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Proximate composition and effect of storage condition on Ascorbic acid content of Baobab fruits (*Adonsonia digitate L.*) pulp from Wudil, Kano State Nigeria

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Abstract

Baobab (*Adonsonia digitata*) fruit pulp is high in vitamin C and minerals. This study determined proximate composition and effect of storage conditions on ascorbic acid of the pulp from Wudil. The research was a 2X2X2 factorial. Fruits were harvested from Tsibiri village; pods broken, lightly pounded, sieved out and stored in clean jar. Moisture content was determined by hot air oven method, fat by soxhlet extraction and ash using muffle furnace. Treatments were coded A – H; ascorbic acid and titratable acidity determined weekly for 8 weeks. The pH of the pulp was determined on first and last days of storage. Data were analyzed using SPSS statistical tool. Proximate composition were 6.35 ± 0.10, 0.20 ± 0.00, 2.30 ± 0.20, 5.20 ± 0.02, 5.63 ± 0.04 and 72.00 ± 0.00 for moisture, fat, protein, ash, crude fibre and carbohydrate respectively. Ascorbic acid content were stable over first two weeks of storage but changed slightly as storage progressed. Highest ascorbic acid of 275.60 mg/100 g and titratable acidity value of 14.05 were observed in all samples on first day. The best treatment in preserving ascorbic acid was storage under refrigerator, with unbroken pod, wrapped in black polyethylene. It could be concluded that ascorbic acid content is affected by storage condition and packaging. It is recommended that fruits be stored under refrigeration, unbroken pod and wrapped in black polyethylene bag and where electricity is a problem; the fruits can be stored under ambient temperature; in unbroken pod and packaged in black polyethylene bag.

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Introduction

Baobab tree (*Adonsonia digitata*) is native to tropical Africa but found in other tropical regions of the world. It is a member of the *Bambacacea* family which consists of around 20 genera and 180 species (Heywood, 1993). Baobab tree is one of the largest trees in the world and it grows to a height of 12 – 18 m; its trunk sometimes spread 30 feet beyond the trunk. The bark is smooth and grayish and has a characteristic reflection (Wilkinson, 2006).

Baobab is popular food source, because the pulp is commonly sucked, chewed or made into a drink by soaking, filtering and sweetening. Baobab pulp is also used as filler in *Nono* (a fermented milk product) and in thinning of *Fura da nono* (a fermented milk and cereal product) by the Fulani tribe across West Africa (Zahra'u *et al.*, 2014).

The oblong woody fruit hangs on long stalks 15 – 30 cm long. It has yellowish wooly hairs on the outside and contains a pleasant tasting dry acid pulp in which the kidney shaped seeds are embedded. The pulp is remarkably high in vitamin C (around 200 mg/100 g of pulp) and also contains several of the B-vitamins; minerals such as calcium, iron and phosphorus in high amounts (NRC, 2008).

Special attention has been given to measuring vitamin C in baobab fruits pulp due to reports of its high content. Ighodalo *et al.*, (1991) recorded 377 mg/100 g for fruits from Nigeria, Adebisi *et al.*, (2012) also from central Nigeria reported 264 mg/100 g while Eldoom *et al.*, (2014) reported that the pulp is rich in Calcium and that is the reason why the baobab pulp is largely consumed by pregnant women and children in the Gambia. A study of pregnant women in Gambia by Prentice *et al.*, (1993) reported that eating the pulp without seeds once daily contributed 30 mg/day of calcium to diet.

Baobab leaves are also known to be rich source of minerals particularly magnesium (Smith *et al.*, 1996). Glew *et al.*, (1997) reported that baobab leaves contains high amount of iron compared to other wild vegetables and are also rich source of calcium. Nordeide *et al.*, (1996) reported that the level of vitamin A was about 1/3 the content of dried Amaranthus leaves.

Baobab fruits have great potential as an industrial plant. Products such as imitation coffee, soft drinks, sweets can be developed from the fruits and seeds. Dandago (2011) has reviewed the uses and industrial potentials of Baobab fruit pulp, seeds and leaves.

Despite the high amount of nutrients, particularly ascorbic acid, calcium and other anti-oxidants which are useful for adults and children; the conditions to which the fruits as well as the pulp are exposed to can destroy some of the these nutrients particularly vitamin C. Although some reports are available on quality of Baobab from Gambia and Southern Nigeria, the literature available on Baobab from Kano is scanty. Therefore the aim of this study is to determine the proximate composition and effect of storage conditions on ascorbic acid content of the fruit pulp from Wudil.

