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Variation in soluble extractives, lignin and holocellulose content of wood of different provenances of *Tectona grandis* L.

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Abstract: The present studies were conducted on variation in soluble extractives, lignin and holocellulose content of wood of different provenances of *Tectona grandis*. The data on cold and hot water solubility, alcohol-benzene solubility, lignin and holocellulose content of wood exhibited significant variation in different provenances of Teak. Among different selected provenances, the highest cold water solubility [16.43% (4.05)] and hot water solubility [19.56% (4.42)] was recorded in APNPL-10 and lowest was recorded in ORPLM-1 [6.34% (2.52)] and [8.34% (2.89)], respectively. Maximum percentage of alcohol-benzene solubility was observed in KLN-2 [17.64% (4.20)] and minimum per cent was recorded in MHSC-J1 [7.13% (2.67)]. Maximum percentage of lignin [39.00 % (38.64)] and holocellulose (76.53%) content was noticed in ORANP-6 and APT-11, respectively. whereas, minimum percentage of lignin 20.83% (27.15) and holocellulose (64.20%) content were found in TNT-10 and APT-20, respectively. The study would help to utilize the findings and developing future strategies for screening the provenances of *Tectona grandis*.

Keywords: Holocellulose, Lignin, Provenances, Soluble extractive, Variation

INTRODUCTION

Teak (*Tectona grandis* L.) the generic name *Tectona* and teak have been derived from the Portugese name *teca*, a derivative of Greek word *tekon,* "a carpenter", Grandis, in Latin means "large" or "great". In India teak is distributed naturally in the peninsular region below 24^{0}N latitude. The teak is indigenous in both peninsular of India, in north-eastern of Indian archipelago. Teak can with stands an absolute mean annual temperature 13 ^{0}C – 40 °C, mean annual rainfall ranging from 1250 - 3750 mm per year, however, for the production of good quality timber the species requires a dry season of at least four months with less than 60 mm precipitation (Kumarvelu, 1991).

Extractive contents consist of lipids (terpenoide, fat, wax, fatacides) and phenolic connexions (single phenolics, stilbenel, lignane, flavonoide, tannin). There are no structural elements, which could be solved in natural liquids and water, included. The most amounts of ingredients can be found in core wood, wood ray, root wood, branch formation and at the bark. The above mentioned ingredients define wood colour, smell and durability as well as quality of pulping and drying & gluing properties (Lange and Schwager, 1997).

The physico-chemical properties of wood are also important parameter for the preliminary characterization of cellulose raw material and its potentiality for pulp and paper, fuel wood, timber and certain other non – timber products for their related uses. The solubility of wood in various solvents is a measure of the extraneous components. The species containing large amount of extractives have better durability, dimensional stability and plasticization. For this reason, it is imperative to study extractives present in wood. The cold water soluble contents are generally tannins, gums, salts and sugars. The hot water soluble content of wood are tannins, gums, sugars, salts and phenols and the components soluble in alcohol-benzene are oleoresin, fats, and waxes (Nimkar *et al.,* 2010). Therefore, the present investigation was conducted to study the variation in soluble extractives, lignin and holocellulose content of wood of different provenances of *T. grandis* L.

MATERIALS AND METHODS

Thirty provenances of *Tectona grandis* were selected at National Teak Germplasm Bank, Lohara, Chandrapur District of Maharashtra. For carrying out the said study, the wood samples were chipped at breast height with the help of hammer and chisel. Laboratory analysis of the collected sample was done in the Department of Forestry, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, (Maharashtra) for studying the cold and hot water solubility, alcohol-benzene solubility extractives, klasan-lignin, and holo-

cellulose content of wood. The cold and hot water soluble extractives were determined by employing the T1m 59 methods (Anonymous, 1959a). alcohol-benzene extractives, kalson-lignin content and holocellulose were determined by using the T6m 59 (Anonymous, 1959b),T12m 59 (Anonymous, 1959c) and T9m 54(Anonymous, 1954) methods respectively. The data recorded for these traits were statistically analyzed by using randomized block design in three replication for each treatment as described by Panse and Sukhatme (1978). The data recorded for cold water solubility, hot water solubility and alcohol-benzene extractives was subjected to square root transformation as suggested by Bartlett (1947).

RESULTS AND DISCUSSION

The data obtained for cold water solubility, hot water solubility and alcohol-benzene extractives of wood of different provenances of Teak (*Tectona grandis*) are presented in Table 1. A critical observation of data revealed significant differences among different provenances of Teak for cold and hot water soluble extractives. The highest value of 16.43 (4.05) per cent was recorded in APNPL-10 for cold water solubility and lowest value of 6.33 (2.51) per cent was obtained for ORPLM-1. The maximum value of 19.56 (4.42) per cent was recorded in APNPL-10 for hot water solubility and the minimum value of 8.34 (2.89) per cent was recorded for ORPLM-1. Cold water and hot water soluble extractives of wood were found to be significant at 5 and 1 per cent level of significances. The variation observed in water soluble extractives was due to the varied level of extractives accumulation in different provenances of *T. grandis*. The variation in wood extractives has been reported by Pariera (1988) in Eucalyptus and significant variation in cold water and hot water soluble extractives of wood has been reported by Nimkar *et al*. (2010) in *Pinus roxburghii* and Kumar *et al*. (2005) in *Dalbergia sissoo.* The maximum alcohol-benzene solubility of 17.64 (4.20) per cent was found in KLN-2 which is showed parity with 15.90 (3.98) per cent in TNT-11, 15.07 (3.88) per cent in APKEC-2. The minimum value of 7.13 (2.67) per cent was recorded in MHSC-J1, which

Table 1. Water soluble extractives (cold water and hot water) and alcohol-benzene soluble extractives of wood of different provenances of *T. grandis*.

