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SCIENTIFIC GRADING OF JUTE

Part II.—Determination of Cellulose in Different Grades of Jute Using the Methods of Cross and Bevan*

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The cellulose content (determined by Cross and Bevan methods) of different grades of white (*Corchorous capsularis*) and tossa (*Corchorous olitorious*) jute has been found to decrease from the higher to the lower grades of jute. The data presented indicates that cellulose content of the various grades of jute may be used as an index for grading of jute.

In our earlier communication[1] on scientific grading of jute some results on the lustre determination of jute were presented and it was suggested that lustre could be used as one of the acceptable indices for the grading of raw jute. Both varieties of jute, namely *Corchorous olitorious* (Tossa) and *Corchorous capsularis* (White) have cellulose as their major chemical constituent. This paper presents some of the analytical findings on the chemical constitution of jute fibres of variously accepted grades. The results indicate that the analyses of cellulose content is acceptable as an index for grading of raw jute.

The samples of professionally graded (new grades) pucca bales of Pakistani white and tossa grades of jute were analysed for their cellulose content by the Cross and Bevan methods. The top portion and the bottom portion of the jute plant can be accepted to differ in their chemical and physical properties due to various factors of plant biology including relative maturity, which makes the bottom portion comparatively more mature and coarser than the top portion. In practice the behaviour is so much different that the normal retting procedure allows the top portion to be retted fully leaving the bottom portion woody and partially retted. Before processing the jute further, these bottom portions are normally cut out and dealt separately as "jute cuttings". The samples of "long jute" from the pucca bales are the fully retted portion of the fibre obtained after removing the cuttings. But even in these strands of long jute fibre the bottom and top portion could be expected to analyse differently. This assumption has been substantiated by the analytical finding in Tables 1 and 2 which clearly show that in all grades of jute of both the varities the superior qualities show more cellulose in the more mature bottom portion as compared to the tops. In the inferior grades namely, Pak White "E", Pak Tossa "D" and Pak Tossa "E", the bottom portion contains less cellulose than the top. The hemi-cellulose, pectin and lignin are the three other components of jute fibre, besides cellulose. And the results can be explained by the fact that the less mature and possibly over-retted tops may be comparatively richer in hemi-cellulose and possibly pectin content in the superior grades, thus giving a lower analytical figure for cellulose. Whereas, the inferior grades are likely to be poorly retted fibres, thus making the bottom portion comparatively stiff, containing more lignin and inorganic residues etc., thus giving a lower cellulose value than the tops.

The cellulose content of tops and bottoms of various grades of jute fibres does show a definite overlapping of values as can easily be expected. But even then it will be seen that the average cellulose content gradually decreases from 70% and 69% for the Pak Special grades of white and tossa, respectively to a minimum average of 58% and 60% for the "E" grades of the two varieties. The difference in the cellulose contents of various grades are clearly defined and should be acceptable as an index for grading.

Experimental[2]

The pucca graded bales were purchased through the Pakistan Jute Association.

Dry jute powder (1.0–1.5 g) was boiled for 30 min with 1% sodium hydroxide[3] solution at constant volume, cooled, filtered and washed well with water in a sintered glass funnel (porosity I) and finally transferred to a conical flask placed in an ice bath and a slow stream of washed chlorine gas was passed through the material for 30 min. With the passage of chlorine the colour of the fibre changed from brown to golden yellow. This fibre was then allowed to stand for 60 min to ensure complete reaction at this stage. The chlorinated fibre was removed, washed well with

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TABLE 1.—CELLULOSE CONTENT IN PAK WHITE JUTE.

Sample		Wt of dry samples (g)	Wt of crucible	Wt of crucible + cellulose	Wt of cellulose (g)	Cellulose (%)	Mean % of cellulose	Range of cellulose(%)
Pak White "Special"	(1)	1.3813	16.2524	17.2298	0.9774	70.75	70.36	69.60–70.36
Bottom	(2)	1.0982	22.8910	23.6596	0.7686	69.98		
Pak White "Special"	(1)	1.0577	17.1632	17.9032	0.7400	69.96	69.60	
Top	(2)	0.9243	19.9738	20.6138	0.6400	69.24		
Pak White "A"	(1)	1.0422	18.3116	18.9974	0.6858	65.80	65.67	64.57–65.67
Bottom	(2)	0.8473	19.0742	19.6296	0.5554	65.54		
Pak White "A"	(1)	0.8865	16.2478	16.8176	0.5698	64.27	64.57	
	(2)	0.7984	22.8910	23.4090	0.5180	64.87		
Pak White "B"	(1)	1.2861	17.1632	17.9896	0.8264	64.25	64.14	62.87–64.14
Bottom	(2)	1.3716	18.3116	19.1900	0.8784	64.04		
Pak White "B"	(1)	0.9672	22.8910	23.4944	0.6034	62.38	62.87	
Top	(2)	1.0689	19.0742	19.7516	0.6774	63.37		
Pak White "C"	(1)	0.8753	20.5208	21.0752	0.5544	63.37	63.38	60.38–63.38
Bottom	(2)	1.1926	19.9738	20.7200	0.7562	63.40		
Pak W ite "C"	(1)	1.2110	17.1632	17.8986	0.7354	60.72	60.42	
Top	(2)	1.3206	16.2478	17.0418	0.7940	60.12		
Pak White "D"	(1)	1.2672	19.0742	19.8584	0.7842	61.88	61.70	60.48–61.70
Eottom	(2)	1.3762	22.8910	23.7378	0.8468	61.53		
Pak White "D"	(1)	1.3671	18.3116	19.1394	0.8278	60.55	60.48	
Top	(2)	1.3003	16.2478	17.0334	0.7856	60.41		
Pak W ite "E"	(1)	1.4578	19.9742	20.7907	0.8165	56.00	56.06	56.06–60.73
Bottom	(2)	1.4527	20.5208	21.3362	0.8154	56.13		
Pak White "E"	(1)	1.3854	17.1632	18.0028	0.8396	60.60	60.73	
Top	(2)	1.4628	19.0742	19.9646	0.8904	60.87		