Materials and methods

The study was laid down in 2X2X2 factorial design. Fresh baobab fruits were harvested from *Tsibiri* village within the neighborhood of Kano University of Science and Technology Wudil, Kano State Nigeria. The fruits were transported to the Food analysis laboratory of the department of Food Science and Technology. Some of the fruits pods were immediately broken and lightly pounded in traditional mortar and pestle to separate the pulp and seeds. The powdered pulp was sieved out and stored in a clean jar for proximate composition.

The moisture content was determined by hot air oven method. Using five grams of the sample was weighed accurately and dried in hot air oven at 105ºC to a constant weight. The percentage moisture was calculated from the difference in weight (Onwuka, 2005).. The fat content was determined using soxhlet extraction method. The sample was extracted for 8 hours using petroleum ether (BP 40 – 60ºC) as the solvent. The amount of fat was then calculated after drying to a constant weight (Onwuka, 2005). The Ash content was determined by incinerating 4 g of the pulp in a

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muffle furnace for 4 hours at 550ºC and the percentage was the carbohydrate was by difference method (Onwuka, 2005).

On the storage trial, the samples were prepared and storage set up. Treatment combinations were as follows:

A- Storage at ambient temperature (32°C), unbroken pod and unwrapped in black polythene bag
B- Storage at refrigeration temperature (10°C), unbroken pod and wrapped in black polythene bag
C- Storage at ambient temperature (32°C), unbroken pod and stored in plastic basket
D- Storage at refrigeration (10°C) temperature, unbroken pod, in plastic basket
E- Storage ambient temperature (32°C), broken pod and stored in glass jar
F- Storage at ambient temperature (32°C), broken pod and stored in glass jar
G- Storage at ambient temperature (32°C), broken pod and stored in open plastic basket
H- Storage at refrigeration temperature (10°C), broken pod and stored in open plastic basket.

Ascorbic acid content was determined on weekly basis for 8 weeks using iodometric method. Ten milliliters of prepared baobab solution was titrated against 0.01 M Potassium iodate until the end point is reached (NSTF, 2004). Titratable acidity was also determined on weekly basis. The acidity (as % total titratable acidity) was determined by titrating 10 ml of the filtered solution against 0.1 M Sodium hydroxide using phenolphthalein Indicator (NSTF, 2004). The pH of the fruit pulp was determined on first and last days of storage (Onwuka, 2005).

Statistical analysis

Data generated were analyzed using SPSS statistical tool. Significant difference was evaluated with one way analysis of variance.

Results

The results of the proximate analysis of the baobab fruit pulp are presented in Table 1 below. From table 1 it can be seen that the values for proximate composition of Baobab fruit pulp were 6.35% ± 0.10, 0.20% ± 0.00, 2.30% ± 0.20, 5.20% ± 0.02, 5.63% ± 0.04 and 72.00% ± 0.00 for moisture, fat, protein, ash, crude fibre and carbohydrate respectively.

The values of the ascorbic acid content of fruit pulp over the 8 week storage period are presented in Table 2. From the table, it can be seen that ascorbic acid value were stable over the first two weeks of storage but change slightly as storage progressed and also with treatment combination. The highest amount of 275.60 mg/100 g was observed in all samples on first day within the first week. On the other hand the least amount of 264.55 mg/100 g was observed in treatment G (storage at ambient temperature, with broken pod and in a plastic basket).

Table 1: Proximate composition of Baobab fruit pulp

S/N	Parameter	Amount (%)
1.	Moisture	6.35 ± 0.10
2.	Fat	0.20 ± 0.00
3.	Protein	2.3 ± 0.20
4.	Ash	5.20 ± 0.02
5	Crude Fibre	5.63 ± 0.039
6.	Carbohydrate	72.00 ± 0.00

Values are means of duplicate determinations ± standard deviations

Table 2: Ascorbic acid content (mg/100 g) of Baobab fruit pulp over 8 weeks storage period

