Academia
A Multi Disciplinary Research Journal

Editorial

Nehru Arts & Science College Kanhangad, affiliated to Kannur University, has entered into the 50th year of its effective functioning. As an educational institution it imparts University level education to students in Science, Social Science, Management and Language streams in the relatively backward district of Kasaragod in Kerala. The institution has made important contribution in the fields of teaching, learning, research and extension activities. *Academia* is a multidisciplinary research journal and the present volume is a rich collection of original research papers of the teachers pertaining to this institution. The journal fosters academic writing and engages in dissemination of knowledge. I profusely thank all the paper contributors for enriching the volume.

A.Ashokan

Academia

A Multi Disciplinary Research Journal

Contents

Test for Variance Using Maple Programme

P. V. Pushpaja

Nehru Arts & Science College Kanhangad, Kerala - 671314
email: pv_pushpa@yahoo.co.in, Mob: +91-9446168593

Abstract

Here we suggest a general parametric method for testing the variance of any distribution using Maple Programme. By deriving the first four central moments of the test statistics its distribution is fitted as a member in the Generalized Lambda Distribution (GLD) family. To conduct the test and to evaluate the power of the test, computer programmes in Maple language are provided. The method can be applied for any unimodal continuous distribution.

Keywords: Parametric tests, Maple Programmes, Moments and Cumulants, Generalized lambda distribution

1. Introduction

The variance is the most reliable and hence frequently used measure of dispersion. Almost all decision making process require the knowledge of variance of the underlying distribution. A comparison of means based on multiple samples often requires their variances to be equal. Hence a test for variance is a pre-requisite for all tests of mean. Because of the wide applicability, the problem of testing the variance is of particular importance. Generally, test for variance is conducted under the assumption of normality of the parent distribution. That is, if m_2 is the variance based on a sample of size n drawn from a normal population having finite variance μ_2, then the test of significance of variance is conducted based on the statistics $\chi^2 = \frac{nm_2}{\mu_2}$, which is distributed as χ^2 with $(n-1)$ degrees of freedom. Pearson and Hartley (1950) and Khamis and Rudert (1965) gave tables of the cumulative probabilities of the distribution of χ^2 statistic. Harter (1964) provided tables of percentage points of the distribution of χ^2 statistic, for different degrees of freedom and for different levels.

The GLD representation of almost all well known distributions are discussed in details in Karian and Dudewicz (2000). Also numerical results reveals that the GLD representation of any unimodal continuous distribution almost agrees with the true distribution both in terms of cumulative distribution and probability distribution functions.

In this article, we suggest a parametric test for population variance. The method is based on the GLD representation of the distribution of the test statistics. This method consists in deriving the first four moments of the test statistics and fitting its distributions under the null and alternative hypotheses. Since it is possible to fit the distribution of the test statistics under the alternative hypothesis, power of the test can also be evaluated under this method. The method is more reliable as it utilizes maximum information from the sample and it can be used for all types of distributions. To apply this method, computer programmes in Maple language are provided. The most significant aspect of the method is that, by inputting the given set of observations in the programme, one can examine whether the

observations are drawn from a population with the specified variance against any of the alternatives.

A brief review of the GLD family is discussed in section 2. By deriving the first four central moments of the test statistics, the proposed test is described in section 3. The application of the method on real life data is also provided in this section.

2. Generalized Lambda Distributions (GLD) Family

The generalized lambda distribution (GLD) family is a four parameter family of distributions derived by Ramberg and Schmeiser (1974), as a generalization of the Tukey's (1960) one parameter family. Unlike most other four parameter family of distributions, GLD has no explicit expression for its pdf, instead, members of the family are specified in terms of their quantile function. The quantile function of a four parameter GLD family is given by

$$Q(p) = \lambda_1 + \frac{p^{\lambda_3} - (1-p)^{\lambda_4}}{\lambda_2}, \ \ \lambda_2 \neq 0, \ \ 0 \leq p \leq 1 \tag{1}$$

Here, λ_1 and λ_2 represent the location and scale parameters where as λ_3 and λ_4 represent the shape parameters of the distribution. The support of the random variable with the above distribution is $[\lambda_1 - \frac{1}{\lambda_2}, \lambda_1 + \frac{1}{\lambda_2}]$ when $\lambda_3 > 0$ and $\lambda_4 > 0$. The support is $(-\infty, \lambda_1 + \frac{1}{\lambda_2})$ when $\lambda_3 < 0$ and $\lambda_4 = 0$ and it is $(\lambda_1 - \frac{1}{\lambda_2}, \infty)$ when $\lambda_3 = 0$ and $\lambda_4 < 0$. The parameters λ_3 and λ_4 are independent of change of origin and scale but λ_1 and λ_2 changes according to the changes in the origin and scale. In other words, if X is a member of the GLD family with parameters λ_1, λ_2, λ_3 and λ_4, then $Y = aX + b$ will also be a member of the GLD family with parameters $a\lambda_1 + b$, $a\lambda_2$, λ_3 and λ_4.

2.1. Estimation of Parameters and Fitting of GLD

The popular method of fitting GLD to a data set is the method of moments due to Ramberg et al. (1979). In this method the parameters λ_3 and λ_4 are first derived by solving the equations $\alpha_3 = \hat{\alpha}_3$ and $\alpha_4 = \hat{\alpha}_4$, where α_3 and α_4 are the coefficients of skewness and kurtosis of the distribution and $\hat{\alpha}_3$ and $\hat{\alpha}_4$ are their sample estimates. This system of equations are too complex, so that to obtain the solutions, computer programme in Maple language is provided. The program utilizes the values of $\hat{\alpha}_1$, $\hat{\alpha}_2$, $\hat{\alpha}_3$, $\hat{\alpha}_4$ and an initial (λ_3, λ_4) as input and a maximum of 10 iterations were used. By solving the equations $\alpha_1 = \hat{\alpha}_1$, $\alpha_2 = \hat{\alpha}_2$ and using the estimated values of λ_3 and λ_4, the values of λ_1 and λ_2 were determined. It may be noted that skewness and kurtosis are independent of location and scale parameters and moments of all orders exist if λ_3 and λ_4 are of same sign.

Since, corresponding to every admissible pair of skewness and kurtosis measures GLD family contains a member, a wide variety of densities with different tail shapes are available in the family. This family was used for Monte-Carlo simulation studies of robustness of statistical procedures and for sensitivity analysis. The family contains unimodal, U-shaped, J-shaped, symmetric and asymmetric distributions. One of the important advantages of this family is that all its members can be represented by a single quantile function and almost all known distributions can be represented as its member.

3. Test for Variance

Existing methods of testing the variance are based on the assumption of normality of the parent population or asymptotic normality of the test statistics. Here, we present a general parametric method of testing the variance without making any assumption regarding the form of the distribution. Here the test statistics is the sample variance m_2. The method involves the determination of the first four moments of m_2 and fitting a GLD to the distribution of m_2. From the quantile function of the fitted

GLD, percentile points of the distribution of the test-statistics for different values of n and α can be computed. By fitting the distribution of the test statistics under the alternative hypothesis, power of the test can also be evaluated. To conduct the test, computer programmes in Maple language are provided.

3.1. Derivation of the First Four Moments of the Variance

For a given sample of n observations, $x_1, x_2, \ldots x_n$, let $m_r^{'}$ and m_r respectively denote the rth order sample raw moments and central moments. Then

$$m_r^{'} = \frac{1}{n} \sum_{i=1}^{n} x_i^r, \ r = 1, \ 2, \ 3, \ \ldots$$

and

$$m_r = \frac{1}{n} \sum_{i=1}^{n} (x_i - m_1^{'})^r, \ r = 1, \ 2, \ 3, \ \ldots$$

If k_r, $r = 1, \ 2, \ \ldots$ denote the rth order sample cumulant, then the relations among the first four sample cumulants and moments are given by (Wishart (1930))

$$k_1 = m_1^{'} \tag{2}$$

$$k_2 = \frac{nm_2}{n-1} \tag{3}$$

$$k_3 = \frac{n^2 m_3}{(n-1)(n-3)} \tag{4}$$

and

$$k_4 = \frac{n^2[(n+1)m_4 - 3(n-1)m_2^2]}{(n-1)(n-2)(n-3)}$$

The expected value of rth order sample cumulant is given as

$$E(k_r) = K_1(k_r) = K_r, \ r = \ 1, \ 2, \ldots. \tag{5}$$

The second cumulant of k_2, denoted as $K_2(k_2)$, is given as

$$K_2(k_2) = \frac{K_4}{n} + \frac{2K_2^2}{n-1} \tag{6}$$

The third cumulant of k_2 is denoted as $K_3(k_2)$ and is obtained as

$$K_3(k_2) = \frac{K_6}{n^2} + \frac{12K_4K_2}{n(n-1)} + \frac{4(n-2)K_3^2}{n(n-1)^2} + \frac{8K_2^3}{(n-1)^2} \tag{7}$$

The fourth cumulant of k_2, denoted as $K_4(k_2)$, is given by

$$\begin{aligned} K_4(k_2) = &\frac{K_8}{n^3} + \frac{24K_6K_2}{n^2(n-1)} + \frac{32(n-2)K_3K_5}{(n(n-1))^2} + \frac{8(4n^2 - 9n + 6)K_4^2}{n^2(n-1)^3} \\ &+ \frac{144K_4K_2^2}{n(n-1)^2} + \frac{96(n-2)K_3^2K_2}{n(n-1)^3} + \frac{48K_2^4}{(n-1)^3} \end{aligned} \tag{8}$$

Using the relation between the population moments and cumulants, the first four moments of the test statistics m_2 are obtained as

$$E(m_2) = \frac{n-1}{n}\mu_2 \tag{9}$$

Variance of m_2 is

$$V(m_2) = \frac{n-1}{n^3}\big[(n-1)\mu_4 - (n-3)\mu_2^2\big] \tag{10}$$

Third central moment of m_2, denoted as $\mu_3(m_2)$ is

$$\mu_3(m_2) = \frac{n-1}{n^5}\big[(n-1)^2\mu_6 - 3(n-5)(n-1)\mu_4\mu_2 \\ - 2(3n^2 - 6n + 5)\mu_3^2 + 2(n^2 - 12n + 15)\mu_2^3\big] \tag{11}$$

The fourth moment of m_2, denoted as $\mu_4(m_2)$ is

$$\mu_4(m_2) = \frac{n-1}{n^7}[(n-1)^3\mu_8 - 4(n-7)(n-1)^2\mu_6\mu_2 \\ - 2(n-1)(12n^2 - 24n + 28)\mu_5\mu_3 \\ + (3n^4 - 12n^3 + 42n^2 - 60n + 35)\mu_4^2 \\ - (6n^4 - 42n^3 + 294n^2 - 630n + 420)\mu_4\mu_2^2 \\ + 16(6n^3 - 27n^2 + 50n - 35)\mu_3^2\mu_2 \\ + (3n^4 - 27n^3 + 279n^2 - 765n + 630)\mu_2^4] \tag{12}$$

To test $H_0 : \mu_2 = \mu_2^0$, under H_0, the estimated values of mean, variance, skewness and kurtosis of the test statistics m_2 are denoted as $(a_1,\ a_2,\ a_3,\ a_4)$ and are given as follows

$$a_1 = \frac{n-1}{n}\mu_2^0 \tag{13}$$

$$a_2 = \frac{n-1}{n^3}\big[(n-1)m_4 - (n-3)(\mu_2^0)^2\big] \tag{14}$$

$$a_3 = \frac{A_3}{a_2^{3/2}} \tag{15}$$

$$a_4 = \frac{A_4}{a_2^2} \tag{16}$$

where

$$A_3 = \frac{n-1}{n^5}\big[(n-1)^2m_6 - 3(n-5)(n-1)m_4\mu_{2,0} - \\ 2(3n^2 - 6n + 5)m_3^2 + 2(n^2 - 12n + 15)(\mu_2^0)^3\big]$$

$$A_4 = \frac{n-1}{n^7}[(n-1)^3m_8 - 4(n-7)(n-1)^2m_6\mu_2^0 \\ - 2(n-1)(12n^2 - 24n + 28)m_5m_3 \\ + (3n^4 - 12n^3 + 42n^2 - 60n + 35)m_4^2 \\ - (6n^4 - 42n^3 + 294n^2 - 630n + 420)m_4(\mu_2^0)^2 \\ + 16(6n^3 - 27n^2 + 50n - 35)m_3^2\mu_2^0 \\ + (3n^4 - 27n^3 + 279n^2 - 765n + 630)(\mu_2^0)^4]$$

The values of $(a_1,\ a_2,\ a_3,\ a_4)$ of the test statistics m_2 can be evaluated using the following programme.

Programme-P_1

Procedure to determine the values of $(a_1,\ a_2,\ a_3,\ a_4)$ of sample variance via observations
    # Function: Findalphas via observations
    # Purpose:– Compute a-values of sample mean
    # Arguments: X- -list of data
    Findalphas:= Proc(X::list)
    Local $n,\ i,\ m_1,\ m_2,\ m_3,\ m_4,\ m_5,\ m_6,\ m_7,\ m_8,\ S,\ S_1,$
$S_2,\ S_3,\ S_4,\ S_5,\ S_6,\ A1,\ A2,\ A3,\ A4\ A5\ a_1,\ a_2,\ a_3,\ a_4, ;$
    $n := nops(X);$
    $m_1 := evalf(convert(X,\ '+')/n);$
    $S := [seq((X[i] - m_1)^2,\ i = 1..n)];$
    $m_2 := evalf(convert(S,\ '+')/n);$
    $S_1 := [seq((X[i] - m_1)^3,\ i = 1..n)];$
    $m_3 := evalf(convert(S_1,\ '+')/n);$
    $S_2 := [seq((X[i] - m_1)^4,\ i = 1..n)];$
    $m_4 := evalf(convert(S_2,\ '+')/n);$
    $S_3 := [seq((X[i] - m_1)^5,\ i = 1..n)];$
    $m_5 := evalf(convert(S_3,\ '+')/n);$
    $S_4 := [seq((X[i] - m_1)^6,\ i = 1..n)];$
    $m_6 := evalf(convert(S_4,\ '+')/n);$
    $S_5 := [seq((X[i] - m_1)^7,\ i = 1..n)];$
    $m_7 := evalf(convert(S_5,\ '+')/n);$
    $S_6 := [seq((X[i] - m_1)^8,\ i = 1..n)];$
    $m_8 := evalf(convert(S_6,\ '+')/n);$
    $a_1 = evalf(\frac{(n-1)\mu_2}{n});$
    $A_1 := evalf(m_4 - \frac{(n-3)\mu_2^2}{n-1});$
    $a_2 := evalf(\frac{(n-1)^2 A_1}{n^3});$
    $A_2 := evalf(m_6 - \frac{3(n-5)m_4\mu_2}{n-1} - \frac{(6n^2-12n+10)m_3^2}{(n-1)^2} + \frac{(2n^2-24n+30)\mu_2^3}{(n-1)^2});$
    $a_3 := evalf(\frac{A_2}{\sqrt{n}A_1^{3/2}});$
    $A_3 := evalf(m_8 - \frac{4(n-7)m_6\mu_2}{n-1} - \frac{(24n^2-48n+56)m_3 m_5}{(n-1)^2});$
    $A_4 := evalf(\frac{(3n^4-12n^3+42n^2-60n+35)m_4^2}{(n-1)^3} - \frac{(6n^4-42n^3+294n^2-630n+420)m_4\mu_2^2}{(n-1)^3});$
    $A_5 := evalf(\frac{16(6n^3-27n^2+50n-35)\mu_2 m_3^2}{(n-1)^3} + \frac{(3n^4-27n^3+279n^2-765n+630)\mu_2^4}{(n-1)^3});$
    $a_4 := evalf(\frac{A_3+A_4+A_5}{nA_1^2});$
    $Ah := [a_1, a_2, a_3, a_4];$ end:

Using these values of $(a_1,\ a_2,\ a_3,\ a_4)$ as arguments in the following programme, the GLD parameters of the distribution of the test statistics and the percentile points can be evaluated.

Programme-P_2

Procedure to determine lambdas and the percentile points from sample A_h-values
    #Function: Findlambdas
    #Purpose: Estimation of GLD parameters by Newton's approx.
    #Arguments: A_h–list of $a_1,\ a_2,\ a_3,\ a_4$;
    # $I_3,\ I_4$–Initial approx. of λ_3 and λ_4
    Findlambdas := Proc(A_h::list, I_3::Numeric, I_4::Numeric)
  Local $A,\ B,\ C,\ D_1,\ D_2,\ D,\ \alpha_1,\ \alpha_2,\ \alpha_3,\ \alpha_4,\ F,\ \hat{A}_1,\ \hat{A}_2,\ \hat{A}_3,\ \hat{A}_4,$
$V,\ J,\ err3,\ err4,\ F_k,\ J_k,\ Y,\ Eq3,\ Eq4,\ A_1,\ A_2,\ L, FirstL,\ SecondL,\ l,\ R_1,\ R_2,\ R_3,\ R_4,$
$R_5,\ R_6,\ R_7,\ R_8;$
    with(linalg, vector, matrix, jacobian, linsolve):
    $\hat{A}_1 := 0; \hat{A}_2 := 1; \hat{A}_3 := evalf(Ah[3]);$
    $\hat{A}_4 := evalf(Ah[4]); L_3 := I_3; L_4 := I_4;$
    $A := \frac{1}{1+\lambda_3} - \frac{1}{1+\lambda_4};$
    $B := \frac{1}{1+2*\lambda_3} + \frac{1}{1+2*\lambda_4} - 2*Beta(1+\lambda_3, 1+\lambda_4);$
    $C := \frac{1}{1+3*\lambda_3} - \frac{1}{1+3*\lambda_4} - 3*Beta(1+2*\lambda_3, 1+\lambda_4) + 3*Beta(1+\lambda_3, 1+2*\lambda_4);$

$D_1 := \frac{1}{1+4*\lambda_3} + \frac{1}{1+4*\lambda_4} + 6*Beta(1+2*\lambda_3, 1+2*\lambda_4);$

$D_2 := -4*Beta(1+3*\lambda_3, 1+\lambda_4) - 4*Beta(1+\lambda_3, 1+3*\lambda_4); D := D_1 + D_2;$

$\alpha_1 := \lambda_1 + A/\lambda_2; \quad \alpha_2 := abs(B-A^2)/\lambda_2^2;$

$\alpha_3 := \frac{C-3*A*B+2*A^3}{abs((B-A^2)^{3/2})};$

$\alpha_4 := \frac{d-4*A*C+6*B*A^2-3*A^4}{(B-A^2)^2};$

$Eq3 := \alpha_3 - \hat{A}_3; Eq4 := \alpha_4 - \hat{A}_4;$

$F := vector([Eq3, Eq4]); V := vector([\lambda_3, \lambda_4]);$

$j := evalf(jacobian(F,V)); err3 := 1; err4 := 1;$

while $(err3 > .0001 \text{ or } err4 > .0001)$ do

$F_k := vector([evalf(subs(\lambda_3 = L_3, \lambda_4 = L_4, -Eq3)), evalf(subs(\lambda_3 = L_3, \lambda_4 = L_4, -Eq4))]);$

$J_k := matrix([[subs(\lambda_3 = L_3, \lambda_4 = L_4, j[1,1]), subs(\lambda_3 = L_3, \lambda_4 = L_4, j[1,2])],$

$[subs(\lambda_3 = L_3, \lambda_4 = L_4, j[2,1]), subs(\lambda_3 = L_3, \lambda_4 = L_4, j[2,2])]]);$

$Y := linsolve(J_k, F_k); L_3 := L_3 + Y[1];$

$L_3 := L_3 + Y[1]; L_4 := L_4 + Y[2];$

$err3 := evalf(abs(subs(\lambda_3 = L_3, \lambda_4 = L_4, Eq3)));$

$err4 := evalf(abs(subs(\lambda_3 = L_3, \lambda_4 = L_4, Eq4)));$

od;

$print(L_3, L_4, err3, err4);$

$A_1 := evalf(subs(\lambda_3 = L_3, \lambda_4 = L_4, A));$

$A_2 := evalf(subs(\lambda_3 = L_3, \lambda_4 = L_4, B));$

$L_2 := abs(sqrt(((A_2 - A_1^2))/\hat{A}_2));$

$L_1 := \hat{A}_1 - A_1/L_2;$

$FirstL := [L_1, L_2, L_3, L_4];$

if $L_3 < 0$ then $SecondL := [-FirstL[1], FirstL[2], FirstL[4], FirstL[3]]$ else $SecondL := FirstL$ fi;

if $evalf(Ah[3]) < 0$ then $L := [-SecondL[1], SecondL[2], SecondL[4], SecondL[3]]$ else $L := SecondL$ fi ;

$l := [L[1]*sqrt(Ah[2]) + Ah[1], (L[2])/(sqrt(Ah[2])), L[3], L[4]];$

$t_{0.05} := l[1] + \frac{(0.05)^{l[3]} - (0.95)^{l[4]}}{l[2]};$

$t_{0.95} := l[1] + \frac{(0.95)^{l[3]} - (0.05)^{l[4]}}{l[2]};$

$t_{0.025} := l[1] + \frac{(0.025)^{l[3]} - (0.975)^{l[4]}}{l[2]};$

$t_{0.975} := l[1] + \frac{(0.975)^{l[3]} - (0.025)^{l[4]}}{l[2]};$

$t_{0.01} := l[1] + \frac{(0.01)^{l[3]} - (0.99)^{l[4]}}{l[2]};$

$t_{0.99} := l[1] + \frac{(0.99)^{l[3]} - (0.01)^{l[4]}}{l[2]};$

$t_{0.005} := l[1] + \frac{(0.005)^{l[3]} - (0.995)^{l[4]}}{l[2]};$

$t_{0.995} := l[1] + \frac{(0.995)^{l[3]} - (0.005)^{l[4]}}{l[2]};$

end:

To find the Power of the test, first fit the distribution of the test statistics under the alternative hypothesis using the programme P_2 and then using these lambda values in the following programme, power is obtained.

Programme-P_3

```
# Procedure to determine the power of the test for variance
# Function: Power via iteration
# Purpose: Compute power values of GLD test for variance
# Arguments: l–list of lambda values
# V0, V1– variance values under H0, H1
# P0–initial approx. of power
#K–percentile point corr. to the test
FindPower:= Proc(L:: list,v0::Numeric, v1::Numeric, P0::Numeric, K::Numeric)
Local Q, E, err, P, p;
```

$Q := evalf(L[1] + \frac{p^{L[3]} - (1-p)^{L[4]}}{L[2]});$

$P := P0; E := K - Q; err := 0.5;$

while $(err > .00001)$ do $P := P + .002;$

$err := evalf(subs(p = P, E));$ od;

if the test is lower tailed then print(P, err) else print$(1 - P, err)$ fi; end

3.2. Application of the Method

Illustrations of the test for variance on real life data are given below.

Example-1: An Experiment of measuring the percentage shrinkage on dying of 50 clay specimens produced the following data.

18.2, 20.8, 16.4, 16.6, 17.4, 19.3, 20.5, 21.2, 19.6, 18.0, 21.2, 19.4, 18.7, 24.0,
23.6, 18.5, 19.0, 20.4, 20.6, 20.8, 23.1, 15.4, 18.2, 17.6, 17.5, 19.3, 17.6, 21.4,
14.8, 15.8, 18.5, 21.2, 19.6, 17.8, 20.3, 21.2, 22.3, 20.3, 19.7, 23.1, 15.6, 13.4,
14.3, 20.2, 16.6, 13.9 18.4, 20.1, 20.5, 17.0.

Do the data indicate that the variance of the percentage shrinkage is equal to 6 against the alternative that it is above 6.

Solution: The hypothesis to be tested in this case is $H_0 : \mu_2 = 6$ against $H_1 : \mu_2 > 6$, where μ_2 denote the population variance. For this sample, the central moments of orders 2 to 8 are $m_2 = 6.1277$, $m_3 = -3.3796$, $m_4 = 98.7197$, $m_5 = -109.8457$, $m_6 = 2124.2$, $m_7 = -3432.2$ and $m_8 = 51167$. Hence the skewness and kurtosis of the sample are $\sqrt{b_1} = -0.23$ and $b_2 = 2.7422$. To fit a GLD to the distribution of m_2, under H_0, using programme P_3, the estimated values of $(\alpha_1, \alpha_2, \alpha_3, \alpha_4)$ are obtained as $(5.88, 1.2329, 0.0637, 3.0214)$, and using programme P the corresponding GLD parameters are obtained as $\lambda_1 = 5.7996$, $\lambda_2 = 0.174$, $\lambda_3 = 0.1224$, $\lambda_4 = 0.1404$. Hence, under H_0, the quantile function of the fitted distribution of m_2 is

$$Q(p) = 5.7996 + \frac{p^{0.1224} - (1 - p)^{0.1404}}{0.174}, \ 0 \le p \le 1 \tag{17}$$

where $p = P(m_2 \le R)$, R is any specified value of m_2. Since the test is upper tailed, for $\alpha = 0.05$, the $(1 - \alpha)$-quantile of the fitted distribution is $R_2 = 7.7369$ and hence under GLD test the rejection region is $m_2 > 7.7369$. Since the observed value of m_2 (6.1277) is less than R_2, the test leads to the acceptance of the null hypothesis. For this example, when we apply the normal approximation method, the rejection region is obtained as $m_2 \ge 31.7538$, which also leads to the acceptance of the null hypothesis. For $\mu_2 = 7$, we got the power of the GLD test as 0.188 while for the normal test it is only 0.0583.

