Estimation of lignin content in some coniferous wood of western Himalayas

KANICA CHAUHAN, KR SHARMA and BHUPENDER DUTT

Department of Forest Products
Dr YS Parmar University of Horticulture and Forestry
Nauni, Solan 173230 Himachal Pradesh, India
Email for correspondence:kanicachauhan@gmail.com

 Received: 22.5.2017/Accepted: 28.6.2017

ABSTRACT

The present studies were conducted to estimate the variation in lignin content of some coniferous wood from different sites of Himachal Pradesh. The data on lignin content of wood exhibited significant variation in different species from variable sites. The highest value of 28.50 per cent was recorded in S_1 (*Pinus roxburghii)* and lowest 25.92 per cent in S_4 (*Cedrus deodara*). Among the sites maximum value of 28.69 per cent was observed in L_1 (Chamba) and minimum 25.42 per cent in L_3 (Solan). The interactions between species and sites were also found to be significant. The maximum value of 30.68 per cent was found in wood of *P roxburghii* (S_1) at Chamba (L_1) while minimum of 23.63 per cent was recorded in *C deodara* (S_4) wood at L_3 (Solan). The results would help to utilize the findings and developing future strategies for screening of coniferous wood for utilization.

Keywords: Lignin; coniferous wood; sites; variation

INTRODUCTION

Lignin is a phenolic substance consisting of an irregular array of variously bonded hydroxyl- and methoxy-substituted phenylpropane units which is distributed throughout the secondary cell wall with the highest concentration in middle lamella. Lignin provides stiffness to the secondary cell wall, cohesion between cells and consequently to wood tissue (Carpita and McCann 2000) and has a strong influence on mechanical properties of wood (Nakajima et al 2009). 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 in the bark. The above mentioned ingredients define wood colour, smell and durability as well as quality of pulping and drying and gluing properties. The physico-chemical properties of wood are also important for the preliminary characterization of cellulose raw material and its potentiality for pulp and paper, fuelwood, 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 contents of wood are tannins, gums, sugars, salts and phenols and the components soluble in alcohol-benzene are oleoresin, fats and waxes (Nimkar and Sharma 2006).The lignin usually functions to provide strength and rigidity to wood. Therefore the present investigations were conducted to study the variation in lignin content of coniferous wood from different sites of Himachal Pradesh.

MATERIAL and METHODS

Experimental material included 5 species of Pinaceae namely *Pinus roxburghii* (S_1), *P wallichiana* (S_2) *Abies pindrow* (S_3), *Picea smithiana* (S_4) and *Cedrus deodara* (S_5) at Chamba (L_1), Sundernagar (L_2) and Solan (L_3).

The investigations were carried out in the Department of Forest Products, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh. The wood samples of 5 species for the present work were procured from the local markets of Chamba, Sundernagar and Solan and after oven drying converted into saw dust with the help of chipper cum grinder. Two grams oven-dry sample pre-extracted with alcohol-benzene (1:2 v/v) was treated with 15 ml of 72 per cent sulphuric acid for 2 hours at 18-20°C with constant stirring. The material was brought down to 3 per cent by adding 545 ml of double distilled water. The solution was refluxed for 4 hours and then allowed to settle. The contents were filtered and washed with hot distilled water. The material was then dried in an oven at 105 ± 2°C till constant weight and expressed in percentage. The lignin (Klason) content was determined by using the T6m 59 (Anon 1959). The data recorded were statistically analyzed by using completely randomized block design (factorial) in three replications for each treatment as described by Panse and Sukhatme (1978).

RESULTS and DISCUSSION

The data obtained for lignin content of coniferous wood (Plate 1) from different sites are presented in Table 1. A critical scrutiny of results reveal significant difference for lignin (Klason) content among different species and sites. For different species the highest value of 28.50 per cent was recorded in S_1 (*P roxburghii*) and lowest 25.92 per cent in S_4 (*C deodara*). Among the sites maximum value of 28.69 per cent was observed at L_1 (Chamba) and minimum of 25.42 per cent at L_3 (Solan). The interactions between species and sites were also found to be significant. The maximum value of 30.68 per cent was found in wood of *P roxburghii* (S_1) at Chamba (L_1) while minimum of 23.63 per cent was recorded for *C deodara* (S_4) wood at L_3 (Solan).

Beleam and Harkin (1975) have reported that lignin content varies among species, individuals and within the plant. The possible reason for variation in cell wall constituents could be production of dry matter. Gullichsen and Fogelholm (2000) have reported similar results in scots pine while Kawamura and Bland (1967) reported that variation in lignin content in several species of *Eucalyptus* was mainly because of climatic changes in the tropical temperate zone.

