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CELLULOSE AND LIGNIN IN STRAWS OF DIFFERENT WHEAT VARIETIES

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Studies on the Chemical composition of wheat straw of four different wheat varieties were conducted in the Department of Fibre Tech: University of Agriculture, Lyallpur, during the year 1973-74. The differences in values of cellulose content were found to be highly significant, with a range of 65.59 to 66.70 per cent, the highest value being for Chenab–70 and the lowest for S.A. 42. The values of Lignin content were found to be only significant, with a range of 19.05 to 19.44 per cent, the lowest value being for Silver-Blue and the highest for Maxi-Pak

INTRODUCTION

At present various types of straws, wood and other fibres are used for paper and card-board industry in different parts of the world. Under the conditions prevailing in Pakistan, the production of food grains has attained a greater significance in the recent years. A number of new wheat varieties have replaced the old varieties and appreciable increase in yield has taken place. As the area under wheat has increased, there is also an increase in the production of wheat straw which is a by-product of wheat crop. About eight million tons of wheat straw is produced in Pakistan, (Latif 1974). The entire quantity is not used for fodder. Even if ten per cent of the total quantity is made available for paper manufacture, this will yield 400,000 tons of pulp. It is already being used locally for making various qualities of paper and board.

The physical and chemical properties of cellulose are already known to vary to a great degree depending upon the nature of the material and condition of growth. It was, therefore, considered necessary to conduct studies to assess the economic importance of the newly introduced wheat varieties.

REVIEW OF LITERATURE

Aronovsky *et al.* (1943) observed that different American straws contained crude fibre 54.4 per cent, as compared to rye straw which contained 54.9

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per cent. Rye straw was found to have a higher cellulose content than other straws. Schneider (1947) concluded that wheat, barley, rice and rye straws contained 38.2, 34.7, 34.3 and 43.6 per cent crude fibre respectively. Ritman *et al.* (1948) showed from the average composition of European Straw that summer wheat contained 72.1 per cent and winter wheat 75.0 per cent of holocellulose. Ritter *et al.* (1933) reported that straws had a lower cellulose content than wood, but inspite of its low cellulose content, straw had a holocellulose approximately equal to that of wood.

Aronovsky *et al* (1943) estimated the lignin content of American straw as 16.7 per cent. Ritman *et al* (1948) determined 17.0 and 15.7 per cent lignin content in summer and winter straw wheat respectively. In a report published by National Academy of Science (N.A.S. 1971), it was stated, that wheat straw contained 13.7 per cent of lignin. Toor and Mubin (1973) reported that lignin content was 16.9 per cent in wheat straw.

MATERIALS AND METHODS

The raw material was cut into small pieces separately and then ground to a fine powder passing through 60 mesh with the help of an electric grinder. The crushed mass was then screened through a cloth gauze. The screened fine powder was used for chemical analysis. Four samples of each of the varieties were analyzed for the following chemical constituents.

Cellulose: In routine analysis the carbohydrates were determined in two groups, crude fibre and nitrogen free extract (N.F.E.) The separation was obtained by a chemical method. After the removal of water and fatty material from a given sample, it was boiled with a weak acid (H_2SO_4) and then with weak alkali (NaoH) for an equivalent time (30 min). This procedure removed the protein, sugar and starch leaving most of the cellulose and other complex polys saccharides along with some other mineral material as a residue. The loss on ignition of this residue was taken as the crude fibre as suggested by A.O.A.C. (1965).

Lignin: Lignin is formed in the middle lamella between the fibres of raw material and it serves to cement them together and gives additional rigidity to fibrous raw material. For its determination, raw material was first treated with solvent ether in the "soxhlet apparatus", to remove fat, wax, resins, etc. and then treated with strong sulfuric acid. The carbohydrates were hydrolyzed, leaving insoluble residue which was determined as lignin as recommended by TAPPT (1966).

RESULTS AND DISCUSSION

Cellulose : The cellulose content in the straws of different wheat varieties are given in Table 1. As is evident from these data the differences among the varieties tested were highly significant. The mean cellulose contents of the four wheat varieties ranged from 65.59 to 66.70 per cent with Chenab-70 having the highest and SA.42 the lowest cellulose content.

TABLE 1. *Cellulose percentage in straws of four wheat varieties.*

Varieties	Mean value	Statistical significance
Chenab-70	66.70	a
Maxi-Pak	66.44	a
Silver Blue	65.84	b
S.A. 42	65.59	b

Analysis of Variance

Variation due to	D.F.	M.S.	F. Ratio	S.E.
Varieties	3	0.9860	23.344**	0.102
Errors	12	0.0422	—	
Total	15			

** Highly significant.

The present values are higher than those presented by (N.A.S. 1971) for wheat straw as 50.1 per cent. It will be further seen that wheat straw has lower cellulose content than wood as presented by Ritter (1933) and Ritman *et al* (1948) found the percentage of holocellulose in wheat straw that is 72.1 and 75.0 which are higher than the values of the present findings. The results of Cellulose content of wheat straw in the present researches slightly differ from the values given by Aronovsky *et al* (1943) who reported that crude fibre in wheat and rice straw were 54.4 and 54.9 per cent and Schneider (1947) who reported 38.2, 34.7, 34.3 and 43.6 per cent crude fibre for wheat, barley, rice and rye straw respectively.

Lignin. The data regarding lignin content in straws of different varieties are given in Table 2. As is evident from these data the differences among the varieties tested were only significant. The mean values ranged from 19.05 per cent for Silver-Blue to 19.44 per cent for Maxi-Pak.

TABLE 2. *Lignin percentage in different varieties of wheat straw.*

Varieties	Mean value	Statistical Significance
Maxi-Pak	19.44	a
S.A. 42	19.39	a
Chenab-70	19.15	b
Silver-Blue	19.05	b

Analysis of Variance

Variation due to	D.F.	M.S.	F. Ratio	S.E.
Varieties	3	0.1331	4.407*	0.09
Errors	12	0.0302		
Total	15			

* = Significant.

The values for lignin content obtained in these studies are higher than those presented by Toor and Mubin (1973) who found a lignin content of 16.9 per cent. The present results vary from the results reported by N.A.S., (1971), Ritman *et al* (1948) and Aronovsky *et al* (1943) who found lignin content in wheat straw as 13.7 per cent, in summer and winter wheat as 17.0 and 15.7 per cent and in American wheat straw it 16.7 per cent respectively.

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