reduced blood glucose concentration significantly (by 9.2%) in STZ induced diabetic rats. The drug effect was compared with that of standard hypoglycaemic drug i.e. glibenclamide (0.01 g/kg b.w.) which exhibited 20.73% decrease in blood glucose concentration. Thus preclinically, the crude drug of *C. alata* was proved to be effective hypoglycaemic agent.

**Key Words:** *Cassia alata*, acute toxicity, antidiabetic, streptozotocin.

## INTRODUCTION

Today, the world is facing increasing risk of a serious chronic disorder called 'Diabetes mellitus'. Currently 10% of global population is suffering from it (Sammaiah and Shrivastava, 2008). Diabetes mellitus is a group of disorders caused by an inability to produce or use insulin. It shows disordered utilization and storage of proximate nutrients such as carbohydrates, proteins and lipids. Among many forms of Diabetes mellitus, Type II occurs predominantly and affects major population i.e. 90% of diabetic patients (Pullaiah and Naidu, 2003). There are various causal factors that lead to development of Diabetes mellitus, some of them are genetic constitution, hormonal imbalance, ageing, obesity, faulty food habits, physical-mental stress etc.

Till the date, insulin and synthetic oral hypoglycemic agents like sulphonylureas and biguanides are the major players in management of this disease. In spite of the availability of synthetic drugs, there is an ever-increasing demand of antidiabetic herbal options. This is because oral administration of insulin is not possible and repeated insulin injections lead to many adverse side effects. Synthetic oral hypoglycemic drugs are also proved to be equally harmful if taken for prolong period. Hence the pharmacological screening and development of new herbal antidiabetic drugs is immediate need of drug science (Harvey and Champse, 2009, Guyton and Hall, 2008, Satoskar et.al. 2007, Xia and Wang, 2006, Brunton et. al, 2006, Mukhtar et.al. 2004). Therefore through the present work, an attempt has been made to confirm antidiabetic claim of *Cassia alata* Linn.

*Cassia alata* Linn. is a large erect shrub that produces prominent terminal and axillary inflorescences of pretty golden yellow flowers. The plant is cosmopolitan in distribution. It grows wild and also cultivated as an ornamental plant throughout many states of India. Various parts of *C. alata* are used for diverse healing actions. According to Ayurvedic literature leaves cure vata, cough and skin diseases. They act as diuretic, cathartic, purgative, laxative, emmenagogue, abortifacient, anti-inflammatory, etc. (Kirtikar and Basu, 2001, Nadkarni, 1976, Ross, 1999, Anonymous, 1992). It is reported that leaves of *Cassia alata* are used for antidiabetic property in North East India and Jamaica (Kumar, 2002). Pharmacologically petroleum ether extract of leaves had been proved to be anti-hyperglycaemic in streptozotocin induced hyperglycaemic rats (Palanichamy and Nagarajan, 1990, Palanichamy et. al. 1988). As the tribal people have been utilizing whole drug of leaf, it felt relevant to assess hypoglycaemic action using acute treatments of crude drug of powdered leaf material.

## MATERIALS AND METHODS

### Plant Material

The samples of leaves of *Cassia alata* were procured from various regions of Mumbai. The mature leaves were obtained during their flowering season of May to July. The botanical identity was confirmed using the standard herbaria at Blatter Herbarium of St. Xavier's College, Mumbai (Accession No. Blat. 15515). Leaf samples were subjected to artificial drying at 40°C and ground to form powder. The powdered drug samples were moderately coarse as they were seivable through mesh no. 710 with 0.710 mm size of aperture (Evans, 2001, Anonymous, 2007). It was stored in closed, airtight containers with silica bags.

## Animals

Laboratory bred male Wistar albino adult rats weighing 200–250 g were used for the studies. All the animals were procured from Haffkine Bio-Pharmaceutical Corporation, Mumbai. The animals were housed in standard environmental conditions of temperature (21±2°C), humidity (55±10%) and a 12-hour light-dark cycle. They were supplied with commercial pellet diet and water *ad libitum*. The experimental protocol was approved by the Institutional Animal Ethic Committee of R.J. College, Mumbai (Registration No. 525/02/a/CPCSEA, Approval No.- 8/5-8-2010).

## Chemicals

The different chemicals used during the study were streptozotocin (Sisco Pharmaceutical Limited, Mumbai) and glibenclamide (Aventis Pharma Limited, Verna, Goa). Glucometer with Blood gluco-strips (SugarScan Thyrocare Technology Limited, Navi Mumbai), all reagents and chemicals were of analytical grade.

## Acute Toxicity Study

The acute toxicity study was carried out as per the procedure given in OECD Guideline No. 420 (OECD, 2004). The male Wistar albino rats (200–250 g) were used in the study. After the sighting study, the drug of *C. alata* at the dose of 2 g/ kg body weight was given to five animals. The animals were continuously observed for 14 days for mortality and general behaviour. No change in behaviour and death were observed till the end of the study. The drug was considered safe up to the dose of 2 g/kg body weight. From the results, test drug dose of 0.5 g/kg body weight was chosen for the efficacy studies.

## Induction of Diabetes by Streptozotocin

Rats were fasted for 16 hours and then a single intraperitoneal injection of 0.05 g/kg body weight Streptozotocin (STZ) in a 0.1 M Citrate buffer (pH 4.5) was given to them. The fasting blood glucose levels were checked after 3 days. The rats with stable fasting blood glucose level above 250 mg/ dl were used for the acute and sub-acute efficacy studies. After induction of diabetes all the animals were kept in laboratory on normal diet (Santhakumari et. al. 2003, Chattopadhyay et al. 1997).

## Acute Study on Normal Rats

To determine the hypoglycaemic activity of the drug, normoglycaemic rats were fasted for 18 hours. They were divided into two groups of six rats each. Group I served as normal control and received orally 2% gum acacia (vehicle). Group II animals were fed with test drug of *C. alata* at oral dose of 0.5 g/kg body weight in vehicle. The samples of blood were obtained zero, second, third, and fourth hour of the treatment. The blood glucose levels were determined using a glucometer (Bhopale et. al. 2007, Neeli et. al. 2007).