Example-2: The following data represents the lifetimes (in hours) of a sample of 40 transistors:

112, 121, 126, 108, 141, 104, 136, 134, 121, 118, 143, 116, 108, 122,
127, 140, 113, 117, 126, 130, 134, 120, 131, 133, 118, 125, 151, 147,
137, 140, 132, 119, 110, 124, 132, 152, 135, 130, 136, 128.

Do the data indicate that the lifetime distribution has a variance equal to 175 hours against the alternative that it is below 175.

Solution: The hypothesis to be tested in this case is $H_0 : \mu_2 = 175$ against $H_1 : \mu_2 < 175$. For this sample, the sample variance $m_2 = 137.444$ and the skewness and kurtosis measures are $\sqrt{b_1} = .0583$ and $b_2 = 2.4175$. To fit a GLD to the distribution of m_2 under H_0, the estimated values of $(\alpha_1, \alpha_2, \alpha_3, \alpha_4)$ are $(170.625, 394.8399, 0.4883, 3.1375)$, and the corresponding GLD parameters are $\lambda_1 = 159.86$, $\lambda_2 = 0.009169$, $\lambda_3 = 0.0645$, $\lambda_4 = 0.19$. For $\alpha = 0.05$, the rejection region for the test is $m_2 < R_1$, where $R_1 = 141.755$. Since the observed value of m_2 (137.444) is less than R_1, the test leads to the rejection of the null hypothesis. For this example, when we apply the normal approximation method, the rejection region is obtained as $m_2 < 110.629$ and the test leads to the acceptance of the null hypothesis. To find the power of the test at $\mu_2 = 170$, the estimated values of $(\alpha_1, \alpha_2, \alpha_3, \alpha_4)$ are obtained as $(165.75, 433.733, 0.4208, 3.1057)$ and the corresponding GLD

parameters are $\lambda_1 = 156.005$, $\lambda_2 = 0.00886$, $\lambda_3 = 0.0731$, $\lambda_4 = 0.1828$ and hence the power of the proposed test is obtained as 0.1122, while for the normal test it is only 0.059.

From the verifications and illustrations described above, it is observed that in all type of distributions, the proposed method provide better tests. Also in the case of real life data the proposed test results in higher power.

References

[1] Harter, H. L. (1964). *New Tables of the Incomplete Gamma-function and of Percentage Points of the Chi-square and Beta Distributions*, U. S. Government Printing office, Washington,D. C.

[2] Karian, Z. A. and Dudewicz, E. J. (2000). *Fitting Statistical Distributions-The Generalised Lambda Distribution and Generalised Bootstrap Methods*, CRC press, NewYork.

[3] Khamis, S. H. and Rudert, W. (1965). Tables of incomplete gamma function ratio, Chi-square integral, Poisson distributions. *Darmstadt: Justus Von Leibig.*

[4] Khamis, S. H. and Rudert, W. (1965). Tables of incomplete gamma function ratio, Chi-square integral, Poisson distributions. *Darmstadt: Justus Von Leibig.*

[5] Kendall, M. G. and Stewart, A. (1977). *The Advanced Theory of Statistics*, Fourth ed., Vol.1 Griffin, London.

[6] Pearson, E. S. and Hartley, H. O. (1950). Tables for the χ^2 integral and of the Cumulative Poisson Distributions. *Biometrika*, 37, 313.

[7] Ramberg, J. and Schmeiser, B. (1974). *An Approximate Method for Generating Asymmetric Random Variables*, Communications of the ACM,17, 78-82.

[8] Ramberg, J. Tadikamalla, P. Dudewicz , E. J. and Mykytka, E. (1979). *A Probability Distribution and Its Uses in Fitting Data*, Technometrics, 21(2), 201-214.

[9] Tukey, J. W. (1960). The practical relationship between the common transformations of percentages of counts and of amounts. boot-strap. *Technical report 36, Statistical Techniques Research Group*, Princeton University.

[10] Wishart, J. (1930).The derivation of certain high order sampling product moments from a normal population. *Biometrika*, 22, 224-238.

A Study of Neelambari and Revagupti Ragas Played on Edakka.

Nishanth P.[1], K. M. Udayanandan[2]

[1] School of Pure and Applied Physics
Kannur University, Kerala- 673 635

[2] Department of Physics
Nehru Arts & Science College Kanhangad, Kerala- 671314
email: udayanandan@gmail.com, Mob: +91-9495147570

Abstract

The study aims to find the spectral features of edakka using 2 sound samples Neelambari and Revagupti. The sound samples are analyzed using mathlab toolbox. The various spectral features are plotted and compared.

1. Introduction

India has a rich musical tradition. There are large number of percussion instruments in India and among them hour glass shaped drums are common in folk music and are found in variety of sizes. Certain drums like udukku are better with hand and drums like damaru knotted string is made to strike the two faces to produce sound. There are hour glass shaped drums that produce music by striking with stick. One among them is edakka, a small percussion drum used in percussion ensembles of Kerala and in temple rituals. No other drum in hour glass type match in technique and control of edakka [1]. The instrument is also called aavanchi. The tension variation mechanism enables it to produce wide variety of tones and the instrument is capable of producing tone nearly to two octaves [2]. This drum is popularised by Njeralathu Ramapothuval in general public of Kerala which was very restricted to play only inside the temple walls. Edakka is considered as a divine instrument, especially when it is presented at Sopanam, during puja sessions. It is performed either solely or accompanied with Sopanam music during the closed door puja time. It is also employed in koodiyat-

tam, kathakali and other art forms. The instrument is suspended over the shoulder and played on right face [3]. In sopanam music edakka is used as musical instrument and in percussion ensemble panchavadhyam it is used as rhythmic instrument. When and where edakka originated is still a dispute but the family of instruments and the construction are mentioned in "Perumkathai" [4]. Some believe that edakka originated from damaru since there are many similarities between the instruments. Edakka is also said to be originated from tudi used by tribes in Waynad [5]. The instrument is made from jack fruit wood and the parts of the instrument can be dismantled easily. The main parts of the instrument include Kutti, Jeevakkol, Poduppukal, Valayangal, Tholkacha and Edakka kol. The construction of the instrument needs concentration and patience. Jeevakol and Poduppukal were not part of the instrument in ancient period but are added recently. Traditionally the instrument is made with hand but machines are now employed for making holes and shaping the wood.

2. MIR toolbox

MIR tool box in mathlab can be used for analysis of music and its content. It consists of many features to study music and musical instruments. Pitch, timbre, rhythm and loudness are the characteristics used to distinguish musical sounds. The sound produced by different instruments like flute, harmonium are recognized by the analysis of zero crossing rate, root mean square energy and MFCC (Mel frequency ceptral coefficients)[6]. Zero crossing rate indicate the noisiness in the audio signal. It is the number of times that the signal changes its phase [7]. Root mean square energy indicate the overall energy content of the signal. It is the square root of the mean of the squares of the amplitude. MFCC indicate spectral shape of the signal. Spectral roll off is another feature that can be used for the analysis of signals. It measures the frequency below which certain amount of energy is concentrated in the signal and default ratio of the energy is 0.85. The amount of energy above certain cut off energy is calculated as brightness. The value range of this feature is between zero and one. The spectral features are low level features and can give only signal characteristics but mid level features like chord and rhythm can give rich information for musical analysis [8]. Perceived fundamental frequency is called the pitch and the regular repeated pattern of sound, rhythm are the mid level features that can give properties of music. Beat and tempo can give good information of rhythm of the music.

3. Neelambari and Revagupthi ragas

Neelambari raga is a carnatic raga said to have sleep promoting qualities. This is a raga that is associated with relaxation, peace, and slumber. A janya of Shankarabharanam, Neelambari has gamakas that flow seamlessly from one note to another. But research done by Gitanjali[11] claims that it has no difference in sleepness when this raga is played. She compared the effect of Neelambari raga and Kalyani raga on sleep in eight subjects and concluded that the sleep promoting quality mentioned for Neelambari is a conditioned response since most lullabies in carnatic music is in Neelambari raga. The arohana and avarohana of Neelambari is as given below [12].
Arohana: S G3 M1 P N3 S

Avarohana: S N3 P D2 N2 P M1 G3 R2 M1 G3 S
Some malayalam songs composed in this raga are "Kanne urangurangu", "Thankamanassu" etc. Revagupthi is a janya raga (derived scale) [9]. It is generally played during **morning**. The arohana and avarohana of the raga are given below [10].
Arohana: S R1 G3 P D1 S
Avarohana: S D1 P G3 R1 S
Some songs composed in Revagupti are "Gopalaka Pahimam" by Maharaja Swathi Thirunal, " Griha bala memi" composed by Tyagaraja, " Sada vinatu sadare" by Muthuswami Dikshitar etc.

4. Materials and Method

The sound samples of the two ragas are collected. They were first converted into wav format for study. To make uniformity the samples are reduced for 20 seconds. Features like zero crossing rate, RMS energy and Spectral roll off are studied.

5. Analysis and Discussion

The features of ragas are obtained using mathlab and frame wise analysis are done. The table below shows the features studied.

Feature	Nilambari	Revagupthi
RMS energy	0.15469	0.088813
Zero crossing rate	1090.7913	965.6047
Roll off (Hz)	8619.2533	6440.9512

The graphs of zero crossing rate of the ragas are given in Figure 1 and 2. The MFCC Coefficients are also found out. The obtained value for MFCC coefficients and the corresponding graphical representations are given in Figure 3 and Figure 4 . The musical content of ragas are studied by finding pitch and tempo. The Figure 5 and Figure 6 give the frame wise pitch content in the ragas. Tempo is another feature which gives information of rhythm. The variation in tempo of two ragas are depicted in Figure 7 and Figure 8.
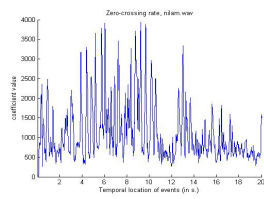
Figure 1: Zero crossing rate of Neelambari.
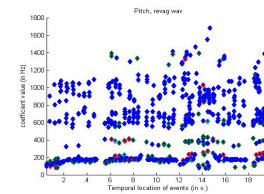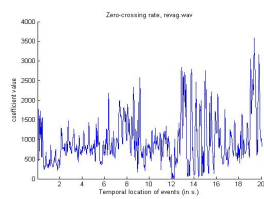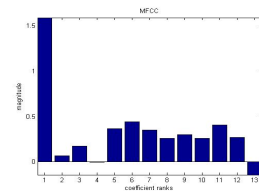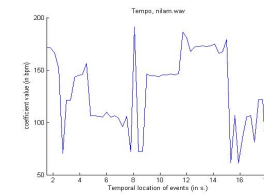

Figure 2: Zero crossing rate of Revagupti.

Figure 3: MFCC of Neelambari.

Figure 4: MFCC of Neelambari.

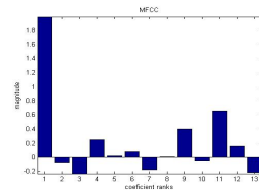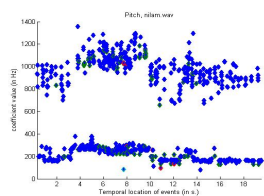Figure 5: Pitch of Neelambari.

Figure 6: Pitch of Revagupthi.

Figure 7: Tempo of Neelambari.
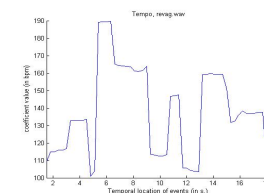
Figure 8: Tempo of Revagupthi.

6. Conclusion

Two Carnatic ragas are analyzed and their features are found. The analysis shows that there are lots of differences in the features of both ragas. The physical interpretation of these obtained features are not done here. We wish to show that there are plenty of features associated with these ragas which were composed thousands of years back and it is possible to study them scientifically.

References

[1] B. C. Deva, Indian Music, New age International (2002).

[2] L. S. Rajagopalan, J. Madras Music Acad.

[3] S. Venkitasubramonia Iyer, J. Madras Music Acad. , 134-141 (1967).

[4] https://issuu.com/shilpajayachandran/docs/edakkacorrected.

[5] Joseph V Fernandaz, Vadhyakala Vidnjaniyam, Kerala Bookmark (2007).

[6] Sankaye S. R., Tandon U. S. , IOSR J. Comp. Eng. , 1-7.

[7] Priyanka S Jhadav, International Journal on Recent and Innovation Trends in Computing and Communication , 3(7), 5001-5006 (2015).

[8] Poonam Priyadarshini et al., American International Journal of Research in Science, Technology, Engineering and Mathematics, 9(2), December 2014-February 2015, pp. 150-153.

[9] https://en.wikipedia.org/wiki/Revagupti.

[10] http://www.ragasurabhi.com/carnatic-music/raga/raga–revagupti.html.

[11] Gitanjali B, Indian J Physiol Pharmacol. 1998 Jan; 42(1):119-22.

[12] http://www.ragasurabhi.com/carnatic-music/raga/raga–neelambari.html.
.

An Introduction to Regional Economics

A. Ashokan

Department of Economics

Nehru Arts & Science College Kanhangad, Kerala - 671314

email: aashokaneco@gmail.com, Mob: +91-9446169090

Abstract

The aim of the paper is to familiarize regional economics to the students of social sciences with a broad development perspective. The paper is presented in six sections. The basic suggestion of the paper is to promote sector wise regional studies which may provide adequate base for regional economic policy fostering national development. From a methodological perspective the study identifies the need for strengthening inter-disciplinary or multidisciplinary regional studies which may provide adequate input for regional economic policy which ultimately encourages spatial and national development.

Conceptualizing Region

Region is a familiar term in geography or in regional science. It refers to a suitable spatial unit such as a climatic region, an industrial region, an agricultural region, a natural region, an administrative region, a political region, and so on. That is, a region is a medium scale area of land or water which can be differentiated on the basis of physical characterisics (such as deserts, mountains, grasslands, forest cover, mineral resources, climate etc), human characteristics (such as historical regions, tourism regions, religious regions etc.), or functional characteristics (such as regions linked by commuting patterns, trade flows, newspaper circulations, television and radio broadcasts etc.). It follows that a region is a sub-system within a system (the country itself). The strength of the sub-systems promotes greater inter-connectivity leading to greater efficiency of the system. However, conceptualizing region has become a difficult and less convincing exercise. This kind of an ambiguity in conceptualizing region has provoked Harry W. Richardson to write: "Defining regions precisely is such a nightmare that most regional economists prefer to shy away from the task, and are relieved when they workwith administrative regions on the grounds that policy considerations require it or that data are not available for any other spatial units". It is true that there has been a great deal of discussion on the concept of region, but this has not led to any kind of firm agreement. Probably the most prevalent view is that there is no unambiguous method of defining an ideal region and that wherever possible spatial analysts should work with the more neutral concept of space. A common procedure is to delimit the region by reference to physical criteria, administrative boundaries or data availability. Certainly, most researchers accept that it is easier to define the core of a region (usually a central city) than to map its outer boundary. Geographers, ecologists, governments, and economists all conceptualize regions differently. Physical geographers might be interested in river basins or mountains, ecologists in interlinked ecosystems, and governments in administrative and political jurisdictions. Economists, in turn, are interested in areas that are bound together by trade links, the buying and selling of raw materials, industrial and consumer goods and services, and labor. An area which covers a relatively contained and cohesive network of trade is called a functional economic area and this

is the type of region that works best for economic modeling. Region may also be viewed as a whole range of different spatial scales, from global, e.g., climatic regions like tropical rain forests, tundra, etc., to local e.g., urban regions such as central business district and high class residential district, etc. Regions' continue to provide a conceptual and analytical focus for often overlapping concerns with economic, social, political, cultural and ecological change. Against the backdrop of inter- and multi-disciplinary perspectives, 'regions' remain an arena in which synthesis across disciplines - economics, geography, planning, politics and sociology - can take place. At the same time regional governance, policy and politics are facing the conceptual, methodological and political complexities of new modes and geographies of governance and emergent multi-agent and multi-level institutional architectures (Andy Pike, 2009). The formation and development of economic regions is a continuous process and their characteristics also change during the growth process. An economic region includes all aspects of economy, i.e., agriculture, industries, resource potentialities, transportation, marketing, etc. Economic region is a territorial component of a country's national economy. The formation of economic regions is closely connected with the territorial (geographical) division of labour.

According to Oxford Dictionary of Geography (2006) "regionalization is the demarcation of regions such that there is little variation within each region while each region is sharply distinct from the others". The bases for regionalization vary so much that different regions may be delimited according to the criteria used. It is a form of classification in which areas are divided into regions on the basis of some specific characteristics. The most important thing in regionalization is to achieve the internal integrity of the region, which takes shape as a result of the development of the country (zone, etc.) of which the region is a part. At the same time regionalism is a process of creating or reinforcing regions, most notably through the cultural and social characteristics which go to identify and reinforce regions. To summarize regionalism is the political manifestation of regional identity and it is the 'voice' of regions at the political level. When we look forward it can be seen that the concept of 'new regionalism' embraces a number of components or discourses such as associational economy, learning

regions, competitive regionalism, and regional innovations systems.

The aim of the paper is to introduce regional economics to the undergraduates or to the post graduates in social sciences within a national development perspective. The paper is presented in six sections. Section I traces transition from regional studies to regional economics. Section II discusses the subject matter, nature and scope of this relatively new branch of knowledge. Section III introduces the methodological perspectives of regional economics and section IV examines the framework for regional development indicators. Section V attempts to unfold the key drivers in regional development. The final section outlines current issues in regional economics research.

1. From Regional Science /Regional Analysis to Regional Economics

The convention has been to speak about either regional science or regional analysis or regional studies. Regional science is a stream of interdisciplinary knowledge within the social sciences focusing on the locational dimension of human activities in the context of their institutional structure and function and its importance in the understanding of social behavior and forms. According to Walter Isard, "regional science is a discipline which concerns the careful and patient study of social problems with regional or spatial dimensions, employing diverse combinations of analytical and empirical research". This diversity combined with definitional uncertainty was very well expressed by Harvey Perloff in the Introduction to the Resources of the Future. To quote him: "No fully satisfactory way of classifying regional studies was found-not unexpectedly. Regional studies tend to deal with many features and often involve the use of several academic disciplines. Thus, no general system of classification can be expected to provide self-contained categories; spill-over is inevitable. The subject classification employed in this report sets up categories whose cores, if not boundaries, are identifiable and whose titles are widely used, with popular and technical meanings that are not too far apart". Another interesting perspective of regional analysis has been given Walter Isard: "An analyst is perplexed with many problems when he looks at a

region. One problem may be to identify specific industries which can individually or in groups operate efficiently and with profit in the region. Another related problem may be to improve the welfare of the people of the region, that is, to raise per capita incomes and perhaps achieve a more equitable distribution of income; the auxiliary problem of measurement of income and of the performance of a society is also present. Still another problem may be to avoid an industrial mix which is too sensitive to the ups and downs of national and world business, and which is composed too heavily of old, slow-growing, or declining industries; this is the problem of diversification. Another problem is to plan industrial development for a region, as part of a system of regions, in an internally consistent manner. Regional economics is a part of regional science and it is a relatively new stream of knowledge. Regional economics is a branch of economic analysis which is concerned with the spatial distribution of economic activity and spatial variation in levels of economic performance. It is concerned with understanding and explaining the spatial or geographic arrangement of the economy, particularly regarding industrial location, regional development, urbanization, migration, land use, etc. Thus, regional economics discusses the spatial distribution of economic activity across geographic areas within a nation. Most of the economic issues are at least in part regional issues.

A planning region must be large enough to take investment decisions of an economic size, must be able to apply its own industry with the necessary labor, should have a homogeneous economic structure, contain at least one growth point and have a common approach to and awareness of its problems. A planning region should be defined according to the purpose of analysis. A planning region in a multi-level setup requires regional plan, which is a spatial plan for the systematic location of functions and facilities in relation to human settlements so that people may use them to their maximum advantages. Planning regions depend upon the type of multi-level planning in the country. A planning region is a sub-national area demarcated for the purpose of translating national objectives into regional programs and policies since plan formulation and implementation need administrative machinery, administrative regions are generally accepted as planning regions. The emergence and persistence

of significant regional disparities is an important issue in regional economics, which calls for appropriate regional development strategy and policy. As regions differ so do the problems of every region. As an inevitable socio-economic process regional economics came into existence to enable us to plan in terms of a specific region. The various fields that regional economists enquire into are: Formal Regions: Areas in which certain characteristics are found throughout the area. Formal Regions such as countries, states, and cities all share the same laws, government, etc. Functional Regions: A central place and the surrounding places affected by it. Perceptual Region: Area defined by people's feelings and attitudes about areas. When the topics of regional economics are considered with specific reference to towns and cities, the term urban economics is used. It is a branch of economics which applies the tools of economic reasoning to the analysis of economic activity in, and the economic problems of, cities and towns. Much of urban economics is concerned with analyzing the pattern of location of economic activities in and between urban areas- thus it has strong links with regional economics and location theory. However, urban economics should not be viewed as simply a form of regional economics since it also discusses topics such as problems of urban transport and urban public services which are not comparable with aspects of regional economics. Regional geography is the study of world regions. Attention is paid to unique characteristics of a particular region such as natural elements, human elements, and regionalization which covers the techniques of delineating space into regions. In geography, regions are areas broadly divided by physical characteristics (physical geography), human-impact characteristics (human geography), and the interaction of humanity and the environment (environmental geography). The three types of landscape regions are Highlands (mountains), Lowlands (plain and coastal areas) and plateaus (raised lowlands).

2. Objectives, Subject matter and Scope

Objectives

The basic philosophy and objectives of economics and regional economics are almost identical. Regional economics is a focused enquiry on spatial

economic problems. For instance, resource mobilization as well as its efficient utilization is the major issue in any branch of economic analysis. Let us look at some of the major aims and objectives of regional economics:

1. Regional economics aims at mobilization and utilization of both human and non-human resources for the overall development of the region which ultimately strengthens national development. This objective brings regional economics closer to economics in general.

2. Regional development strategy involves regional development policy which aims at altering the regional pattern of economic activity and economic performance.

3. It aims at generating a regional implementation agenda. An implementation agenda is that which clearly establishes what must be done, the date by which it will be done, and who will be responsible for doing the work, etc. This is crucial because a major development obstacle in developing countries is attributed to poor or ineffective implementation of development schemes or projects known as 'implementation failures'.

4. Regional economic development aims at exploiting regional scale economies through appropriate development strategies including innovation and growth which are rooted in specific places or regions, rather than countries.

5. Ultimately regional development leads to integrated national development.

Subject Matter

There is a larger space for convergence between the subject matter of economics and regional economics. Not only the subject matter, but the method of economics and regional economic analysis has also tended to converge. The subject matter of regional economics can broadly be divided into two: regional microeconomic and regional macroeconomics. In regional macroeconomics, the analysis is usually carried out in terms of the comparative economic performance of a number of regions within a national economy but each region is regarded, in economic terms, as homogeneous.

That is, no attention is given to variations within each region. Topics in regional macroeconomics include: the comparative economic growth of regions within a nation, variations in unemployment levels between regions and the movement of factors of production (labour and capital) between regions. The macroeconomic aspect of regional economics has developed largely as an applied analysis and its growth owes much to a political concern with regional variation in prosperity and economic performance. Regional economics also addresses macroeconomic issues of growth and econometric modeling of region and public policy towards regional imbalances. Regional microeconomics is concerned with the location and interaction of particular economic activities. It considers the influence of space and distance on economic activity and does not treat regions as homogeneous entities. The topics of regional microeconomics are generally dealt with in location theory. The importance of space and distance is characteristic of regional microeconomics. The subject matter and scope of regional economics has further widened because many of the modern research designs now attempted in regional economics require a considerable behavioral understanding of the research issues under consideration and actually enter into the domain of behavioural economics. As an inter-disciplinary subject, the major themes in regional economics include: (1) Physical elements and natural resources; (2) Population and human ecology; (3) Regional planning, regional policy and economic development; (4) Metropolitan studies and metropolitan planning and urbanization (5) Regional history, literature, and socio-cultural elements. (6) Methods and techniques of regional analysis (7) Comprehensive interdisciplinary regional studies (8) Industrial location and its determinants (9) Migration and land use; and other related issues.

