Production of Soda Semi-Chemical Pulp From *Sesbania sesban* (Linn.) Merr.

K. S. BHANDARI & G. M. MATHUR*

INTRODUCTION

With the growing population and civilisation, the demand of paper is increasing day by day while our sources for conventional fibrous raw material are comparatively limited. It is therefore, obvious that the search for new fibrous raw material to meet our requirement is of utmost importance. In this context, this work on *Sesbania sesban* (Linn.) Merr., belongs to natural order *Loguminosai*, commonly known as "Jainti" in Hindi, is investigated for its suitability as a fibrous raw material for the production of wrapping paper on the request of a farmer of Hanumangarh, Rajasthan.

It is a soft wood, quick growing, short lived shurb, 1,8 to 6 m. high, found cultivated throughout the plains of India upto an altitude of 1200 m. It can grow under different[1] conditions and can provide large amount of green manure by forming up symbotic association with nitrogen soil bacteria on roots[2]. It can also be grown under wa'er-logged conditions and ac dic soils[3]. The plant consists of woody portion. The bark has long fibres the woody portion has comparatively short fibres. The use of entire stem for pulping will give a mixture of long and short fibres which is desirable for smooth running of paper machine specially in case of small unit based on agricultural residues. Being a quick growing species it has an advantage over conventional raw material as it could be harvested just after few months. The wood from *Sesbania sesban* is white and extremely soft weighing[4] about 43.2 kg. per cu.m.

Almost each part of the plant has already been analysed for its chemical composition viz. leaves[5], flowers[6], seed[7,8] bark[4], but no work on suitability of this raw material for papermaking has been done.

*Cellulose and Paper Branch, Forest Research Institute, D. DUN

RAW MATERIALS

About 5 kg. of air dried stems with bark were received. The sample has been collected from District Hanumangarh, Rajashtan. Whole stem was used for pulping experiments. The stems were cut into pieces of 1 to 3 cm in length. Moisture content in the sample was 10%.

EXPERIMENTAL

Proximate Chemical Analysis : Dust passing through 60 mesh and retained on 80 mesh was prepared and used for proximate chemical analysis, TAPPI Standards Methods were used for proximate chemical analysis. The results are recorded in Table-I.

TABLE–1 PROXIMATE CHEMICAL ANALYSIS OF *Sesbania sesban*

Sl. No	Particulars	% on oven dry basis	
		S. sesban	H. sabdariffa
1.	Ash	1.4	1.5
2.	Cold water solubility	2.04	11.5
3.	Hot water solubility	4.20	13.7
4.	1% NaOH solubility	16.20	31.9
5	Alcohol-benzene solubility	4.25	12.0
6.	Lignin	22.00	22.5
7.	Holocellulose	68.90	78.0

Fibre Dimensions : Fibre dimensions were determined, average value of fibre length, fibre diameter and wall thickness are recorded in Table-II.

TABLE–II FIBRE DIMENSIONS OF *Sesbania sesban*

Sl. No	Particulars	S. sesban	H. sabdariffa
1.	Average fibre length	14.40 μ	1.36 μ
2.	Average fibre diameter	21.7 μ	29.5 μ
3.	Average lumen diameter	12.95 μ	3.59 μ
4.	Average wall thickness	4.37 μ	7.85 μ

Production of Pulp by Soda Semi-chemical Process in Laboratory : For the production of Soda Semi-chemical Pulps, chips were given a softening treatment using caustic soda solution. The chips were loaded in a series digester. Each digester was loaded with 200 o.d. chips. Chips to liquor ratio was 1:6. The time schedule and other conditions of pulping are recorded in Table III.

