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Effects of storage of Bagaruwa on its tannin content

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ABSTRACT

The decrease of tannin concentration over time in bagaruwa pod and its prepared extract is reported. An initial average concentration of 30.20 ± 0.85% at harvest decreased to 23.61 ± 0.49% after sixteen weeks of pod storage. In the prepared extract, tannin concentration also decreased rapidly on storage; in a typical observation, an initial tannin concentration of 30.20 ± 0.85% decreased to 0.00% within eight days of storage in the unpreserved extract. Tannin loss in the extract was ascribed to hydrolysis by mould that grew on it during storage with consequent accumulation of acid. The mould growth and tannin loss in the extract were inhibited for up to one and a half years using 0.025% benzoic acid as preservative.

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INTRODUCTION

In general vegetable tannins are polyphenols with a molecular weight in the range 500-20,000. As their name suggests they are tanning materials from plant sources. [1-4].

There are many tanneries scattered across Nigeria; Most of these use traditional techniques in tanning hide and skin while a few make use of modern technology. However, they all use tannin obtained from local vegetable sources. The two main sources of tannin in Nigeria are the pods of *Acacia nilotica*, which is mostly found in Northern Nigeria and is called "Bagaruwa" in Hausa language, and the bark of the mangrove tree found in the mangrove forest belt of Southern Nigeria. [5].

Tannin from *Acacia nilotica* pod yield softer leather than the mangrove tannin [5,6] hence the *Acacia nilotica* pod tannin is commercially more important. "Bagaruwa" pods are usually ready for harvest and use between February to mid March. Some quantities are usually stored for use after the harvest period. However, during storage these pods get infested by weevils and deteriorate.

In addition, water extracts of bagaruwa pods have been observed to develop mould growth after a few days of preparation [5, 7].

The aim of this work is to determine the level of reduction of the tannin content of bagaruwa pod and its extract over a period of storage time. Also, the effect of a preservative added to the extract on the tannin content was studied.

EXPERIMENTAL

Vegetable Materials

Fresh bagaruwa pods were obtained from trees within the premises of the College of Chemical and Leather Technology Samaru, Zaria. The pods were selected and dried in an oven for about five hours at 50^{o}C [8]. The seeds were removed from the pods and discarded while the empty pods were blended and used for analysis.

Extraction Process / Tannin Determination (Modified Lowenthal's Method [9]

Materials

All chemicals used in this work were of analytical grade and distilled water was used throughout. The reagent solutions used include Potassium Perman ganate solution (0.008 moldm^{-3}); indigo carmine solution; gelatin solution; Acid sodium chloride; powdered kaolin (China clay) and concentrated sulphuric acid (98%) [9, 10].

Tannins in bagaruwa were extracted using hot (boiling) water at 98.5 – 100^{o}C. The extract was filtered through cotton wool and then through filter paper. The bagaruwa extract was titrated with potassium permanganate before and after addition of gelatin in the presence of kaolin [9, 11].
(1cm^3 0.2M $KMnO_4$ = 0.0416g tannin) [9, 10] So that,

$$Percent\ \tan nin = \frac{Weight\ of\ \tan nin}{Weight\ of\ sample\ in\ 4cm^3\ of\ extract} \times 100$$

$1cm^3$ 0.008M $KMnO_4$ = 0.001664g tannin

Tannin content of stored extract

The tannin content of the extract prepared was determined and this constituted the zero month. Some portion of this extract was kept in a well stoppered volumetric flask on the bench and its tannin content was determined every twenty four hours until the percent tannin in the extract reached zero level.

The percent reduction of tannin per day was calculated as follows

% Tannin reduction =

$$\frac{\%\ \tan nin\ day\ 1 - \%\ \tan nn\ day\ Y}{\%\ \tan nin\ in\ day\ 1} \times 100$$

where Y is from 2 to 8 days

Effect of preservation on the tannin content of bagaruwa extract

An extract of 4g/1000cm^3 of freshly harvested "bagaruwa" pods was made as already described. The

Table 1: Trends in percent tannin of bagaruwa and its extract on storage (modified Lowenthal's Method)