## Acute Study on Streptozotocin induced Diabetic Rats

For testing drug activity on diabetic rats, 18 hour fasted animals were distributed into three groups, each containing six rats. Group III served as diabetic control and was given 2% gum acacia vehicle. Group IV was fed test drug of *C. alata* at the dose of 0.5 g/kg body weight in vehicle. Dosing of 0.01 g/kg body weight of the standard oral hypoglycaemic agent glibenclamide was done for group V. The blood was withdrawn by tail vein puncturing. The samples of blood were obtained at zero, second, third, and fourth hours of the treatment. The blood glucose levels were determined using a glucometer (Bhopale et. al. 2007, Neeli et. al. 2007).

## Statistical analysis

The values of all parameters are expressed as Mean ± SE in tables. The data was statistically analysed by student t test and one-way ANOVA test. P values <0.05 and <0.01 were considered to be significant (Ghosh, 2005).

## RESULTS AND DISCUSSION

In acute oral toxicity study, at dose of 2 g/ kg body weight of *Cassia alata* mortality was not observed. The animal behaviour was found to be unchanged. Therefore 0.5 g/kg body weight dose of drug was considered safe and used for further investigation.

In acute treatment the effect of single dose (0.5 g/kg body weight) of test drug was checked till 4<sup>th</sup> hour of drug administration. Statistical analysis of data showed that test drug produced insignificant reduction in blood glucose levels of normal rats (Group II) as shown in Table 1.

**Table No. 1 Acute study on normal rats**

Gr. No.	Groups	Mean Blood Glucose Levels in mg/dl ± Standard Error			
		0 Hr	2 Hrs	3 Hrs	4 Hrs
I	Normal Control	91.83 ± 4.9	79.33 ± 5.8 (13.61)	74.17 ± 7.4 (19.24)	72.83 ± 8.9 (20.69)
II	<i>C. alata</i> 0.5 g/kg b.w.	82.33±7.8	69.67±8.0 (15.39)	62.50±10.4 (24.09)	54.67±6.7 (33.61)
	t values	1.04	0.97	0.91	1.63
	P values	0.166	0.178	0.192	0.067
n = 6 in each group, df = 10, Table t <sub>[0.05]</sub> = 2.228					
Values in parentheses indicate % reduction in glucose level as compared to 0 Hr					



In case of diabetic rats (Group IV) test drug produced significant decrease in blood glucose level at 3<sup>rd</sup> hour (5.68%) while the standard drug started action at 4<sup>th</sup> hour after drug administration. At 4<sup>th</sup> hour, diabetic rats (Group IV) and standard drug rats (Group V) exhibited quite significant ( $P < 0.05$ ) results with 9.2% and 20.73% reduction in comparison with diabetic control respectively. (Table 2)

**Table No. 2 Acute study on diabetic rats**

Gr. No.	Groups	Mean Blood Glucose Levels in mg/dl $\pm$ Standard Error			
		0 Hr	2 Hrs	3 Hrs	4 Hrs
III	Diabetic Control	481.33 $\pm$ 27	481.67 $\pm$ 11.6 (- 0.07)	486.17 $\pm$ 28.7 (- 1.00)	484.17 $\pm$ 26.1 (- 0.59)
IV	<i>C. alata</i> 0.5 g/kg b.w.	417.00 $\pm$ 18.2	408.00 $\pm$ 17.9 (2.16)	393.33 $\pm$ 17.9 <b>(5.68)*</b>	378.67 $\pm$ 18.3 <b>(9.20)**</b>
V	Standard 0.01 g/kg b.w.	482.33 $\pm$ 5.5	460.17 $\pm$ 14.9 (4.59)	413.5 $\pm$ 13.9 (14.27)	382.33 $\pm$ 11.8 <b>(20.73)**</b>
F values		3.35	3.20	5.35	<b>9.30</b>
CD <sub>[0.05]</sub>				77.68	72.28
CD <sub>[0.01]</sub>				102.23	95.12
P values		0.063	0.070	0.018	0.003
n = 6 in each group, df <sub>1</sub> = 2 and df <sub>2</sub> = 15, Table F <sub>[0.05]</sub> = 3.68					
Values in parentheses indicate % reduction in glucose level as compared to 0 Hr					
* and ** indicate significant results at $P < 0.05$ and $P < 0.01$ in comparison with Diabetic Control Group					

## CONCLUSION

Streptozotocin produces diabetic condition in rats by selectively damaging insulin producing pancreatic  $\beta$ -cells. Consequently it leads to abnormally raised levels of blood glucose, triglycerides and cholesterol while protein level is considerably lowered. These conditions are analogous to human diabetes. In diabetes treatment, the utmost important factor is to maintain abnormally elevated blood glucose concentration within normal range. The present work involved preclinical study of hypoglycaemic potential of leaves of *Cassia alata* in diabetic rats. The drug was ineffective on normal rats. But in diabetic rats, the hypoglycaemic activity might be the result of the synergistic action of antidiabetic active principles of leaves. The drug showed remarkable activity in acute treatment. It can be said that, in comparison with standard oral hypoglycaemic drug, *Cassia alata* showed moderate action. It can be used in polyherbal formulations in combination with other herbal options. In conclusion *Cassia alata* leaves are effective oral hypoglycaemic agent. Further studies involving sub acute treatment and elucidation of action of active phytochemicals are in progress.

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### **3.4.3. JBNN Journal Online website link**

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Original Research Article

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## Fungal Flora Isolated from Deteriorating Card Board and Corrugated Box Samples in Thane and Bhiwandi, India

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### ABSTRACT

#### Keywords

Mycoflora, corrugated boxes, cardboard, biodeterioration

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Many cellulose based articles have found their way into human requirements and have become articles of necessity, paper being one such article. Card board and corrugated boxes are used as packing materials universally and alike paper, these are vulnerable to invasion by cellulose degrading fungi. The study in regions of Thane and Bhiwandi cities on the outskirts of Mumbai city in Western coastal part of Maharashtra, India focused on the invasion of cardboard and corrugated paper boxes by fungi. Twenty four species of fungi belonging to 11 genera were found on the deteriorating card board and corrugated paper samples during the study, prominent amongst them being the genus *Aspergillus*, *Chaetomium*, *Curvularia*, *Trichoderma*, *Penicillium*, *Alternaria* and five other cellulolytic fungal genera. Growth of fungi resulted in crumbling of the cardboard at places due to loss of strength. Many of the fungal forms isolated were potential health hazards which was cause for concern.