Scope

There is an increasing recognition that the future of a nation's prosperity is mainly determined by activities at the local, regional or sub-national levels. Firms are more innovative and more productive when they can easily access to capacities that support and encourage the creation and utilization of knowledge for promoting creativity, innovation, risk-taking entrepreneurship and business development. The ability of the firms to sell goods and

services to the region, nation and the world is very much a function of their regional context. An important aspect of national economic policy has been investing in regional economic capabilities that cultivate the ability of firms to compete at the national and global levels. There is a need for national, state and local policy makers to understand and respond to the rapidly evolving geography of national economic activity. Information is among the most essential and cost-effective of the policy tools at government's disposal. Both the policy makers and market participants require current, accurate, detailed economic statistics to monitor, assess, and respond to competitiveness issues and opportunities. As a consequence, there has been recognition of the need for coherent, evidence-based regional policy. In particular, developing countries have not addressed the value and role of national and regional economic statistics. National (economic) statistical agencies have not traditionally viewed the provision of regional statistics that understand industrial competitiveness as central to their mission. We require quality and standard regional data sources and tools for properly contextualizing the regional development indicators. Further, the policy makers should encourage and ensure the periodicity of either quinquennial or decennial data base for proper understanding and implementation of regional development agenda. These data base also provide the resources for researchers, planners and policy makers to understand the nature of regional economies, the factors that influence competitiveness, and principles for designing national and regional policies and programs to promote economic development and prosperity. The scope of regional economics gets further extended when we incorporate some of the ideas found in modern decision theory and particularly the notion that the costs of obtaining better decisions should be compared with the obtainable yield. As noted elsewhere, the major problem in regional economics is the non-availability of quality and dependable data at the spatial level. Greater knowledge of regional growth processes and related behavioral patterns help highlighting actual regional development challenges. The distinctive elements in regional economics in recent years suggest that regional economics as well as economics in general has become increasingly indistinguishable. Such a development should be viewed with great alarm in a world made increasingly smaller and more homogeneous by political and institutional developments and by improvements in transportation, communications, and other technologies. Some of the specific issues involved in scope and importance of regional economics may be summarized as follows:

1. Regional economic development is significant because, in general, innovation and growth are rooted in specific places or regions, rather than countries. It focuses on the processes that generate and spread learning and new knowledge production at the local level.

2. The cultural and socio-institutional characteristics of regions drive the economic behaviour and attitudes of local actors/factors/agents by providing the appropriate structural relational assets to the regional economy. That is why we say that innovation and development is not a linear but a multidimensional process affecting local relations, absorptive capacity and the capability to re-use knowledge.

3. Globalization sharpens the localized nature of innovation and development rather than alleviating it. Successful regions become able to exploit external knowledge as well as to serve international markets. Here development is a localized process dependent on spatially-bounded elements as well as past trajectories. This type of path dependency provides an explanation for inequalities between regions within countries.

4. The pattern of regional disparities is more evident in developing countries due to the scarcity of resources to exploit the economies of scale.

5. Incentives to firms for locating their investment activities in the less developed regions further extend the operational profile and strengthen the economies of scale in production and exchange.

6. National governments can assist an underdeveloped region in building an adequate infrastructure for social and economic overhead capital which stimulates regional development through diffusion of primary, secondary and tertiary economic activities.

7. Bottom-up policies are precisely designed to influence innovation and development in specific locations. Such policies are in contrast with traditional top-down strategies that basically offer the same general measures of economic policy regardless of local conditions and characteristics.

8. The relevance of local forces shaping regional development strategies have been documented in the decentralization initiatives in many parts of the developing world during the last two decades. Decision-making at the local level could extremely be positive for regional development because it encourages strategies and collective action to address local needs. Regional development theories highlight that development potential and competitive advantage are strongly localized elements. Therefore, development strategies should aim at basically to adopt balanced regional development policies to build up local strengths and try to alleviate local weaknesses.

9. The increasing demand for decentralization of powers and resources from central governments to regional and local administrations (Local Self Government Institutions) in most parts of the world in the last two decades reveal that regional forces and characteristics are strongly relevant in shaping local development trajectories in a context of increasing globalization.

10. Regional collaborations working together across geographical, industrial and political boundaries are essential for successful economic development in today's economy.

11. Identification and description of critical issues will help to assist what is truly important to the region's economic prosperity.

12. The scope of regional economics gets further extended because innovation is spatially concentrated. Moreover, knowledge spillovers are geographically localized. Regional universities are necessary because they provide technical and infrastructural support for innovation.

13. In the typical regional economics context, places are defined over time by an evolutionary process.

3. Method of Regional Economics

Method is a term used in economics to describe the way in which economists proceed in their analysis of a problem. That is, it is the study of the principles which we employ to establish and validate economic theories. The scientificity and acceptability of a theory or policy depends largely on the philosophy of that discipline. The basic theory and philosophy underlying regional economics is almost identical with respect to theory and philosophy of modern economic analysis. In general, regional economics or regional studies employ either inter-disciplinary or multi-disciplinary approaches.

Inter-disciplinary aspects

There are three important aspects of the prefix inter. Firstly, inter implies the contested space between disciplines; Secondly, inter also implies the action taken on disciplinary insights, typically called integration. Finally the result of integration that constitutes a more comprehensive understanding of the topic. In the context of inter-disciplinarity, integration is a process by which ideas, data and information, methods, tools, concepts, and/or theories from two or more disciplines are synthesized, connected, or blended. Thus, an interdisciplinary study is a process of answering a question, solving a problem, or addressing a topic that is too broad or complex to be dealt with adequately by a single discipline or profession and draws on disciplinary perspectives and integrates their insights through construction of a more comprehensive perspective. Traditionally different social science disciplines collectively employed a common methodology in social sciences. However, specialization led to the development of discipline specific approach to analyze complex socio-economic problems. In order to understand the given socio-economic problem researchers started integrating the tools and findings of different disciplines. Interdisciplinarity has the basic advantage that it may check the harmful effects of excessive specialization. Interdisciplinary research results in better solution to the problems than otherwise. Thus, interdisciplinary studies is a mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental

understanding or to solve problems whose solutions are beyond the scope of a single discipline or area of research. The basic philosophy of interdisciplinarity is that it is a "collaboration of several disciplines and the concepts, methodologies or epistemologies are explicitly exchanged and integrated, resulting in a mutual enrichment". It involves closer and more frequent collaborative exchanges among researchers drawn from different fields who are working together on a common problem. That is, it analyses, synthesizes and harmonizes links between disciplines into a co-ordinated coherent whole. Here goals are first agreed by the team, whose members then co-ordinate their input to the common project plan. Thus, we realize that inter-disciplinarity is a synthesis of two or more disciplines establishing a new level of discourse and integration of knowledge, innovation and development. For instance, in an interdisciplinary pediatric under nutrition team (consisting of nursing, social work, psychiatry, nutrition, education, public health, child health, etc.) members come together as a whole to discuss their individual assessment and develop a joint or integrated service plan for the child.

The basic attributes of interdisciplinary studies include:

1. Interdisciplinary research has a particular substantive focus; 2. The focus of interdisciplinary research extends beyond a single disciplinary perspective; 3. A distinctive characteristic of interdisciplinary research is that it focuses on a problem or question that is complex; 4. Interdisciplinary research is characterized by an identifiable process or mode of inquiry; 5. Interdisciplinary research draws explicitly on the disciplines; 6. The disciplines provide insights about the specific substantive focus of interdisciplinary research; 7. Interdisciplinary research has integration as its goal; 8. The objective of the interdisciplinary research process is pragmatic. It produces a cognitive advancement in the form of a new understanding, a new product, or a new meaning.

Multidisciplinary, on the other hand, refers to the placing side by side of insights from two or more disciplines. Multi- disciplinary studies can be compared to a bowl of fruit containing a variety of fruits, each fruit representing a discipline and being in close proximity to the others. The number of fruits used and the proportions of each in the bowl

may not be based on anything more than visual appeal. This is not so with interdisciplinary studies. "Multidisciplinary studies are those in which researchers representing different fields/disciplines contribute methods and ideas from their respective disciplines toward the analysis of a particular research problem but stays within the boundaries of those disciplines". The objectives of multidisciplinary approach are to resolve real world or complex problem, to provide different perspectives on problems, to create comprehensive research questions, to develop consensus and to provide a comprehensive system of response to the problem identified. For instance, in multidisciplinary team dealing with pediatric under nutrition, members function as independent specialists rather than interactive team members. The child or the family is assessed individually by several professionals (such as Nursing, Social work, Psychiatry, Nutrition, Education, Public health, Child health, etc.) but generally at the discretion of the team leader, usually a physician in medical settings.

4. Indicators of Regional development

The strength of regional development depends on the quality of regional development indicators. These indicators include: Sector wise regional employment, regional income, regional distribution of economic activity, regional investment, regional education levels in relation to sate or regional average, regional taxes/finances, regional poverty, regional transport infrastructure such as rail, road and water transport , housing, water, energy, etc., land access, planning, public infrastructure, capital and maintenance levels, use: capacity ratios, cost to providers compared to consumers, regional health indicators, regional environmental sustainability: such as biodiversity the variety of species, populations and, habitats and ecosystems; ecological integrity the general health and resilience of natural systems, including their ability to withstand stresses and assimilate waste; natural capital the stock of land, air, water and biotic resources that support essential ecological processes and sustain human existence., demographic indicators, the accessibility/remoteness Index is a standard approach to measuring remoteness and uses distances to population centres as the basis for quantifying service

Summary	Indicators	Important Assumptions
1. Goals: Growing a diversified economy	1. GDP per capita	Regional residents recognize the components of regional economic performance.
	2. Economic diversity and structure	
	3. Employment	
	4. Equity in participation	
	5. Net contribution to wider economy	
2. Catalytic factors: Regionally focused actions that encourage regional economic growth.	1. Regionally relevant R&D	The assumption is that investment into higher levels of each of the catalytic factors will contribute through time to achievement of the economic goal.
	2. Local procurement	
	3. Infrastructure	
	4. Direct government support	
	5. Skills development	
3. Drivers: external and internal factors, that promote economic growth.	1. All forms of investment into the regional economy	The drivers have a significant impact on the economic outcomes experienced by regional residences. Trends in these indicators are able to explain trends in economic outcomes.
	2. Terms of trade	
	3. Natural resources	
	4. Population resources	

Table 1: Framework for Regional Economic Indicators
Source: Indicators of Regional Development in Western Australia, 2003. P.46.

access and hence remoteness migration: both in migration and out migration, economic performance: traditional measures of economic performance eg. GDP, participation in the workforce, unemployment, regional price index, terms of trade for commodities, and savings/debt levels, re-distribution of taxes from the regions, retail turnover, net investment into the region, land utilization pattern. Table 1 summarizes framework for regional economic development indicators.

5. Problems of regional economic development/underdevelopment

Countries, states, regions, and cities are interested in stimulating economic development in their jurisdictions through various spatial development strategies. Specific regional development strategies are essential to sustain integrated national development: Some of the relevant strategies are: encourage entrepreneurship; improve the talent base; enhance the attractiveness of the region to outsiders with creative talents; create a legal, fiscal, and regulatory environment that encourages new businesses; create larger pools of venture capital; attract out-of-region businesses through regional business-attraction centres; encourage research and development in local/regional/state universities; facilitate the movement of inventions from the lab to the business plan. Regional economic development entails the creation of new businesses and expansion of existing businesses, in a way that

expands the total number of jobs and results in a rising average wage. So regional economic development aims at creating more employment and a rising standard of living in the region, and it seeks to do this through causing expansion of profitable business activity in the region. New jobs in low-productivity manufacturing or service businesses will not increase the average wage. Regional policy is a necessary part of government economic policy. This is mainly attributed to efficiency and equity. Efficiency grounds relate to the best or optimal use of scarce resources i.e. not wasting the human and capital resources on unemployment and idle plant. Equity grounds suggest that continuing/high unemployment has harmful political and social consequences. Economic development is in its nature (spatially) uneven, and left to market mechanisms economic growth usually benefits the core rather than the periphery. There are a number of fairly obvious efficiency issues linked to bringing unused labour, capital and land back into us. They include: creating additional employment, utilization of underused land and capital , more efficient use of social capital and public services, reducing inflationary pressures by spreading capacity, positive multiplier effects, equity issues etc. Substantial differences in living standards cause dissatisfaction and resentment, correlation between chronic unemployment and social factors poor housing etc. It is argued that if unemployment can be reduced then social conditions will be improved and a net gain in social welfare will result. Regional imbal-

ances in a country may be natural due to unequal distribution of natural resources and/or man-made in the sense of neglect of some regions and preference for others for investment and infrastructural facilities. There are four types of imbalances: such as Inter-sectoral and intra-sectoral imbalances and Inter-regional and intra-regional imbalances. In India, apart from uneven distribution of geographical advantages, historical factors have also contributed to regional inequities. India's successive Five Year Plans have stressed the need to develop backward regions of the country. In promoting balanced regional development, public sector enterprises were located in backward areas of the country during the early phase of economic planning. In spite of pro-backward areas policies and programmes, considerable economic and social inequalities exist among different States of India, as reflected in differences in per capita State Domestic Product. While income growth performance has diverged, there is welcome evidence of some convergence in education and health indicators across the states.

6. Key Drivers in Regional Development

The key drivers in regional development largely depend on regional economic policy. We have to specify the regional parameters to be included in the spatial development policy. Conceptually, regional economic policy is a form of economic policy which is aimed at altering the regional pattern of economic activity or economic performance. Regional policy is a broad investment policy in key strategic policy areas. It supports job creation, competitiveness, economic growth, improved quality of life, educational and health status and sustainable regional development. Regional policy also expresses solidarity with less developed regions, concentrating funds on the areas and sectors where they can make the most difference. Regional policy aims at reducing the significant economic, social and territorial disparities that exist between regions in the country. The objective of the Regional Economic Modeling is to provide analytical support to policymaking by developing a regional model in close collaboration with the national development of the country for regional policy. The growing influence of new communication technology is a critical factor in shaping modernity and the distribution of economic advantage and regional

development. The diffusion of ICT and the Internet directly impacts on interactions between local and global forces. Globalization can be viewed as the stretching process between local involvement and interaction across distance whereby the "local transformation is as much part of globalization as the lateral extension of social connections across time and space". Applying his so-called glocalization framework, Roland Robertson (1995) places spatial issues on an equal footing with temporal ones by examining local and global forces in a locality. On the other hand, the concept of new regionalism focuses on social and institutional learning as the prime driving force behind regional economic growth. Regions are being turned into so-called learning regions, in which socially a variety of regional agents and institutions are intended to form networks and take part in interactive learning cycles. By formulating networks and entering into interactive learning processes, it is believed that regions, like firms, can reduce uncertainty, foster innovative milieu, and augment creative capacity for firms by way of information and knowledge diffusion throughout the local network. While connectivity does enable e-business and global positioning, it is a technological platform that extends the region's marketing channels, and, as such, cannot be considered a critical factor for change.

7. Current Issues in Regional Economics Research

In recent decades, the revival in regional economics research has added a new directional slant to development studies. In a large and heterogeneous country like India, Research and Development has to be streamlined to even out regional imbalances by focusing on the democratic decentralization initiatives. The story is no different in most of the developing countries of the world. Regional development strategies strengthen integrated national development. Specific regional development trajectories can minimize regional disparities and stimulate spatial development. However, we require sector wise in depth regional enquiries on agriculture, industry, power, education, health, tourism, infrastructure, gender, marginalized communities, environment, waste management, sustainable development, etc. These independent regional studies provide adequate base for regional

economic policy fostering spatial and ultimately national development.

References

[1] Wlater Isard (1960) Methods of Regional Analysis. New York.

[2] H. S. Perloff, Regional Studies at U.S. Universities: A Survey of Regionally Oriented Research and Graduate Education Activities. Washington, D.C. 1957 , as a quoted in John R Meyer (1963)

[3] Andy, Pike, (Ed.2009).Whither Regional Studies? Regional Studies Association, The International Forum for Regional Development Policy and Research, Routledge

[4] Harry Ward Richardson (Ed .1969) Regional Economics: A Reader, St. Martin Press

[5] John R,Meyer (1963) Regional Economics: A Survey, American Economic Review, Vol. 53, No. 1, Part 1,Mar., 1963, pp. 19-54

[6] John Friedman and William Alonso (1964) Regional Development and Planning: A Reader, The MIT Press, Massachusetts Institute of Technology, Cambridge, Massachusetts.

[7] Niles M Hansen (1972) Growth Centres in Regional Economic Development, The Free Press, New York.

[8] A.J Brown and E.M Burrows (1977) Regional Economic Problems: Comparative Experience of Some Market Economies, George Allen & Unwin Ltd, London.

[9] Hugh O. Nourse (1968) Regional Economics: A Study in the Economic Structure, Stability and Growth of Regions, Mc Graw Hill Book Company, New York.

[10] William H Leahy, David L. Mckee and Robert D Dean (1970) Urban Economics: Theory, Development and Planning, The Free Press, New York.

[11] A.P. Thirlwall(1985) Growth and Development with Special Reference to Developing Countries, Palgrave, Macmillan

Survey, Collection and Conservation of Local mangoes (Mangifera indica) Existing in Kasaragod District of Kerala

Manjula C.

Department of Botany

Nehru Arts & Science College Kanhangad, Kerala - 671314

email: manjucnasc@gmail.com, Mob: +91-9495346466

Abstract

Kasaragod is a treasure house of good mango varieties, desert and pickle types. But due to urbanization it is under threat. This work aims to find out the various local varieties of mango trees available with the farmers holdings in Kasaragod District and to conserve it for future generations.Vegetative propagation is the good method for the conservation of these mango trees.

Keywords: Mangoes-Kasaragod-Conservation-vegetative propagation.

1. Introduction

Mango (Mangifera indica) is the leading fruit crop of India and it is considered to be the king of fruits. Besides delicious taste, excellent flavour and attractive fragrance, it is rich in vitamin A & C. Mango fruit is utilised at all stages of its development both in its immature and mature stages.The raw fruits are used for making chatney, pickles and juices. The ripe fruits besides being used for desert are also utilised for preparing several products like squashes, syrups, nectars, jams and jellies. The mango kernel also contains 8-10 percent good quality fat which can be used for soap and also as a substitute for cola in confectionery. Ripe mango fruit is considered to be invigorating and freshening. The juice is a restorative tonic and used in heat stroke. The seeds are used in asthma and as an astringent. Most parts of the tree are used medicinally and the bark also contains tannins, which are used for the purpose of dyeing. Mango can be grown under both tropical and sub-tropical climate from sea level to 1400 m altitude, provided there is no high humidity, rain or frost during the flowering period. Places with good rainfall and dry summer are ideal for mango cultivation. Though there are nearly 1000 varieties of mangos in India, recently some new mango hybrid varieties have been released for cultivation by different institutes/universities.

1.1. Mango cultivation in Kerala

Kerala is located in the Southern part of India with a total geographical area of 38.85 thousand square kilometres. The climate is humid tropic with an annual rainfall of 307 cm, distributed in two main monsoons namely, South-West monsoon and North- East monsoon. Mango is not considered as a commercial crop of Kerala, but mango trees are inevitable components of homesteads of the state [3]. The total estimated area under mango cultivation is 75,911 hectares with an annual production of 323,517 tones. Commercial orchards of mango are being established in Palakkad district, where the climatic conditions are more suitable for mango trees. A detailed survey was attempted to collect all the details of mango cultivation in the Palakkad district, which represents the commercial mango production in Kerala [5]. The mango population consists of both seedling and grafted trees but the commercial orchards are of

grafted trees only. The cultivated varieties include Alphonso, Bennet Alphonso, Bangalora, Banganapally, Neelum, Kalapady, Guddadat and Prior.

1.2. Mango cultivation in Kasaragod District

Mango varieties are not commercially cultivated in Kasaragod District. But there is a habit among the village population as well as urban people to plant one or two mango trees in their house compounds. Mango is an integral part in the homesteads and the tree had varied uses in households. So in the homesteads of kasaragod, noticed a lot of local mango varieties with good quality. But due to fragmentation of land and mushrooming of independent houses have wiped off a lions share of Kerala,s rich gene pool of mango cultivation. A rough estimate shows that annually 10-20% of the existing trees are being removed. Whatever that remains is confined to road sides and to some home stead in the rural areas. This study was intended to find out the various local varieties of mango trees available with the farmers holdings in Kasaragod District. The main objectives of the present work is to find out the local mango varieties existing in kasaragod District, characterization of locally available mango varieties and conserve the important varieties of local mangoes in Kasaragod Disrict.

2. Materials and Methods

As a part of the study, a wide survey was conducted in different parts of Kasaragod District to find out the locally available mango varieties based on the mango descriptor obtained from Kerala agricultural university. Through this detailed survey, located local mango trees existing in the homesteads of kasaragod. The survey work from Trikaripur to Kumbala was conducted from 23.07.2014 to 20.11.2014. Based on the survey and interviews of the house holders, find out a lot of different varieties of mangoes. From this, 53 local mango trees were selected for detailed study by using the mango descriptor. The Descriptor contains the following details.

2.1. Preliminary Survey

The Performa contains Date of survey, Name and address of the farmer, Name of the local variety, Age of the plant, Tree habit, Height of the plant and Shape of the tree etc.

2.2. Tree Characters

The tree characters included Bearing habit, Time of flowering, Time of harvest, Fruit quality, Approximate yield, Status of tree, Condition of the tree, Whether tree will be retained or not and Seedling characters etc.

2.3. Leaf characters of the plant

Here collected 5-8 leaves from the selected trees and observed their leaf characters like Shape, Length, Width, Colour of young leaf, Tip, Margin, Petiole length and Aroma of the crushed leaves etc. After analyzing the survey details, we selected 15 good varieties of the mango trees based on the following characters - Regular bearing, Age > 50, Availability of scion from the trees, Fruit quality of the mango based on the visit report.

2.4. Conservation of mango trees using vegetative propagation

After the survey work, the need for the conservation of these mango verities was understood and steps were taken to conserve them by preparing grafts. Two grafting Techniques namely Stone grafting and soft wood grafting were followed.

3. Results and Discussion

3.1. Survey

After the detailed survey, a total number of 53 trees were located from the following locations of Kasargod District. Padenekkad and Pallikara (6each), Cheruvathur (9), Trikkaripur (8), Nileshwar (4) Cheemeni (3), Parappa and Kumbala (4each), Mayyai, Rajapuram, Alinkal,(2each), Mavungal, Guruvanam, Ravaneshwar (1each). Visit of the selected locations were made during the vegetative growth stage of mango trees. Accession numbers were allotted to the located trees in serial order starting from PS14/01 to PS 14/53. The source of the accessions indicated as PS (Plant Science) and Year of survey 2014.01to 53 is the number allotted to selected trees.

3.2. Preliminary survey report

In the preliminary survey, details such as local name, age of the tree, tree habit, height and shape of the trees were collected. Out of 53 trees located, the age of the trees ranged from10years to 125 years. The local name also shows variations depending on locations. According to Radha and Manjula 2000 the name and characters of the mango were different according to the location where they are growing. Kappa mango and go mango were seen in most of the locations. Height of the mango tree also seen variations depending on the location. The height of the tree range from 5 m to 50 m. The habits of trees are of three types, out of 50, 20 are intermediate, 16 are spreading and 14 are erect. Wide range of variations were observed in the shape of the trees, out of 53, 21 were round, 17 erect , 6 were pyramidal in shape 2 of them are intermediate and upright , one in arch shape, one in elongated and one in linear. Jyothi and Parameswaran (1999) reported variations of local mango trees in their shape, height, and their bearing habit etc.

3.3. Tree characters

Nine tree characters were studied like bearing habit, time of flowering and harvesting, fruit quality, yield, status of the tree, condition of the tree, retaining capacity and seedling characters. Out of 53 plants observed 30 plants are regular bearer and 23 were irregular. Time of flowering started from October to May and time of harvest March to June. Jyothi and Parameswaran (1999) reported distinct variations in tree characters of local mango trees of Kerala. Same types of variations were observed in these studies also. About the fruit characters 24 are dessert or table type 21 are used for dessert and pickling and 8 were used only for pickling. Yield of the plant shows wide range of variations it is ranged from 5Kg to 250Kg per /year. The status of trees observed that 38 plants were land raised and 12 were wild type, only 3 plants were cultivated for commercial purpose. The condition of the trees 48 was heathy, 3 were very old and 2 of them are diseased type. About the retained capacity 46 were retained and 7 not retained. The seedling characters showed that 46 seedlings were monoembryony and 7 were polyembryony (fig.1). Radha and

Figure 1: Mono and poly embryonic seedling

Manjula (2000) studied the mono and polyembryonic characterization of mangos in Kerala. According to them polyembryonic characters were noticed mostly in local mango seedlings, the polyembryony mango seedlings produced 3 to 6 seedlings from one seed. Same types of seedlings were observed in this study also.

3.4. Leaf Characters

The leaf characters like Shape, length, width, colour of young leaf, tip, margin, petiole length and aroma of crushed leaves were noticed. Wide range of variations were noticed in this characters .In shape of the trees out of 53 studied ,36 were lanceolate, 13 oblong and 4 eliptic. Length and the width of the leaves also observed variations. The length of the leaves range from 5to 25 cm, and width from 3 to 7 cm.

