XXXIII. THE VARIATION IN THE METHOXYL AND CELLULOSE VALUES OF THE FIBRE OF THE FRUIT OF *COCOS NUCIFERA* DURING ITS GROWTH FROM INFANCY OF THE NUT TO ITS ULTIMATE DRYING ON THE TREE.

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(Received December 10th, 1934.)

THE belief is held by coir workers on the Malabar Coast that nuts about ten months old yield the best fibre (in colour as well as in strength), and accordingly all the high quality coir from Allepey and Cochin is the product of nuts of this age.

The subject is one that has not received adequate scientific investigation [*cf.* Barker, 1933]. The present work records the determination of "Cross and Bevan cellulose" and of methoxyl in samples of fibre from nuts of different ages, the latter being regarded as an index of the extent of lignification.

EXPERIMENTAL.

Preparation of samples for analysis.

Coconuts of different ages from the youngest to the ripest on the trees were collected. It was difficult to persuade coir workers to extract the fibre from unretted husks of young nuts.

The husk was first of all peeled to pieces, soaked in water for a day and then heated to boiling in water with a little tamarind, the latter being supposed to hasten dissolution of the gummy matter and liberation of the fibre from the corky tissues. After this the husks were beaten out, and the bulk of the corky refuse was removed by repeated shuffling and combing.

The crude fibre samples obtained in this way were brought to Madras and further treated as follows. After boiling for 10 minutes with 20 % acetic acid¹, the samples were alternately beaten with a pestle on an inverted mortar and washed vigorously under the tap for an hour, followed by removal by hand of the last traces of corky matter. Finally they were washed with distilled water and air-dried.

Grinding of the samples for analysis presented difficulty and the device was adopted of cropping a bundle of fibre with a "Kodak trimmer," followed by sieving through a 40-mesh sieve. The powdered samples were preserved in stoppered weighing bottles.

Physical appearance of the samples.

The physical appearance and quality of the fibres varied considerably. That extracted from the infant nut was pale yellow in colour, shrivelled, exceedingly thin and much shorter than the fibres of the older nuts. The colour grew more

¹ The use of dilute acetic acid is thought not to affect the chemical nature of the fibre. Thus Cross and Bevan [1903] showed that in the case of jute the action of dilute mineral acids consisted only in a physical dissolution of the fibre, and the dissolved portion isolated from the solution resembled the original fibre in all chemical properties.

intense and the thickness of the fibre increased with age until the best colour with maximum gloss was found in the fibre of the nut that was 10 months old. Thereafter the fibre reddened and became "drier" with increasing age of the nut.

Analyses.

Moisture was determined by vacuum-drying at 110°. The percentages ranged from 7 to 13, 10 % being a usual figure. Other determinations were made on air-dried samples, the results being then calculated on a dry basis. Methoxyl determinations were carried out by Zeisel's method.

Estimation of "Cross and Bevan cellulose."

Coir fibre proved unexpectedly resistant to chlorination when the original Cross and Bevan method [1889] was employed, this resistance increasing with the age of the nut to a maximum at the 10 months stage and decreasing thereafter. The following modification of the method was found to give consistent results.

A small sample (less than 0.5 g.) is boiled for half an hour (in a 100 ml. beaker with a glass rod) with 40 ml. of 1 % caustic soda solution, allowed to settle and washed thoroughly with hot water by decantation, the first liquor and washings being poured through a weighed sintered glass crucible. The moist fibre is then spread over the sides of the beaker, and the latter with the crucible exposed to a slow stream of chlorine in a glass chamber with gas inlet and outlet. The fibre is well washed by decantation as before and then heated slowly to boiling with 40 ml. of 2 % sodium sulphite solution; 0.1 % of sodium hydroxide (calculated on the weight of the solution) is then added and boiling continued for 5 minutes.

After again washing by decantation as much as possible the fibre is transferred by means of a glass rod and the aid of a jet from a wash-bottle, both from the beaker and the crucible to a small glass mortar. After trituration the fibre is again chlorinated (in the mortar). This treatment is found to lessen the number of chlorinations required. The whole series of operations is repeated until a uniformly yellowish-white cellulose is obtained, as many as five chlorinations being necessary in the case of the mature fibre, although three are enough for the infant coconut fibre.

The crude cellulose is finally purified by bleaching with dilute permanganate solution followed by sulphurous acid in the usual manner, washed on the filter, acidified with acetic acid, again washed and dried at 110° to constant weight. The crucible is weighed in a weighing bottle since the cellulose is somewhat hygroscopic.

By this procedure results concordant within 3 % could be obtained. The following table shows the results obtained:

Approximate age of the nut from which fibre was extracted	Mean value of the methoxyl percentage	Mean value of the "Cross and Bevan cellulose" percentage
3 months	3.9	66
5 " (tender coconut)	4.3	62
7 months	5.0	59
10 " (mature nut, but husk green)	5.7	53
12 months	5.3	57

The figures on the dry nut were not consistent and so are not included; the methoxyl percentage of this sample was however below and the cellulose percentage above the corresponding values for fibre from the 10 month nut.

DISCUSSION.

The results show a maximum for the methoxyl value and a minimum for the cellulose value for the fibre from nuts 10 months old, that is the nuts most favoured on the Malabar coast for the manufacture of coir.

The possibility is borne in mind that the tannin matter which increases in quantity as the nut matures, may be a disintegration product of lignin and that the apparent increase in percentage of cellulose after a minimum has been reached may be due to elimination of the lignin component. Further work on this and allied subjects is projected.

I have to express my thanks to Prof. B. B. Dey, for providing facilities for the present work.

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