### Introduction

Fungi have received attention in recent years, especially after fungal infections came into limelight during COVID-19 and post COVID-19. Although plenty of studies and surveys have been carried out the true extent of fungal diversity is still not fully known and is expected to be much more than what is known

today (Hawksworth, 2001). Apart from taxonomic placement, fungi are also divided into functional groups and one such group with social and environmental relevance is cellulose degrading fungi. Several cellulose based articles having found their way into human civilizations have become articles of necessity. Paper is one such article. Card board and corrugated boxes, derivative



products of the paper industry, have found universal utility as an economical packaging material. Both these cellulosic materials, like paper, are vulnerable to invasion by this consistent group of cellulose degrading fungi, which bring about deterioration of cellulosic materials.

The present study was initiated to conduct a study of cellulose degrading fungi inhibiting cardboard and corrugated paper box samples from cartons used for packaging cutlery, printing papers and other utilities in Mumbai region of Western India. Mumbai is the commercial capital of India and the cities of Thane and Bhiwandi are situated on its outskirts. Both cities, like Mumbai are situated in coastal region of western part of Maharashtra state, India. While Thane is known as the 'lake city', Bhiwandi is famous as the 'Manchester of India' due to its thriving power loom industry. The entire region has a huge demand for paper, cardboard and corrugated packing materials. A survey of literature revealed scattered and scanty literature on fungal organisms invading cardboard in the areas of study which influenced the study.

### Materials and Methods

Samples of cardboard and corrugated boxes showing few signs of deterioration were collected from Thane and Bhiwandi areas in Western parts of Maharashtra state from June-September 2020. The samples were as follows:

Sample No. 1. Cardboard cover of long book register stored in closed dark loft showing signs of dampness during monsoon.

Sample No. 2. Corrugated paper sample from corrugated box used for packaging and storing

cutlery. The samples after collection were stored in sterilized polythene bags at room temperature for further processing. Both the samples showed few visible signs of deterioration. Serial dilution method (Pramer and Schmidt, 1966) was used for isolation of pure cultures of fungal organisms from the samples. Suspensions from the samples were diluted up to  $10^{-5}$  and 1 ml each of the respective dilutions was plated on nutrient medium (Czapex Dox Agar, Czapex Dox Agar with cellulose, PDA) in separate petri plates. The plates were incubated at room temperature for expression of fungal growth. Streptomycin ( $50 \text{ mg l}^{-1}$ ) was added to suppress bacterial growth and contamination. The isolated fungi were identified using standard literature and the standard system of fungal classification.

### Results and Discussion

The different fungal organisms isolated from the cardboard and corrugated paper box samples are depicted in Table 1. Twenty four species of fungi belonging to 11 genera were found on the paper samples during the study. The sample No. 1 viz. cardboard cover of long book register yielded the maximum number of fungal forms followed by the second sample.

The typically dark, humid conditions of storage in the loft, accompanied by dampness during monsoon apparently contributed to the high number of fungi encountered on this sample. Prominent among the isolates was the genus *Aspergillus* with 7 species, followed by *Chaetomium* and *Curvularia* with 3 species each; *Trichoderma*, *Penicillium* and *Alternaria* with 2 species each and the rest of the genera represented by a single species. *Aspergillus*, *Chaetomium*, *Alternaria* and *Memnoniella* were encountered on both the samples.

**Table.1** Fungal forms isolated from the samples

No.	Fungal Organism	No. of Isolates	Isolated from sample		Total presence (No. of samples)
			1	2	
1	<i>Mucor sp.</i>	1	+		1
2	<i>Chaetomium globosum</i> Kunze	3	+	+	2
3	<i>Chaetomium olivaceum</i> Cooke & Ellis	2		+	1
4	<i>Chaetomium crispatum</i> Fuckel	1	+		1
5	<i>Trichoderma pseudokoenigii</i> Rifai	1	+		1
6	<i>Trichoderma viride</i> Pers.	1	+		1
7	<i>Aspergillus fumigatus</i> Fresenius	4	+	+	2
8	<i>Aspergillus nidulans</i> G Winter	1	+		1
9	<i>Aspergillus sydowii</i> Thom & Church	1	+		1
10	<i>Aspergillus flavus</i> Link	5	+	+	2
11	<i>Aspergillus terreus</i> Thom	3	+	+	2
12	<i>Aspergillus niger</i> van Tieghem	7	+	+	2
13	<i>Aspergillus tamari</i> Kita	4	+	+	2
14	<i>Penicillium citrinum</i> Thom, C	2		+	1
15	<i>Penicillium digitatum</i> Pers. (Sacc.)	1	+		1
16	<i>Paecilomyces varioti</i> Bainier	1	+		1
17	<i>Memnoliella echinata</i> (Rivolta) Galloway	2	+	+	2
18	<i>Cladosporium cladosporioides</i> (Fresen) G.A. de Vries	1	+		1
19	<i>Curvulata lunata</i> (Wakker) Boedjin	1	+		1
20	<i>Curvularia pallescens</i> Boedjin	1	+		1
21	<i>Curvularia brachyspora</i> (Boedjin)	1	+		1
22	<i>Alternaria alternata</i> (Fr.) Keissi	2	+	+	2
23	<i>Alternaria solani</i> Sorauer	1	+		1
24	Non sporulating mycelium	1	+		1

The findings are in agreement with those of Dawar *et al.*, 2015. The genus *Aspergillus* dominated the fungal flora which is a fairly common phenomenon (Das and Prasad, 1996). Growth of fungi resulted in symptoms such as crumbling of the cardboard at places due to loss of strength. This is in conformity with symptoms reported by Dhawan and Garg (1993). Many of the fungal forms isolated were potential health hazards by virtue of their capability to cause allergic reactions (Cramer *et al.*, 2014) or as pathogens (English 1980) which was ample cause for concern.