Day / Months	0	1	2	3	4	5	6	7	8
0	30.20±0.85	28.08±0.28	25.92±0.49	23.23±0.49	18.32±0.56	15.06±0.54	11.75±0.49		0.00
	[3.58]	(7.02)	(14.17)	(23.08)	(39.34)	(50.13)	(61.09)		(100)
1	29.12±0.72	27.39±0.96	26.35±0.24	20.45±0.24	17.42+0.56	14.35±0.49	12.63±0.82	6.74±0.49	0.00
	[17.19]	(5.94)	(9.51)	(29.77)	(40.18)	(50.72)	(56.63)	(76.85)	(100)
2	25.01±0.31	22.53±0.49	19.06±0.49	11.78±0.49	7.97+0.49	3.92±0.51	0.00		
	[19.77]	(9.92)	(23.79)	(52.90)	(68.13)	(84.33)	(100)		
3	24.23±0.49	22.87±0.63	21.13±0.51	14.91±0.49	11.44±0.85	8.32±0.85	4.56±0.49	0.00	
	[23.82]	(5.61)	(12.79)	(38.46)	(52.79)	(65.66)	(81.18)	(100)	
4	23.61±0.49	22.53+0.49	21.15±0.49	16.29±0.49	9.65±0.51	5.54±0.49	0.00		
		(4.57)	(10.42)	(31.00)	(59.13)	(76.54)	(100)		

Values in brackets ( ) are the percent reduction in tannin per day
Values in boxes [ ] are the percent reduction in tannin per month

Tannin content of bagaruwa Pods

The 'bagaruwa' pods were stored in a plastic tray on the laboratory bench for four months. At the end of each month, the tannin content of the pods were determined and some portion of the extract was kept for daily determination of the tannin content as above. This was to fully establish the degradation pattern of tannins in stored "bagaruwa".

pH was recorded. 0.25g benzoic acid was dissolved in the extract and the pH of the extract was again recorded. The percent tannin of the fresh extract was determined. The remaining extract was kept on the bench in a well-stoppered volumetric flask and the tannin determined every two weeks for a period of four months.

RESULTS AND DISCUSSION

Bagaruwa extract

The result of the "bagaruwa" extract storage is shown in Table 1. It can be seen from the table that the

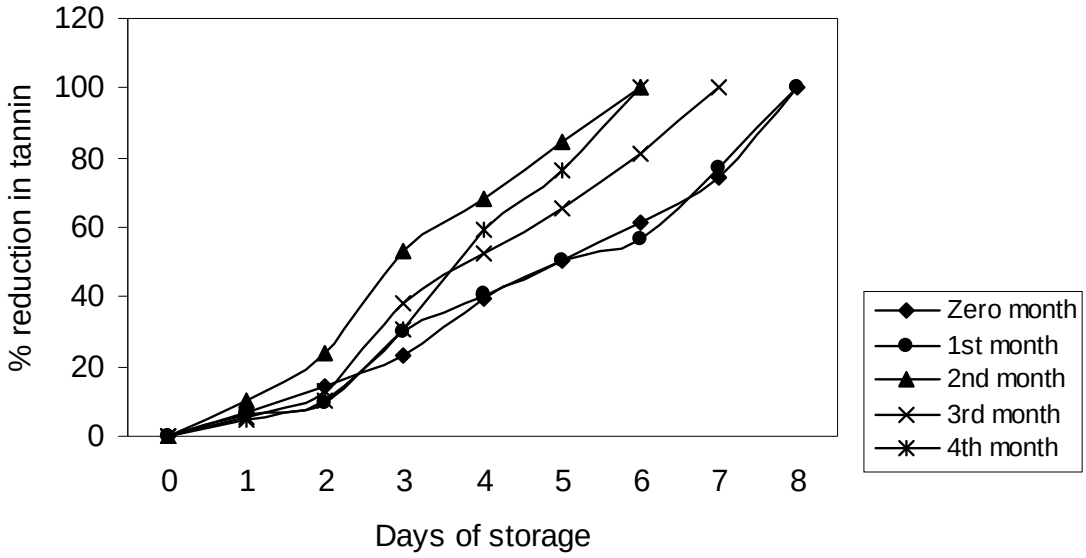

Figure 1: Trend in percent reduction of tannin in Bagaruwa per day for each month of observation

mean percent tannin decreased daily from the day it was

prepared until the eighth day for each of the preparations in the different months. The rate of decrease was initially slow then increased.