After treatment, the chips were washed with fresh water and refined in a Sprout-Waldron 12 inches laboratory single disc refiner at a zero plate clearance. The pulp consistency was about 4%. The pulps after refining were screened over La Most Fils laboratory screen using a screen plate having 0.35 mm size slots. The screened pulp yield and screened rejects were determined. Kappa number of screened pulps were also determined. The freeness of the pulp after refining was 250±10 ml C.S.F.. therefore no further beating treatment was given to the pulp. Standard sheets were made on sheet making machine. The standrad sheets were air dried and conditioned. The coditioned sheets were tested for various strength properties. Results of pulp evaluation are recorded in Table

TABLE–III CONDITIONS OF CHEMICAL TREATMENT OF SESBANIA SESBAN FOR SODA SEMI CHEMICAL PULPING AND RESULT OF PULP EVALUATION

Sl. No.	Name of Plant	Active* alkali %	Unbleched screened pulp %	Screen* rejects %	Kappa Number	Bulk $\frac{cm^3}{g}$	Density g/cm³	Burst factor	Breaking length km.	Stretch %	Folding endurance double folds	Tear factor
1.	S. Sesban	7.75	67.8	1.51	—	1.93	0.51	19.0	4.00	2.1	16	67
2.	,,	9.70	63.5	0.64	63.7	1.74	0.58	27.0	5.15	2.5	39	72
3.	,,	11.60	58.7	0.52	56.5	1.64	0.61	37.0	6.67	3.2	100	71
4.	,,	11.60	63.0	0.40	59.9	1.70	0.59	29.0	5.56	2.6	38	79
5.	,,	15.50	59.0	0.32	51.5	1.77	0.57	34.0	6.06	3.4	47	80
6.	,,	15.50	54.0	0.14	40.6	1.59	0.63	41.0	7.21	3.9	83	72
7.	H. sabdariffa	7.75	62.9	—	—	—	—	28.3	6.00	—	—	58.3
8.	,,	15.50	47.1	—	28.7	—	—	42.2	7 65	—	—	60.8

*Percentage expressed on o.d. chips basis.

Note : In all experiments, the time taken for raising the temperature from room temperature to 162°C is 90 min.

In case of experiments at Sl. No. 1, 2, 3, and 6 a temperature of 162°C was maintained for 120 min. For experiments at Sl. No. 5 and 6 the temperature of 162°C was maintained for 90 min.

III. For comparison, results of *Hibiscus sabdariffa*[9] are also recorded in the table.

DISCUSSION

1. Results of proximate chemical analysis given in Table I show that cold water, hot water, alcohol-benzene, 1% NaOH solubility and holocellulose contents are comparatively high in *Hibiscus sabdariffa,* while lignin content is almost the same in both the plants. High solubility of later plant indicate comparatively lower yield on identical conditions of pulping.

2. Fibre dimensional data given in Table II indicate that the tear factor of paper from *Sesbania sesban* should be higher than *Hibiscus sabdariffa,* while low value for burst and breaking length could be predicted on the basis of fibre diameter and wall thickness of fibre.

3. Yield and Kappa Number of pulp obtained from *Sesbania sesban* at different concentration of chemical and cooking time have been recorded in Table III, results show that with the increase in active chemical for cooking and cooking time pulp yield and Kappa Number decrease, as expected.

4. Results of pulp evaluation of soda semi-chemical pulp from *Sesbania sesban* given in Table III, clearly indicate that with the increase in active alkali, there is an improvement in strength properties. However. at higher concentration of chemical (above 11.5% as Na_2O) appreciable improvement in strength properties is not observed. Therefore, from the available data recorded in Table III, it could be said that the conditions of serial No. 3 are the optimum cooking conditions for the production of soda semi-chemical pulp for wrapping paper.

5. Comparison of results of Serial No. 3 Vs 4 and 5 Vs 6 indicates that with the increase of cooking time (at same concentration of chemical) the breaking length and burst factor seems to be improved while the tear factor decreases.

6. Results recorded in Table III indicate that the burst factor and breaking length of unbleached pulp sheets of *H. sabdariffa* is slightly high and tear factor is slightly low than unbleached pulp sheets obtained from *S. sesban.* These results support the conclusion drawn on the basis of fibre characteristic.

CONCLUSION

The result of present investigation shows that the *S. sesban* is a suitable raw material for the production of wrapping paper by soda semi-chemical process and pulps in good yield and strength properties can be obtained from *Sesbania sesban.*

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