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# Nesting site studies of White-bellied Sea Eagle (*Haliaeetus leucogaster* Gmelin, 1788) along Konkan Coast, Dist. Ratnagiri, M. S., India

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## ABSTRACT

Nesting behaviour of White-bellied Sea Eagle has been meagerly studied though; the raptor is widely distributed along the coast of Maharashtra. Present study was carried out by conducting surveys for locating their nesting sites along coast of Ratnagiri district and 12 nests of White-bellied Sea Eagle *Haliaeetus leucogaster* at different sites along Velas to Dabhol were studied. Various ecological parameters such as nesting tree species, nesting tree height, nesting tree GBH, nest height, geo-coordinates, distance from coast, disturbance level were considered. WBSE was found to be most abundantly nesting (N =12) on *Casuarina equisetifolia* tree which, accounts to 83% of the total nesting trees and only 02 nests, just 17% of the total nesting trees studied, were on *Sterculia foetida*. In most cases, it was observed that WBSEs prefer nest trees with larger GBH as compared to same tree species of smaller girth. Location of nest from the supratidal mark was measured to study nesting preference about distance from the sea and we found that, the nearest nest was 30 m away from the coast and the farthest one was at a distance of around 900 m. A positive correlation (Pearson's Correlation test,  $r = 0.865$ ,  $P < 0.05$ ) between the nest height and the nest tree indicates the characteristic nest building of WBSE on the top most canopy of the nesting tree. Highest and lowest nest height recorded was 34 m and 18 m from ground, respectively. At each study site, the level of threat was noted with respect to anthropogenic disturbances and those caused by other species. The land ownership of the nesting sites was noted as it would be a crucial parameter for preparing conservation guidelines.

**Key words :** Nest site characteristics, Ecological parameters, Land ownership, Anthropogenic disturbances, Conservation guidelines.

## Introduction

Coastal region of Maharashtra, popularly known as Konkan coast is characterized by beautiful serene beaches, coconut (*Cocos nucifera*) and Whistling Pine (*Casuarina equisetifolia*) plantations and dense forests. It comprises of 5 major districts and Ratnagiri

among them being located towards southwest part of Maharashtra. The district is bordered by portion of biodiversity hotspot Western Ghats to the east, i.e., Sahyadri hills and open Arabian Sea on its west. Being coastal region, variation in temperature is insignificant, ranging between 22 °C to 30 °C. It is highly humid and experiences heavy rainfall during

rainy season resulting into copious vegetation that includes large trees, shrubs, and herbs sheltering variety of animals.

White-bellied Sea Eagle (WBSE) (*Haliaeetus leucogaster*) is observed to be distributed along both the coasts, i.e., west and east coast of India. It is large sized, diurnal, monotypic bird of prey confined to aquatic bodies like inshore sea, islands, estuaries, and wetlands (Quinn, 1969). Global distribution stretches from India, Sri Lanka, SE Asia, Philippines to Australia and Tasmania (del Hoyo *et al.*, 1994; Mayr and Cottrell, 1979). Though, it is a resident avian species, it has been meagerly studied from research point of view.

Morphologically it can be described as, large sized raptor having wing span of around 180-220 cm, wedge shaped tail measuring around 75-85 cm in length and adult with exclusively with grey and white plumage. Males can be distinguished from females as they are slightly smaller in size. These birds are usually in pairs and prefer tall tree tops for nesting. Huge sized nest serves for feeding, breeding and resting.



Fig. 1. An adult White-bellied Sea Eagle



Fig. 2. Juvenile White-bellied Sea Eagle

## Materials and Methods

Sea shores of villages in Ratnagiri district from Velas (in North) to Dabhol (in South) were extensively scanned for identifying the nest locations of WBSE.

### Following are the nesting sites

**Nest locations:** 1) Velas 17°57.629'N; 73°1.683'E, 2) Velas - 17°57.655'N; 73°1.87'E, 3) Kelshi 17°54.85'N; 73°3.327'E, 4) Kelshi 17°54.64'N; 73°3.715'E, 5) Aade 17°53.263'N; 73°4.408'E, 6) Anjarle 17°50.825'N; 73°5.46'E, 7) Anjarle 17°51.216'N; 73°5.157'E, 8) Murud 17°46.855'N; 73°6.945'E, 9) Murud 17°47.078'N; 73°6.823'E, 10) Karde 17°45.09'N; 73°7.418'E, 11) Ladghar 17°43.216'N; 73°8.053'E, 12) Kolthare 17°39.049'N; 73°8.054'E. Field studies were conducted (from November 2016 to April 2017) using modern instruments like binoculars (Celestron 8 x 40), GPS (Garmin Etrex -10) for defining the coordinates, cameras (Nikon Cool Pix P 600 Nikon D 5300 SLR coupled with AF-S NIKKOR 55-300mm lens and a tripod), Laser Range Finder (Spypoint 1500 PRO) and measuring tape for measuring Girth at breast height of the trees. WBSE nests were identified by conducting reconnaissance survey, multiple visits at different sites and opportunistic finding by following the bird. The nesting occupancy was identified by observing activities like adult carrying food, bird calls and other movement of WBSE within one km radius from the nesting tree (Azman *et al.* 2013). Some nests were found on private lands and were observed by seeking help from local people.

The visual surveys were carried out for recording parameters like:

(1) Height of the nesting tree, (2) Height of the nest from the ground, (3) Nesting tree species, (4) GBH of nesting tree, (5) Distance from sea and (6) Status of occupancy of each nest. Some nests were found on private lands and were observed by seeking help from locals. Nesting locations spread in entire study area of almost 80 km coastline were covered on two-wheeler.

## Results and Discussion

During survey, 8 villages of Ratnagiri district namely Velas, Kelshi, Aade, Anjarle, Murud, Karde, Ladghar, Kolthare were identified with 12 nests of WBSE. They were seen performing various activi-