The petiole length of the leaves ranges from 1to 6cm (table .3). Tip and margin of the leaves showed variations, out of 53, most of the leaves tip is acute (46), 5 obtuse and 2 accuminate. Margin of the leaves, 36 of them where flat and 17 were wavy . Colour of young leaves observed that 32were reddish brown, 19 were light green and 2 were brick red (table.3). Accoding to the smell of the crushed leaves 43 showed good smell, 5 were no smell,4 were pleasant smell and one is light smell(table.3). Jyothi and Parameswaran (1999) and Radha and Manjula(2000) reported distinct variations of tree habit, leaves characters and fruit characters of local mango trees of Kerala. Same types of variations were noticed in the local mango types of Kasaragod district.
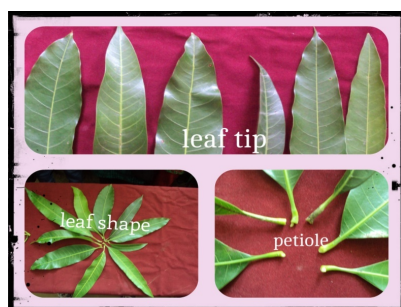
Figure 2: Leaf Characters

Figure 3: Stages of grafting

3.5. Plant Conservation

For the conservation of selected plants two types of grafting were practiced in the selected plants, soft wood grafting and stone grafting. The result of the grafting was furnished in table .4 and Fig.2. It was noticed that in Stone grafting the sprouting of the graft started after eight days of grafting and the percentage of survival after three months was 50%. But in Soft wood grafting, compared to stone grafting it took 12days to see the sprouting, and percentage of survival was 45%. The various stages of grafting were presented in Fig.3.

Type of grafting	No. of scion grafted	First sprouting noticed after grafting	% of survival after three months
STONE	50	8 days	50%
SOFT WOOD	50	12 days	45%

Table 1: Grafting details

Mango being a highly heterozygous crop, mul-tiplication of desired varieties could be possible only through vegetative methods of propagation. According to Radhamony (1987) and Dhungana (1984), varietal responses of scion to stone grafting in mango for commercial propagation. In this study also noticed varietal difference in grafting of local mango types. Radhamony (1987) also reported that, poor survival of local mango varieties of epicotyls grafting. In this study also clear that, the survival rate of grafting percentage is less, compare to soft wood grafting, the percentage of survival and grafting response were higher in stone graft. In mango varietal response to grafting has been clearly demonstrated in the genetic makeup which influences the histological and physiological development within the shoot [6]. According to Dhakal(1979) and Kulkarni et al (1985), the survival rate of stone grafting in commercial mango trees where 61 to 85%.

4. Conclusions

Mango is an integral part of the homesteads in Kerala and the tree has varied uses in households. The future of mangos in Kerala is not very encouraging. The old seedling progenies that spread their shades in the road sides may be lost in the developmental processes where conservation of natural wealth is not an important consideration. The fate of the mango trees are same in homesteads as well. The chances for natural dissemination of mangos are getting reduced considerably.The homesteads of kasaragod also noticed a lot of local mango types of good quality, but due to industrialization, construction of big buildings and widening of roads, reduced the local mango trees considerably.

From this study it was observed that, Kasaragod is a real treasure house of good mango varieties of desert and pickle types. But due to urbanization it is under threat. Vegetative propagation is good for the conservation of the mango trees. Among vegetative propagation grafting is found good. But in local mango types the survival rate of grafting is very low. Among the grafting types practiced, stone grafting is good for conservation of local mango trees compared to soft wood grafting.

References

[1] Dhakal D D 1979. Studies on stone grafting in mango.MSc.(Agri) Thesis submitted to Konkan Krishi Vidhya Peeth, Dapoli.

[2] Dhungana D B.1984. Standardisation of methods of vegetative propagation in mango. MSc.(Hort) Thesis submitted to KAU, Vellanikkara.

[3] Jyothi M L and Parameswaran N K .1999. Conservation of mango germplasm. KSHS. Souvenir Published by Kerala Agricultural University.

[4] Kulkarni V J ; Ratnam K K and Ramakrishnan G.1985. Propagation studies in mango. Abst.Second In. Symp. On mango Bangalore. May 20th -24.

[5] Radha T and Nair S R.1998. Physico- chemical analysis of alphonso and bangalora varieties of mango.J. Tropic.Agri. 34.145-146.

[6] Radha T and Aravindakshan K. 1998. Respose of mango varieties to epicotyls grafting on commercial scale. The Hort. J. 11(1): 25-31.

[7] Radha T and Manjula C.2000. Characteritic of some polyembryyonic mango types grown under Kerala conditions. ISHS. Acta Horticulture. 509.

[8] Radha T and Manjula C.2000. Characteritic of some polyembryyonic mango types grown under Kerala conditions. The 6th international symposium at Thailand.

[9] Radhamony P S.1987. Varietal responses of scion to stone grafting in mango for commercial propagation. MSc(Hot) Thesis submitted to KAU, Vellanikkara.

Modeling Real and Ideal Gas

Lisha Damodaran [1] and K. M. Udayanandan [2]

[1] School of Pure and Applied Physics
Kannur University, Kerala - 673635

[2] Department of Physics
Nehru Arts and Science College Kanhangad, Kerala - 671314
email: udayanandan@gmail.com, Mob: +91-9495147570

Abstract

Magnetism and phase transition in magnetic materials can be explained by imagining spins on lattices. Similar to this we show that we can model ideal and real gases using an imaginary lattice where atoms or molecules can be filled.

1. Introduction

Theoretical treatments of spins on lattices is an important tool in physics to model magnetic systems. Instead of spins, particles on lattices are used to model liquid-gas phase transitions, percolation and fragmentation. The term lattice gas was first coined by Yang and Lee in 1952 [1, 2], though the interpretation of the model as a gas was known earlier [3]. Here it is assumed that a fluid system is divided into a regular lattice of cells of volume roughly equal to the particle (atom, molecule) volume.
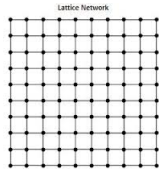
We say that the cell is occupied if a particle falls into this cell. Since the cell volume is comparable to the particle volume, there can be not more than one particle per cell.
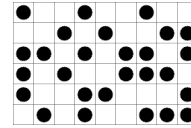
A lattice gas is thus a collection of particles whose kinetic energy is neglected and that are arranged into discrete cells. The cells are either occupied by one atom or empty [4].

2. Ideal gas

Consider a lattice gas of N particles distributed among M lattice cites (with $N \leq M$). The number of microscopic states of this system is given by

$$\Omega = \frac{M!}{N!(M-N)!}$$

Using the equation of entropy

$$S = k \ln \Omega$$

$$S = k \big[\ln M! - \ln N! - \ln(M-N)! \big]$$

$$= k \left[-N \ln \frac{N}{M} - (M-N) \ln(1 - \frac{N}{M}) \right]$$

Taking the total volume $V = Ma^3$ where a is the radius of the atom and V is the total volume,

$$S = -\frac{Vk}{a^3}\left[\frac{Na^3}{V}\ln\frac{Na^3}{V}\right.$$

$$\left. +(1-\frac{Na^3}{V})\ln(1-\frac{Na^3}{V})\right]$$

and taking the thermodynamic relation
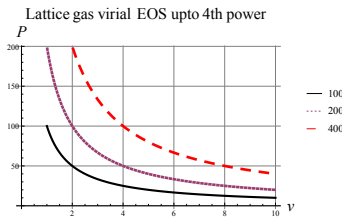
$$\frac{P}{T} = \left(\frac{\partial S}{\partial V}\right)_{E,N}$$

$$\frac{P}{T} = -\frac{k}{a^3}\ln(1-\frac{Na^3}{V})$$

Taking the expansion of logarithmic function

$$\frac{P}{T} = \frac{k}{a^3}\left[\frac{\frac{Na^3}{V}}{1} + \frac{(\frac{Na^3}{V})^2}{2} + \frac{(\frac{Na^3}{V})^3}{3} + ...\right]$$

$$\frac{PV}{NkT} = \left[1 + \frac{a^3}{2}\left(\frac{N}{V}\right) + \frac{(a^3)^2}{3}\left(\frac{N}{V}\right)^2 + ...\right]$$

The P-V diagram for Virial equation of state for the lattice gas are shown at temperatures $100^o, 200^o, 400^o$ as shown below.

These graphs are plotted by taking $\frac{P}{k}$ on y axis and $v = \frac{V}{N}$ on x axis and $a = 5 \times 10^{-15}m$. The graphs doesn't exhibit phase transitions. Thus an ideal gas can be modeled using atoms placed in lattice sites. Now we can proceed to model a real gas. In the case of real gas the system consisting of atoms or molecules must have inter atomic or inter molecular forces. The vectorial treatment will be a difficult one. So we use Ising energy which has an interaction term for modeling the real gas and look for the possibility of phase transitions. [5].

3. Real gas

Our aim is to obtain an expression for pressure which will show phase transition. We use Ising energy to model the interaction [6, 7, 8]. It is known that with Ising energy, pressure is

$$P_{LG} = -\left(\frac{A}{N} + \frac{1}{2}qJ - \mu B\right) \tag{1}$$

volume is related to magnetisation as

$$\frac{1}{2}\left(\frac{M_I}{N\mu} + 1\right) = \frac{1}{v} \tag{2}$$

and fugacity is related to external field B as

$$z = e^{2\beta(qJ - \mu B)} \tag{3}$$

A can be obtained from the bridging equation in canonical ensemble by

$$A = -kT\ln Q_N$$

where k is the Boltzmann constant, T is the absolute temperature, and Q_N is the N particle partition function which can be obtained from

$$Q_N = \sum \Omega(E)e^{-\beta E}$$

Here $\Omega(E)$ is the number of states available, E is the energy of the system and $\beta = \frac{1}{kT}$. We had to find Ω and E.

3.1. Number of micro states Ω

In the lattice gas model we consider lattice spaces where atoms/molecules can be filled. Let the number of particles occupying the lattice sites be N_+ and unfilled lattice sites be N_-. So the total lattice sites will be

$$N_+ + N_- = N$$

Let us define an order parameter L such that

$$L = \frac{N_+ - N_-}{N}$$

So

$$N_+ = \frac{N(1+L)}{2}$$

and

$$N_- = \frac{N(1-L)}{2}$$

Number of ways in which we can distribute particles in lattice sites is given by

$$\Omega = \frac{N!}{N_+!N_-!} = \frac{N!}{N_+!(N - N_+!)}$$

3.2. Energy

For the Ising model the energy is given as

$$E = -J \sum_{<ij>} \sigma_i \sigma_j - \mu B \sum_{i=1}^{N} \sigma_i$$

where J is a constant. This equation as such cannot be used directly since it is difficult to solve the partition function. So Bragg- Williams approximation is used. The equation is approximated as

$$E = -J \left(\frac{1}{2} q \bar{\sigma} \right) \sum_{<i>} \sigma_i - \mu B \sum_{i=1}^{N} \sigma_i$$

$\sum_{i=1}^{N} \sigma_i$ can be taken as NL. So energy becomes

$$E = -J \left(\frac{1}{2} q L \right) NL - \mu B N L$$

. So

$$E = -N \left(\frac{q J L^2}{2} + \mu B L \right)$$

3.3. Partition function

The partition function is given by

$$Q_N = \sum_{L+-1}^{L=+1} \frac{N!}{N_+!N_-!} e^{\beta N(\frac{q J L^2}{2} + \mu B L)}$$

As $N \longrightarrow \infty$ the $\ln Q_N$ is equal to the logarithm of the largest term in the summand. Then simplifying

$$\frac{1}{N} \ln Q_N = \beta \left(\frac{q J \bar{L}^2}{2} + \mu B \bar{L} \right) - \left(\frac{1 + \bar{L}}{2} \right)$$

$$\ln \left(\frac{1 + \bar{L}}{2} \right) - \left(\frac{1 - \bar{L}}{2} \right) \ln \left(\frac{1 - \bar{L}}{2} \right)$$

where $\bar{L}$ is the value of L that maximizes the summand. Then Helmholtz free energy is

$$\frac{A}{N} = \frac{q J \bar{L}^2}{2} + \frac{kT}{2} \ln \left(\frac{1 - \bar{L}^2}{4} \right)$$

3.4. Pressure

Substituting A in the equation (1) for P_{LG} we get

$$P_{LG} = \mu B - \frac{qJ}{2}(1 + \bar{L}^2) - \frac{kT}{2} \ln \frac{(1 - \bar{L}^2)}{4}$$

Taking $M_I = N\bar{L}$ the equation (2) changes to

$$\frac{1}{v} = \frac{1}{2}(1 + \bar{L})$$

Rearranging equation (3) we get

$$\mu B = \frac{kT}{2} \ln z - Jq$$

Substituting we get expression for pressure as

$$P_{LG} = qJ - \left(\frac{kT}{2} \right) \ln z - \frac{qJ}{2} \left(1 + \left(\frac{2}{v} - 1 \right)^2 \right)$$

$$- \frac{kT}{2} \ln \left(\frac{1 - (\frac{2}{v} - 1)^2}{4} \right)$$

The P-V diagram is

Lattice gas
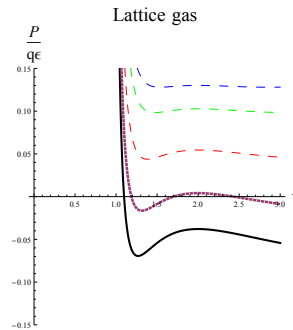
which clearly exhibits phase transition.

Conclusion

We use the lattice model to obtain the equation for pressure and plotted the P-V diagram for ideal as well as real gases. There is no phase transitions in the case of ideal gases which agrees with earlier derivations of ideal gas pressure. In the case of real gases there is phase transition. Hence this method can be used to model and study real gases.

Acknowledgement

References

[1] Lee T. D, and Yang C. N, Statistical Theory of Equations of State and Phase Transitions. I. Theory of Condensation. Phys. Rev. 87, pp. 404-409 (1952).

[2] Lee, T. D. and Yang, C. N, Statistical Theory of Equations of State and Phase Transitions. II. Lattice Gas and Ising Model. Phys. Rev. 87, pp. 410-419 (1952).

[3] Lennard Jones, J. E., and Devonshire, A. F. Proc. R. Soc. Lond. A, 163, 53(1937); Proc. R. Soc. Lond. A, 165, 1, (1938).

[4] Rodney J. Baxter, Exactly Solved Models in Statistical Mechanics, Academic Press Limited, (1989).

[5] Silvio R. A. Salinas, Introduction to Statistical Physics, Springer(2001).

[6] R. K. Pathria and Paul D. Beale, Statistical Mechanics, 3rd Edition, Elsevier, India (2011).

[7] Terrell L. Hill, An Introduction to Statistical Thermodynamics, Dover Publications Inc. New York, (1986).

[8] Kerson Huang, Statistical Mechanics, Second Edition, John Wiley and Sons (1987).

Growth and Characterization of N'-[(E)-4-Bromobenzylidene]-2-(4-isobutylphenyl) Propanohydrazide Crystal

K. Naseema[1] and K. V. Sujith[2]

[1]Department of Physics
Nehru Arts & Science College Kanhangad, Kerala - 671314

[2]Department of Chemistry
Payyannur College, Payyannur, Kerala - 670327

email: k.naseema@gmail.com, Mob: +91-9447813903

Abstract

Single crystals of N'-[(E)-4-Bromobenzylidene]-2-(4-isobutylphenyl) propanohydrazide (BIPH), $C_{20}H_{23}BrN_{20}$ were grown from ethanol by slow evaporation of the solvent at room temperature. Powder XRD confirms the crystallinity of the sample. Optical absorption studies show that the sample is optically transparent over a wide wavelength region and minimum absorption is observed in the entire visible region. TGA/DSC shows good thermal stability of the material. TGA analysis reveals that pure BIPH crystal is thermally stable up to $165^{o}C$, after which the sample undergoes an appreciable weight loss. From the curves, it is inferred that the vapourization takes place in the vicinity of $337^{o}C$. From the peak of DSC curve, it is inferred that the melting of the material takes place at $176^{o}C$. The surface morphology of the sample reveals that rectangular rod like microcrystallines unevenly distributed on the epilayers of the surface.

Keywords: growth from solution; characterization; organic material.

1. Introduction

Single crystals are essential in research especially in condensed-matter physics, materials science, surface science etc. Electronic and photonic industries and fiber optic communications depend on crystals such as semiconductors, superconductors, polarizers, transducers, radiation detectors, ultrasonic amplifiers, ferrites, magnetic garnets, solid state lasers, non-linear optics, piezo-electric, electro-optic, acousto-optic, photosensitive, refractory of different grades, crystalline films for microelectronics and computer industries.

The strong influence of single crystals in the present day technology is evident [1, 2, 3, 4, 5, 6]from the recent advancements in the above mentioned fields. Hence, in order to achieve high performance from the device, good quality single crystals are needed. Growth of single crystals and their characterization towards device fabrication have assumed great impetus due to their importance for both academic as well as applied research. Only in single crystals, it is possible to study directional dependence of various properties. Hence we are interested in the characterization of crystal of the title compound, N'-[(E)-4-Bromobenzylidene]-2-(4-isobutylphenyl) propane
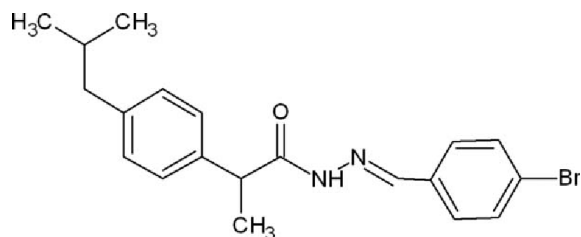
Figure 1: Structure of BIPH

hydrazide(BIPH), $C_{20}H_{23}BrN_{20}$.

2. Material synthesis and crystal growth

The title compound was obtained by refluxing a mixture of 2-[4-(2-methylpropyl)phenyl]propane hydrazide (0.01 mol), 4-bromobenzaldehyde (0.01 mol) in ethanol (30 ml) and 3 drops of concentrated sulfuric acid for 1 h. Excess ethanol was removed from the reaction mixture under reduced pressure. The solid product obtained was filtered, washed with ethanol and dried. Single crystals suitable for X-ray analysis were obtained by slow evaporation of an ethanol-N,N-dimethyl formamide (DMF) (3:1) solution.

3. Characterization

3.1. XRD studies

The XRD pattern of the powdered crystal is recorded in a BRUKER AXS-D 8 Advance with copper target ($\lambda = 1.54^o$A) (figure 4.2). The revelation of well defined Bragg reflections at specic 2θ angles in the diffraction patterns suggests crystallinity of the sample

3.2. UV- visible spectroscopy

UVvisible spectrum of the grown crystal was recorded using a SHIMADZU UV-VIS-NIR scanning spectrophotometer, model 3101 PC. There is no absorption of light from near UV to the near IR (figure 4.3). Wider the transparency window more will be the practical applicability of the material. Optical absorption spectrum of the grown crystal was recorded in the wave range of 200-900 nm. The lower cut off is observed at 300 nm. The absorption is negligible in the entire visible region of the electromagnetic spectrum.

Figure 2: Powder XRD pattern of BIPH

Figure 3: UV-visible spectrum of BIPH

3.3. Thermal analysis

The TGA curve gives useful information regarding the thermal stability and composition of the sample under investigation. The recorded thermogram is fist analysed for obtaining the weight loss at different temperatures and hence about the thermal stability and dissociation of the crystal. Thermo gravimetric run was taken on Perkin Elmer Diamond TG anal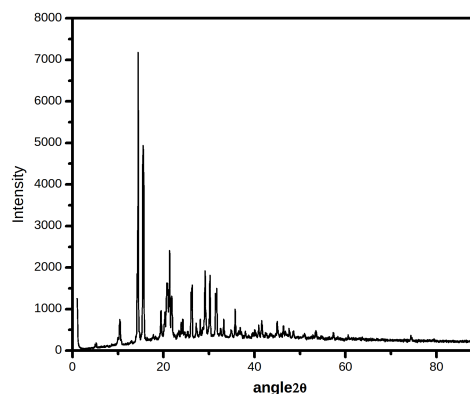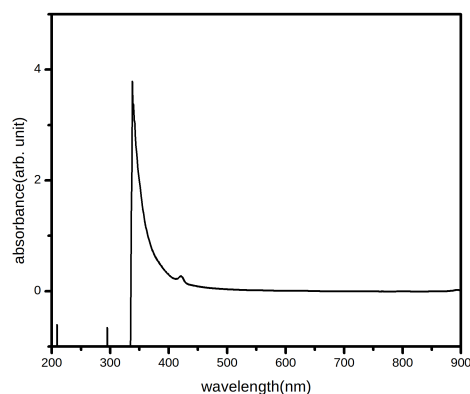yser by scanning at the rate of 10 K/min in an atmosphere of nitrogen, in the temperature range 30-650°C (figure 4.4). The initial mass of the material subjected to analysis was 7037μg and the final mass left out after the experiment was only 69μg at a temperature of about 650°C, indicating the bulk decomposition occurring in the sample. TGA analysis reveals that pure BIPH crystal is thermally stable up to 165°, after which the sample undergoes an appreciable weight loss. From the curves, it is inferred that the vapourization takes place in the vicinity of 337°C. Gradual and signicant weight loss was observed as the temperature increases. Also it is seen that, an almost total decomposition of the compound takes place at a temperature of about 650°C. Since the decomposition temperature is beyond 100°C, there is no evidence for entrapped water in the crystal lattice or any adsorbed water on the crystal surface.

DTA analysis was taken on Perkin Elmer Diamond TG analyser by scanning at the rate of 10 K/min in an atmosphere of nitrogen, in the temperature range 30-650°C. To analyse the thermal stability and to confirm the melting point of the material, the differential thermal analysis (DTA) were carried out using (Fig 4.5). The decomposition was indicated by the endothermic peak near 168°C. It undergoes an exothermic transition around 338°C followed by another exothermic peak at 494°C.

DSC was taken on Mettler Toledo DSC 822e . The DSC analysis was done between 30°C to max. 250°C at a heating rate of 700°C / 7 min and is shown in gure 4.6. From the peak it is inferred that the melting of the material takes place at 176°C.

Figure 4: TGA curve of BIPH
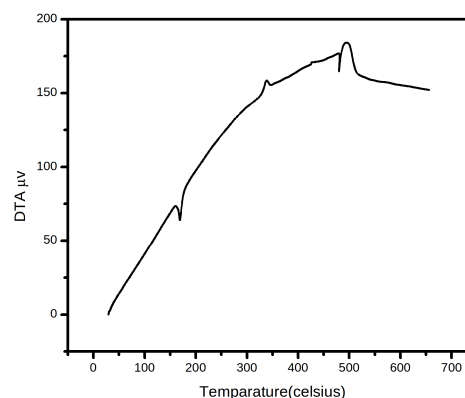
Figure 5: DTA curve of BIPH

3.4. SEM studies

The SEM provides information about the topographical features, morphology, phase distribution, compositional differences, crystal orientation

(a)   (b)

Figure 7: SEM images of BIPH
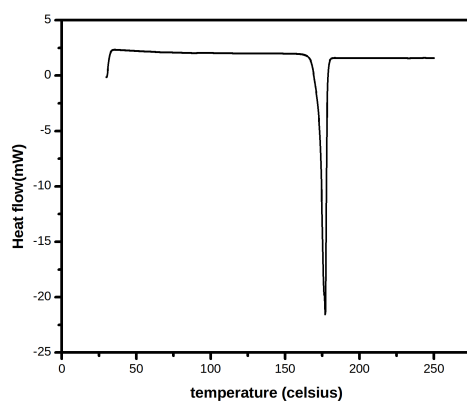
Figure 6: DSC Thermogram of BIPH

etc. Fig. 4.7. shows the SEM micrographs of the grown crystal corresponding to different magnification.The surface morphology of the sample reveals that rectangular rod like microcrystallines unevenly distributed on the epilayers of the surface.

4. Conclusions

Single crystals of N'-[(E)-4-Bromobenzylidene]-2-(4-isobutylphenyl) propanohydrazide (BIPH), $C_{20}H_{23}BrN_{20}$ were grown from ethanol by slow evaporation of the solvent at room temperature. Powder XRD confirms the crystallinity of the sample. Optical absorption studies show that the sample is optically transparent over a wide wavelength region and minimum absorption is observed in the entire visible region. TGA/DSC shows good thermal stability of the material. TGA analysis reveals that pure BIPH crystal is thermally stable up to

165°C, after which the sample undergoes an appreciable weight loss. From the curves, it is inferred that the vapourization takes place in the vicinity of 337°C. DSC curve shows that the melting of the material takes place at 176°C. The surface morphology of the sample reveals the rectangular rod like microcrystallines unevenly distributed on the epilayers of the surface.

References

[1] R.W. Munn, C.N. Ironside, Principles and Applications of Nonlinear Optical Materials, Chapman & Hall, London, 1993.

[2] H. Minemoto, Y. Ozaki, N. Sonoda, J. Appl. phys., Vol. 76, 3975(1994).

[3] H.S. Nalwa, S. Miyata (Eds.), CRC Press, Baca Raton, FL, 1997.

[4] S. Brahadeeswaran, V. Venkataramanan, J. Sherwood and H. L. Bhat, J. Mater. Chem., vol. 8, 613(1998).

[5] Guanghus Zhang, Mingguo Lin, Dong Xu and Duorong Yuan, J. Mater. Sci. Lett.19, 1255 (2000)

[6] H. Figi, M. Jazbinek, C. Hunziker, M. Koechlin, P. Gnter, Opt. Express 16 (15)11310 (2008) .