S. N.	Source	Provenances No.	Cold water soluble extractives (%)	Hot water soluble extractives (%)	Alcohol-benzene soluble extractives (%)
1.	Maharashtra	MHSC-A2	10.33 (3.21)	15.39 (3.92)	14.50 (3.80)
2.	Maharashtra	MHSC-A1	9.17 (3.02)	15.31 (3.91)	14.50 (3.81)
3.	Tamil Nadu	TNT-8	6.41 (2.53)	9.70 (3.11)	9.18 (3.03)
4.	Maharashtra	MHSC-J1	7.35 (2.71)	10.86 (3.29)	7.13 (2.67)
5.	Andhra Pradesh	APT-22	8.21 (2.86)	11.83 (3.44)	10.72 (3.27)
6.	Andhra Pradesh	APT-11	14.57 (3.82)	16.02 (4.00)	11.74 (3.42)
7.	Tamil Nadu	TNT-14	7.65 (2.77)	10.38 (3.22)	7.23 (2.69)
8.	Tamil Nadu	TNT-13	11.33 (3.36)	14.02 (3.74)	8.00 (2.83)
9.	Kerala	KLN-2	11.98 (3.46)	16.27 (4.03)	17.64 (4.20)
10.	Tamil Nadu	TNT-10	9.50 (3.08)	12.69 (3.56)	11.33 (3.36)
11.	Andhra Pradesh	APT-20	9.00 (3.00)	12.18 (3.49)	13.34 (3.65)
12.	Andhra Pradesh	APT-3	7.32 (2.70)	9.33 (3.05)	11.60 (3.40)
13.	Andhra Pradesh	APT-16	9.33 (3.05)	14.30 (3.78)	14.13 (3.75)
14.	Tamil Nadu	TNT-12	10.20 (3.19)	12.52 (3.54)	13.56 (3.68)
15.	Andhra Pradesh	APT-17	12.50 (3.54)	15.10 (3.89)	8.50 (2.91)
16.	Tamil Nadu	TNT-11	12.91 (3.59)	15.36 (3.92)	15.90 (3.98)
17.	Orissa	ORANP-3	9.91 (3.15)	14.36 (3.79)	12.50 (3.53)
18.	Kerala	KLS-3	10.18 (3.19)	13.29 (3.65)	14.50 (3.80)
19.	Andhra Pradesh	APNPL-11	16.17 (4.02)	19.50 (4.41)	12.80 (3.58)
20.	Andhra Pradesh	APKEA-24	10.77 (3.28)	12.33 (3.51)	13.03 (3.60)
21.	Orissa	ORANR-3	9.33 (3.05)	13.55 (3.68)	14.49 (3.80)
22.	Orissa	ORPB-18	8.87 (2.98)	12.50 (3.54)	14.30 (3.78)
23.	Andhra Pradesh	APKEC-2	12.67 (3.56)	15.43 (3.93)	15.07 (3.88)
24.	Orissa	ORNAP-7	8.21 (2.86)	11.39 (3.37)	10.33 (3.20)
25.	Andhra Pradesh	APNPL-10	16.43 (4.05)	19.56 (4.42)	11.90 (3.44)
26.	Kerala	KLS-4	9.50 (3.08)	10.44 (3.23)	9.00 (3.00)
27.	Orissa	ORANR-2	9.27 (3.04)	12.17 (3.49)	12.66 (3.55)
28.	Orissa	ORPLM-1	6.34 (2.52)	8.34 (2.89)	11.16 (3.33)
29.	Orissa	ORANR-6	9.33 (3.05)	11.08 (3.33)	11.33 (3.36)
30.	Orissa	ORANP-6	9.24 (3.04)	16.76 (4.09)	8.26 (2.87)
		Mean	10.13 (3.15)	13.39 (3.64)	12.01 (3.44)
		SE(m)	0.0554	0.0373	0.0683
		CD (0.05)	0.1569	0.1055	0.1935

Figures in parenthesis are square root

Table 2. Lignin and holocellulose percentage of wood of different provenances of *T. grandis*.

