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The Baobab Tree: A Good Source of Ascorbic Acid

BY

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In the course of investigating the nutritional value of indigenous foods of Southern Rhodesia, the pulp of the baobab fruit (*Adansonia digitata* Linn.) was found to contain comparatively high concentrations of ascorbic acid (Carr, 1955). Similar results were obtained by B. M. Nicol (1957) in Northern Nigeria, although the ripe fruit appears heavier and the moisture content higher than the Rhodesian specimens.

In view of the encouragingly high quantities of vitamin C determined in a few samples, further investigations were undertaken to see whether any correlation could be found between size, degree of ripeness and moisture content with the ascorbic acid content and also the stability of the vitamin under different conditions.

I. HABIT AND HABITAT OF *A. DIGITATA* IN SOUTHERN RHODESIA

The baobab tree grows in most areas of Southern Rhodesia which lie below about 3,000 feet, but is perhaps most widespread in the Sabi and Limpopo valleys. The trees come into leaf and flower in September, and the pods ripen in early May and often stay upon the trees until the advent of the next rainy season. In fact, samples of a previous year's crop have been taken in the following March. Unless deliberate attempts are made to harvest the crop, some pods will remain on the trees for up to a year, although most will fall in June and July. It is obvious, therefore, that the stability of the pulp ascorbic acid is of some importance.

II. COMMON NAMES AND USES OF *A. DIGITATA*

The baobab is known by a multitude of names. Watt and Breyer-Brandwijk (1932) and Wild's dictionary (1952) give a number of them. In English it may be known as the monkey bread tree, cream-of-tartar tree or lemonade tree, and in Afrikaans as Krimmetatboom. The following African names are widely used: muBuyu (Man-yika, Lozi, Shangaan), muGuya (Kalanga), umKomo (Ndbele), muUyu (Shona), muWiyu (Zezezuru).

Watt and Breyer-Brandwijk state that the fruit has been used in making an acidulous drink for fever cases and also used as a dysentery remedy. The leaf has been used as a

diaphoretic and a prophylactic against fevers to check useless perspiration and as an astringent. The bark has been used as a substitute for cinchona bark under the name "Cortex cael cedra."

M. Gelfand (1957), in his book on David Livingstone, observes that the missionary treated indolent sores with a poultice made from powdered baobab leaf, and he considers that the ulcers may well have been of dietetic origin.

In Nyasaland, Jessie Williamson (1955) states that the pulp may be used as a substitute for cream of tartar in baking powders, the seeds may be roasted and used instead of groundnuts to add to side dishes, and that the scraped seeds and pulp make a "milk" if pounded and boiled with water. She also states that the leaves are eaten cooked with potash.

Nicol (1957) says that the Hausa-speaking Natives in Nigeria make soup from the leaves, and the emulsion prepared by mixing the pulp with water is used to dilute the thick guinea corn dough to a thin gruel. A milk and baobab fruit juice mixture is a popular drink with the Hausa farmer.

In S. Rhodesia a drink is commonly prepared from the pulp mixed with water, and this emulsion is often mixed with maize or millet meal to give a thin gruel similar to the Nigerian practice. The seeds are sucked to remove the pulp, and amongst the Shangaans in the southern low veld it is a common sight to see large quantities of washed seeds lying in the sun to dry, after which they are roasted and ground to produce a product like peanut butter (*dowi*).

The leaf is cooked with cooking soda (or the traditional soda prepared from burnt mealie or millet stems) to produce a mucilaginous side dish known by the generic name of *derrere*, but this practice is not very widely carried out. Generally speaking, most Africans living in the low veld will collect baobab pods to suck the seeds or make a drink from the pulp, but amongst the Shangaans and Batonga more effort will be taken to utilise the seed and pulp in different ways. Other uses include the stripping of the bark to use as rope and string, and in areas of the Zambesi valley where baobabs are rather scarce, this has resulted in the death or partial death of many trees.