Synthesis and Swelling Studies of Biocompatible Polymeric Gels

A. Mohanan

Department of Chemistry

Nehru Arts & Science College Kanhangad, Kerala - 671314

email: drmohanan75@gmail.com, Mob: +91-9847983922

Abstract

Biocompatible polymeric gels have been made from a hydrophilic polymer Sodium Alginate (NaAlg) in the presence of glycerol using metal ions as cross linkers. Gels have been prepared with varying amounts of cross linking agent, plasticizer and cross linking time. The effect of these parameters, the preparation conditions and the pH of the medium on the swelling behavior of these gel films has been investigated. Dynamic swelling studies have been carried out and the equilibrium swelling processes have been evaluated.

Keywords: Gel, biocompatible, plasticizer, cross linking, swelling

1. Introduction

A gel is a solid jelly-like material that can have properties ranging from soft and weak to hard and tough. Gels are defined as a substantially dilute cross-linked system, which exhibits no flow when in the steady-state. The rate of permeation of solute molecules through polymer network structure depends predominantly on the swelling ability of the network in the medium of transport. Several parameters affect the swelling of the network system and permeability of solute, such as the chemical structure of the polymers composing the network system, hydrophilicity of the substituent groups in the polymers, morphology of the membrane and the chemical environment of the medium of transport. Thus selective and controlled transport of solute molecules across polymer gels can be achieved by a delicate control of the network structure and chemical nature of the medium [1, 2, 3]. Carbohydrate polymers find extensive use in biomedical and pharmaceutical fields due to their biocompatible and biodegradable nature. IPN systems of biopolymers, such as sodium alginate, chitosan, carboxymethyl cellulose, gelatin, and others, have been investigated by several researchers as potential biodegradable implants, such as systems for the controlled release of pharmaceuticals and insecticides [4, 5, 6, 7, 8, 9].

2. Experimental

Preparation of Sodium alginate gels

The following method was employed in the preparation of the Sodium Alginate gels. 2% (w/v) aqueous solution of the sodium alginate was made by stirring at a temperature of 45^oC. The solution was stirred for 4 hours to make it homogeneous. This solution was added drop wise into NaCl, $CaCl_2$ & $FeCl_3$ solutions of different concentrations using a pipette. After specific time intervals, the crosslinked gels were taken out and washed with distilled water to remove the adhering salt solution. The gels were prepared in $CaCl_2$ & $FeCl_3$ medium by adding glycerol as a plasticizer. The gels thus obtained were dried at 40^oC and stored. The details of the preparation conditions and the codes used for the designation of the gels are compiled in Table 1.

Gel Code	NaCl (M)	CaCl$_2$(M)	FeCl$_3$(M)	Glycerol (drops)	Crosslinking time (min.)
SA1	1	-	-	-	30
SA2	-	0.1	-	-	10
SA3	-	0.1	-	-	30
SA4	-	0.1			60
SA5	-	0.5			10
SA6	-	0.5			30
SA7		0.5			60
SA8		1			10
SA9		1			30
SA10		1			60
SA11		1		2	30
SA12			1	2	30
SA13		-	1	-	30

Table 1: Preparation of Sodium Alginate Gels

Swelling Studies

The swelling behaviour of the gels was investigated by swelling measurements carried out in aqueous solution. Pre-weighed dry gels (xerogels) were immersed in excess of the aqueous medium at room temperature. After specific intervals of time, the gels were removed from the medium, the surface adhered liquid drops were wiped by blotting and the increase in weight of the films were measured using an electronic balance with an accuracy of ± 0.1 mg. The measurements were continued till the weight of the swollen films attained a constant value. The percentage of swelling (S%) at the given time 't' was calculated using the following expression,

$$\text{Swelling(S)\%} = \frac{(W_t - W_0)}{W_0} \times 100$$

Where, W_t & W_0 are the mass of the swollen gel at time t and the dry gel respectively.

3. Results and Discussions

Gel formation

When sodium alginate is put into salt solution the metal ions replace the sodium ions in the polymer. The experiments have been carried out in salt solutions like NaCl, CaCl$_2$ & FeCl$_3$. No gel formation taken place in NaCl. Fine gels were obtained in the rest of the two solutions. The size of the gel obtained in FeCl$_3$ medium is small than that in the CaCl$_2$ medium. Each Ca^{2+} ion can attach to two other polymer strands and make the polymer

Sl. No.	Time(min)	Weight(g)	%S
1	0	0.0649	0
2	5	0.0819	26
3	10	0.1523	134
4	30	0.1724	164
5	60	0.1766	166
6	120	0.1968	203

Table 2: Swelling studies of SA2

crosslinked. Since Fe^{3+} can attach to three polymer strands, the extend of crosslinking is more and the size of the gel becomes small.

Swelling Studies

The swelling data collected as a function of time in the medium of distilled water are displayed in Table 2-13. The data clearly indicates the influence of network composition, extent of crosslinking and ionization of the functional groups on the swelling behaviour of the polymers. The nature of the swelling data indicates that amount of water absorbed into the gel increases with time at a faster rate in the beginning and after a certain period, the rate slows down and the gels gradually reach their equilibrium swelling level.

4. Effect of various parameters on swelling

4.1. Crosslink Density

The number of crosslinks in the gel increases with the increase in the concentration of the CaCl2 and the time period of contact of the gels with the

Sl. No.	Time(min)	Weight(g)	%S
1	0	0.1057	0
2	5	0.2114	100
3	10	0.221	109
4	30	0.2383	125
5	60	0.2637	149
6	120	0.2719	157

Table 3: Swelling studies of SA3

Sl. No.	Time(min)	Weight(g)	%S
1	0	0.0646	0
2	5	0.0987	53
3	10	0.1003	55
4	30	0.1166	80
5	60	0.1215	88
6	120	0.1406	118

Table 4: Swelling studies of SA4

Sl. No.	Time(min)	Weight(g)	%S
1	0	0.0806	0
2	5	0.1008	25
3	10	0.1227	52
4	30	0.1566	94
5	60	0.1577	96
6	120	0.1746	117

Table 5: Swelling studies of SA5

Sl. No.	Time(min)	Weight(g)	%S
1	0	0.129	0
2	5	0.147	14
3	10	0.1746	35
4	30	0.2003	55
5	60	0.2022	57
6	120	0.2189	70

Table 6: Swelling studies of SA6

Sl. No.	Time(min)	Weight(g)	%S
1	0	0.3217	0
2	5	0.3218	0.031
3	10	0.3219	0.062
4	30	0.3221	0.124
5	60	0.3228	0.342
6	120	0.3311	2.92

Table 7: Swelling studies of SA7

Sl. No.	Time(min)	Weight(g)	%S
1	0	0.0971	0
2	5	0.1079	11
3	10	0.1307	35
4	30	0.1327	37
5	60	0.1529	57
6	120	0.1715	77

Table 8: Swelling studies of SA8

Sl. No.	Time(min)	Weight(g)	%S
1	0	0.1331	0
2	5	0.1732	30
3	10	0.1843	38
4	30	0.1882	41
5	60	0.1889	42
6	120	0.1891	42

Table 9: Swelling studies of SA9

Sl. No.	Time(min)	Weight(g)	%S
1	0	0.2956	0
2	5	0.3352	13
3	10	0.3464	17
4	30	0.3571	21
5	60	0.3684	25
6	120	0.3798	28

Table 10: Swelling studies of SA10

Sl. No.	Time(min)	Weight(g)	%S
1	0	0.311	0
2	5	0.329	5
3	10	0.340	9
4	30	0.367	18
5	60	0.382	23
6	120	0.389	25

Table 11: Swelling studies of SA11

Sl. No.	Time(min)	Weight(g)	%S
1	0	0.2458	0
2	5	0.2803	14
3	10	0.300	22
4	30	0.307	25
5	60	0.309	26
6	120	0.310	26

Table 12: Swelling studies of SA12

Sl. No.	Time(min)	Weight(g)	%S
1	0	0.5826	0
2	5	0.6236	14
3	10	0.6359	22
4	30	0.6498	25
5	60	0.7250	26
6	120	0.7842	26

Table 13: Swelling studies of SA13

crosslinking medium. As seen from Fig. 1 (a) & (b)., the films crosslinked with 0.1 M $CaCl_2$ solution at 10 min., (SA2) showed the equilibrium swelling ratio of 203 whereas those made with 0.5 (SA5) & 1.0 M (SA8) solutions showed the value of 117 & 77 respectively. The influence of time of contact of the gels with the crosslinking medium was determined by crosslinking the gels with 1M $CaCl_2$ for 10 (SA8), 30 (SA9) & 60 (SA10) minutes respectively. The swelling behaviour of these gels was in the expected order. Higher the time of contact, lower is swelling . i.e., SA8>SA9>SA10 (77, 42 & 28). With increase in the crosslinking nature of the network, the polymer chains are held tight, decreasing the hydrodynamic free volume available for accommodation of water molecules thereby causing decrease in swelling.

Glycerol

The effect of addition of Glycerol to the polymer during the preparation of the gels is reflected on the swelling behaviour of the gels, as indicated in Figure 2(a). The gel SA13 made without Glycerol exhibited the highest swelling capacity when compared to those made with amount of Glycerol (SA12). The glycerol when added to the polymer mixture binds to the polymer chains through H bonding and acts as an additional crosslinker. This enhances the compactness of the chains effecting in the reduction in swelling.

Valency of metal ions

It is observed from the Figure 2(b) that as the valency of the metal ion increases the % swelling decreases. The % swelling of SA9 (Ca^{2+} crosslinked) is 42 and that of SA13 (Fe^{3+} crosslinked) is 35. Since Fe^{3+} can binds to three polymer chains the gel becomes highly crosslinked. With increase in the crosslinking nature of the network, the polymer
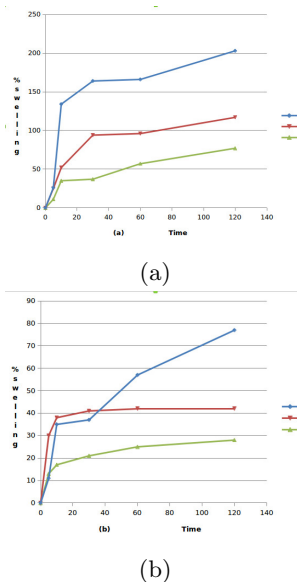

(a)

(b)

Figure 1: Swelling studies as a function of concentration & time of contact
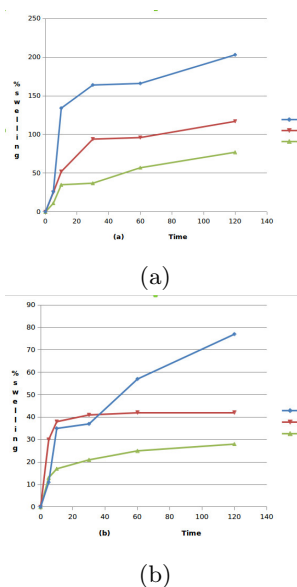

(a)

(b)

Figure 2: Swelling studies as a function of plasticizer valency of metals ion

chains are held tight, decreasing the hydrodynamic free volume available for accommodation of water molecules thereby causing decrease in swelling.

5. Conclusions

Sodium Alginate gels have been made in the presence of glycerol using Ca^{2+} & Fe^{3+} as crosslinkers. The swelling capacity of the gels and the rate of swelling were observed to be influenced by gel composition and the preparation conditions. The crosslink density of the gel increases both with the increase in the concentration of the salt solution and the time period of contact of the gels with the crosslinking medium. As the crosslink density increases the % swelling decreases. Glycerol is used as a plasticizer in the preparation of the gel. The glycerol when added to the polymer mixture binds to the polymer chains through H bonding and acts as an additional crosslinker. This enhances the compactness of the chains effecting in the reduction in swelling. As the valency of the metal ion increases the extend of croolinking increases and there by swelling decreases.

Acknowledgement

References

[1] Kariduraganavar, M. Y., Kittur, A. A., Kulkarni, S. S., and Ramesh, K. J. Membrane Sci. 238, 165 (2004).

[2] Vishalakshi, B., and Kalpagam, V. Indian J. Chem. 31A, 334 (1992).

[3] Kikuchi, Y., and Kubota, N. Bull. Chem. Soc. Jap. 61, 2943 (1988).

[4] Kim, S. J., Yoon, S. G., and Kim, S. I. J. Appl. Polym. Sci. 91, 3705 (2004).

[5] Rokhade, A. P., Agnihotri, S. A., Patil, S. A., Mallikarjuna, N. N., Kulkarni, P. V., and Aminabhavi, T. M. Carbohydrate Polymers 65, 243 (2006)

[6] Xiao, C., Liu, H., Lu, Y., and Zhang, L. J. Macromol. Sci: Part A: Pure. Appl. Chem. A38, 317 (2001).

[7] Kim, S. J., Lee, K. J., Kim, S. I., Lee, K. B., and Park, Y. D. J. Appl. Polym. Sci. 90, 86 (2003).

[8] Babu, V. R., Rao, K. S. V. K., Sairam, M., Naidu, B. V. K., Hosamane, K. M., and Aminabhavi, T. M. J. Appl. Polym. Sci. 99, 2671 (2006).

[9] Isiklan, N. J. Appl. Polym. Sci. 99, 1310 (2006).

Historical Geography of Manjeri Town, 1800-1947

Sharafunnissa C. H.
Department of History
Nehru Arts and Science College Kanhangad, Kerala - 671314
Email: sharafusch@gmail.com, Mob: +91-9846981206

Abstract

Manjeri, a major town in southern Indian state of Kerala, is the administrative headquarters of Ernad taluk today. It is situated 30 miles away from Kozhikode. It was for a while the headquarters of the Mysorean troops during Haider Alis invasion of Malabar. In recent times it served as the venue of the famous Malabar district political conference held in 1920. Manjeri was also the strong holds of the rebels during the Malabar rebellion of 1921. The ancient history of the space of Manjeri town is not thoroughly explored by scholars and researchers. There is much relevance in investigating the evolution of this place into a city in the post-independence period through the colonial time.

A city is the point of maximum concentration for the power and culture of a community. It is the form and symbol of an integrated social relationship; it is the seat of temple, the market, the hall of justice and the academy of learning. It is a welcome sign that Indian historians have turned their serious attention to urban history, at a time when fast changing landscape of cities has left many of the old recognizable features still intact. Many of these would also disappear leaving behind a few important monuments. It would be difficult to fill the gaps on the basis of surviving features.

This study, however, deals with Manjeri town. As is well known, Manjeri, a major town in southern Indian state of Kerala, is the administrative headquarters of Ernad taluk today. A big city and a municipality in Malappuram District, nobody denies the important role that this town played in the Malabar district administration as its key functionaries. The historical geography of Manjeri town is shrouded in mystery due to lack of enough historical evidences. We have only a few records relating to the revenue settlement. So there is need to conduct historical investigation on the basis of sources such as literary, archival, and administrative accounts.

The town stretches 110 05 North latitude and 760 05 East longitude[1]. It is 10 miles distant from Melattur railway station and on the maintained road from Manjeri to Kozhikode and. Ernad is at once the largest and most typical taluk in Malabar[2]. It consists of the Hoblees of Manjery, Elankoor, Wandoor, Kilmury, Karikad, Malappuram, Iryvetty, Chengara, Nediiyirippu, and Edeady. "Eranaud is only a Division so called in Malabar, but Munjairy, being centrically situated is considered the capital"[3].

The taluk of Eranad is bounded on the North generally by the ridge of Ghauts from Wynad for 48 miles, on the North East by the crest of Nilagiries and Koondah mountains for 28 miles, to the South East and South by the Walluvanad taluk for 47 miles, the Pandaloor range of Hills, and a portion of Tiruvangady defines the limits on this side, to the South West from the Shernad taluk for 28 miles, to the West and North West by the Kozhikode district for 33 miles, and the Punnycode range to the West defines the limit of 22 miles: its whole parameter is being 184 miles[4]. It seems that being centrically located Manjeri was well protected by

natural boundaries.

As per the colonial survey settlement register of Manjeri *desam* No: 173 of the Eranad taluk, this *desam*[5] is the Head Quarters of the taluk[6]. The settlement was introduced in to this *desam* in Fasli 1313. The area of the *desam* by settlement is 2009 acres and 84 cents. This *desam* together with Anakkayam, Arukizhaya, Kottupttt, Vakketodi, and Vengalur *desams* formed the old revenue amsam[7] of Manjeri.[8] Nothing in this memoir or the settlement register should be understood as admitting any title to the exclusive use or occupation of any land over which the public has a right of way or which by law or custom, vests in government or the public.

This *desam*, as now formed by settlement, contains 340 survey fields, 13 boundary stations 4 division stations and 2073 field stones[9]. The amsam officials have given receipts for them. The ryots are responsible for the maintenance of the survey marks. It is the duty of village officers to prevent the destruction, injury or alteration of any survey marks and to report any such destruction, injury or alteration to the revenue Inspector without delay. The land assessment of Manjeri amsam for the year 1903 was Rs 3138 - 11 - 5; by settlement it is Rs 6040 7 0; increase Rs 2901 11 7. The chief crops cultivated here are paddy, ginger, coconut, areaconut and jack.

All the taluks in Malabar were resurveyed between 1923 and 1935[10]. The resurvey and resettlement register of Manjeri Amsam No: 64 comprise the old *desams* of Manjeri, Arukilaya and Vakkethodi[11]. It contains 606 survey fields. The land assessment for the year 1933 was Rs 3350 - 1 - 0; by settlement it is Rs 4241 6 - 0; increase Rs 891 5 - 0. The roads, rivers, forests etc have in great part been defined by the resurvey.

Manjeri was populated several times. The role of religion has also been examined in the growth of cities. Religion has no doubt played a very important role in our history, it would be wrong to ignore it. The cities grew up with a population of different religions, people coming from different parts of the country. Manjeri is a predominantly Muslim town, where the Mappillas outnumber the Hindus. The population of the *desam* as ascertained by the different censuses was as under[12]. Table 1. shows the rise of population.

Neither inscriptions nor works of classical geogra-

phers and Tamil poets which form a valuable source of information for the early history of Kerala help us in reconstructing in full its early history. However it certain that during the Sangam Age the district formed part of the Empire of the Cheras, a branch of which exercised sway over Northern parts of Kerala, with its capital at Tondi [13]. Cheras, beginning their imperial expansion northwards, established their sway over the whole of Kudanad (Cochin and south Malabar area) which includes the present Manjeri town also.

From the time of Cheraman Perumal until the period of Haider Ali Manjeri to be governed by the descendants of Samoothiri's. The rulers of Ernad were the ancestors of Samoothiri and the later history of the taluk is interwoven with the history of Samoothiri rulers. Francis Buchanan recorded, "Malabar which formerly belonged to Tamura Raja, as the Zamorin is called by the natives"[14]. The original seat of this provincial dynasty was probably located in the interior, perhaps in the hilly area near the present town of Manjeri[15].

It was for a while the headquarters of the Mysorean troops also, during Haider Ali's invasion of Malabar[16]. Haider Ali established his headquarters at Manjeri[17]. To secure the conquests he established several block-houses in different parts of the country, where food and ammunition were stored[18].

Tippu Sulthan was similar to his father in his courage and capacity for leadership. It is said that Tippu's officers in the occupied territory oppressed the common people and this caused hatred even among the Muslims of Ernad and open rebellion broke out under the leadership of the Kurikkal, a notable Muslim leader of Manjeri. With the help a Rajah from Samoothiris family Arshad Beg Khan suppressed the rebellion and as gratitude some land was allotted to Samoothiris family.

"For in 961(1785-6)the Goorkul Mopilla of Munjery rose in rebellion, and Arshad Beg Khan was not even able to face him with such of Tippoo's troops as were in the province, till, by messages and promises, he prevailed on the younger Ruvee Vurma, one of the Rajas of Samoorys family, to join him, and with their united forces, the said Goorkul was discomfited and fled; for which meritorious service, and with a view also of gaining over the others of the same family, Tippoo settled

Year of Census	No. of Inhabited Houses	Total Population			Religion			Occupation				Population per 100 acres of occupied land
								Agriculturists				
		Males	Females	Total	Hindu	Muhammadans	Others	Land Holders	Labourers	Weavers	Others	
1	2	3	4	5	6	7	8	9	10	11	12	13
1891	430	1294	1189	2483	1436	1015	32	648	594	9	1232	324
1901	542	1651	1659	3310	1823	1431	56	282	488	12	2528	431
1931	1312	3554	3704	7258	3704	3445	109	-	-	-	-	393

Table 1: Rise of population

a pension, and such after a considerable jaguar, on the Rajah in question."[19]

The annals of Ernad have since 1830 been disfigured by frequent Mappilla outrages. Malappuram, Manjeri, Pandikkad, Pandalur, and Wandur are the fanatical zone[20]. It was also the stronghold of the rebels during the Malabar Rebellion of 1921[21]. The taluk treasury was looted by the rebels on the 22nd August 1921 and more than six lakhs of rupees carried away by them. The treasury strong box was opened by a notorious criminal of Tirurangadi who happened to be then in Manjeri sub-jail, and who was specially released by the rebels for this purpose. That day and the next was given up to looting in the village and the Khilafat King Variyan Kunnath Kunjahammed Haji, who came here on the 24th stayed on till 26th, opened the Nambudiri Bank and returned all pledged jewels[22].

The general percentage of literacy in Malabar increased during the years of 1930s. In 1905 the government published a notification for the acquisition of land for building a Mappilla primary school in Manjeri[23].The natural aptitude of the higher castes for education and the increased grants given by governments since 1919 for elementary education have been responsible for a great increase in the number of schools and scholars[24]. But Ernad, the only Taluk where Mappillas outnumber Hindus, was in a backward tract for special reasons, being the most illiterate taluk in the District.

Manjeri served as the venue of the famous Malabar District Political Conference, which held on 1920[25]. This capital was also the venue of Ernad

Taluk Board meeting held on Tuesday, the 25th January 1927[26]. The proceedings of the Taluk Board assure that 15 selected members were presented here and V. Kunhi Moyi Haji Sahib Bahadur was the president. The interpretations and resolutions were made by M.R.Ry M R Venkata Raya Ayyar Avarkal, who requested to the president about the circumstances under which the Head master of Manjeri Hindu Elementary School was transferred to Chaliyam Mappilla School[27].

About a quarter of a mile south-east of the taluk office is the Sri Mutra Kunnu or Kunnath Ambalam dedicated to Goddess Durga, and situated on a low hill, and just below it is the residence of Manjeri Karanamulpad[28]. A vattezhuthu inscription on the eastern wall of the temple records the fact that the temple was built and dedicated by Mana Vikrava Manavikravan in M.E. 827 (1652 AD), and another relates that an adjacent well was sunk and purified by the 'Victorious Vikrama Tirumulpad' in M. E. 833. The temple at present belongs to Manjeri kovilakam, has a melancholy interest as the scene of three Mappilla outbreaks. In 1784 this temple and the Karanamulpads palace were attacked by a large body of Mappillas, and after a three days siege were burnt to the ground. The temple was not fully restored till 1849, in April a new idol was installed.

It was this temple that was seiged by a gang of Mappilla fanatics under Attan Kurikal in 1849, and Ensign Wyse, who lies buried on the taluk cutchery hill, was killed in an attempt to take the temple from the fanatics[29]. The annual festival known as

Manjeri pooram is held here during March-April and lasts for seven days. There are three mosques and two churches, protestant and catholic at Manjeri.

A weekly market is held here, which is generally well attended. Manjeri is the seat of the Tahsildar; District Munsif; Sub Magistrate; hospital; travelers bungalow; overseers shed; chattram; sub registrars office; police station; post and telegraph office [30], and high school. In 1906 the government built a boundary wall around these offices[31]. Registration of land was inaugurated in 1799 when a proclamation was issued that, all writings in evidence of the transfer of landed property shall be registered either in the provincial or local adawlets.

It is the centre of the road system of Ernad, and roads radiate hence in all directions to Areacode, to Feroke , Nilambur, and the Karkkur ghat via Edavanna, Angadippuram and Malappuram[32]. There are three rock cut caves in this amsom and a hat stone close to the Kondotty road at Pattukulam.

Manjeri town during the colonial period played an active role in the urbanisation of Malabar District. In the medieval period it acted as a place to link the coastal and inland trade through the Thamarassery pass. The migration of people also raised the population of this area. The establishment of a township in Manjeri was not sudden event in the colonial period. The colonial authorities founded the city as a rebel area and to handle the resistance of the Mappillas against British dominance in Malabar.

References

[1] A Sreedhara Menon ., Kerala District Gazetteers: Kozhikode, Thiruvananthapuram, 1962, P. 765

[2] C. A. Innes, and F.B. Evans, Madras District Gazetteers: Malabar, Vol. 1, State Editor-Kerala Gazetteers, Thiruvananthapuram, 1997 (1908), p. 438

[3] Ward and Conner, A Descriptive Memoir of Malabar, Reprint by the State Editor, Kerala Gazetteers, Thiruvananthapuram, 1906, p. 112

[4] Ibid

[5] *Desam* is a territorial unit of the military organization in the ancient regime or a village in the Malabar province

[6] Survey and Settlement Register of Mancheri Desam No: 173, Ernad Taluk, Malabar District, Printed at the Scottish Press, by Graves, Cookson and Company, Madras, 16th May 1905, Kerala State Regional Archives, Kozhikode.