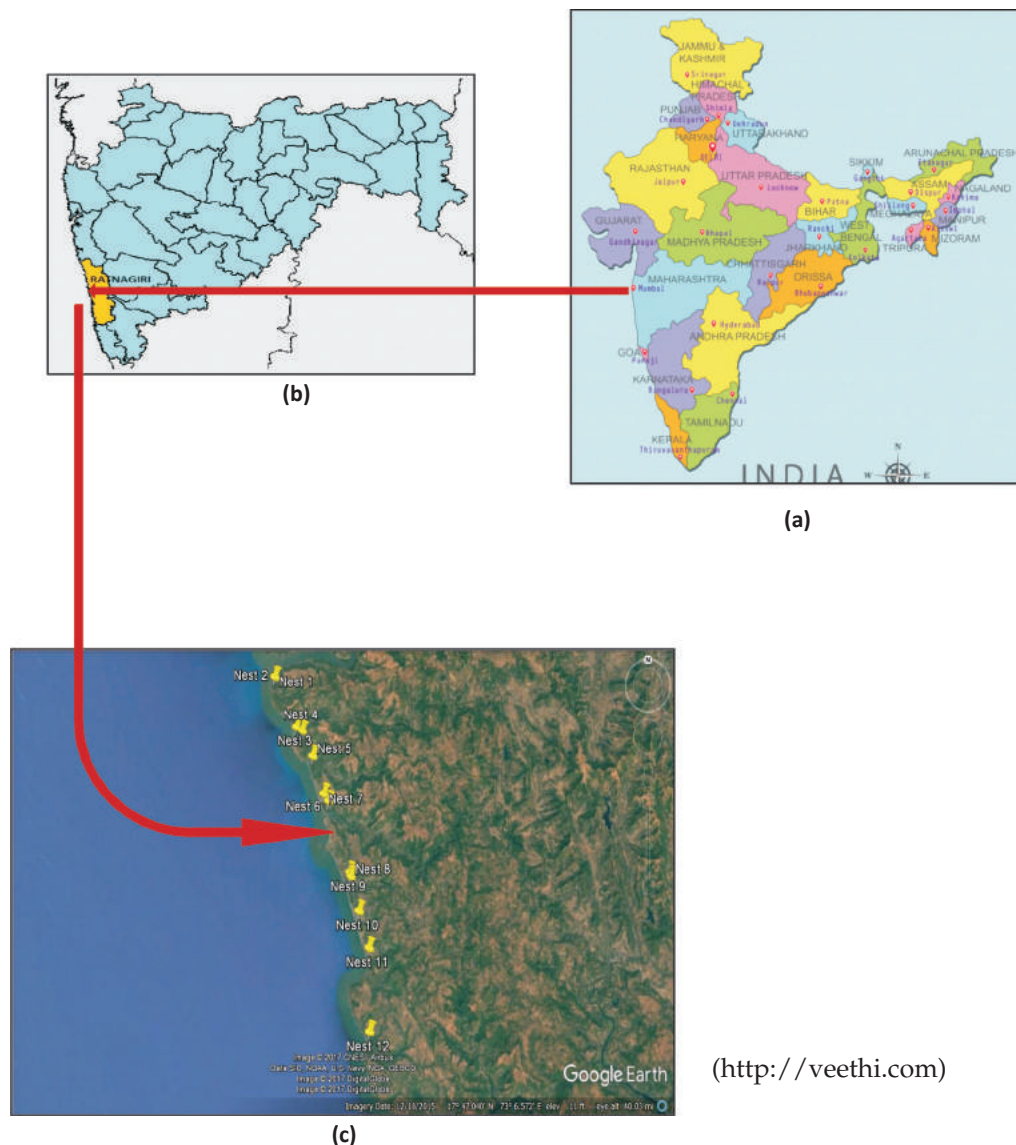


Fig. 3. Study Area- a) Map of India b) Ratnagiri District map c) Nest-sites

ties like roosting, feeding, nest repairing, soaring, and courtship display. Courtship display such as diving, gliding, flying parallelly, mating and duetting, i.e. continuous calls given by male and female simultaneously after mating were heard. At many occasions the raptor was seen getting into territorial fights with intruders, like House crow and other predatory birds mainly Black kite and Brahminy kite. House crows were seen stealing food items and nesting materials from WBSE's nest and were usually seen mobbing the juvenile when adult wasn't around. It was frequently seen bringing mango (*Mangifera indica*) leaves to a nest site where juvenile was present. WBSE were observed capturing prey

items like sea snake, fishes and wader birds. In one isolated incidence, an adult was observed feeding a sea snake to its young ones. Juvenile was seen indulging in various activities like wing flapping, nibbling small barks of the nesting tree, playing around with the adult.

The presence of nests of other raptors in nearby areas were recorded which could pose threat to the productivity of WBSE nest. Anthropogenic disturbances such as logging, lopping and recreational activities were also considered. Different levels of disturbances were categorized as low, moderate and high depending upon the qualitative data collected.

- (a) Low: Rare human activity, low recreational use and no nest of other raptors within 200 m radius.
- (b) Moderate: Moderate recreational use, moderate human activities in the vicinity and no nest of other raptors within 200 m radius.
- (c) High: High human activities and high recreational use and/or nests of other raptors or



Fig. 4. House crows stealing nesting



Fig. 5. An adult carrying nesting material material from the WBSE's nest



Fig. 6. Fight with Black kite



Fig. 7. Mating pair

crows within 200 m radius.

Table 1 shows different parameters of nesting recorded during studies and nesting tree species as well. It can be seen that, out of 12 nests 10 nests are on *Casuarina equisetifolia* while remaining two on *Sterculia foetida*.

### Nesting Preference

WBSE was observed to be mainly nesting on *Casua-*

Table 1. Nest Characteristics at different sites

Place	Nest tree	Height (m)		GBH (cm)	Distance from sea (m)	Distance from other water body (m)
		Tree	Nest			
Velas	<i>Casuarina equisetifolia</i>	33	26	183	200	45
Velas	<i>Casuarina equisetifolia</i>	35	31	137.2	220	30
Kelshi	<i>Casuarina equisetifolia</i>	32	25	223	141	NA
Kelshi	<i>Casuarina equisetifolia</i>	27	25	244	900	NA
Aade	<i>Casuarina equisetifolia</i>	31	29	264.16	142	500-550
Anjarle	<i>Sterculia foetida</i>	27	26	188	260	350
Anjarle	<i>Casuarina equisetifolia</i>	35	27	289.56	46	NA
Murud	<i>Sterculia foetida</i>	19	18	237.74	340	150
Murud	<i>Casuarina equisetifolia</i>	27	25	508	349	8
Karde	<i>Casuarina equisetifolia</i>	26	24	279.4	30	120
Ladghar	<i>Casuarina equisetifolia</i>	28	27	269	40	400—420
Kolthare	<i>Casuarina equisetifolia</i>	37	34	374.9	100	700-1000

*rina equisetifolia* (N =10) tree that forms 83% of the total nesting trees (i.e. N=12) and only 2 nests (that is 17%) are on *Sterculia foetida*. But the result does not imply that the species actively selects *Casuarina* sp., because most beaches are covered with *Casuarina* plantation. So, the preference for *Casuarina* tree might be ascribed to the abundance of *Casuarina* plants at most of the near beach areas. In addition, it has been observed that WBSE builds its nest high on tree. *Casuarina* being the only taller species available on these beaches, can also be one of the reasons for preference otherwise WBSE is reported selecting other tall trees such as *Mangifera indica* in Maharashtra (Katdare and Mone 2003; Katdare *et al.*, 2004) and *Ficus* sp. in Netrani island (Pande *et al.*, 2011).