This pattern was general for all months of observation. The tannin content decreased until no tannin was observed after 6-8 days. The highest rate of tannin loss in each month occurred between the third and fourth days of extract storage (Figure 1).

The decrease in tannin content observed over time is ascribable to hydrolysis of tannin by the mould whose growth is observed by the second or third day of storage of the extract [7]. It can be assumed that tannin hydrolysis intensifies as the mould colony increases, hence the sharp increase in tannin loss between days 2 to 4.

Temperature seems to have an influence on the rate of tannin loss, laboratory temperature in which the extracts are stored increased from February through March and April to May and June. The condition becomes more favourable for mould growth and mould activity, particularly tannin hydrolysis in this case.

Tannin content of stored bagaruwa pods

The results presented in Table 1 also show that "bagaruwa" pods loose tannin from month to month of storage (Figure 2). There is a gradual decrease from a value of 30.20% tannin in February to 29.12% in March, 25.01% in April, 24.23% in May and 23.61% in June.

This slight but continuous loss of tannin may be because of a weevil infestation of the pods during storage. The weevil drills a hole in the pod from outside and enters the soft part of the pod, which is gradually eaten up causing the inner layers of the pod to become more brittle.

pH values of Pod Extract

The trend in pH values of "Bagaruwa" pod extracts stored unpreserved is presented in Table 2. The pH of the fresh extract was observed to be acidic (pH = 3.62). The acidity increased with time till it became 2.81 on the eight day of extract storage by which time all the tannin had been hydrolysed. This implies the accumulation of acid as tannins are hydrolysed, the acid most probably being gallic acid [12,13]

Table 2: pH values of unpreserved Bagaruwa extract over a period of time

Time (days)	pH
0	3.62
1	3.57
2	3.49
3	3.41
4	3.38
5	2.96
6	2.80

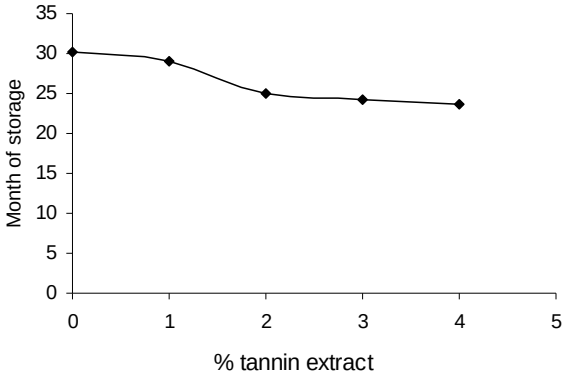

Figure 2: Reduction in tannin content of bagaruwa pod during storage

7	2.81

Table 3: pH of preserved bagaruwa extract over a period of time

Time (weeks)	pH
0	3.69
2	3.69
4	3.57
6	3.55
8	3.56
10	3.51
12	3.53
14	3.53
16	3.53

Effect of preservation on tannin content

The percent reduction in tannin during the period following the addition of preservative is shown in Figure 3. A decrease of only 14.52% of the initial tannin content was observed after sixteen weeks and 37.78% after a period of about $1^1/_2$ years. This percent decrease in tannin, represents a negligible rate of tannin loss when compared with the case of the unpreserved "bagaruwa" extract (Figure 1) where the initial tannin content was reduced to 0.00% in only seven days. This result indicates that tannin concentration in the preserved extract remains conserved over the period of observation. The tannin content of the preserved extract left standing on the laboratory bench remained mould free with an average tannin content of 17.9 ±0.22% after a period of about one and a half years.

Only a slight decrease in pH values was recorded during the period of preservation of the extract (Table 3). An initial pH value of 3.69 decreased to 3.55 after a period of sixteen weeks. This is unlike the case of the unpreserved extract (Table 2) where an initial pH value of 3.62 reduced to 2.81 in just seven days. This indicates that pH plays a very important role in extract stability.

CONCLUSION

It is informative here that, at a dose of 250mg benzoic acid per litre of extract, the mould growth was inhibited in all extracts. The mould growth was not seen in the preserved extracts left standing on the laboratory bench for one and a half year.

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