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Variation in hot and cold water soluble extractive content in gymnosperms from Western Himalayas

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Abstract
Background: The extractives represent a large number of compounds often of complex chemical structure which can be extracted from wood with the help of polar and non polar solvents. The wood is composed of extractives in the form of organic compounds *viz*., Fats, waxes, alkaloids and phenols etc. that are soluble in the hot water.
Methods: The wood samples of 5 species for the present work were procured from the forest department from 3 locations and further, after oven drying converted into saw dust with the help of Chipper cum grinder. The methodology used for Hot and cold Water Extractives was (T1m-59-Anonymous, 1959a) which was statistically analyzed by using completely block design (factorial) in three replication for each treatment as described by Panse and Sukhatme (1978).
Result: The data on hot and cold water extractives content of wood exhibited significant differences for different species and locations. the maximum cold water (6.81%) and hot water (8.70%) extractives were found in *Pinus roxburghii* while, the minimum cold water (4.77%) and hot water (6.50%) extractives were observed in *Picea smithiana*. Significant variation has been observed for hot and cold water soluble extractives between different species due to variation in composition of extractives from species to species and the total amount of extractives in a given species depends on growth conditions. Values for hot water soluble extractives are higher than those of cold water. The difference in solubility is due to hydrolysis and corresponding increase in solubility of wood substance during the boiling with water.

Keywords: Hot water extractives, coniferous wood, western Himalayas, variation

Introduction
Extractives are the group of non-structural wood constituents which usually represent the minor fraction i.e. 1-5 per cent of wood. Variation is usually evident in the occurrence as well as chemical composition of wood within families and even between closely related wood species. Furthermore, various parts of the same tree, e.g. stem, branches, roots, bark and needles, differ markedly with respect to both their amount and composition of extractives. The extractives comprise both inorganic and organic components. Generally, content of extractives is higher in bark, leaves and roots, as compared to stem wood. The inorganic components measured as ash seldom exceeding 1per cent of the dry wood weight. However, the ash content of needles, leaves and bark can be much higher. Organic components are an extraordinarily large number of individual compounds of both lipophilic and hydrophilic type, and their contents are usually less than 10%, but it can vary from traces up to 40% of the dry wood weight. Organica extractives of wood are further classified into fifferent groups viz., Aliphatic and Alicyclic compounds, phenolic compounds and other compounds. Wood extractives are known to have a negative effect on the pulp and paper making processes (Sefara and Birkett, 2004; Speranza *et al.* 2002) [10, 11]. Although majority of the extractive compounds dissolve in cooking liquors during pulping, some are carried over to the bleaching processes and accumulate to form sticky deposits called pitch, which reduces the impacts on the strength properties of the paper. Therefore, the estimation of extractives is necessary to improve the quality of pulp and paper industry.

Material and Methods
Experimental materials included 5 species of Pinaceae and locations are as follows

Table 1: Experimental site and planting material

Species	Sites
1. *Pinus roxburghii* (S_1)	Chamba(L_1), Sundernagar(L_2) and Solan(L_3)
2. *Pinus wallichiana* (S_2)	Chamba(L_1), Sundernagar(L_2) and Solan(L_3)
3. *Abies pindrow* (S_3)	Chamba(L_1), Sundernagar(L_2) and Solan(L_3)
4. *Picea smithiana* (S_4)	Chamba(L_1), Sundernagar(L_2) and Solan(L_3)
5. *Cedrus deodara* (S_5)	Chamba(L_1), Sundernagar(L_2) and Solan(L_3)

The present investigation was carried out in the Department of Forest Products, College of Forestry, Dr. Y S Parmar university of Horticulture and Forestry, Nauni, Solan (HP). The wood samples of 5 species for the present work were procured from the local markets of Chamba(L_1), Sundernagar(L_2) and Solan(L_3) and further, after oven drying converted into saw dust with the help of Chipper cum grinder.