III. ANALYSIS

(a) *Methods Used*

The methods used were the same as those described in a previous communication (Carr, 1955). The majority of ascorbic acid assays

were carried out by the 2:6-dichlorophenolindophenol method, with occasional checks with the osazone method. It was noted that the former method invariably gave about 5 per cent. higher figures than the latter, suggesting that a small amount of interfering substances was present. However, all the figures given are those obtained with the former method, i.e., reduced ascorbic acid. The moisture content was obtained by heating the sample for four hours at 100° C.

(b) *Results*

(i) *Sample of Fresh Young Leaf.—*

Ascorbic acid content: 85.5 mg./100 g.

Moisture content: 74.5 per cent.

No reduced ascorbic acid could be detected in a relish prepared from the leaves.

(ii) *Unripe Pods.—*The samples were taken at the Sabi Experiment Station in early March. Immediate analysis of the wet pulp showed moistures in the order of 80 per cent. and no ascorbic acid. The pods were allowed to stand on the bench for a fortnight and pods from seven different trees gave figures from nil to 111.7 mg./100 g. ascorbic acid (11 samples), with moistures ranging from 64.6 per cent. to 76.2 per cent. Generally the lower the moisture the higher was the ascorbic acid content. Further "drying out" trials were inconclusive, as the pods became very mouldy on keeping. Seventy-five per cent. is approximately the limiting moisture content for the presence of ascorbic acid.

(iii) *Ripe Pods.—*Eight pods from one medium-small-sized tree at the Nyanyadzi Irrigation Scheme in the Sabi Valley were selected in 1956 to decide whether any association between size of pod, moisture content and ascorbic acid content existed. No relationship between these variables could be detected.

	<i>Mean.</i>	<i>Max.</i>	<i>Min.</i>
Weight of whole fruit	59.5 g.	88 g.	33 g.
Ascorbic acid (mg./100 g.) of pulp	309.6	394.8	240.4
Moisture of pulp	10.5%	10.9%	10.2%

These samples were stored one month in the laboratory before testing.

Further tests in 1957 were carried out on 20 pods from three more trees in the same area.

	<i>Mean.</i>	<i>Max.</i>	<i>Min.</i>
Weight of whole fruit	173.2 g.	252 g.	119 g.
Ascorbic acid (mg./100 g.) of pulp	361.3	422	302
Moisture of pulp	12.1%	14.9%	11.4%

Mean per cent. seed in whole fruit: 34.9%

Mean per cent. pulp in whole fruit: 14.3%

There was again no relation between weight, ascorbic acid content and moisture content, but it is interesting to note that all three are higher than the previous year's figures. Nicol (1957) in Nigeria found a mean weight for six pods of 462 g., mean moisture content of 20.8 per cent. and mean ascorbic acid content of 373 mg./100 g. (range 302-445 mg./100 g.).

The Nigerian fruit weighs nearly three times that of the Rhodesian, although a very large range of sizes can be found in Rhodesia; however, the author has seen no local pods which approach the Nigerian weight. The moisture content of the pulp is also considerably higher, but the ascorbic acid content remains much in the same order.

(iv) *Keeping Trials and Stability of Ascorbic Acid.—*Pulp from fruit collected at the Sabi Experiment Station was kept on the bench in clear glass bottles for six months, in the form of a fine powder. The bottles were exposed for part of the day to direct sunlight. The pulp from fruit from each of 10 different trees was

Table I

COMPARISON OF ASCORBIC ACID AND MOISTURE CONTENTS OF THE PULP FROM PODS STORED FOR SIX MONTHS WITH THE BULKED PULP FROM PODS COLLECTED FROM THE SAME TREE