Treatment	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week8
A	275.60 ± 0.00	275.35 ± 0.01	275.20 ± 0.00	274.00 ± 0.12	274.70 ± 0.23	274.10 ± 0.69	272.805 ± 2.08	272.35 ± 2.02
B	275.60 ± 0.00	275.30 ± 0.00	275.20 ± 0.12	275.20 ± 0.12	274.85 ± 0.01	273.10 ± 1.62	274.45 ± 0.01	274.40 ± 0.00
C	275.60 ± 0.00	275.30 ± 0.00	275.10 ± 0.12	275.00 ± 0.12	274.40 ± 0.69	273.45 ± 1.44	270.60 ± 0.23	267.95 ± 2.37
D	275.60 ± 0.00	275.25 ± 0.06	275.15 ± 0.12	275.05 ± 0.12	274.20 ± 0.00	272.45 ± 0.87	270.50 ± 0.23	267.95 ± 2.37
E	275.60 ± 0.00	275.05 ± 0.17	274.00 ± 0.12	274.60 ± 0.12	273.80 ± 0.46	270.85 ± 0.23	268.30 ± 0.35	266.65 ± 0.87
F	275.60 ± 0.00	274.90 ± 0.12	274.75 ± 0.06	274.76 ± 0.12	274.50 ± 0.00	274.05 ± 0.23	269.10 ± 0.23	267.50 ± 0.00
G	275.60 ± 0.00	273.65 ± 0.06	272.60 ± 0.58	271.75 ± 0.40	270.45 ± 0.17	269.95 ± 0.01	266.65 ± 0.17	264.55 ± 0.17
H	275.60 ± 0.00	274.70 ± 0.00	274.50 ± 0.00	273.15 ± 0.01	272.35 ± 0.29	270.30 ± 0.00	268.05 ± 0.01	267.20 ± 0.00

Values are means of duplicate determinations ± standard deviation

Key: A - Room temperature, unbroken pod, black polythene
B - Refrigeration temperature, unbroken pod, black polyethylene
C - Room temperature, unbroken pod basket
D - Refrigeration temperature, unbroken pod, basket
E - Room temperature, broken pod, jar
F - Refrigeration temperature, unbroken pod, jar
G - Room temperature, broken pod, basket
H - Refrigeration temperature, broken pod, basket

The titratable acidity (as % ascorbic acid) of the fruit pulp of all the treatments for the 8 weeks period are presented on Table 3. From the table it can be seen that the titratable acidity of the pulp changed in virtually all the treatments as storage progressed. The highest titratable acidity value of 14.05 (as % ascorbic acid) was recorded on the first day within the 1st week in all treatments while the least value of 11.98 (as % ascorbic acid) was recorded by treatment G on the eight week of storage.

The values of pH of the fruit pulp are presented on Table 4. The pH was determined on the control sample (G) which is storage at ambient temperature (32ºC), with broken pod in an open basket on the first and last day of storage. From the table, it can be seen pH on the first day was 3.40 ± 0.00 while it was 4.00 ± 0.01 on the last day of storage.

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Table 3: Titratable acidity (as % ascorbic acid) of Baobab fruit pulp over 8 weeks storage period

Treatment	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
A	14.05	14.05	13.99	13.47	13.17	12.96	12.96	12.48
B	14.05	14.05	14.00	13.93	13.64	13.17	12.92	12.54
C	14.05	14.05	13.89	13.52	13.22	12.89	12.72	12.11
D	14.05	14.05	13.99	13.66	13.44	12.94	12.9	12.08
E	14.05	14.05	13.99	13.64	13.20	12.88	12.54	12.10
F	14.05	14.05	13.88	13.73	13.24	12.84	12.67	12.00
G	14.05	13.98	13.80	13.34	13.07	12.26	12.24	11.98
H	14.05	14.05	13.94	13.40	13.20	12.76	12.20	12.00

Values are means of duplicate determinations ± standard deviation

Key: A - Room temperature, unbroken pod, black polythene
B - Refrigeration temperature, unbroken pod, black polyethylene
C - Room temperature, unbroken pod basket
D - Refrigeration temperature, unbroken pod, basket
E - Room temperature, broken pod, jar
F - Refrigeration temperature, unbroken pod, jar
G - Room temperature, broken pod, basket
H - Refrigeration temperature, broken pod, basket

Table 4: pH values of Baobab pulp

Parameter	First day of storage	Last day of storage
pH	3.40 ± 0.00	4.00 ± 0.01

Values are means of duplicate determinations ± standard deviation

Discussion

Table 1 indicates the proximate composition of the fruit pulp over the 8 weeks storage period. The moisture content was slightly above the 5.61 % reported by Eldoom *et al.*, (2014) for baobab pulp without shell but below 10.20 % reported by Adebisi *et al.*, (2012). The fat content of the pulp in the present study was lower than 0.4 % reported by Adebisi *et al.*, (2012) and 0.5 % reported by Magaia *et al.*, (2013). The protein content was within the range of 2.1 – 2.4 % reported by Magaia *et al.*, (2013). The crude fibre content in the present study was 5.63%. The value was slightly below the 5.7 % reported by Adebisi *et al.*, (2012). Ash content was found to be 5.20 % which was slightly lower than the 5.5 – 7.4 % range reported by Magaia *et al.*, (2013) and 7.6% reported by Adebisi *et al.*, (2012). Carbohydrate content was found to be 72.00 %. The value is slightly lower than 73.87 % reported by Adebisi *et al.*, (2012).