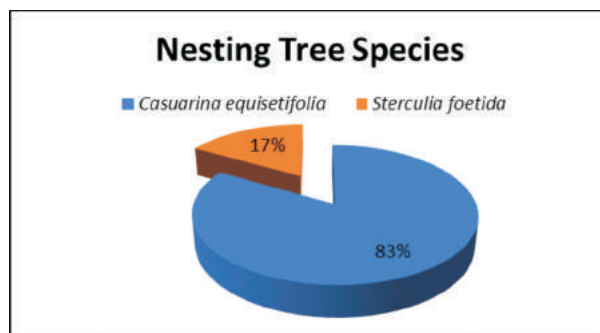


Fig. 8. Nesting tree species of White-bellied Sea Eagle

### Correlation-regression analysis

The correlation between the height of the nest and height of the nesting tree shows positive association (Pearson's Correlation test,  $r = 0.865$ ,  $P < 0.05$ ) between them, which indicates the characteristic nest building on the top most canopy of the nesting tree.

### Nesting tree GBH preference

Nesting tree GBH was assessed for checking whether

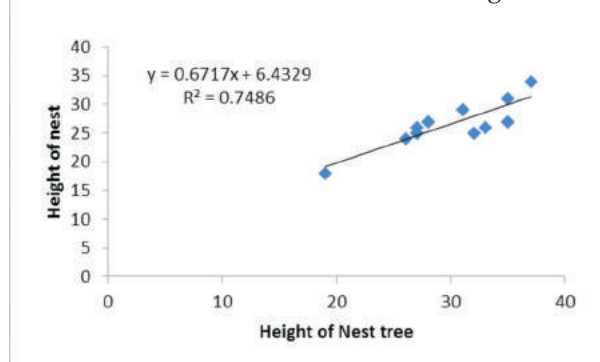


Fig. 9. Nest Height Vs nesting tree height

the nest-building is related to the tree girth. As most of the nests were found on the *Casuarina* tree plantations it could be concluded that WBSE prefers nest trees with larger GBH as compared to the trees with smaller GBH (approximately less than 100 cm) in the surrounding area.

It can be seen from the Figure 10, that majority of the nests were placed in the GBH range of 250-300 cm followed by the ranges 200-250 and 150-200, while single nests were observed in the ranges 100-150, 350-400 and 450-500.

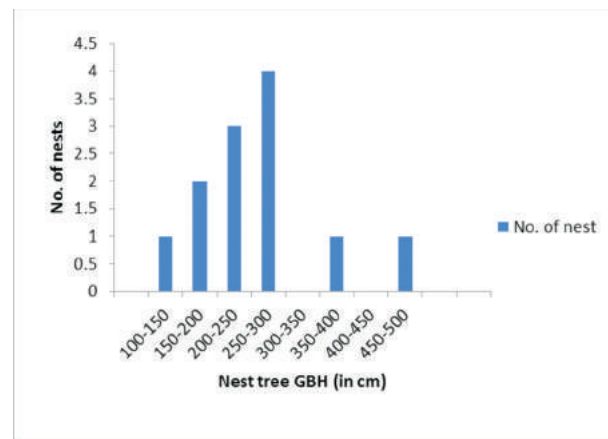


Fig. 10. No. of Nests Vs Nest Tree GBH

### Preferred distance from the sea

Distance between nesting site and the sea was measured to know how far WBSE preferably nests away from sea. 3 nests were seen in ranges of 0-100, 100-200 and 200-300 meters away from sea and 2 nests in range 300-400 meters and a single nest was seen in range 900-1000 meters which was the farthest single nest that was recorded. No nest was seen from meters 400 to 900. It can be understood that, proximity to sea can serve advantageous as sea is the main hunting ground for the bird.

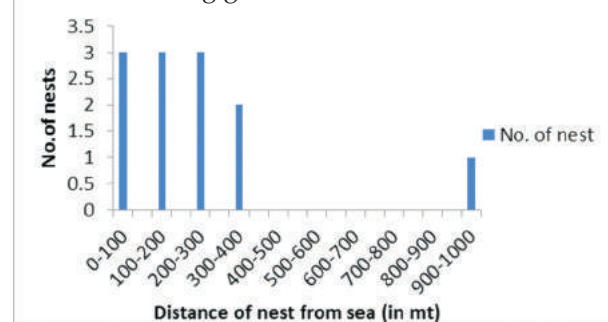


Fig. 11. No. of nests Vs Nest distance from sea



### Conservational importance

During field survey, extent of threats and disturbance at each of the nest site was studied and the same is shown in Table 2. The analysis reveals that, habitat of WBSE majorly included *Casuarina* plantations. Most of the other nests were on private land ('wadi') owned by locals, where coconut and areca nut are cultivated along with ketki (*Pandanus sp.*) plantations which form the hedges. Study sites were assigned high, moderate and low threat levels.

The nests were frequently monitored to confirm their constant occupancy. Thus, 11 out of 12 nests were found to be occupied, while one was found to be inactive. From the information given by locals, it was noted that 1 inactive nest was active in the previous breeding season at Velas and a second nest was built by the same pair for the current breeding season. According to a survey done by Sahyadri Nisarg Mitra - a Chiplun based environmental NGO - during 1996-1998, three nesting sites (total 6 nests) were observed, wherein the respective breeding pairs were using two nests (both in good condition) in alternate years.