Hot Water Extractives: (T1m-59-Anonymous, 1959a)

Two gram of oven dried coarsely ground wood was taken in a flask having 100 ml of double distilled water fitted with reflux condenser. It was digested on boiling water bath for 3 hours. The contents were then filtered through IG-1 crucible and residue was dried in an oven at 105 ±2 ˚C till constant weight. The solubility was determined by calculating the loss in weight of the sample taken and expressed as percentage. The data recorded was statistically analyzed by using completely block design (factorial) in three replication for each treatment as described by Panse and Sukhatme (1978) [8].

Cold Water Extractives: (T1m-59-Anonymous, 1959a)

Two gram of oven dried coarsely ground wood was weighed and transferred into a conical flask containing 300 ml of distilled water. The mixture was digested at room temperature with frequent stirring for 48 hours. The material was then filtered through IG-1 crucible and washed thoroughly with cold distilled water and dried to a constant weight in an oven at 105 ±2 ˚C. The cold water solubility was determined by calculating the loss in weight of sample taken and was expressed as percentage on the basis of oven dry weight of wood.

Result and Discussion

Cold water soluble extractives (%)

The per cent of hot water soluble extractives in wood for all the species and locations are presented in Table 2. The table showed significant differences for different species and locations. The maximum value of 8.70 per cent was recorded in S_1 (*Pinus roxburghii*) and minimum value of 6.50 per cent was noticed in S_5 (*Picea smithiana*). Among the locations, maximum value of 7.44 per cent was observed in L_1 (Chamba) and minimum value of 7.07 per cent in L_3 (Solan). The interactions between species and market locations were found to be non-significant and the data was found to range between 6.31 and 8.88 per cent.

Table 2: Variation in hot water soluble extractives (%) of coniferous wood from different market locations

Species (S)	Locations (L)			Mean
	L_1(Chamba)	L_2(Sundernagar)	L_3(Solan)	
S_1(*Pinus roxburghii*)	8.88	8.70	8.52	8.70
S_2(*Pinus wallichiana*)	7.87	7.71	7.50	7.70
S_3(*Abies pindrow*)	6.85	6.62	6.49	6.66
S_4(*Cedrus deodara*)	6.90	6.75	6.53	6.73
S_5(*Picea smithiana*)	6.68	6.52	6.31	6.50
Mean	7.44	7.26	7.07	
$CD_{0.05}$				
Species (S)	0.05			
Location(L)	0.04			
Species×Location(S×L)	0.08			

The wood is composed of extractives in the form of organic compounds *viz*., Fats, waxes, alkaloids and phenols etc. that are soluble in hot water. Significant variation has been observed for hot water soluble extractives between different species because of variation in the composition of extractives from species to species and the total amount of extractives in a given species depends on growth conditions. Values for hot water soluble extractives are higher than those of cold water. The difference in solubility is due to hydrolysis and corresponding increase in solubility of wood substance during the boiling with water. This variation observed in the samples from different locations may be due to different amount of accumulation of these compounds which may be due to difference in the site of occurrence or due to age of the trees. Jain *et al.* (2014) [6] have reported similar results in *Cedrus deodara*. Gierlinger *et al.* (2006) [3] have studied the hot water extractive (%) from different species of different origin (*Larix decidua* var. decidua, *L. decidua* var. sudetica, *L. kaempferi*, *L eurolepis*) and have reported similar variation. Guler *et al.* (2007) [4] in *Pinus nigra*; Esteeves *et al*. (2005) [2] in *Pinus pinaster;* Hernandez and Salazar (2006) [5] in *Quercus coccolobifolia, Q. durifolia, Q. rugosa* and *Q.oleoides;* Gierlinger *et al.* (2006) [3] in *Larix* species while, Bautista and Hnorato (2006) [1] in four Mexican oak species (*Quercus coccolobifolia, Q. durifolia, Q. ugosa and Q. oleoides*) have also reported similar results.

Cold water soluble extractives (%)

The data pertaining to the cold water soluble extractives in wood for all the species and market locations are presented in Table 3. The examination of data revealed significant difference among different species and locations at 5 per cent level of significance. The maximum value of 6.81 per cent was recorded in S_1 (*Pinus roxburghii*) and minimum of 4.77 per cent was noticed in S_5 (*Picea smithiana*). Among locations, the highest value of 5.84 per cent was observed in L_1 (Chamba) and lowest value of 5.06 per cent in L_3 (Solan). The interactions between species and locations were also found to be significant. The highest value of 7.18 per cent was found in the wood of S_1 (*Pinus roxburghii*) from L_1 (Chamba) while lowest value of 4.41 was recorded in S_4L_3 and S_5L_3.