[7] Amsham or parishes was a smallest administrative unit in Malabar: part of a village or share

[8] See settlement register Survey Map No: 173, prepared by C. A. Innes, the then settlement officer, Malabar on 16th may 1905, Kerala State Regional Archives, Kozhikode.

[9] Descriptive Memoir of Manjeri Desam No: 173 of the Eranad Taluk, Kerala State Regional Archives, Kozhikode.

[10] S. Boothalingam was the special settlement officer, Malabar on 28th February 1935.

[11] esurvey and Resettlement Register of Amsam No: 64, Manjeri, Ernad Taluk, Malabar District, Printed by Superintendent, Government Press, Madras, 1937, Kerala State Regional Archives, Kozhikode.

[12] See Survey and Settlement Register of Mancheri Desam No: 173, Ernad Taluk, Malabar District, Kerala State Regional Archives, Kozhikode.

[13] A Sreedhara Menon , op. cit ., P. 765

[14] Francis Buchanan ., A Journey from Madras Through Mysore, Canara and Malabar, London, 1803, p. 345

[15] M.G.S. Narayanan, Political and social conditions of Kerala under the Kulasekhara Empire (c. 800 AD to 1124 AD), unpublished ph. D Thesis, University of Kerala, 1972, pp. 305-307

[16] A Sreedhara Menon , op. cit ., P. 765

[17] A. P. Ibrahim Kunju, Mysore Kerala Relations in Eighteenth Century, Thiruvananthapuram, 1975, p. 9

[18] Ibid., pp. 6-7

[19] The Joint Commissioners Report on Malabar: 1792-93, Madras, 1862, Kerala State Archives, Government of Kerala, Reprint 2010, Para: 51, p. 61

[20] C. A. Innes, and F.B. Evans, op cit., p. 440

[21] A Sreedhara Menon , op. cit., P. 765

[22] C. A. Innes, and F.B. Evans, op cit., p. 446

[23] DR Files- Revenue 1905, Bundle No: 25, Kerala State Regional Archives, Kozhikode, R- 61-P- 1905, dated 22/12/1905, sub: Acquisition of land publishing draft notification of government for the acquisition of land for constructing a Moplah primary school at Manjeri.

[24] Madras Files-Education Department, G.O.No: 78, dt 15/1/1923- Budget- Ele. Edn- Fund- Ernad Taluk Board- approved- reg, Kerala State Regional Archives, Kozhikode.

[25] A Sreedhara Menon , op. cit., P. 765

[26] The Malabar District Gazette, Calicut, Tuesday, 1st February 1927, Kerala State Regional Archives, Kozhikode.

[27] Ibid

[28] C. A. Innes, and F.B. Evans, op cit., p. 445

[29] William Logan, , Malabar: Manual of the Malabar District, Government Press, Madras, 1951(1887), p. ccclviii

[30] Public- R. DIS Files- 1905, Bundle No: 18, File No: 23, dt 30- 05-1905, paper regarding the extension of the telegraph line from Manjeri to Nilambur, Kerala State Regional Archives, Kozhikode.

[31] DR Files- Public- 1906, Bundle No:41, File No: 900, dated 14/06/1906, Government order- Boundary wall round the public offices at Manjeri, Malabar district an estimate, amounting to Rs 2480/- for completing the boundary wall round the public offices at Manjeri, Malabar district approved and returned to the Superintend Engineer for sanction and execution, Kerala State Regional Archives, Kozhikode.

[32] C. A. Innes,. and F.B. Evans, op .cit., p. 445

Study on Isolation, Sub culture and Effect of Light and Darkness on the Growth of Trichoderma Viride

Prajith P. K.

Department of Botany

Nehru Arts and Science College Kanhangad, Kerala - 671314

email: pk.prajith@gmail.com, Mob: +91-9539608494

Abstract

The native population of Trichoderma species collected from different habitats was quantified and characterised. T. viride was the most common in all of the habitats. Trichoderma was found to have adapted to an acidic habitat. The effect of Light and Darkness on the growth of Trichodrma viride in different media are studied. Considerable growth is obtained in natural medium like starch and coconut juice. Dry weights are quantified and compared.

Keywords: Isolation, distribution, Trichoderma, dry weight

1. Introduction

Plant diseases may play a direct role in the destruction of natural resources in agriculture. In particular, soil-borne pathogens cause important losses, fungi being the most aggressive. The distribution of several phytopathogenic fungi, such as Phythium, Phytophthora, Botrytis, Rhizoctonia and Fusarium, has spread during the last few years due to changes introduced in farming, with detrimental effects on crops of economic importance. In addition, not only growing crops but also stored fruits are prey to fungal infections[1].

Chemical compounds have been used to control plant diseases (chemical control), but abuse in their employment has favored the development of pathogens resistant to fungicides. Unfortunately, the more specific the effect of a chemical on an organism, the greater the probability of decreasing the effect through genetic shifts in the population, whereas fungicides of broad spectrum produce undesirable consequences on non-target organisms [2]. By contrast, the use of microorganisms that antagonize plant pathogens biological control is risk free when it results in enhancement of resident antagonists.Moreover,the combination of such biological control agents(BCAs) with reduced level of fungicides {integrated control} promotes a degree of disease suppression similar to that achieved with full fungicide treatment[3].

Trichoderma species have been investigated for over 80 years. They have been used recently as biological control agents and their isolates have become commercially available of late. This development is largely the result of a change in public attitude towards the use of chemical pesticides and fumigates such as methyl bromide[5, 6, 7]. In this respect, Trichoderma spp. have been studied as biological control against soil-borne plant pathogenic fungi[7, 8, 9]. Results from different studies showed that several strains of Trichoderma had a significant reducing effect on plant diseases caused by pathogens such as Rhizoctonia solani, Sclerotium rolfsii, Phythium aphanidermatium, Fusarium oxysporum, F. culmorum and Gaeumannomyces graminis var. tritici under greenhouse and field conditions[11, 12] . Knowledge concerning the behavior of these fungi as antagonists is essential

for their effective use because they can act against pathogens in several ways. Isolates of Trichoderma harzianum can produce lytic enzymes and antifungal antibiotics and they can also be competitors of fungal pathogens and promote plant growth.

Benefits of Trichoderma:

1. Disease control: - It is a potent biocontrol agent and used extensively for soil born diseases. It has been used successfully against pathogenic fungi belonging to various genera, viz, fusarium, phytopthara, scelerotla etc.

2. Plant growth promoter: - Trichoderma strains solubilize phosphaters and micronutrients. The application of Trichoderma strains with plants increases the number of deep root, thereby increasing the plants ability to resist drought.

3. Biochemical Elicitors of Disease: - Trichoderma strains are known to induce resistance in plants. Three classes of compounds that are produced by Trichoderma induce resistance in plants. These compound, induce ethylene production, hypersensitive responses and other defense related reactions in plant cultivars.

4. Transgenic plants:- Introduction of endochitinase gene from Trichoderma into plants such as tobacco and potato plants has increased their resistance to fungal growth. Selected transgenic lines are highly tolerant to foliar pathogens such as Alternaria alternata , A.solani and Botrytis cirerea as well as to the soil borne pathogen, Rhizectonia species.

5. Bioremediation:- Trichoderma strains play an important role in the bioremediation of soil that are contaminated with pesticides and herbicides. They have the ability to degrade a wide range of insecticides, organochlorines, organophosphates and carbonates.

T.viride is a mold which produces spores asexually, by mitosis. It is the anamorph of Hypocrea rufa its telemorph which is the asexual reproductive stage of the fungus and produces a typical fungal fruiting body. The mycelium of T viride can produce a variety of enzymes, including cellulases and chitinases which can degrade cellulose and chitin. It parasitizes mycelia and fruiting bodies of other fungi including cultivated mushroom, and and it

has been called the "green mould disease of mushroom".

In the present study we aimed to isolate, sub culture and analyse the growth of Trichoderma viride in different media as well as the influence of light and darkness in their growth.

2. Materials and Methods

Isolation, identification and quantification of Trichoderma spp.

The soil samples were taken from a 15cm depth and for isolation of Trichoderma strains, a serial dilution technique was followed and a 10^3 dilution of each sample was prepared. One milliliter of each solution was pipetted onto a Rose Bengal gar (RBA) plate and incubated at 28^oC for 1 week. The culture plates were examined daily and each colony that appeared was considered collected in sterile polyethylene bags and stored at 4^oC in laboratory to heat one colony forming unit (cfu) . After enumeration of cfu, individual colonies were isolated from the same plates and each uncommon colony was reisolated onto a fresh Potato Dextrose Agar (PDA) plate. Distinct morphological characteristics were observed for identification and the plates were stored at 4^oC.

Two techniques, visual observation on Petri dishes and micro-morphological studies in slide cultures were adopted for identification of Trichoderma species. For visual observation, the isolates were grown on PDA agar for 3-5 days. The mode of mycelia growth, color, odour and changes of medium color for each isolate were examined every day. For micro-morphological studies, a slide culture technique was used[17]. Examination of the shape, size, arrangement and development of conidiophores on phialides provided a tentative identification of Trichoderma spp. Samples were compared to a taxonomic key for the genus Trichoderma[18].

Estimation of moisture content:

Freshly collected samples were placed in glass tubes and initial weights were recorded. The samples were then placed inside a hot-air incubator at 110^oC until constant weight was achieved. The moisture content was calculated using the following formula provided by American Wood Preservation Associations Standards(AWPA)[19].

$$MC(\%) = W - w/w * 100$$

Where MC is moisture content, W is the initial weight and w is the constant weight after oven drying.

3. Isolation And Mass Multiplication Of Trichoderma

Isolation of Trichoderma from soil:

Ten gram of soil sample collected from the root zone [at 5-15 cm] is suspended in 90 ml of sterile distilled water and mixed well. From this, one ml of the suspension is transferred to 9 ml of sterile distilled water [10^{-2} dilution]. Similarly serial dilutions up to 10^5 are prepared. Then, under aseptic conditions, 1 ml of 10^5 dilutions is transferred to a sterile Petri plate. About 15 ml of Trichoderma selective medium is poured over this and the plate is swirled well so as to have proper mixing of the diluted suspension with the medium. After solidification, the plates are incubated at 28°C. After 3 days, the plates are observed for the development of typical Trichoderma colonies and the developing colonies are brought in to pure culture by transferring to fresh PDA plates and are later transferred to PDA slants for future use.

Composition of Trichoderma specific medium [TSM][15]

Magnesium Sulphate	- 0.20g
Dipotassium hydrogen phosphate	- 0.90g
Ammonium nitrate	- 1.00g
Potassium chloride	- 0.15g
Glucose	- 3.00g
Metalaxyl [fungicide]	- 0.30g
PCNB [fungicide-banned]	- 0.20g
Rose Bengal	- 0.25g
Agar	- 15g
Distilled water	- 1000ml

Preparation of Nucleus culture:

Individual colonies of Trichoderma grown on TSM are transferred aseptically to PDA medium taken in sterile Petri plates following single hyphal tip method or single spore isolation methods .The plates are incubated are room temperature for 4 to 5 days and it serves as the nucleus culture . Simultaneously, slant cultures are prepared and stored for the future use.

Mass production [small scale]:

The mycelial discs grown in potato dextrose agar medium are transferred to glucose bottles containing 300 ml PDB medium and is incubated for 10 days. The mycelial mat along with the broth is homogenized and mixed with talc powder [500 mesh] at 1:3. Carboxy methyl cellulose is added @ 5 g per kg of the product which serves as a sticker. The product is shade dried until it attains 20% moisture level. The clumps are broken, homogenized and packed in polythene bags of 1kg capacity.

Note:

- The shelf life of the product is about 120 days.

- The required population level at the time of packing should be 28×10^7 cfu (colony forming units) per gram of the product.

- At the end of the expiry the cfu should not be less than 20×10^6 per gram of the product.

Potato Dextrose Agar medium (PDA) composition:

Peeled potato	- 200 g
Dextrose	- 20 g
Agar-agar	- 20 g
Distilled water	- 100 ml

Potato Dextrose Broth [PDB] Composition :

Peeled potato	- 200g
Dextrose	- 20g
Distilled water	- 1000ml

Preparation of potato extract:

Peeled and sliced potatoes in 500ml of distilled water are boiled until the potatoes became soft and then the extract is filtered through a muslin cloth in clean glass beaker.

Preparation of PDA :

Agar - agar powder is separately melted in 500 ml of water and then added to potato extract. Volume of the filtrate is made up to 1 litre after the addition of dextrose to it. The PH of the medium is adjusted to 6.8 by the addition of lactic acid. About 150 ml of the medium is dispensed in to 250 ml Erlenmeyer flasks, closed with non-absorbent cotton plugs and then is sterilized in an autoclave at 15 psi for 15 min.

Preparation of PDB for mass multiplication of Trichoderma:

The prepared potato extract is mixed with 500 ml of dextrose solution and made up to 1 litre and is directly dispensed in to the suitable containers [glucose bottles or conical flasks]and autoclaved at 15 psi for 15 min for further use.

Results And Discussion

Species of Trichoderma are distributed worldwide. They are generally found in soils, including Forest, humus layers and agricultural orchards soils. All the species level, however, individual species aggregate may be restricted in their geographic distribution. Trichoderma populations were significantly for various sites on padnekat and in its suburban area .There was a significant difference in distribution of Trichoderma species among the different habitats. Seasonal variations is a factor that affects the number of Trichoderma species in the samples. Danielson and Devey (1973) found that T.viride are restricted to areas where low temperature prevails . In the present study T.viride has been isolated using Rose Bengal (Elad and Chet,1983) is grown in three different mediums. They are PDA, Starch and Coconut juice respectively . Also replicates were grown in light and dark and harvested attaining maximum growth. T.viride shows maximum growth in PDA and least growth observed in starch in the case dark grown samples where as maximum growth is shown in PDA and considerable growth shows in Coconut juice and starch in the case of light grown samples (Table no.1) . Moisture content in dark grown T. viride in PDA is found to be four times more than their respective natural mediums like starch and coconut juice.

Medium	Light grown(gm/150ml)	Dark grown(gm/150ml)
PDA	2.55	0.68
Coconut	2.13	0.35
Starch	2.13	0.105

Table 1: Dry weight of Trichoderma grown in different medium under the influence of light and darkness

The first description of the effect of light on conidiation of Trichoderma was made in 1957 (Gressel and Galun, 1967;Gutter,1957). In the dark Trichoderma grows indefinitely as mycelium,and a brief pulse of light applied to the actively growing zone of the mycelium leads to the formation of dark green mature conidia forming a ring at what was the edge of the colony when light was applied. A few years ago two genes(brl-1 and brl-2) from T atroviride were identified (Casas-Flores et al.,2004). Although sexual development requires light; it is not known yet, whether BLR1 and BLR2 proteins are essential for this process.

Method of application of Trichoderma spp:

- Seed treatment: - Mix 6-10g of Trichoderma powder per kilogram of seed before sowing.

- Nursery treatment: - Apply 10-25g of Trichoderma per 100 m2 of nursery bud. Application of neem calee and FYM before treatment increases the efficiency.

- Cutting and seedling root clip:- Mix 10g of Trichoderma powder along with 100g of well rotten FYM/L of water and clip the cuttings and seedlings for 10 minutes before planting.

- Soil treatment: - Apply 5kg of Trichoderma powder per hector after turning of sun hem or dhainch into the soil for green manufacturing, or mix 1kg of the polythene.Sprinkle the heap with water intermittently. Turn the mixture in every 3-4 day, interval and then broadcast in the field.

- Plant treatment:- Drench the soil near stem region with 10g Trichoderma powder mixed in a litre of water.

Trichoderma formulations

Important commercial formulations are available in the name of Sanjibani, Guard,Niprot and Bioderma.These formulations contain 3x106 cfu per 1g of carrier material. Talc is used as carrier for making powder formulation.

Uses:-

- Used in damping off caused by Pythium species,phytophthora species.

- Root rot caused by Pellicularis filamentosa

- Seedling blight caused by Pythium

- Collar rot caused by Pellicularia rolfsii

- Dry rot caused by Macrophomina phaseoli

- Charcoal rot caused by Macrophomia phaseoli

- Hoose smut caused by Ustilago segetum

Precautions:-

- Don't use chemical fungicide after application of Trichoderma, for 4-5 days.

- Don't use Trichoderma in dry soil. Moisture is an essential factor for its growth and survivability.

- Don't put the treated seeds in direct sun rays.

- Don't keep the treated FYM for longer duration.

4. Summary & Conclusion

This study is an attempt to know much about the production of Trichoderma viride by taking three easily available and low cost mediums like PDA, Starch and Coconut Juice. From the above mediums used, it was found that good yield can be obtained from PDA after an incubation period of one week. From the present study following conclusions were made :

1. PDA is an ideal medium for sub culturing Trichoderma viride.
2. Considerable growth is observed when grown in natural mediums like Starch and Coconut juice. So it can be used as an alternate economic medium.
3. Variations in dry weight is observed while T.viride grown in dark and light.
4. Exact reason for dry weight variations is still unknown so it provides new opportunity for further findings.

References

[1] Chet I, Inbar J, Hadar I (1997) Fungal antagonists and mycoparasites.In: Wicklow DT, Soderstrom B (eds) The Mycota IV: Environmental and microbial relationships. Springer-Verlag, Berlin, pp 165-184

[2] Tjamos EC, Papavizas GC, Cook RJ (eds) (1992)Biological control of plant diseases. Progress and challenges for the future. Plenum Press, New York

[3] Monte E (2001)Understanding Trichoderma: between biotechnology and microbial 4:1-4

[4] Chet I. Trichoderma Application, Mode of Action and Potential asa a Biocontrol Agent of Soil-borne Plant Pathogenic Fungi. In:"Innovative Approaches to Plant Disease Control", ed. Chet I.,Wiley, New York, pp. 137-160. 1987.

[5] Elad Y, Chet I, Katan Y. Trichoderma harzianum a biocontrol agent effective against Sclerotium rolfsii and Rhizoctonia solani. Phytopatology. 70: 119-121. 1980.

[6] Basim H., Ozturk SB, Yegen O. Effificacy of a biological fungicide (Planter Box (Trichoderma harzianum Rifai T-22)) against seedling root rot pathogens (Rhizoctonia solani, Fusarium sp.)of cotton. GAP-Environmental Symposium. Sanliurfa, Turkey. p.137-144. 1999

[7] Kucuk C. Trichoderma harzianum ile Topark Kokenli Bazi Bitki Patojenlerinin Kontrolu. MSc. Thesis. Anadolu University. Eskisehir. 2000.

[8] Henis Y. Biological control. In "Current Perspective in Microbial Ecology", eds. Klug, Reddy CA, American Society of Microbiology, Washington pp. 353-361. 1984

[9] Chet I, Baker R. Induction of suppressiveness to R.solani in soil. Phytopathology 70:994-998. 1980.

[10] Chet I, Inbar J. Biological Control of Fungal Pathogens. Applied Biochemistry and Biotechnology 48: 37-43. 1994.

[11] Inbar J, Abramsky M, Cohen D, et al. Plant Growth Enhancement and Disease Control by Trichoderma harzianum in Vegetable Seedlings Grown under Commercial Conditions. European Journal of Plant Pathology 100: 337-346. 1994.

[12] Whipps JW. Effect of media on growth and interactions between a range of Soil-borne Glasshouse Pathogens and Antagonistic Fungi. New Phytol 107: 127-142. 1987.

[13] Chet I, baker R. Isolation and biocontrol potential of Trichoderma hamatum from soil naturally suppressive to R. solani. Phypatology 71: 25-39. 1971.

[14] Haran S, Schickler H, Chet I. Molecularmechanisms of Lytic Enzymes Involved in the Biocontrol Activity of Trichoderma harzianum. Microbiology 142, 2321. 1996.

[15] Elad Y , Chet I, Boyle P and Henisy (1983) Parasitism of Trichoderma spp. on Rhizoctonia solani and sclerotium rolfsii scanning election microscopy and fluorescence microscopy. Phytopathology, 73, 85, -88

[16] Danielson, R.and Devey, c.1973 The aleun dance of Trichoderma propagules and the distribution of species in forest soi-soils , Biological biochemical. 5, 485-494.

[17] Leahy JG, Colwell RR. Microbial degradation of hydrocarbons in the environment. Microbial Rev 54(3):305-315,1990.

[18] Rifai MA. A revision of the genus Trichoderma. Mycological papers no. 116. Commonwealth Mycological Institute, Kew, Surrey, England. 1969.

[19] AWPA. Book of standards. American woodpreserves Association Standards. Maryland 21666. USA;1986.

[20] Gressel J., Galun E. Morphogenesis in Trichoderma :photoinduction and RNA. DevBiol. 1967; 15:575-598.[PubMed]

[21] Gutter Y. Effect of light in sporulation of Trichoderma viride. Bull. Res. Council Israel Sect. D. 1957;5:273-286.

[22] Casas-Flores S., Rios-Momberg M., Rosales-Saavedra T., Matinez-Hernandez P., Olmedo-Monfil V., Herrera-Estrella A. Cross talk between a fungal blue-light perception system and the cyclic AMP signaling pathway. Eukaryot. Cell. 2006;5:499-506.[PMC free article][PubMed]

Theoretical Foundations Of Welfare Economics: Dialogues In Retrospect

M. Anoopkumar

Department of Economics

Govt. College, Munnar, Idukki, Kerala - 685612

email: anoopkumarmaniyeri@gmail.com, Mob: +91 9496296413

Abstract

The paper is an attempt to explore the theoretical foundations of welfare economics and to make an account of the major antecedents in the branch in retrospect. It has been observed that being a sound tool box of theories the welfare economics branch provides necessary foundation for many of the modern branches of economics. The foundations of welfare economics could be observed in the theories of classical and neo-classical economists and the horizon of Welfare Economics has widened with the contributions by later modern economists.

1. Contextualising Welfare Economics

An astonishing debate which started way back in the 1930s and continued for more than half a century regarding the very role of economists resulted in many intellectual discourses and deliberations [21]. The debate was marked in economic history as a path breaking one, which provided Economics a new direction in its approach. "The time has come for the economists to make a choice; if he wants to maintain strict objectivity, he becomes a technician; if he wants to advice on policies he must relinquish his claim to the objectivity of natural scientists" says Scitovsky [1]. The whole debate was on a point that whether economics should be positive or normative. One group of economists were on the strong foot that the economists should refrain from normative discussions and value judgements [9]. They are the positivists, who were of the opinion that economists indulging in normative discussions will make the subject rather unscientific. There were another group of economists who strongly argued that economists should not abstain from value judgments so as to make the subject not just some algebra and theories. They were the proponent of Welfare Economics, who believed that Economics should be valuable for framing public policies involving normative concerns.

In the mean time of the debate, going in a judicious line of thought by synthesising both the arguments, Hicks made a significant remark that Welfare Economics and "...the utilitarian calculus should be considered as an integral part of economic theory and policy analysis, capable of the same logical precision and the same significant elaboration as its twin brother, the positive economics or economic calculus" [21]. It is difficult to trace the history of Welfare Economics as it has been growing side by side with its twin brother positive economics and the nuances are found here and there; ever since the science of Economics became an organised body of thought. Notwithstanding the fact that the seeds of Welfare Economics were found even in the Wealth of Nations of Adam Smith, the first magnum opus book in Economics, Welfare Economics as an organised branch of Economics began with the publication of "Economics of Welfare" by A. C Pigou in 1920. But even be-

---

[1] T. Scitovsky, "The State of Welfare Economics", American Economic Review, Vol. 41, No. 3 (Jun., 1951), pp. 303-315

fore that many developments paved the foundation for Traditional Welfare Economics. The Pareto optimality, which formed the conceptual foundation for the first fundamental theorem of Welfare Economics, was stated as early as 1906. It could also be noted that the first fundamental theorem which states that "every competitive equilibrium is Pareto optimal", is also in consistent with the Adam Smiths Philosophy of invisible hand, which came in 1776. From such an intertwined beginning, presently Welfare Economics has become a matured discipline, which encompasses many issues of policy concern and forms a sound background for many applied branches of Economics like Environmental Economics, Public Economics, International Economics and the so forth. It is in this backdrop that the present paper attempts to look into the theoretical foundations of welfare economics which is necessary for understanding the dialogues in the discipline.

2. Exploring the Nature of Welfare Economics

Ever since gathering momentum, Welfare Economics has been looked at by many economists with so much optimism; as a branch which takes care of the welfare of the people by bringing in deliberations and discourses. Welfare Economics is expected to formulate propositions by which we can compare and contrast social welfare in different contexts; so as to remain as a better public policy informer. Hence, Welfare Economics has been recognised as "...that part of the general body of economic theory which is concerned primarily with public policy" [23]. Welfare Economics, thus, is not mere bundles of theoretical formulations, but are serious formulations in bringing maximum social welfare. Now it has become clear that Welfare Economics makes a significant departure from the main stream positive economics in terms of its footing in the normative value judgments. Hence Welfare Economics in its very nature is basically a normative discipline, which involves a lot of value judgement considerations.