REFERENCES

Anonymous 1959. Lignin in wood. Official standard, T12m-59, Indian Pulp and Paper Technical Association, Saharanpur, Uttar Pradesh, India.

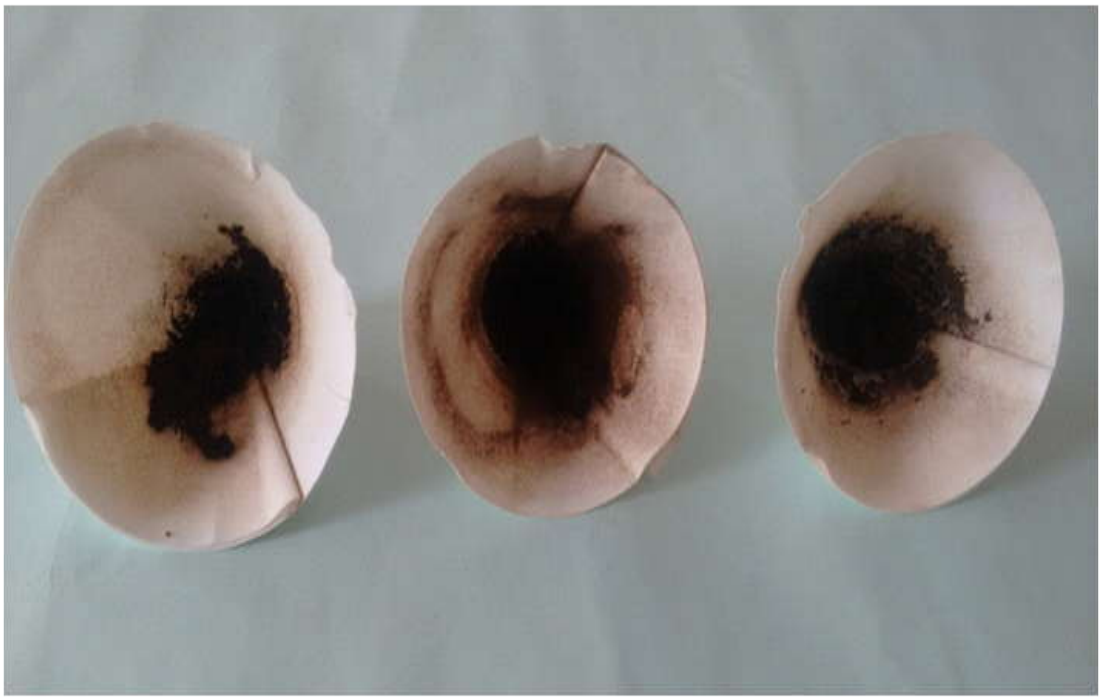

Plate 1. Lignin content in coniferous wood

Table 1. Variation in lignin (Klason) content (%) of coniferous wood from different sites

Species (S)	Site (L)			Mean
	L_1 (Chamba)	L_2 (Sundernagar)	L_3 (Solan)	
S_1 (*Pinus roxburghii*)	30.68	27.92	26.89	28.50
S_2 (*P wallichiana*)	28.34	26.89	25.66	26.96
S_3 (*Abies pindrow*)	28.78	27.08	25.88	27.25
S_4 (*Cedrus deodara*)	27.97	26.17	23.63	25.92
S_5 (*Picea smithiana*)	27.66	26.75	25.03	26.48
Mean	28.69	26.96	25.42	

$CD_{0.05}$	
Species (S)	0.49
Site (L)	0.38
Species × site (S × L)	0.84

Beleam RD and Harkin MJ 1975. Lignins of hardwoods growing on southern pine sites. Wood Science **8(2):** 122-129.

Carpita N and McCann M 2000. The cell wall. In: Biochemistry and molecular biology of plants (BB Buchanan, G Wilhelm and RL Jones eds), American Society of Plant Physiologists, pp 52-108.

Gullichsen J and Fogelholm CJ 2000. Chemical pulping: paper making science and technology. Helsinki, Finland, TAPPI, pp 19-243.

Kawamura I and Bland DE 1967. The lignin of *Eucalyptus* wood from tropical and temperate zones. Holzforsch **2(3):** 181-182.

Nakajima M, Furuta Y, Ishimare Y and Ohkoshi M 2009. The effect of lignin on the bending properties and fixation by cooling of wood. Journal of Wood Science **55(4):** 258-263.

Nimkar AU and Sharma KR 2006. Variation in bark thickness and specific gravity if wood is high resin yielder of chir pine (*Pinus roxburghii*). My Forest **42(3):** 279-283

Panse VG and Sukhatme PV 1978. Statistical methods for agricultural workers. ICAR, New Delhi, India, 610p.