S. N.	Source	Provenances No.	Lignin (%)	Holocellulose (%)
1.	Maharashtra	MHSC-A2	26.16 (30.76)	69.60
2.	Maharashtra	MHSC-A1	26.16 (30.76)	71.00
3.	Tamil Nadu	TNT-8	28.16 (32.05)	74.46
4.	Maharashtra	MHSC-J1	27.50 (31.61)	73.46
5.	Andhra Pradesh	APT-22	23.66 (29.10)	74.20
6.	Andhra Pradesh	APT-11	26.83 (31.20)	76.53
7.	Tamil Nadu	TNT-14	29.50 (32.89)	75.33
8.	Tamil Nadu	TNT-13	30.00 (33.21)	65.43
9.	Kerala	KLN-2	21.33 (27.50)	65.26
10.	Tamil Nadu	TNT-10	20.83 (27.15)	71.80
11.	Andhra Pradesh	APT-20	36.16 (36.96)	64.20
12.	Andhra Pradesh	APT-3	22.83 (28.54)	67.40
13.	Andhra Pradesh	APT-16	23.83 (29.21)	76.33
14.	Tamil Nadu	TNT-12	32.50 (34.75)	76.06
15.	Andhra Pradesh	APT-17	28.00 (31.94)	72.87
16.	Tamil Nadu	TNT-11	25.16 (30.10)	69.57
17.	Orissa	ORANP-3	23.33 (28.88)	72.00
18.	Kerala	KLS-3	27.00 (31.29)	74.53
19.	Andhra Pradesh	APNPL-11	29.00 (32.58)	72.46
20.	Andhra Pradesh	APKEA-24	26.00 (30.65)	72.00
21.	Orissa	ORANR-3	29.70 (33.02)	73.00
22.	Orissa	ORPB-18	22.00 (27.97)	75.19
23.	Andhra Pradesh	APKEC-2	26.33 (30.87)	74.70
24.	Orissa	ORNAP-7	28.33 (32.15)	71.66
25.	Andhra Pradesh	APNPL-10	23.33 (28.88)	74.46
26.	Kerala	KLS-4	30.36 (33.43)	70.20
27.	Orissa	ORANR-2	22.33 (28.18)	73.43
28.	Orissa	ORPLM-1	26.16 (30.76)	70.46
29.	Orissa	ORANR-6	28.33 (32.15)	73.40
30.	Orissa	ORANP-6	39.00 (38.64)	70.73
		Mean	26.99 (31.24)	72.05
		SE (m)	0.5169	0.4476
		CD (0.05)	1.4633	1.2672

* Figures in parenthesis are arcsine transformed value

was statistically at par with TNT-13 8.00 (2.83) per cent. Alcohol-benzene solubility of wood is an important character representing extractives percent in wood, which affects the pulping quality. Bray (1928) has reported alcohol-benzene soluble content of wood as a measure of waxes, fat, resins and certain other soluble components including wood gums. Statistically significant differences were observed for alcohol -benzene solubility in different provenances of Teak wood. Significant variation in alcohol-benzene extractive has been reported by Nimkar *et al*. (2010) in *Pinus roxburghii*, Kumar *et al.* (2005) in *Dalbergia sissoo*.

The data pertaining to the lignin and holocellulose content of different provenances of Teak are presented in Table 2. It is evident from the experiment that there was significant variation in lignin content of wood among different provenances of Teak. The highest value of 39.00 (38.64) per cent was noticed in ORANP -6, which was followed by APT 20 36.16 (36.96) per cent. The minimum value of 20.83 (27.15) per cent was found in TNT-10 preceded by KLN-2 22.33 (27.50) per cent. It is evident from the experiment that there is a highly significant variation in lignin content of wood.

Perusal of data revealed significant variation in different provenances of Teak for holocellulose content of wood. The maximum value of 76.53 % was recorded in APT-11, which was statistically at par with APT-16 (76.33%) and TNT-12 (76.06%). The APT-20 (64.20%) recorded minimum holocellulose content preceded by KLN-2 (65.26%) and TNT- 13(65.43%). Statistically significant differences were observed for holocellulose content in different provenances of Teak wood. Significant variation in holocellulose and lignin content of wood has been observed by Kumar *et al.* (2005) in *Dalbergia sissoo* and Nimkar *et al*. (2010) in *Pinus roxburghii* and Szczukowski *et al.* (2008) has also reported that variation in lignin and holocellose content of *Salix viminalis* and its cross with *S. Purpur-purea.*

Conclusion

The physico-chemical properties of wood are important parameter for the preliminary characterization of cellulose raw material and its potentiality for pulp and paper, fuel wood, timber and timber products for their related uses. The study would be helpful to utilize the findings and developing future strategies for screening the provenances of *T.grandis.* The highest cold water solubility [16.43% (4.05)] and hot water solubility [19.56% (4.42)] was recorded in APNPL-10 and lowest was recorded in ORPLM-1 [6.34% (2.52)] and [8.34% (2.89)], respectively. Maximum percentage of

alcohol-benzene solubility was observed in KLN-2 [17.64% (4.20)] and minimum per cent was recorded in MHSC-J1 [7 13% (2.67)]. Maximum percentage of lignin [39.00 % (38.64)] and holocellulose (76.53%) content was noticed in ORANP-6 and APT-11, respectively. whereas, minimum percentage of lignin 20.83% (27.15) and holocellulose (64.20%) content were found in TNT-10 and APT-20, respectively.

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