Table 3: Variation in Cold water soluble extractives (%) of coniferous wood from different market locations

Species (S)	Locations (L)			Mean
	L_1(Chamba)	L_2(Sundernagar)	L_3(Solan)	
S_1(*Pinus roxburghii*)	7.18	6.69	6.57	6.81
S_2(*Pinus wallichiana*)	5.87	5.69	5.31	5.62
S_3(*Abies pindrow*)	5.77	5.26	4.62	5.22
S_4(*Cedrus deodara*)	5.32	4.94	4.41	4.89
S_5(*Picea smithiana*)	5.06	4.82	4.41	4.77
Mean	5.84	5.48	5.06	
$CD_{0.05}$				
Species (S)	0.07			
Location (L)	0.06			
Species×Location (S×L)	0.13			

The wood species from different locations show variation in cold water extractives which may be due to type of wood (normal, tension or compression), geographical location, climate as well as soil conditions. The species with large amount of extractives have better durability, dimensional stability and plasticization capacity. In wood, the cold water soluble content generally consists of tannins, gums, sugars and salts. The maximum value of cold water extractives has been observed in *Pinus roxburghii* which is in conformity with Kumar (2016) [7] in the same species. Similar results have been reported by Guler *et al.* (2007) [4] and Jain *et al.* (2014) [6] for *Pinus nigra* and *Cedrus deodara*, respectively. Qin *et al.* (1999) [9] have investigated plantations of seven softwood species (*Pinus taeda*, *Pinus massoniana*, *Pinus elliottii*, *Pinus yunnanensis*, *Larix algensis*, *Larix kaempferi and Cunninghamia lanceolata*) for cold water extractives, hot water extractives, NaOH extractives and alcohol-benzene extractives and have found that extractives in juvenile wood are higher than those from mature wood.

Conclusion

The present study concluded the presence of amount (%) of extractives in the softwood. Among the different chemical properties studied, the maximum cold water (6.81%) and hot water (8.70%) extractives were found in *Pinus roxburghii* while, the cold water (4.77%) and hot water (6.50%) extractives were observed to be minimum in *Picea smithiana*. Among the locations, the maximum cold water (5.84%) and hot water (7.44%) extractives were found for Chamba while, the minimum cold water (5.06%) and hot water (7.07%) extractives were observed for Solan location. The wood species from different locations show variation in hot and cold water extractives which may be due to type of wood (normal, tension or compression), geographical location, and climate as well as soil conditions. The species with large amount of extractives have better durability, dimensional stability and plasticization capacity. The water soluble compounds consist of various phenol compounds, carbohydrates, glycosides and soluble salts which determine the utilization of different softwood in various pulp and paper industry.

