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CHEMICAL CHARACTERISTICS OF PULPS OF SOME FIBROUS MATERIALS AVAILABLE IN PAKISTAN

*Nisar A. Jamil, *Mushtaq Ahmad, *N. M. Shamsi and **Ishrat A. Syed

ABSTRACT

Pulp characteristics viz. moisture, alpha-cellulose, pentosan, lignin and ash of Maxi-Pak and Chenab-70 wheat straw, AC-134 and Desi-9 cotton stalks, Kahi grass and Bagasse, Pine and Poplar woods, were studied The differences among the pulp characteristics were significant, except alpha-cellulose. The highest percentage of alpha-cellulose, lignin, and pentosan was noted in descending order Desi-9 cotton stalks, Pine wood and Maxi-Pak straw, respectively.

INTRODUCTION

Paper making is essentially a chemical process and the basic raw material required for this purpose is cellulose which is found in fibres of a wide variety of growing plants. Cellulose exists in bust fibres, grasses, woods and in certain plants, e. g. pine, cotton, etc. Seed fibre is pure cellulose bnt the collulose in woody tissues is associated with other substances like lignin.

Pakistan is developing its paper industry. To make it self-sufficient in paper production, it is necessary to utilize the indigenous raw material available in the country. Sufficient quantity of wheat straw, cotton stalks, grasses and soft woods is available in the country which can feed the paper mills round the year. Considering the utility of such material for paper industry, the pulps of these materials were studied for their chemical characteristics. The pulp yield alongwith physical characteristics has already been discussed in an earlier paper (Ahmad *et al.*, 1981). The importance of some chemical constitutents of pulp viz. cellulose, pentosan, lignin, ash and moisture for paper manufacturing has been reported by Casey (1952).

*Department of Fibre Technology, University of Agriculture, Faisalabad.
**Department of Applied Chemistry, University of Karachi, Karachi.

MATERIALS AND METHODS

A series of experiments to determine the pulp characteristics in terms of moisture, alpha-cellulose, pentosan, lignin and as contents in different materials viz. Maxi-Pak and Chenab-70 wheat straws (*Triticum aestivum*), AC-134 and Desi-9 cotton stalks (*Gossypium arborium*), Kahi grass (*Saccharum spontanium*), Bhgasse (*Saccharum officinarum*) and soft woods of Pine (*Pinus sylvestris*) and Poplar (*Populus alba*) were carried out in accordance with standard methods (TAPPI, 1966). The data were analysed statistically with Complete Randomised Block Design and the varietal differences for these characteristics were studied by Duncan's New Multiple Range Test.

RESULTS AND DISCUSSION

Table 1 presents the results of percentage moisture, alpha-cellulose, pentosan, lignin and ash contents observed in the pulps of Maxi-Pak, Chenab-70, AC-134, Desi-9, Kahi, Bhagasse, Pine and Poplar, while the analysis of variance of these data has been shown in Table 2.

The moistnre in AC-134 and Desi-9 cotton stalks and Pine did not show a significant difference between each other but they differed significantly from others. Similarly, Chenab-70 wheat straw, Kahi and Pine differed significantly from all other materials (Table 1). Maximum moisture (i. e. 12.43%) was noted in AC-134 cotton stalks and minimum (i.e. 6.20%) in wheat straw of Maxi-Pak. This seems logical as the density of cotton stalk is more than that of wheat straw. The present mean values are in conformity with Casey (1952) but deviated from the higher average values quoted by Toor and Mubin (1973). The lower values obtained in this study might be due to the prevalent hot climatic conditions.

It was interesting to find that the cellulose content of various fibres under study showed no significant difference (Tables 1 and 2). However, the maximum alpha-cellulose (i.e. 53.52%) was obtained in cotton stalks (AC-134), while Chenab - 70 wheat straw produced the minimum values (i. e. 33. 43%) for this component. These results are in close agreement with those reported by Casey (1952) and Toor and Mubin (1973) but disagree with those of Browning (1963). It has been reported that alpha-cellulose in plants varies according to soil potential and general conditions of the plants.

Table 1. *Percentage of some chemical constituents of different pulp materials*

Source of material	Moisture	Alpha-cellulose	Pentosan	Lignin	Ash
(a) *Wheat straws*					
Maxi-Pak	6.20 c	35.62 a	24.91 a	19.20 b	4.25 a
Chenab-70	7.75 bc	33.43 a	22.32 a	18.95 b	4.66 a
(b) *Cotton stalks*					
AC-134	12.43 a	53.52 a	15.90 b	7.48 c	3.41 a
Desi-9	10.59 a	48.39 a	17.40 b	8.20 c	3.71 a
(c) *Grasses*					
Kahi	8.09 b	33.84 a	24.60 a	19.41 b	3.93 a
Bhgasse	6.58 c	35.92 a	23.12 a	20.79 b	1 68 b
(d) *Soft woods*					
Pine	10.01 ab	38.74 a	13.40 b	25.11 a	0.79 b
Poplar	6.21 c	50.53 a	17.35 b	24.40 a	0.40 b

Any two means in the same column, bearing different letters are significantly different at $P \leqslant 0.05$.

Table 2. *Analysis of variance for chemical constituents of different pulp materials*

SOV	DF	F-ratios				
		Moisture	Alpha-cellulose	Pentosan	Lignin	Ash
Pulp material	7	6.23*	NS 1.80	93.86*	52.02*	24.74*
Error	24	3.30	143.82	0.77	3.56	0.91

* Significant at $P \leqslant 0.05$; NS = non-significant.

Cotton stalks and soft wood groups differed significantly from both straw and grass groups in pentosan content (Table 1). Maxi-Pak showed dominance over other materials yielding 24.91 per cent pentosan. Pine wood produced the

lowest Pentosan percentage. The present values of this parameter are slightly lower than those reported by Casey (1952), but are quite in line with Toor and Mubin (1973). Small deviation may be due to the effect of soil, growing conditions, and variation in material used.

Various fibres used in this study differ significantly from one another in lignin content, except wheat straw and grass groups. Pine wood showed the highest value (25.11%), followed by Poplar, Bhagasse, Maxi-Pak, and Chenab-70 (Table 1). These findings are in close conformity with previous work reported by Doree (I950) and Casey (I952).

Bhagasse and soft woods differed significantly from Kahi, wheat straws and cotton stalks in their ash content. Chenab-70 produced the highest ash content (i. e. 4. 66%) followed by Maxi-Pak, Kahi, Desi-9, AC-134, Bhagasse, Pine and Poplar (Table 1). Contrasting results have been reported by earlier workers (Toor and Mubin, I973; Rehman, I979). The variations in the present values are, therefore obvious. However, the trend of these results is, in general, in conf rmity with Casey (1952) who stated that ash content of straw is higher than that of wood.

No relationship could be established between any two parameters determined in this study. Actually, the chemical constituents of raw material for paper pulp vary considerably due to wide variation in their structure, soil, climatic conditions and the processes applied in the preparation of pulps. Some of these parameters play a significant role in mechanical properties of paper (Ahmad *et al.*, 1985).

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