The locations of the nesting habitat of WBSE were recorded and the ownership of land where the nesting tree is located is shown in Figure 12. The trees with nest were found either in Private Land or in the land belonging to Forest Department. This is a crucial parameter as it directly poses threat to the

occupied nest and its inhabitants, viz., adults, juveniles, eggs. During the present study, 75% nests were found in private land and only 25% of them were found in the government regulated land (Figure 12). The protection of nesting trees on private land is at the sole discretion of land owner. Such lands provide a limited access and hence, there are restrictions on the movement of people in these lands. This obviously limits the disturbances to nesting activities of WBSE. Also, the nesting trees lying in jurisdiction of forest department are subject to revenue generation since *Casuarinas* are planted so that can be logged after certain years for timber pur-

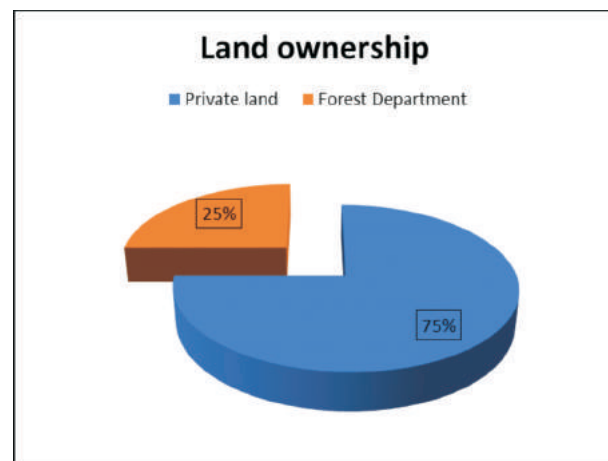


Fig. 12. Land ownership of the 12 Nest sites of White-bellied Sea Eagle

Table 2. Nest-details

Sr. No.	Place	Habitat	Land ownership	Disturbance level	Occupied
1.	Velas	Plantations of <i>Casuarina equestifolia</i> , <i>Calotropis sp.</i>	Forest dept.	High	-
2.	Velas	Plantations of <i>Casuarina equestifolia</i> , <i>Calotropis sp.</i>	Forest dept.	High	+
3.	Kelshi	Plantations of <i>Casuarina equestifolia</i> , <i>Areca catechu</i> and <i>Cocos nucifera</i>	Private	Moderate	+
4.	Kelshi	Plantations of <i>Mangifera indica</i> , <i>Tectona grandis</i>	Private	Low	+
5.	Aade	Plantations of <i>Pandanus sp.</i> , <i>Casuarina equestifolia</i>	Private	High	+
6.	Anjarle	Plantations of <i>Casuarina equestifolia</i> , <i>Areca catechu</i> and <i>Cocos nucifera</i>	Private	moderate	+
7.	Anjarle	Plantations of <i>Cocos nucifera</i> and <i>Musa sp.</i>	Private	Low	+
8.	Murud	Plantations of <i>Mangifera indica</i> , <i>Areca catechu</i> , <i>Musa sp.</i> and <i>Cocos nucifera</i>	Private	Moderate	+
9.	Murud	Plantations of <i>Cocos nucifera</i>	Private	Low	+
10.	Karde	Plantations of <i>Casuarina equestifolia</i> , <i>Cocos nucifera</i> , and <i>Ipomea sp.</i>	Forest dept.	High	+
11.	Ladghar	plantations of <i>Cocos nucifera</i>	Private	Moderate	+
12.	Kolthare	Plantations of <i>Cocos nucifera</i> , <i>Calotropis sp.</i> , <i>Castor</i> , <i>Pandanus sp.</i> , <i>Ficus sp.</i>	Private	Low	+

[- = not occupied, + = occupied]

poses. This is one of the prime concerns as it was seen that these trees remain unprotected which, may subsequently destroy their micro-habitat and force WBSEs to relocate elsewhere. These nesting trees are prone to destruction due to activities such as lopping, logging and tree cutting. These activities could have large scale implications on the nesting by WBSE. The adults may eventually, abandon their eggs or young ones, which further could be destroyed or preyed upon and this in turn may greatly affect the nest productivity.

## Conclusion

Though mentioned as least concern (with declining population) in IUCN red list (<https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22695097A93489471.en>), it is known to be vulnerable because of human interference and habitat loss. It was observed that these eagles select nesting near the human dominated landscapes. They were predominantly seen nesting on the tree commonly used for timber collection. The most ironical point is that, *Casuarina* plantation has been conducted in large areas by locals for obtaining timber. The trees in private land are logged for raising money and also sometimes for firewood and it has already been mentioned that majority of WBSE nests were on these trees. The existence of WBSE in the study area is being threatened by loss of habitat due to developmental activities, disturbance to nesting pairs by various human activities like clearing of the revenue lands, building private beach resorts that attract tourists and consequent tourism activities along the shore. This might force the birds to abandon their nests and relocate to sub-optimal habitats where their breeding success can get affected (Bell, 1983; Bilney and Emison 1983; Clunie, 1994; Dennis and Lashmar, 1996; Mayr and Cottrell, 1979). Considering the anthropogenic interferences, a sudden decline in population of WBSE in the near future could be expected. Thus, monitoring the population in this region is essential, conservation of population of this bird by creating awareness amongst the locals is mandatory for the management of the species.

This study is a preliminary assessment of the nesting sites of WBSE in the northern Ratnagiri district of Maharashtra. Monitoring future changes will be possible as this survey should serve as groundwork for the collection of baseline data that will add

to the better conservation and management of WBSE in these regions.

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# CERTIFICATE OF GRANT INNOVATION PATENT

**Patent number:** 2021106648

The Commissioner of Patents has granted the above patent on 8 December 2021, and certifies that the below particulars have been registered in the Register of Patents.

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**Title of invention:**

A METHOD FOR FORMULATING VEGETABLES AND FRUITS WASTE CULTURE MEDIUM FOR INDUSTRIAL FUNGI CULTIVATION

**Name of inventor(s):**

Saranraj, P.; Sudha, A.; Anitha, B.; Totewad, Narayan Dattatraya; Jabeen, T. M. Sadiqua; Hasan, Mustafa Salah and Manjaramkar, Vinda

**Term of Patent:**

Eight years from 23 August 2021

NOTE: This Innovation Patent cannot be enforced unless and until it has been examined by the Commissioner of Patents and a Certificate of Examination has been issued. See sections 120(1A) and 129A of the Patents Act 1990, set out on the reverse of this document.



Dated this 8<sup>th</sup> day of December 2021

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**Sec 128                      Application for relief from unjustified threats**

- (1) Where a person, by means of circulars, advertisements or otherwise, threatens a person with infringement proceedings or other similar proceedings a person aggrieved may apply to a prescribed court, or to another court having jurisdiction to hear and determine the application, for:
- (a) a declaration that the threats are unjustifiable; and
  - (b) an injunction against the continuance of the threats; and
  - (c) the recovery of any damages sustained by the applicant as a result of the threats.
- (2) Subsection (1) applies whether or not the person who made the threats is entitled to, or interested in, the patent or a patent application.