2.1. Welfare Economics as a Normative Science

To understand clearly whether a branch of learning is normative or positive, a clear distinction between the two approaches should be made first. The distinction between positive and normative science comes more often from the methodological point of view. To put it differently, a normative science deviates from positive science in its way of approaching a typical issue. A positive science is concerned with the question of "what is, was or will be" and covers theories and laws to explain a given observed phenomenon. A normative science on the other hand makes a major deviation and it tries to find answer to the question "what ought, should or might be". A positive science, hence, will be either experimental or empirical and a normative science on the other hand will be more often qualitative and value judgmental.

Hence, positive economics is that part of economic science, which is more concerned with the question of "What is". The economic theory in general falls in the realm of positive science, as it deals with explanation, prediction and modelling of a given economic phenomena, which results in a definite answer. Questions like "what determines the price of a single product?", "what determines the equilibrium price and output of a single firm or an industry?", and "what decides the wage rate of a particular labourer?" are all falling in the category of positive micro economic analysis. We also come across queries like "what determines the national income of an economy?", "what decides the rate of consumption, saving and investment in an economy?" Those are falling under positive macro economic analysis. Normative economics, on the contrary, deals with a category of issues which are out of direct logical scientific enquiry as we have seen under positive economics. It is that part of economic science which is concerned with the fundamental issues relating to the question of "what ought to be", which involves a lot of value judgements. Normative economics deals, often with the questions like "what should or ought to be the prices in the market, so that the farmers welfare is the maximum?", "what should be the ideal saving rate to enhance economic growth and social welfare?", "what should be the pattern of resource allocation to achieve maximum social welfare?" and so on. Questions like this are difficult to be answered as they require proper context specific value judgements. Welfare economics answers to these types of normative questions based on sound value judgements.

2.2. Relevance of Value Judgements in Welfare Economics

Value judgments are highly significant in Welfare Economics, as it is concerned with the desirability or otherwise of economic policies. Hence, Welfare Economics is to be treated not simply as a bundle of theories in an academic interest, but relevant for evaluating an economic policy from the societys point of view. Before entering into the relevance of value judgements in Welfare Economics it is better to clarify what a value judgement is and what are its peculiarities. By value judgement we mean the conceptions or ethical considerations of individuals regarding what is good and bad. The conceptions regarding values are rooted in ethical, cultural, political, philosophical and even religious beliefs of individuals; and not based on any scientific law or logic. Hence, value judgements involve ethical considerations like "what is morally right and wrong" or "what is good and bad". Value judgments are often confused with statements which are difficult to provide an explanation. For instance, Mr. X states that "this picture is beautiful" is a value judgement, as it may not look as beautiful to another person, who doesnt like pictures at all. Just changing the statement can make it positive. Suppose, if X makes a statement as "this picture appears to me as beautiful", is a positive one since it clearly says it is beautiful only to him. Hence value judgements are context specific and subject to sound ethical considerations of each individual who makes the judgement. Value judgments can be both "basic" and "non-basic".

Sen in his "On Inequality" makes a distinction between a basic and non-basic value judgement, which is very much relevant in Welfare Economics. To quote Sen, "A value judgement can be called basic to a person, if the judgement is supposed to apply under all conceivable circumstances, and it is non-basic otherwise". Hence, a basic value judgement is applicable under all the possible circumstances and it is context rigid. For instance, a person X expresses that "A rise in national income indicates a better situation for an economy". The statement will not be basic value judgement if he also agrees in another situation that "the rise in national income does not indicate a better situation, if poor are made much poorer". The statement made earlier becomes non-basic because the

judgement changes with changes in context or conditions. Hence, a value judgement is basic only when it is generally accepted by him in all the contexts irrespective of any changes in economic policy. The statement can be basic if stated as "for a poor country in which everyone has the same income, it will be better situation if every ones income increases by the same amount". If the judgement is maintained throughout in any context in which a country is poor and income increases for everyone equally, the statement is a basic value judgement. Hence, a basic value judgement is independent in its own ethical appeal. Amartya Sen makes an appeal for value judgements to be "basic" to derive proper normative conclusions.

The relevance of value judgments in Welfare Economics can be well appreciated from its very nature and philosophical background. Many economists were against the use of value judgements in Economics; they are the so called Positivists. They were of the argument that inclusion of value judgements will make Economics unscientific and therefore economists should refrain from value judgements. Another school of thought argues that economists should not feel shy of making use of value judgements as they are as relevant as logical conclusions. They made it clear that it is only with the aid of value judgements an economic policy can be well evaluated and implemented or revised. It doesnt make full sense in searching for a logical answer or conclusion for an issue whether an airport project in Aranmula in Pathanamthitta district of Kerala will be god or bad, as it involves many ethical and environmental considerations. Since the primary concern of Welfare Economics is to understand and conceptualise social welfare and design policies to promote the same, which is difficult to be answered objectively, Welfare Economics cannot be free from value judgements.

3. Developments in Welfare Economics: A Retrospective View

The very subject matter of Welfare Economics, being a normative science, is a balance of theory and issues of policy concern. The traditional Welfare Economics had its roots in the celebrated principle of Pareto optimality, which is a background for the fundamental theorems of Traditional Welfare Economics [23]. Welfare Economics during

those times was an attempt to find an optimal position for a society in term of resource allocation and welfare. The Pareto optimality, which states that it is a state in which "no one can be made better off without making somebody else wore off" is reflecting an ideal of such a case. Hence, a change will become improvement and desirable if it makes at least one person better off without making any body worse off. This implies that if a society can raise its aggregate welfare by making one person better off without making the other one worse off, it hasnt reached its optimality in resource allocation; towards which every economy should march ahead. The idea of Pareto optimality has become sound background for the first and second fundamental theorems of Welfare Economics. The first fundamental theorem of Welfare Economics enunciates that in a general equilibrium framework, all competitive equilibrium positions are Pareto optimal. The argument is based on the logic that a competitive market will always lead to an efficient allocation of resources which will bring in Pareto optimality. The second fundamental theorem rested on the possibility of reaching a competitive equilibrium from a Pareto optimal case. It states that all Pareto optimal solutions will lead to competitive equilibrium provided there is an initial resources re-allocation by an external agency probably the government. The second fundamental theorem was an attempt to convey a message that ultimately all efficient equilibrium positions are only Pareto optimal.

Modern Welfare Economics, which primarily attempted to design appropriate tests for Pareto optimality and improvements came later. The school was lead by Hicks, Kaldor and Scitovsky. Hicks and Kaldor initially advocated a compensation criterion for testing Pareto improvements, which later formed the basis for the well known and applied Cost Benefit Analysis in highly technical project evaluations. Pareto optimality basically postulated that a change is an improvement and also desirable if and only if it makes some one better off without harming the other. Hicks and Kaldor rejected the basic proposition of Pareto improvement on the ground that no policy can make only betterments with zero cost. Some are always harmed by policies especially in a democratic setting. Hence, an improvement would also happen and be accepted if the gainer is able to compensate the looser and still

be better off than before. The logic is simple that an improvement in overall welfare would happen if the benefits are substantially larger than the costs, so that the policy may be adopted. The technical lacunas in the criterion was later identified and corrected by Scitovsky using his double criterion of welfare.

Meanwhile a school of thought was developing in Welfare Economics, which primarily addressed the fundamental questions which Pareto, Hicks, Kaldor and Scitovsky have been unable to answer. This was the school of social welfare function approach to the Welfare Economics. The primary contributions were made by A. Bergson and Paul A Samuelson. They were primarily interested in constructing a social welfare function covering the preference of all individuals in the society. They idealised a situation in which every society will reach a point of maximum social welfare, where the highest possible social welfare function will meet the grant utility function of the society representing general equilibrium. This was followed by the so called critic of Kenneth J Arrow, which was renowned as the Arrows Impossibility theorem. With clear logic and clarity Arrow demonstrated the difficulties involved in constructing a social welfare function in the context of democratic decision making by following all of its properties. Arrows theorem later resulted in mind blowing repercussions in the literature of Welfare Economics and social choice.

4. Concluding Observations

The paper attempted to make a theoretical note on the major developments in Welfare Economics. The paper has attempted to explore the nature and scope of the branch and the relevance of making value judgements for ensuring maximum conceptual clarity. It has been observed that the branch of welfare economics is essential to many developments which came later in the science of economics. Welfare economics was found to be a logical departure from the main stream theoretical economics in many respects as it involves value judgments and considerations. Even though welfare economics started as an elementary thought, it has become an independent discipline. The foundations of welfare economics could be observed in the theories classical and neo-classical economists. With the modern developments to the branch contributed by later

economists like J.R Hicks, N. Kaldor, K. J. Arrow, A. K. Sen and the so forth the horizon of Welfare Economics has been widening.

References

[1] Amartya Sen & James E Foster (2002), "On Economic Inequality", Oxford India Paper Backs

[2] Amartya Sen (1970), "Collective Choice and Social Welfare", Elsevier Science, AE Amsterdam, the Nederland

[3] Andrew Mas-colell, Jerry R Green & Michael P Winston (1995), "Micro Economic Theory", Oxford University Press

[4] Bhaskar Dutta and P K Pattanaik (2003), "Welfare Economics and Social Choice", Chapter I, "The Nature and Structure of Welfare Economics", December 2013

[5] Boadway Robbin W (1984), "Welfare Economics", Oxford OX4 IJF, Basil Black Well Publishers Ltd

[6] Charles K Rowley and Allan T Peacock (1975), "Welfare Economics A liberal Restatement", Mashin Robertson & Co. Ltd

[7] Feldman Allen. M (2006), "Welfare Economics and Social Choice Theory", Springer US, 2nd Edition

[8] Gregory Mankiw N (1998), "Principles of Economics", Teel Buchhol Z & Co. Ltd, Fourth Edition

[9] HLA Myint (1965), "Theories of Welfare Economics", London School of Economics and Political Science", Booksellers

[10] Joseph E Stiglitz (2000), "Economics of the Public Sector", Norton and Company, Third Edition January 2000

[11] K. N Prasad (1987), "Lectures on Micro Economic Theory", Himalaya Publishing House, March 1987

[12] Kenneth J Arrow (1951), "Social Choice and Individual Values", Yale University Press, June 26, 1951

[13] Massino Florio (2014), "Applied Welfare Economics", Routledge, Revised Edition, 2014 October

[14] Yew - Kwang (1983), "Welfare Economics: Introduction and Development of Basic Concepts", McMillan London, 2nd Edition

[15] Yew Kwang (2004), "Welfare Economics towards a More Complete Analysis", Palgrave McMillan, First Edition

[16] Lipsey RG & Lancaster K (1956), "The General Theory of Second Best", Review of Economic Studies, Volume 24, No 1, Pp 11 32

[17] Richard E Wagner (2015), "Welfare Economics and the Second Best Theory: Filling Imaginary Economic Boxes", Cato Journal, Volume 35, No. 1, Winter 2015

[18] Kenneth J. Arrow (1951), "An Extension of the Basic Theorems of Classical Welfare Economics", Cowles Commission Paper, New Series, Number 54, Pp 507 532

[19] Francis M Bator (1958), "The Anatomy of Market Failure", Quarterly Journal of Economics, Volume 72, No 3 (August 1958), Pp 351 379

[20] Alan Randall (1983), "The Problem of Market Failure", Natural Resource Journal, Volume 23, Pp 131 148

[21] J R Hicks (1939), "The Foundations of Welfare Economics", The Economic Journal, Volume 49, No. 196, December 1939, Pp 696 712

[22] David Zilberman (1999), "Externalities, Market Failure and Government Policy", Department of Agricultural and Resource Economics, University of California, Spring Semester 1999

[23] Tabor Scitovsky (1951), "The State of Welfare Economics", The American Economic Review, Volume 4, No 3, Pp 303 3015

The Poetry of Ted Hughes: Metaphors or Extended Analogies?

Rukhaya M. K.

Department of English, Nehru Arts and Science College Kanhangad, Kerala - 671314
email: rukhaya_mk@rediffmail.com, Mob: +91-8714801359

Abstract

Ted Hughes poetry is singular in that though it focuses on animal imagery, it serves as a statement on civilization. The bestial instinct serves to foreground the impulsive stance of human nature. Hughes' animal imagery transcends all facets of life, be it the liminal nature of the Wodwo, the power politics of the Hawk, the killer instinct of the pike, the creative impulse apostrophized in the thought-fox, the single-minded purpose of the thrushes or the winter of the Snowdrop that underlines the transience of life, or the triggering of Mother Earth into the Ice Age. Therefore the animal and natural imagery function as extended metaphors that delineate different aspects of human inclination.

Andrew Motion pays tribute to Ted Hughes as "one of the two great poets of the last half of the last century," the other being Philip Larkin. Hughes was singular in transforming the blameless bestiality of animals into metaphors and mouthpieces of his perspectives on life. His works are rooted in nature"but they also serve as a comment on Nature, rather Human Nature. His animal imagery transcends all facets of life, be it the liminal nature of the Wodwo,the power politics of the Hawk,the killer instinct of the pike, the creative impulse apostrophized in the thought-fox, the single-minded purpose of the thrushes or the winter of the Snowdrop that underlines the transience of life, or the triggering of Mother Earth into the Ice Age. The essay analyzes a few popular poems of Hughes and the allegorical statements they make.

1. Pike

The Introduction to Ted Hughes' "Pike" can be found in "Poetry in the Making" as Ted Hughes states:"Here, in this next poem, is one my prize catches. I used to be a very keen angler for pike, as I still am when I get the chance, and I did most of my early fishing in a quite small lake, really a large pond. This pond went down to a great depth in one place. Sometimes on hot days, we would see something like a railway sleeper lying near the surface, and there certainly were huge pike in that pond. I suppose they are even bigger by now. Recently I felt like doing some pike fishing, but in circumstances where there was no chance of it, and over the days, as I remembered the extreme pleasures of that sport, bits of the following poem began to arrive. You will see by looking at the place in my memory very hard and very carefully, and by using the words that grew naturally out of the pictures and feelings. I captured not just a pike, I captured the whole pond, including the monsters I never hooked." The poet underlines the perfection of the Pike in the first stanza. The pike appears to be just perfect in dimension:"three inches long, perfect." The whole body of the pike has green and yellow stripes across it. The killer-instinct exists right from the hatching of the egg. This violent streak is hereditary: it goes generations back: "the malevolent aged grin." They stage a dance on the surface attracting the flies, asserting their presence. Hughes has always utilized animals as a metaphor for the instinctual inclination of Man.

They move stunned and overcome by their own grandeur; exhibiting narcissistic tendencies in the

process. The alga appears as a bed of emerald. As one looks from above the waters, their silhouette appears magnified and the length is pronounced: "a hundred feet long in their world." The line may also signify the flamboyance of the Pike. It is fragile; and holds the enigma and secrecy of submarines.The allusion to submarines points to a latent and subtle intelligence that keeps a low profile. In the ponds, they are found also below the heat of the lily pads. They can be discovered in the shadow of the flowers stillness. Either they are attached as logs to last year's leaves or appear to hang in a cavern of weeds. The jaws are perfectly formed 'clamped' to easily prey upon their victims, and the fangs haunt since generations. There appears to be no change in the practical utility of these preying instruments. Theirs is a life subdued to its instrument-the fan and jaw-the purpose is relegated to the practicality of the situation. The kneading of the gills and the pectorals involuntarily performs their respective functions. Fry (the young ones of fish) are kept in a glass jar, for the pike to prey on. There were three of these small fish. As these kept disappearing, the Pike seemed to get bigger and bigger. With the pike having devoured the other fishes, it now had a sagging belly. It held the grin that it was born with. This particular grin is more pronounced now as the fish is satisfied. The truth is that they spare nobody, even their own kind as the poet talks of two pikes "six pounds each, over two feet long." They are dead in the willows as one gets choked while swallowing up the other. One jammed past its gills down the other's gullet. The part of the pike, being eaten, projected its eye with the same firmness (iron) that was characteristic of the species, as the film of the fish shrank in death. The pond that the poet fished in had lilies and tenches that foregrounded the scene .The tench is a fresh water fish of the carp family that had a tenacious grip over life. Therefore, its exuberance seemed to exist and "outlast" the preexisting stones in the pond. The term 'monastery' refers to how the stones were ordained to live a secluded life: but the blossoming of the lilies and the liveliness of the tenches had relegated their concerns.

As Hughes refers to "depth," note the reference to the depth in the introduction to the poem above. This 'depth' is by itself 'legendary' as it is emblematic of the deep-rooted heritage that England is synonymous with. This depth was 'stilled' or static not meant to change with ravages of time. The Pike was not only an aspect of this heritage; it was an inherent part of man's basic nature as this violent streak is universal .The humanbeing also has this killer/survival instinct right when he cracks from the egg. This instinct is inborn, but the sophistication that he develops is acquired. Nevertheless, this aggression behavior remains in the subconscious.This killer instinct is a metaphor for the revolutionary instinct of England that makes its heritage what it is today.

Fishing in Pike: A Metaphor of Self-Discovery

The poet silently engaged himself in fishing. In the poem, fishing stands as a metaphor of 'self-discovery'. The hair that had grown after his birth was a symbol of his sophistication; as he probed his roots, it had frozen. In the darkness of the night, the poet 'fished 'for the slightest sign of instinct-"for what might move, what eye might move." In contrast, to the deeper concentration of the poet, the splashes seemed conspicuous in the still of the night. The nocturnal owls seemed to be hushing up the floating woods that appeared to be floating to the poet in his partial dream. Beneath the night's darkness another darkness was revealed (freed)-that of the poet's. "That rose slowly towards me, watching." This was the poet's other self that he encountered: his darker side.

When one grasps the real meaning of the poem, one comprehends that what the poet referred to in the Introduction to the poem as "quite small lake" is really his refined self. As he reaches the phase of self discovery, he asserts that he caught all the inherent irrational impulses in him:" I captured not just a pike, I captured the whole pond, including the monsters I never hooked." This is his "prize catch."

2. Hawk Roosting: A Statement on Power

"Hawk Roosting," published in 1960, is included in Ted Hughes's second book, Lupercal. The Hawk in Ted Hughes' poem "Hawk Roosting" is power personified. The roosting of the hawk signifies its self-assertion. The very first word of the poem "I" is a sign of the Supreme Ego. The hawk declares that he sits on top of the 'wood' that stands for his kingdom. His eyes are closed in oblivion, for at the present, for him, only he exists.

His world is limited between his hooked head and hooked feet. He is in 'inaction'. For action does not define him, rather, he defines action. This is no falsifying dream, a castle built-in the air, but the omnipresent truth. Hedreamsabout "in sleep rehearse perfect kills and eat." Therefore, it is not the necessity of killing and eating that concerns him but the style of it.

Thus, the hawk transforms into a metaphor of the supreme arrogance of man where he is haunted by power. It echoes the Faustian endeavor disregarding salvation, and Tughlaq(GirishKarnad'sTughlaq) who ventured to become another God. Aziz in the play Tughlaq stands as an aspect of Tughlaq when he asserts: "What's the point in raping for sheer lust? That's a mug's game. First one must have power, the authority to rape! Then everything takes on meaning." Just as the hawk avows that, the style of preying on the weak is more significant than the act itself.

The trees are indeed convenient as they are high, enabling him to reach new heights. The air's buoyancy enables him to float in the air; the sun's rays lend him rays of hope. These are all metaphors for circumstances that allow the hawk to stay in the position that he is. His being up, it appears to him as if the earth is laid down for his inspection. The poet affirms here how power is only a matter of perspective. The hawk's narcissistic tendencies are strongly resonated in the lines:

My feet are locked upon the rough bark.

It took the whole of Creation

To produce my foot, my each feather:

Now I hold Creation in my foot

He is creation personified as he professes, and by his flying up, he can revolve all creation. This also highlights how he considers himself the centre of his own universe. Creation here refers to God as the word is capitalized. The line is a typical instance of a metaphysical conceit. As its position is topmost in the food chain, it asserts triumphantly "I kill where I please because it is all mine."

Critics have pointed out this as an instance of fascism. By the term 'sophistry', the poet says that the physiology in his body does not abide by any rules. His way of life pertains to the tearing off of all heads; suggesting that he is also above all moral and social laws. He decides the allotment of death. The path of his flight through the bones of the living is direct; there are no two ways about it. It is outrageously stark and true. He does not require any objective argument or certificate to claim his right. It existed on its own.

On an ending note, he declares that the sun is behind him. He has eclipsed the sun. To put it further, the sun lives in his shadow. Nothing is constant as times passes. The composition of the entire universe is susceptible to change within fractions of seconds. However, the hawk states that nothing has changed here as his eye has not permitted it to do so. The word 'eye' denotes both 'vision' and 'insight'. The last line functions as an open challenge to the universal fact that change is inevitable: I am going to keep things like this.

2.1. Hawk Roosting: An Alternative Interpretation

Hughes put forth his take on the poem in a 1971 interview. "Actually what I had in mind was that in this hawk Nature is thinking. Simply Nature. It's not so simple because maybe Nature is no longer so simple." Going by what the poet Ted Hughes had in mind, it might pertain to the destructive aspect of nature (natural disasters) and the instinctive violence of its irrational beings. In keeping with this interpretation, the last line: "I am going to keep things like this," may read that nature is going to maintain its original diversity and composition in opposition to man-induced natural calamities (deforestation, global warming,pollutionetc.)

3. Wind

Hughes gives us a short introduction to his poem "Wind" poem in "Poetry in the making."

"On and off I live on a house on top of a hill in the Pennines, where the wind blows without obstruction across the tops of the moors. I have experienced some gales in that house, and here is a poem I once wrote about one of them. The grass of the fields there is a particularly brilliant watered green, and the stone walls of the enclosures that cover the hill-sides like great nets thrown over whales look coal black. The poem is simply called: Wind"(Casagnere 32).

The house referred to here is a house on top of a hill in the Pennines. The belligerent effects of the wind are underlined in the prescribed poem; as when it tends to get violent. The house is situated

on top of a hill; therefore it is island-like in its solitude. The poet here describes it as a boat stranded on a stormy sea as he states: "This house has been far out at sea all night." The pounding effects of the wind resemble that of a boat enraged at sea. The wind is so intense that it appears as though the storm is a prolonged one. The aggressive wind produces violent effects as though woods crash through the darkness, the thunder of the storms make it appear as though the hills are booming.

As the winds make their way across the field, and as one witnesses the same through the window, the fields appear to be crushed by a stampede. One is overwhelmed by the tremendous darkness. The phrase 'blinding wet' suggests that the storm is so full that it renders their vision blind to the landscape. It may also imply that owing to the impact of the storm, the blindings on the window have become wet.

The storm went on till the day rose. The word 'rose' in the phrase the "day rose," may mean that the sun 'rose'.It may also denote the 'roseate colour' of the sky owing to sunrise. Under the tremendous impact of the wind, one was forced to believe that the hills had new places. So sharp was the effect of the wind, that it appeared as though it wielded the light like a blade. The loud effect of the wind is likened to the luminous black and emerald flexing of a mad eye. Hughes brings out the vile surrealism in the image.

The field seems to be quivering owing to the overwhelming effects of the wind, the skyline (horizon) appears to be contorted. The skyline comes across as weak to the eye, in the presence of the fierce, reckless wind: it looks as though it may bang and flap like a strip of folded paper. The reckless wind flung a magpie away. The black gull undeterred in its purpose appeared to be bent like an iron bar gradually. So great was the will-power of the gull.

Wind: An Extended Metaphor

The poem has been described as an extended metaphor of Hughes' turbulent relationship with Sylvia Plath. The recurring 'green color' in the poem may refer to an element of envy or jealousy in their relationship. They were aware of how fragile their relationship was like a delicate glass (green goblet).They sat in their chairs, a symbol of their domestic domain, and pondered upon the great fire or chaos in their relationship.Relationshipscould

not be limited to thoughts, but must be expressive and practical. Neither could they be preset by two individuals in an association because Human nature could not be altered.

In such a stance, the external surroundings function as an objective correlative of their relationship. They could watch the fire blazing and the roots of the house (relationship) move on. Nevertheless, they had to sit on, as they were bound to each other by the ties of matrimony. They could feel the fragile windows (a symbol of insight) close in. They could discern the stones, emblematic of fixity and stability, cry out in abandon. Human beings are powerless in the face of Nature. Here nature has two meanings -the outer manifestation of God's grandeur, and inner nature. One cannot pre-define emotions, and predetermine relationships. For the reason that, all these eventually depend upon Nature.

4. The Jaguar

Ted Hughes' "The Jaguar" is a tribute to the majesty of the animal. The eminence of the jaguar is contrasted against the insignificance of other animals. The apes yawn at their humdrum existence. Their only point of adoration is aimed at the fleas that inhabit or surround them. The parrots have to screech to invite attention to themselves, as though one gets the impression that they are on fire. These shrieks are particularly aimed at the stroller with nuts. The tiger and lion appear lethargic and are overcome with lassitude. Through the mechanical routine of the animals' life, the poet seems to make a statement on the current mechanized human condition where people relegate the true meaning of life to basic biological functions. The Boa constrictor is a large, heavy-bodied species of snake. Its color pattern is highly variable yet distinctive. Yet, its static nature gives the impression of it being a fossil, an archeological remnant. It appears as though it has no utility value. Though the animals are supposed to be a source of amusement in the zoo, they fail to make their presence felt. Cage after cage appears to be empty as all the animals lie in indolence. The only evidence of their being alive seems to be the stink emanating from the cages. The picture of the animals in sluggishness appears as static as a painting on a nursery wall.

