

Isolation And Ultraviolet Ionisation Spectra of Alkali Lignin And Organosolv Lignin From *Ailanthus Excelsa*

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ABSTRACT

Ionisation spectra of alkali lignin (AAL) and organosolv lignin (AOSL) from Ailanthus excelsa have been analysed and an attempt has been made to calculate the number of moles of phenolic hydroxyl group contents of both the preparation.

INTRODUCTION

Ailanthus excelsa Roxb. (Simaroubaceae) a large deciduous tree commonly known as "Maharukha" is indigenous to central and southern India. The plant is reported to be astringent, febrifuge and antelmintic¹.

A survey of chemical literature show that no isolation of lignin and chemical characterisation thereof, although the presence of different chemicals in its various parts has been reported^{2,3}. Its chemical pulp is suitable for writing and printing papers can be prepared from wood by suitable process. Easy bleaching pulp with satisfactory strength properties can be prepared under suitable condition of digestion. *Ailanthus excelsa* being short fibred (average fibre length 1.22 mm) admixture with long-fibred pulp such as bamboo pulp is necessary for the manufacture of paper on commercial paper machine.⁴ As the plant is quite interesting and of immense value in indigenous medicine, it was considered worthwhile to undertake the present study in continuation with the earlier work.¹²

The lignin is an essential component of woody stem and angiosperm in which their amount ranges from 20 to 40%.⁵ and it is well known that lignin exist as a polymeric cell wall constituents in almost all dry plants and to carbohydrate in natural polymer, lignin are second to carbohydrate in natural abundance.

Lignin owing to its aromatic nature, absorbs strongly in ultraviolet range of the spectrum. Ultraviolet spectra of large number of lignin preparation and lignin model compounds have been determined by many investigators^{6,7,8}. The characteristic bands in the lignin spectrum are attributable to oxygen substituted benzene rings, and that the relatively high absorption in the 300-450 nm region suggest the presence of carbonyl groups or double bonds conjugated with the benzene rings⁹. The u.v. absorption spectrum definitely proved the aromatic nature of lignin¹⁰.

The hydroxyl groups - their differentiation and quantitative determination have played an important role in recent lignin chemistry. There is no doubt that lignin contains phenolic and aliphatic hydroxyl groups and since some of them may be etherified and form ether alkyl ether or heterocyclic rings, their quantitative determination may contribute to the elucidation of structure of lignin molecule. Ultraviolet ionisation spectra of alkali lignin (AAL) and organosolv lignin (AOSL) of *Ailanthus excelsa* have

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been analysed and an attempt has been made to calculate the number of moles of phenolic hydroxyl group contents of the alkali lignin using an average λ max value of the sample and an average $\Delta\epsilon$ max (4100) value of conidendrin and eugenol as a reference compounds which has the following relation¹¹.

$$\text{Mole of phenolic OH per gram} = \lambda \text{ max} / 4100.$$

EXPERIMENTS AND METHODS¹²

Preparation of sample

A log of fully grown (in the month of Nov.) *Ailanthus excelsa* was selected and after removing its bark, it cut into chips of size 2 to 3 inches in length. These chips were dried in the oven at 105°C for 24 h. These dried chips were then subjected to pulverizer to convert it into powder and then passed through 40-60 mesh sieves. The 40-60 mesh fraction were used for analysis and oversize of 60 mesh was taken for isolation of alkali lignin (AAL) and organosolv lignin (AOSL).

ISOLATION OF ALKALI LIGNIN¹³ (AAL)

The wood meal (350 g) was mixed with six litres of 5% NaOH and the mixture was kept in digester at 100 psi for 2 h. After digesting, the contents were filtered through fine mesh. The residue was washed with little distilled water and filtrate was collected. The filtrate was, then, neutralised with conc. HCl when coagulated lignin was separated. The solution was warmed at 60-65°C to get solid lignin. The light brown colour lignin was filtered and washed with water and dried. The yield was 18.6%. The crude lignin was purified by dioxane extraction. The purified sample was dried in vacuum over silica gel.

ISOLATION OF ORGANOSOLV LIGNIN¹⁴ (AOSL)

The extractive free wood meal (350 g.) was mixed with ethanol and water (1:1) 6 litres and was kept in the digester at 100 psi for 2 h. After digestion, the contents were filtered through fine mesh. The residue was washed with ethanol and water (1:1) and the filtrate was collected. The filtrate was concentrated in vacuo and it was poured into three times their volume of water¹⁵. The precipitated lignin was filtered and dried. The yield was 6.2%. The crude lignin was purified and dried as usual.