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*Certain threats of infringement proceedings are always unjustifiable.*

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  - (b) the person, by means of circulars, advertisements or otherwise, threatens a person with infringement proceedings or other similar proceedings in respect of the patent applied for, or the patent, as the case may be; then, for the purposes of an application for relief under section 128 by the person threatened, the threats are unjustifiable.

*Courts power to grant relief in respect of threats made by the applicant for an innovation patent or the patentee of an uncertified innovation patent*

- (2) If an application under section 128 for relief relates to threats made in respect of an innovation patent that has not been certified or an application for an innovation patent, the court may grant the application the relief applied for.

*Courts power to grant relief in respect of threats made by the patentee of certified innovation patent*

- (3) If an application under section 128 for relief relates to threats made in respect of a certified innovation patent, the court may grant the applicant the relief applied for unless the respondent satisfies the court that the acts about which the threats were made infringed, or would infringe, a claim that is not shown by the applicant to be invalid.

**Schedule 1                      Dictionary**

**certified**, in respect of an innovation patent other than in section 19, means a certificate of examination issued by the Commissioner under paragraph 101E(e) in respect of the patent





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# CERTIFICATE OF GRANT INNOVATION PATENT

**Patent number:** 2021107045

The Commissioner of Patents has granted the above patent on 1 December 2021, and certifies that the below particulars have been registered in the Register of Patents.

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**Title of invention:**

A METHOD FOR FORMULATION OF NATURAL LABORATORY DISINFECTANT USING ORANGE PEEL WASTE

**Name of inventor(s):**

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**Term of Patent:**

Eight years from 24 August 2021

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  - (b) an injunction against the continuance of the threats; and
  - (c) the recovery of any damages sustained by the applicant as a result of the threats.
- (2) Subsection (1) applies whether or not the person who made the threats is entitled to, or interested in, the patent or a patent application.

*Certain threats of infringement proceedings are always unjustifiable.*

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    - (i) has applied for an innovation patent, but the application has not been determined; or
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  - (b) the person, by means of circulars, advertisements or otherwise, threatens a person with infringement proceedings or other similar proceedings in respect of the patent applied for, or the patent, as the case may be;
- then, for the purposes of an application for relief under section 128 by the person threatened, the threats are unjustifiable.

(2) If an application under section 128 for relief relates to threats made in respect of an innovation patent that has not been certified or an application for an innovation patent, the court may grant the application the relief applied for.

(3) If an application under section 128 for relief relates to threats made in respect of a certified innovation patent, the court may grant the applicant the relief applied for unless the respondent satisfies the court that the acts about which the threats were made infringed, or would infringe, a claim that is not shown by the applicant to be invalid.

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# CERTIFICATE OF GRANT INNOVATION PATENT

**Patent number:** 2021103195

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**Title of invention:**

A NOVEL METHOD FOR PREPARATION OF SILVER NANOPARTICLES

**Name of inventor(s):**

Totewad, Narayan Dattatraya; Saranraj, P.; Nile, Shivraj Hariram; Manjramkar, Vinda; Marakwad, Tejaswini  
Ramchandra and Bhalerao, Anil Laxman

**Term of Patent:**

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  - (b) an injunction against the continuance of the threats; and
  - (c) the recovery of any damages sustained by the applicant as a result of the threats.
- (2) Subsection (1) applies whether or not the person who made the threats is entitled to, or interested in, the patent or a patent application.

**Sec 129A**                      **Threats related to an innovation patent application or innovation patent and courts power to grant relief.**

*Certain threats of infringement proceedings are always unjustifiable.*

- (1) If:
- (a) a person:
    - (i) has applied for an innovation patent, but the application has not been determined; or
    - (ii) has an innovation patent that has not been certified; and
  - (b) the person, by means of circulars, advertisements or otherwise, threatens a person with infringement proceedings or other similar proceedings in respect of the patent applied for, or the patent, as the case may be; then, for the purposes of an application for relief under section 128 by the person threatened, the threats are unjustifiable.

*Courts power to grant relief in respect of threats made by the applicant for an innovation patent or the patentee of an uncertified innovation patent*

- (2) If an application under section 128 for relief relates to threats made in respect of an innovation patent that has not been certified or an application for an innovation patent, the court may grant the application the relief applied for.

*Courts power to grant relief in respect of threats made by the patentee of certified innovation patent*

- (3) If an application under section 128 for relief relates to threats made in respect of a certified innovation patent, the court may grant the applicant the relief applied for unless the respondent satisfies the court that the acts about which the threats were made infringed, or would infringe, a claim that is not shown by the applicant to be invalid.

**Schedule 1**                      **Dictionary**

**certified**, in respect of an innovation patent other than in section 19, means a certificate of examination issued by the Commissioner under paragraph 101E(e) in respect of the patent



Australian Government

IP Australia

# Register of Patents

Patents Act 1990

## Innovation Patent

Patent no: 2021104201

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**Inventor(s):** Totewad, Narayan Dattatraya  
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Manjramkar, Vinda  
Balasaheb, Joshi Vikas  
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**Title:** AN ORGANIC FOOD PRESERVATIVE COMPOSITION

**Term:** Eight years from 15 July 2021

**Date Granted:** 13 October 2021

**Date Certified:**

**Date of Patent:** 15 July 2021

**Status:** REVOKED

**Expiry Date:** 15 July 2029

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**Date Revoked:** 29 April 2022

## Design Application Details

### Application Number:

357992-001

### Cbr Number:

213011

### Cbr Date:

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### Applicant Name:

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## Design Application Status

### Application Status:

Design Accepted and Published, Journal No is 18/2022 and Journal Date is 06/05/2022

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Design Office, Kolkata : [controllerdesign.ipo@nic.in](mailto:controllerdesign.ipo@nic.in)

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## Design Application Details

**Application Number:**

354562-001

**Cbr Number:**

210671

**Cbr Date:**

08/12/2021 19:56:25

**Applicant Name:**

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## Design Application Status

**Application Status:**

Design Accepted and Published, Journal No is 07/2022 and Journal Date is 18/02/2022

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## Design Application Details

**Application Number:**

356425-001

**Cbr Number:**

211879

**Cbr Date:**

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## Design Application Status

**Application Status:**

Design Accepted and Published, Journal No is 13/2022 and Journal Date is 01/04/2022

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## Design Application Details

### Application Number:

356423-001

### Cbr Number:

211879

### Cbr Date:

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## Design Application Status

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Design Accepted and Published, Journal No is 11/2022 and Journal Date is 18/03/2022

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