	<i>Tree No. 3</i>	<i>Tree No. 9</i>	<i>Tree No. 10</i>
Bulked pulp moisture, 6/7/55	10.0%	11.4%	10.0%
Stored Pod: Pulp moisture, 4/1/56	14.5%	15.3%	14.5%
Per cent. increase in moisture	45%	34%	45%
Bulked pulp ascorbic acid content, 6/7/55	399 mg./100 g.	433 mg./100 g.	175 mg./100 g.
Stored pod pulp ascorbic acid content, 4/1/56	264 mg./100 g.	340 mg./100 g.	144 mg./100 g.
Per cent. loss of ascorbic acid	31.3%	21.5%	17.9%

bulked, giving 10 samples, which were re-assayed for ascorbic acid. The following figures were obtained:—

Mean ascorbic acid content of fresh pulp	.....	306 mg./100 g.
After six months' storage	.....	276 mg./100 g.
Mean loss of ascorbic acid	.....	9.9%
Maximum loss of ascorbic acid	.....	14.1%
Minimum loss of ascorbic acid	.....	6.4%

After a further eight months' storage one sample was exposed to direct sunlight and air for seven weeks in a thin layer with frequent turning. The pulp turned from a cream to a brownish-pink colour, and the following figures were obtained:—

	mg./100 g.	% Loss
Ascorbic acid content of fresh pulp	295	—
After six months	264	10.7
After 14 months plus seven weeks of sunlight	161	45.5

In the same series three pods from three different trees were stored on the bench for six months. In this case only the trends can be examined, as there is almost as much variation between individual pods from the same tree as between pods from different trees. The results are expressed in Table I. Appreciably greater losses in ascorbic acid content than in the case of the bottled pulp seemed to be related to increased moisture content, which was probably due to the higher humidity occurring in January. This was further borne out when two samples of the previous season's crop were taken in March, i.e., the ripe fruit had remained on the tree for approximately 10 months. The ascorbic acid and moisture contents of the pulp were 65 mg./100 g. (moisture 20.1 per cent.) and 50 mg./100 g. (moisture 19.2 per cent.). Notwithstanding these losses, a considerable amount of ascorbic acid was present in the pods.

Plumtree School herbarium kindly donated a pod that was at least five years old. The pulp had turned a brown colour, but was easily reduced to a fine powder. The intense pigmentation made it difficult to obtain a result in the 2:6-dichlorophenolindophenol method for ascorbic acid, but there was a great deal of difference between this and the result obtained in the osazone method. However, the following results were obtained:—

Weight of whole fruit	.....	90 g.
Pulp moisture content	.....	12.9%
Ascorbic acid content (indophenol method)	.....	± 15 mg./100 g.
Ascorbic acid content (osazone method)	.....	68 mg./100 g.
Per cent. seeds	.....	37.7%

Per cent. pulp 8.9%

It appears, therefore, that some ascorbic acid will remain after many years' storage.

SUMMARY AND CONCLUSIONS

No correlation between moisture, weight and ascorbic acid content of the pulp of normal ripe baobab fruit could be detected, but the unripe fruit does not show any ascorbic acid content until the moisture of the pulp drops below 75 per cent.

An average ripe pulp will have an ascorbic acid content of about 350 mg./100 g., which will remain remarkably stable for many months if protected from increased moisture content. Even if no precautions are taken, appreciable quantities of the vitamin will remain in the pulp for many years. The pulp showed no signs of bacterial or fungal decomposition after two years' storage in a glass bottle.

Some seasonal difference in the ascorbic acid content of the pulp was detected, but it appeared to be small.

The baobab leaf was also shown to be a good source of ascorbic acid, but a relish prepared from the leaves showed no reduced ascorbic acid; however, no assay for dehydroascorbic acid was undertaken, and the presence of cooking soda may have produced this form of the vitamin. Obviously the baobab is an important antiscorbutic for the low veld African, and is undoubtedly an important factor in the comparatively low incidence of scurvy in these areas. It is made more valuable in the way it can be regarded as a storehouse of the vitamin due to the remarkable stability of the vitamin in the pulp.

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