Two separate samples for each grade and each portion of the fibre (top and bottom) were analysed. The results are presented as under (1) and (2).

TABLE 2.—CELLULOSE CONTENT IN PAK TOSSA JUTE.

Samples		Wt of dry samples (g)	Wt of crucible	Wt of crucible cellulose	Wt of cellulose (g)	Cellulose (%) (%)	Mean % of cellulose	Range of cellulose (%)
Pak Tossa "Special"	(1)	1.8891	19.0740	20.3975	1.3235	70.06	70.04	68.19–70.04
Bottom	(2)	1.9165	18.3134	19.6556	1.3422	70.03		
Pak Tossa "Special"	(1)	1.4130	22.8908	23.8564	0.9656	68.33	68.19	
Top	(2)	1.4096	19.9738	20.9324	0.9586	68.05		
Pak Tossa "A"	(1)	1.5875	23.0742	24.1740	1.0998	69.27	69.14	68.66–69.14
Bottom	(2)	1.6193	20.5208	21.6384	1.1176	69.01		
Pak Tossa "A"	(1)	1.2726	17.1632	18.0356	0.8724	68.55	68.66	
Top	(2)	1.4568	18.3116	19.3136	1.0020	68.78		
Pak Tossa "B"	(1)	1.5263	16.2478	17.2894	1.0416	68.24	68.38	66.58–68.38
Bottom	(2)	1.4670	19.0742	20.0796	1.0054	68.53		
Pak Tossa "B"	(1)	1.4886	18.3140	19.3084	0.9944	66.80	66.58	
Top	(2)	1.4748	19.9730	20.9518	0.9788	66.36		
Pak Tossa "C"	(1)	1.2971	18.3146	19.1614	0.8568	65.28	65.26	64.71–65.26
Bottom	(2)	1.3725	16 8030	17.6984	0.8954	65.24		
Pak Tossa "C"	(1)	1.2651	22.8908	23.7072	0.8164	64.53	64.71	
Top	(2)	1.3260	18.3136	19.1742	0.8606	64.90		
Pak Tossa "D"	(1)	1.3990	19.0742	19.9528	0.8786	62.80	62.55	62.55–63.78
Bottom	(2)	1.5957	17.1632	18.1576	0.9944	62.31		
Pak Tossa "D"	(1)	1.5311	16.2518	17.2274	0.9756	63.71	63.78	
Top	(2)	1.5468	22.8906	23.8784	0.9878	63.86		
Pak Tossa "E"	(1)	1.4578	19.0756	19.9228	0.8472	58.11	58.38	58.38–61.78
Bottom	(2)	1.3560	16.2478	17.0432	0.7954	58.65		
Pak Tossa "E"	(1)	1.5074	23.0762	24.0058	0.9296	61.66	61.78	
Top	(2)	1.4683	20.5224	21.4314	0.9090	61.90		

Two separate samples for each grade and each portion of the fibre (top and bottom) were analysed. The results are presented as under (1) and (2).

water to remove hydrochloric acid and was placed in a conical flask containing 2% Na_2SO_3(50 ml) and gradually heated to boiling point. At this stage 4% NaOH (2.5 ml) was added to it, to give 0.2% NaOH concentration, and the solution boiled for another 5 min. The cellulose was removed to a sintered glass funnel, filtered, washed repeatedly with hot water and finally bleached by immersion in dilute permanganate (0.1%) solution, followed by oxalic acid solution (5%). The bleached cellulose was filtered, washed, digested[4] for 30 min in hot water, cooled, filtered, dried at 105°C to a constant weight (about 15 hr). The experimental results are summerised in Tables No. 1 and 2.

References

1. M. Manzoor-i-Khuda, M.A. Karim, Manzoorul Huq and Shahidullah, Pakistan J. Sci. Ind. Res., **12,** 414 (1969).
2. C. Doree, *Methods of Cellulose Chemistry* (1947), second edition, pp. 352,53.
3. A.G. Norman and S.H. Jenkins, Biochem. J., **27,** 818 (1933).
4. G. J. Ritter, Ind. Eng. Chem., **16,** 808 (1924).