People, however, do not hold harbor any sort of fascination for these animals. They just rush past these animals like the rest. The cage that holds the onlookers spell-bound is the cage of the Jaguar. The jaguar holds the crowd mesmerized like a child in a trance. The atmosphere in the cell seems to pale into darkness as compared to the fierce-gleam in the jaguar's eye. This temporary darkening of his cell is not owing to boredom on part of the on-looker. People prefer to be blinded by the splendor of this fire. The wildness in the tiger's blood is 'bang on' to the human brain. The grandiose-roar falls on deaf ears. As he traverses distances within the cage, there are no bars for him, for nothing can imprison his magnificent spirit. The jaguar is be-yond cages and taming. It is just as: the imprison-ing of a visionary cannot incarcerate his profound thoughts, or freedom of expression. His instinc-tive attitude and wildness of spirit is implicit in each stride of his. The world is encompassed in the stride of his paw as he enamours humanity with his innate elegance. He does not have to look out-side the cage to look beyond the horizon. Rather, the cage floor traces horizons over it, owing to the colossalcharisma of the tiger.

5. Second Glance at the Jaguar

"Second Glance at a Jaguar" fromWodwo(1967) is a companion piece to the "The Jaguar," and should be read along with the same. Ted Hughes wrote "Second Jaguar" ten years after he wrote the first "The Jaguar." The 'glance' in the title far from being a mere glance focuses on intricate detail.

In the "Jaguar," Ted Hughes depicts a zoo in which animals are caged in different slots, each characterized by sluggishness and sloth. In contrast to the other languorous creatures, the jaguar holds its own, through its magnificence and sounds its existence by asserting itself. Thus, the poem "The Jaguar" is a statement on man's modern state of existence where people are compartmentalized into leading a mechanical life. In a machine-like state, they relegate their individuality, and function like cogs in the wheel of society and pay no heed to voice their seity.

The poem "Second Glance at a Jaguar" fo-cusses on the animal itself. The latter lacks the co-ordination and conventional form of the former poem. The poem succeeds in the effect it makes on

the reader. The poem comes across as an artist's instinctive stroke focusing on detail. Hughes foregrounds the Jaguar and marks his deviation from the System. He appears formidable in his movements. To quote David Punter in "Eastern and Western Metaphor": "The movement and shape of the jaguar challenge all our preconcep-tions about mind and body."

The hip going in and out of joint, dropping the spine
With the urgency of his hurry
Like a cat going along under thrown stones, under cover,
Glancing sideways, running

Though it darts and holds cover like the cat, the difference is marked in the majesty of itself and the need for survival. As Hughes compares it with the cat, it cannot be perceived as an escapist movement. It is rather its expression for a continued existence.

Under his spine. A terrible, stump-legged waddle
Like a thick Aztec disemboweller,
Club-swinging, trying to grind some square
Socket between his hind legs round,

Alan Norman Bold describes the poem as a kind of travesty of Hughes' previous poems with regard to the above lines where each feature is exaggerated. The phrase "Aztec disemboweller" he says, is used to refer to the one-eyed Aztec Gods. Apart from the statement of this critic, the comparison may also serve to mythify the tiger not as a specimen of reality but by investing it with supernatural powers. Verbs like 'swinging', 'trying' give the sense of things occurring right before our eyes in the present continuous. There is the attempt to evoke the image visually through mentioning of shapes like 'round', square'. etc. The word 'terrible' juxtaposed against 'waddle' makes the creature real yet surreal; with the attribute of clumsiness mixed awe.

Carrying his head like a brazier of spilling embers,
And the black bit of his mouth, he takes it
Between his back teeth, he has to wear his skin out,
He swipes a lap at the water-trough as he turns,
Swiveling the ball of his heel on the polished spot,
Showing his belly like a butterfly
At every stride he has to turn a corner

In himself and correct it. His head
Is like the worn down stump of another whole jaguar

The hair on his head comes across as spilling embers with its fiery colour. The jaguar is celebrated through assigning significance to each of its action, like for instance, even the slightest action of his lapping water from the trough. The act of sticking his tongue out is described as wearing his skin out. The idea of action occurring in the present is reiterated with verbs such as 'showing','carrying'. etc. The comparison of his belly to the butterfly serves to illustrate the instinctive freedom that this jaguar possesses and exploits to the full, as opposed to the one in "The Jaguar" that is caged and is unable to fully realize itself. Each stride of the Jaguar is corrected to perfection. Again, there is the juxtaposition of the majestic and trivial,once again, as the poet asserts that the jaguar's head is like "the worn down stump of another whole jaguar" This reinforces the idea of tagging the poem as a travesty of Hughes' previous poems.

His body is just the engine shoving it forward,
Lifting the air up and shoving on under,
The weight of his fangs hanging the mouth open,
Bottom jaw combing the ground. A gorged look,
Gangster, club-tail lumped along behind gracelessly,
He's wearing himself to heavy oval,
Muttering some mantrah, some drum-song of murder
To keep his rage brightening, making his skin
Intolerable, spurred by the rosettes, the cain-brands,
Wearing the spots from the inside,
Rounding some revenge. Going like a prayer-wheel,
The head dragging forward, the body keeping up,
The hind legs lagging. He coils, he flourishes
The blackjack tail as if looking for a target,
Hurrying through the underworld, soundless.

The inexorable vitality and vigour is underlined as the body is portrayed as an engine focusing on the action, and not intent. The air is lifted and shoved right under as though nature is his plaything. His wild looks coupled with the daredevil fangs portray him as a Gangster. The attempt here is reciprocal to the previous attempt of the poet as the paranormal, and is humanized here. The phrase "drum-song of murder" points to the inherent violent impulse, the killer-instinct. Again there is the concurrence of the splendid and the inconsequential

as there is the description of the club-tail lumped along gracelessly (with connotations of impotency). The mantra is his fuel to fire his rage. The passion renders his skin intolerable. It is the rosette that spurs this trait in him. By 'rosette', the poet means the badge assigned to him, the inevitable gene. This gene (vulnerable to violence) in him defines him, like violence defined Cain in history, rather than Cain defining violence. The conspicuous spots are worn from the inside as they truly belong to him, and are not just an external embellishment. The spots at once echo 'revenge' and 'prayer-wheel' in the same vein-they combine instinct and religiosity in a single instance. The head dragging, the hind legs lagging, the body keeps it up in studied balance. The blackjack tail coils and flourishes as it seeks out a target . The last line has the words 'underworld' and 'soundless' attributing an enigmatic secrecy to the Jaguar.

6. Thought Fox

Ted Hughessaid that long after I am gone, as long as a copy of thepoemexists, every time anyone reads it the fox will get up somewhereout of the darkness-sand come walking towards them(Robinson 271). Thepoemappeared inTed Hughes's first collection-The Hawk in the Rain. It is the most frequently anthologized of Hughes'poems.

Midnight is the chosen at the time as it is without any addition tothe day, as blank as the poet's mind itself. The time is unmarked, and yet mature. The clock is alone as it is devoid of minutes and seconds, it being midnight. Further, the clock is alive as it is lonely. And there is something else that accompanies the loneliness of the clock-that is the poet's creative consciousness. The metaphor for the poet's fresh poetic perception is the "blankpaper" where his fingers move.

Through thewindow Isee no star:
Something more near
Though deeper within darkness
Is entering the loneliness.

Note that the poet cannot observe any star but can comprehend something that holds more promise for him. He cannot apprehend it through the senses but experience it through instinct. The image is first formless and can only be a professed

feeling formless as the poetic vision of the poet itself, until it assumes a concreteshape. It does not enter in a strained and enforced manner but as delicately as the snow falls in. The fox's nose touches deftly against the twig and leaf. The nose feels its way through the darkness. At once the fox transforms itself to theconcreteand persistent image of the poet's creative working progress. By utilizing an animal as the reflection for his thought process, one wonders whetherTed Hugheswrites primarily through instinct.

Two eyes serve a movement, that now
And again now, and now, and now

These eyes appear to the readers to be the fox's eyes and as well as the poet's'studied' eye movements. The fox goes on to set neat prints on the snow; the writing comes across coherently and clearly on thepaper. The soft snow brushing against the trees falls in dark flakes to the ground, as the words on the blankpaper, and in a lovely manner fall into place. The words: "now/And again now, and now, and now" point to the continuity that has been picked up by the poet. The continuity is accompanied by 'punctuation'-therefore it is a staggering continuity; the idea being reinforced by the word 'lame'. The poet also departs from a predictable rhyme scheme, reflecting urgency on the part of the poet and the fox to reach their destination disregarding rhythm for the time being. The movement of the lines voices the movement of the fox. Alliteration is utilized to mime coherence. Though at first, the fox is agile, it staggers occasionally

Between trees, and warily a lame
Shadowlags by stump and in hollow
Of a body that is bold to come

At times, it appears like 'a lameshadow' endeavoring to pick up speed and accelerate towards the final goal. The term 'stump' refers to the base of the tree that is incomplete without the tree-top. The 'stump' at once functions as a invasive metaphor for thewriter's block. The poet has to make his creativity go beyond the stump' and not leave his poetic capabilities stunted'. It is in the hollow of a body that is "bold to come," yet to flourish and blossom.

Across clearings, an eye,
A widening deepening greenness,
Brilliantly, concentratedly,
Coming about its own business

Across the clearings and the undergrowth, there is indeed "an eye." The "eye" standing for insight here. This insight is coupled with a widening and deepening "greenness,". The greenness symbolizing fertility and creation at once. Its business is that of its own, not one of after-thought, but that of impulse.

Till, with a sudden sharp hot stink of fox
It enters the dark hole of the head.
The window is starless still; theclock ticks,
The page is printed.

The poet thought process is filled with "hot stink" of the fox, the heat of its passion. The thought-process is saturated now, and hence hot and humid. As thepoemcomes into place, the window is starless still. The poet had at first set eyes outside the window, for inspiration. Nevertheless, towards the end of thepoemhe comes to recognize that inspiration comes from within, and not outside. The window is starless still, yet-"the page is printed" Intuition reigns over inspiration here, and instinct over reason.

References

[1] Casagnere, Christian La. "Ted Hughes' Crying Horizons: Wind and the Poetics of Sublimity. " Moulin, Joanny. Ted Hughes: Alternative Horizons. London: Taylor and Francis, 2004. Print.

[2] Hughes takes his place in Westminster Abbey 8 December 2011. Retrieved 7 December2011. 8 December 2011. 29 December 2011.

[3] Poem Introduction: Ted Hughes' "Pike." 2014. 20 January 2015. http://childrenspoetryarchive.org/poem/pike.

[4] Robinson, Craig. "The Achievement of Ted Hughes. " Sagar, Keith. The Good Shepherd: Moortown Elegies. Manchester: Manchester University Press, 1983. Print.

Medicinal Plants Of *Tulunadu*

Subrahmanya Prasad K.
Department of Botany
Nehru Arts and Science College Kanhangad, Kerala - 671314
Email: prasadks83@gmail.com, Mob: +91-8281142656

Abstract

Each geographical area is blessed with many such plants which are needed for the living beings of that area. Locally available drugs are the best suited for treating the diseases of native people. Tulunadu, the ancient heritage site is not an exception. Tulunadu is the Tulu speaking region consisting of Dakshina Kannada and Udupi districts of Karnataka and the northern parts of Kasaragod district of Kerala. It is the land of bio-cultural diversity and oral tradition. Present paper narrates the medicinal plant wealth of Tulunadu, their uses, formulations, mode of usage and present status.

Keywords: Tulunadu, Medicinal plants, Therapeutic efficacy, Threats, Conservation

1. Introduction

The relation between healing plants and human beings dates back to pre-historic era. Seeking relief from sickness is as natural as eating. Use of plants to alleviate human sufferings and as health rejuvenators is perhaps as old as humans themselves. Primitive men lived at the mercy of nature. The long and intimate association of our ancestors with their flora and their dependence made them the kings of extensive knowledge. India has one of the oldest, richest and most diverse cultural traditions known as folk traditions associated with the use of medicinal herbs. Traditional medicine is a part of Indian tradition since Vedic times. It is the pristine system of medicine which uses plants as chief drug or source of drug. It is a system developed over years of observation, trial and error, inference and inheritance. Plants have traditionally served as mans most important weapon against a vast variety of pathogens. These are state-of-art chemical laboratories, capable of biosynthesizing a number of biomolecules with diverse therapeutic efficacies [7, 8]. Herbal medicines are being used by about 80% of the world population. They have stood the test of time for their safety, efficacy, cultural acceptability and lesser side effects. Medicinal plants are the local heritage with global importance. These are living and irreparable resource, which is exhaustible if over used [4, 17].

Due to the lack of communication, intermingling, breeding of ideas and varying way of life, many of these earlier remedies survived only by word of mouth from generation to generation. Most of these wild medicinal plants are highly habitat specific, occupying highly specialized ecological niche with restricted distribution. Over 70% of the plant collections involve destructive harvesting. Alien species invasion and modern agricultural practices have also lead to local extinction of many plants. Majority of healers are neglected lot and the tradition is dying out fast without patronage. Due to various human activities such as deforestation, rapid industrialization, urbanization and other developmental activities, both natural vegetation as well as traditional culture in India is fast declining [5, 11, 18].

Each geographical area is blessed with many such plants and natural materials which are needed for

the living beings of that area. Locally available drugs are the best suited for treating the diseases of that area and native people. *Tulunadu*, the ancient heritage site situated along the west coast of India is not an exception.

Tulunadu

Tulunadu is the Tulu speaking area, lying along the Malabar Coast, at 13^0 00' N and 75^0 40' E, sharing a number of geographic, culinary and social traits with the neighboring Konkan and Kerala regions. It spans an area of 8, 441 Km^2 (3,259 Sq. m). It is the Tulu speaking region of Karnataka and Kerala. It consists of Dakshina Kannada and Udupi districts of Karnataka and the northern parts of Kasaragod district of Kerala up to the river Chandragiri. Tulu, Kannada and Konkani are the major three languages in vogue. Konkani, Marathi, Hindusthani, Biary and Malayalam are minor languages and sparingly used [2, 3].

Tulunadu is agro-ecologically, climatologically and socio-culturally diverse. Even from time immemorial the people of this area have given much importance to the plants which is evident in their socio-cultural life, folk beliefs and rich vocabulary. They have given sacred status to a number of plants in order to conserve them for the posterity. The folk, through trial and error developed their own method for identification of local plants through ethno-linguistic approach and doctrine of signature. Even many places and surnames were named after the plants. In this context, documentation of traditional knowledge of the local people, which is transferred orally from generation to generation is an urgent need as the major languages, Tulu, Konkani and Byary are script less.

Objectives of the study

The major objectives of present study are:

a) Study of folklore and traditional knowledge regarding the plants and their uses.

b) Ethnolinguistic approach in classification of plants.

c) Etymology and doctrine of signature.

d) Medicinal plant distribution, status, availability and endemism.

e) Exotic, naturalized plants and weeds as medicine.

2. Methodology

Present study consisted of two parts, a systematic review of the research literature and a pilot methodical survey from July 2007 to December 2011 in all seasons at every nook and corner, which aimed to explore the traditional medicinal plants. During the field work, integrated approach of botanical collections, interviews (structured and unstructured), discussion with the knowledgeable persons, specimen display method and forest walk with healers were carried out to collect the data. Initially a list of herbal healers residing in the study area was prepared by gathering information from the local people. A total of 215 knowledgeable persons (men, women and children) of different age groups were selected and interviewed. Local people were convinced of the academic significance and bonafide intention of the study through repeated contacts, explanations and interviews. Both oral and written (Prior informed consent - PIC) consent were taken from them as per the CBD guidelines to publish the results of the study in the interest of the society.

During the field visits, data regarding the traditional methods of plant identification, specificity in drug collection, form of usage, detailed method of drug preparation, dosage, drug administration, restrictions if any, duration of treatment, response of patient, complications if any and possible substitutes of a drug were collected. Collected information was authenticated by repeated queries, crosscheck with other healers and by interviewing the beneficiaries. Data collected were processed species wise, arranged alphabetically by their botanical name. Each plant was described with its correct botanical name, family, vernacular names, habit, habitat, status, botanical description, medicinal uses, etymology and special notes. Voucher specimens were made into herbaria and each plant was recorded with photographs. Collected plants were correctly identified with the aid of floras, checklists [1, 6, 9, 12, 13, 14, 15, 16], and were confirmed by herbaria. IPNI, TROPICOS and Brumitt & Powell were referred for correct nomenclature of these plants, while IUCN red list [10] for their status.

3. Medicinal Plant Wealth Of *Tulunadu*

Present study aimed at the exploration of medicinal plant wealth of *Tulunadu* and neighbouring ar-

eas resulted in the documentation of 1001 plants used as medicine by the rural people, botanically belonging to 156 families and 624 genera. These can be categorized into two based on their availability. One group includes those plants, which are either naturally found in the study area or are grown for various purpose. A total of 941 species falling under 147 families and 573 genera come under this category. The second group is the bazaar medicines, which includes 60 species of 56 genera and 32 families. These are the plants which are not found in the study area, but their products are brought from the market for treatment.

Among the diverse plant groups, Angiosperms are the most commonly used category as they account for 983 plants. *Adiantum capillus-veneris, A. caudatum, A. lunulatum, Asplenium trichomanes, Cheilanthes farinosa, Drynaria quercifolia, Lygodium flexuosum, Marsilea minuta, Parahemionitis cordata, Salvinia molesta, Selaginella delicatula and S. involvens* are the twelve Pteridophytes, which are used for medicinal purposes in *Tulunadu*. *Cycas circinalis* and *Gnetum edule* are the two naturally occurring Gymnosperms, whose various parts are used as medicine, while heart wood of *Cedrus deodara*, gum resin of *Pinus sylvestris* and dried leaves of *Taxus baccata* are collected from the market. Basidiocarp of *Ganoderma lucidum* is the lone representative of the kingdom Fungi.

Of the 156 plant families, Papilionaceae dominates as 70 species are used for medicine, followed by Euphorbiaceae and Rubiaceae with 50 and 43 species respectively. There are 51 families, which are represented by single medicinally important species.

Out of 624 genera, *Ficus* (figs) show dominance as 13 figs are much valued by the traditional healers, followed by *Ipomoea* and *Solanum*. Herbs and trees are the most used plant forms as 326 herbaceous and 301 trees are in use as medicine. Among these 274 are palatable and 44 poisonous. 172 plants are exotic in origin but are now naturalized. 182 plants which are usually known as weeds are also employed for medicine preparation. Use of aquatic plants in medicine is also significant as 35 plants belong to this category.

Among the different parts, leaf is the most used part. Leaves of 474 plants are used 2124 times for preparing medicines, followed by whole plant, root, bark, fruit, seed, tuber, tender shoot, flower, stem and heart wood.

Among the different kinds of drug preparation employed by the traditional healers, juice accounts for 31.25% of the preparations. Decoction, paste, oil, powder, gruel, *tambuli*, latex, *lehyam* and pickle also make considerable contribution.

1001 plants are used for a total of 9859 formulations. Of these 5796 formulations are single drug remedies with 59% share, while the rest 41% are combination drugs. Thus each plant on an average used for 9.85 formulations. The sacred basil, *Ocimum tenuiiflorum* is the most used plant as it is used for 130 traditional formulations followed by *Achyranthes aspera* and *Tinospora cordifolia* with 93 and 79 formulations respectively. 176 plants have single formulation to their credit. Only 17 plants were utilized for more than 50 formulations.

Analysis of therapeutic profile of each plant helps to provide data regarding the number of plants available for a particular disease. There are 750 plants in *Tulunadu* which are utilized for digestive disorders. 458 plants are credited by their wound healing property and 433 are employed for rheumatic complaints. *Achyranthes aspera* is used for treating 59 diseases, while *Ocimum tenuiiflorum* for 55 diseases. Only two plants, *Achyranthes aspera* and *Ocimum tenuiiflorum* are used for more than 50 diseases, while majority (516) used for diseases in the range of 2 9 and 105 for any one disease. Out of the total 9859 formulations 26.07% i.e. 2570 formulations are administered through different media other than water. Among the diverse media, milk is the most used one as it is used for 653 formulations. Honey is used for 378 formulations while breast milk has least share with 14 uses.

Of the total 1001 medicinal plants, 103 are endemic while 119 qualify for IUCN red list categories with 5 critically endangered, 16 endangered, 32 vulnerable, 39 rare, 10 near threatened, 16 low risk and one data deficient plants. During extensive field visit, a total of 215 knowledgeable persons were interviewed for collection of data regarding the various aspects of medicinal plants. Of these 176 (82%) informants were male and the rest 39 (18%) females. 67% (145) of the informants had the inherited knowledge regarding the medicinal uses of plants. Only one informant was below the age of 40 and a great majority (85%) was above 50 and maximum in the age group 70 79. Mother tongue of 104 informants was Kannada while, scriptless lan-

guages Tulu, Konkani and Hindustani accounted for 70 (32.5%).

4. Conclusion

Tulunadu is not only bio-culturally diverse but also rich in phytomedicine. This small geographical area accounted for a total of 1001 medicinal plants of which 103 were endemic and 108 belonging to RET categories, indicating the importance of conservation. Each and every part of *Tulunadu* has characteristic medicinal flora and uses. Even though western medicine is widely used throughout, the rural people highly depend on traditional therapies for a number of chronic health issues like gastro intestinal tract problems, jaundice, skin diseases, antenatal care, postnatal care, poisonous bites and many more. From present study it is evident that each plant on an average is used for 9.85 medicinal formulations. 58% of the formulations were single drug remedies and 105 plants were used to treat any one disease. In this context, loss of a single species might result in the loss of 10 medical formulations and even treatment for a disease. 74.5% of the formulations need destructive harvesting due to the utilization of root, whole plant, fruit, seed and bark, which makes cultivation, identification of alternative sources and sustainable utilization of natural resources the need of the hour. As the 85% of informants were aged above 50 (maximum in the age group 70 79), the study clearly indicates the highly vulnerable status of traditional knowledge and makes the traditional healers a threatened category. Moreover, 32.5% healers are from the oral tradition due to lack of written manuscripts, documentation of their traditional knowledge is *sine qua non*.

References

[1] Anilkumar, N., Sivadasan, M. and Ravi, N. 2005. Flora of Pathanamthitta (Western Ghats, Kerala). Daya Publishing House, Delhi.

[2] Anon. 1973. South Kanara District Gazetteer. Govt. of Karnataka, Bangalore, Karnataka.

[3] Anon. 2001. Census of India. Govt. of India, New Delhi.

[4] Anon. 2002. WHO traditional medicine strategy 2002 2005. WHO, Geneva.

[5] Behera, K. S. and Misra, K. M. 2005. Indigenous phytotherapy for genito - urinary diseases used by the Kandha tribe of Orissa, India. J. Ethnopharmacol. 102: 319 325.

[6] Bhat, K. G. 2003. Flora of Udupi. Indian Naturalist (R), Udupi, Karnataka.

[7] Biswas, K., Chattopadhyay, I., Banerjee, R. K. and Bandyopadhyay, U. 2002. Biological activities and medicinal properties of neem (*Azadirachta indica*). Curr. Sci. 82 (11): 1336 1345.

[8] Deshkar, N., Tilloo, S. and Pande, V. 2008. A comprehensive review of *Rubia cordifolia* Linn. Phcog Rev. 2 (3): 124 134.

[9] Gamble, J. S. and Fischer, C. E. C. 1915 1936. Flora of Presidency of Madras. Vols. I III. Adlard & Son Ltd., London, UK.

[10] IUCN. 2011. The 2011. IUCN Red list of Threatened species. IUCN, Gland, Switzerland.

[11] Kala, C. P. 2005. Current status of medicinal plants used by traditional vaidyas in Uttaranchal state of India. Ethnobot. Res. Appli. 3: 267 278.

[12] Manilal, K. S. and Sivarajan, V. V. 1982. Flora of Calicut. Bishen Singh Mahendra Pal Singh, Dehra Dun, Uttarakhand.

[13] Mathew, K. M. 1984. The Flora of Tamilnadu Carnatic. Vols. I III. The Rapinat Herbarium, St Josephs College, Thiruchirapalli, Tamil Nadu.

[14] Nayar, T. S., Beegam, A. R., Mohanan, N. and Rajkumar, G. 2006. Flowering plants of Kerala. TBGRI, Palode, Kerala.

[15] Ramachandran, V. S. and Nair, V. J. 1988. Flora of Cannanore. BSI, Calcutta, West Bengal.

[16] Sasidharan, N. 2004. Flowering Plants. KFRI Handbook No. 17, KFRI, Peechi, Kerala.

[17] Shaikh, T. B. and Hatcher, J. 2005. Complementary and alternative medicine in Pakistan: Prospects and limitations. eCAM. 2 (2): 139 142.

[18] Shivanna, M. B. and Rajakumar, N. 2010. Ethno-medico-botanical knowledge of rural folk in Bhadravathi taluk of Shimoga district, Karnataka. Ind. J. Trad. Knowl. 9 (1): 158 162.