The range of Ascorbic acid content of the fruit pulp in the present was 264.55 – 275.60 mg/100g. The value falls within the range of 150 – 499 mg/100g reported by Sidibe *et al.*, (1996) and lower than 377 mg/100g reported by Ighodalo *et al.*, (1991). Edoom *et al.*, (2014) reported 392 mg/100g while Adebisi *et al.*, (2012) reported 264 mg/100g. The wide in moisture, protein, fat, ash and ascorbic acid may probably be due to soil, varietal and geographical differences.

All the treatments recorded the same value for ascorbic acid within the first week. In the second week of storage the amount of ascorbic acid dropped slightly in all the treatments but the drop was more in treatments F, G and H.

The changes in Ascorbic acid content of the baobab pulp in the 3rd week was also slight across all treatments but more pronounced in treatments E,F,G and H. As the storage advanced to weeks 4, 5 and 6, the amount of ascorbic acid reduced significantly in all the treatments. In treatments G, the amount of ascorbic acid drops to 271.75, 270.45 and 269.95 mg/100g in 4th, 5th and 6th weeks respectively.

Weeks 7 and 8 recorded a modest reduction in the amount of ascorbic acid because of the of the prolonged storage period in all treatments. Here also treatment G recorded the least amount of 266.65 and 264.55 mg/100g ascorbic acid for 7th and 8th week of storage respectively. Looking at the treatments from the angle of ascorbic acid retention, treatments B (storage at refrigeration temperature, with unbroken pod and wrapped in black polyethylene bag) was the best treatment in preserving the highest amount of ascorbic acid content. It recorded 0.44 % reduction in ascorbic acid over the eight weeks storage period. This could be as a result of the low temperature which retards the rate of reactions as well as the additional protection given by the unbroken pod and the black polyethylene bag. The findings of the present study agreed with the report of Eldoom *et al.*, (2014) who reported minimum changes in ascorbic acid in samples packaged in polyethylene. This could be attributed to the modified atmosphere condition created by the polyethylene sheet which in turn reduces degradation of ascorbic acid. On the other hand, the highest loss in ascorbic acid content over the storage period was recorded in treatment G (storage at ambient room temperature with broken pod and in open plastic basket) or control. Ascorbic acid reduced from 275.60 to 264.55mg/100g. The findings in the present study also agreed with Eldoom *et al.*, (2014) who also reported maximum loss in ascorbic acid in samples kept in basket. The decrease in the amount of ascorbic acid could be attributed to exposure to the environmental factors as oxygen can oxidize ascorbic acid hence the reduction.

The changes in titratable acidity of the fruit pulp followed the same pattern with that of Ascorbic acid. Gradual decrease in all treatments was observed over the period of storage. Sample B recorded least reduction from 14.05 – 12.54 (as % ascorbic acid) while the control (sample G) recorded highest from 14.05 – 11.98 (as % ascorbic acid).

The findings of this study agreed with Eldoom *et al.*, (2014) who reported least change in titratable acidity in polyethylene packaged fruits and maximum change in fruit pulp stored in baskets.

The pH of the fruit pulp was measured to be 3.40 on the first day and 4.00 on the last day of storage in control fruits. The values were slightly above the 3.33 reported by Adebisi *et al.*, (2012) for similar treatment. The change could be attributed to the reduction in the amount of ascorbic acid in the pulp over the storage period.

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Conclusion

From the foregoing, it can generally be concluded that baobab fruit is rich in nutrients particularly ascorbic acid or vitamin C. The amount of vitamin C in the fruits is affected by the storage temperature as well as the packaging material. For maximum retention of ascorbic acid, it is recommended that the fruits be stored under refrigeration, unbroken pod and wrapped in black polyethylene bag. In developing countries where electricity may be a problem, the fruits could be stored under ambient temperature with unbroken pod and packaged in black polyethylene bag as this would also preserve the ascorbic acid compared to other methods.

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