U.V. IONISATION DIFFERENCE SPECTROSCOPY

Ultraviolet ionisation difference spectra of the isolated alkali lignin were recorded with u.v. spectrophotometer, Shimadzu, UV-240 following the procedure adopted by Goldschimid¹⁶ with slight modification in choosing buffer capacity¹² (Figure 1).

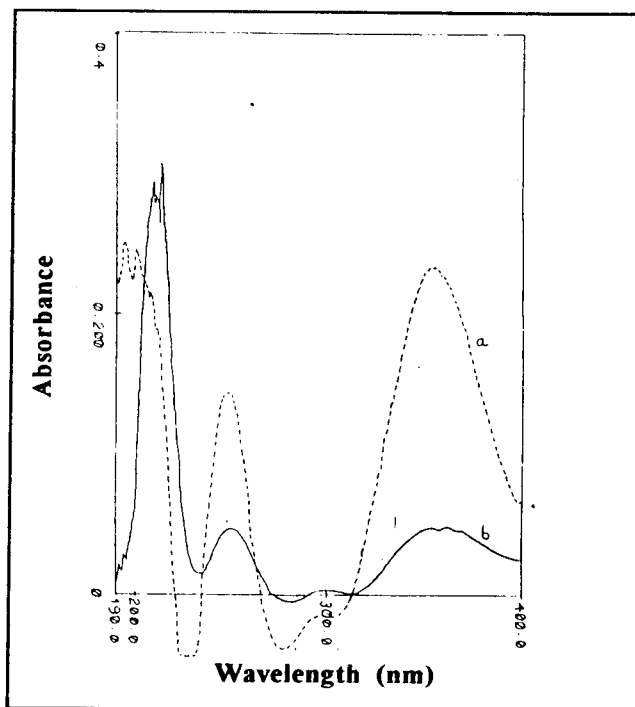


Figure 1 : a) ----- U.V. Ionisation spectra of *Ailanthus* Alkali Lignin.
b) U.V. Ionisation Spectra of *Ailanthus* Organosolv Lignin.

Isolated alkali lignin [0.1053 g.] and organosolv (0.1000 g.) were dissolved in a buffer [100 ml. pH 9.2] and 6 ml. of it was made up to 50 ml. with the same buffer solution. Another 6 ml. of the original solution was neutralised with 6 ml. 0.1 N H₂SO₄ and diluted to 50 ml with a buffer of pH7. The difference spectra were measured as the absorbance of the alkaline solution relative to that of the neutralised solution in the reference cell. The difference spectra were plotted in terms of absorptivity obtained by dividing the absorbance by the concentration of the diluted solution in gram per litre.

RESULTS AND DISCUSSION

Proximate analysis of the sample were carried out using the TAPPI standard Table 1: Proximate analysis of dried wood powder of *Ailanthus excelsa*

Contents	Percentage
Water extraction	5.2
Ethanol extraction	2
Benzene Extraction	2.2
Ethyl acetate extraction	1.8
Dioxane extraction	0.92
Ethanol-Benzene [1:2] extration	2.2
Lignin	40.02
Moisture	1.4
Ash content	2.9
Cold water solubility	2.4
Hot water solubility	2.97
1% NaOH solubility	18.3

Both the lignin preparations, AAL and AOSL renders difference maxima at 210 nm and 250 nm assigned to first primary and secondary band respectively due to ionisation of phenolic hydroxyl groups in alkaline solution; where as maxima 360 nm is ascribed to phenolic hydroxyl groups conjugated with carbonyl groups or possibly with biphenyl or ethelnic groups. The resulting spectra with a linear shoulder near 270 and a maximum at 350 clearly indicate the formation of carbonyl group during ethanolysis. The peak maxima at 210 was used to determine unconjugated phenolic hydroxyl contents of alkali lignin and organosolv lignin. The moles of unconjugated phenolic hydroxyl contents of both AAL and ASOL per gram was found to be 0.05122.

CONCLUSION

UV ionisation spectra of AAL and AOSL are almost the same in both the preparations under the discussion, the absorbance value of the AOSL is lower

than that of AAL. This anomaly any be due to the complex chromophoric system of the lignins.¹² The relatively high absorption in the 350-370 nm region suggesting the presence of carbonyl groups or double bonds conjugated with benzene ring⁶. It also support the aromatic nature of lignin.

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