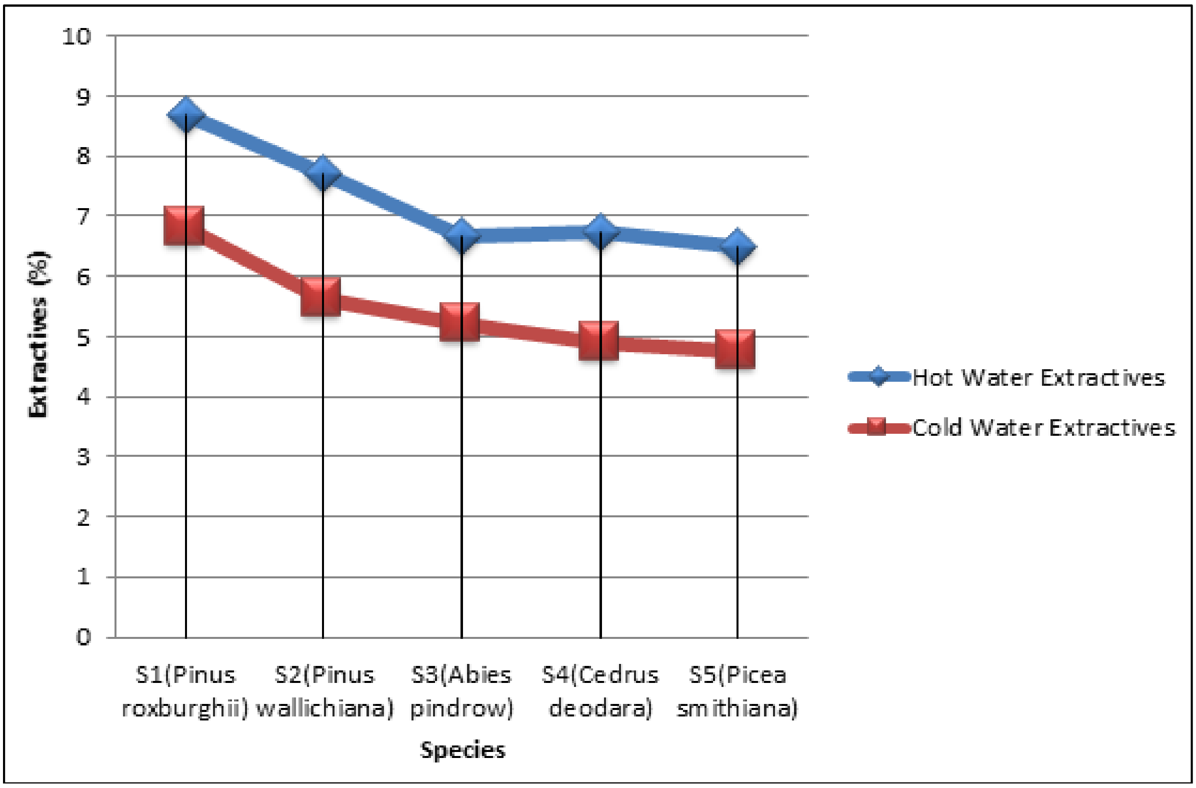

Plate 1: Depiction of overall range of cold and hot water extractives in wood

References

1. Bautista HR, Honorato SJA. Chemical composition of the wood of four species of *Quercus*. Ciencia Forestal en Mexico. 2006; 30(98):25-49.
2. Esteeves B, Gominho J, Rodrigues JC, Miranda I, Pereira H. Pulping yield and delignification kinetics of heartwood and sapwood of maritime pine. Journal of Wood Chemistry and Technology. 2005; 25(4):217-230.
3. Gierlinger N, Schwanninger M, Reinecke A, Burgert I. Molecular changes during tensile deformation of single wood fibers followed by Raman microscopy. Biomacromolecules. 2006; 7:2077-2081.
4. Guler C, Copur Y, Akgul M, Buyuksari U. Some chemical, physical and mechanical properties of juvenile wood from black pine (*Pinus nigra* Arnold) plantations. Journal of Applied Sciences. 2007; 7(5):755-758.
5. Hernandez BR, Salazar HJA. Chemical composition of wood of four species of *Quercus*. Ciencia Forestalen Maxico. 2006; 30(98):25-49.
6. Jain S, Jain A, Vaidya A, Kumar D, Jain V. Preliminary phytochemical, pharmacognostical and physico-chemical evaluation of *Cedrus deodara* heartwood. Journal of Pharmacognosy and Phytochemistry. 2014; 3(1):91-95.
7. Kumar V. Evaluation of *Pinus roxburghii* sargent populations for wood characteristics. M.Sc. Thesis, submitted to Dr. Y S Parmar University of Horticulture and Forestry, Nauni, Solan (H P), 2016, 74.
8. Panse VG, Sukhatme PV. Statistical method for agricultural workers, ICAR, New Delhi, 1978, 610.
9. Qin Z, Xixan LU, Luo HH, Zhou Q, Lu XX, Huang LH. Comparison analysis on extractives from seven plantation softwood species. China Wood Industry. 1999; 13(1):23-25.
10. Sefara NL, Birkett M. African Pulp and Paper Week, 2004, 1-7.
11. Speranza M, Martinez MJ, Gutierrez A, del Rio JC, Martinez AT. Journal of Pulp and Paper Science. 2002; 28(9):292-297.