# Cottage processing of cashew apple juice in Nigeria: physico-chemical and sensory evaluation of product.

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**Abstract**

**Some manually operated equipment were employed for cottage processing of cashew apples into juice. These include an extractor, mixer pasteuriser and a bottling machine. The apples were preheated with steam for 10, 20 and 30 minutes before juice extraction. The average capacity and efficiency of the extractor were 31.82g/hr and 87.20% respectively. Treatment time affected the colour, acidity and vitamin C content of the juice. Apples treated for 30 minutes gave a brownish colour (which was not acceptable to consumers) with the least amount of vitamin C (120.60mg/100ml of juice). The 10 minute extracted juice was attractive in terms of colour and acceptability. Soluble solids, pH, and specific gravity values of the juice were not affected by heat treatment. From the sensory evaluation of the products, no significant differences were obtained for taste, mouthfeel and overall acceptability. It was concluded that 10-minute treatment time was ideal for the juice extraction.**

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## Introduction

Cashew tree (*Anacardium occidentale*) is a cash crop in Nigeria. Most of the nuts produced are exported hence the economy of the producing areas has a considerable dependence on price fluctuation in the international market.

The use of by-products can be an opportunity for diversifying activities on the farm. The farmers' revenue can increase through various opportunities which, exist for using cashew apples. However, these opportunities are presently not utilised adequately. The high level of investment required on fruit juice processing may discourage commercial interests since most farmers are of the peasant status. Farmers can however be encouraged at co-operative level to come together as processors. Being highly perishable, cashew apples will not require to be transported over long distances and need to be processed, if possible, at the farm settlements.

At Cocoa Research Institute of Nigeria, a manually operated fruit juice-processing machine was employed for cashew juice processing at the cottage (or village level). The machine will serve the small holders farmers to process the apples hygienically and bring in more income, thereby improving the social status of the family.

This paper reports the performance of the locally fabricated extractor, and physico-chemical characteristics and sensory evaluation of the juice extracted by the machine.

## Materials and Methods

The manually operated equipment was fabricated locally by Edson Engineering Company, an agro-industrial company in Ibadan, Oyo State, Nigeria according to standard specifications for cottage processing of cashew apples. The equipment consists of the extractor, mixer pasteuriser (stainless steel) and bottling machine (**Fig. 1**). Ripe and matured cashew apples were harvested from Kosoniola farm, Oro, Kwara State. They were sorted, weighed, washed and processed at the farm

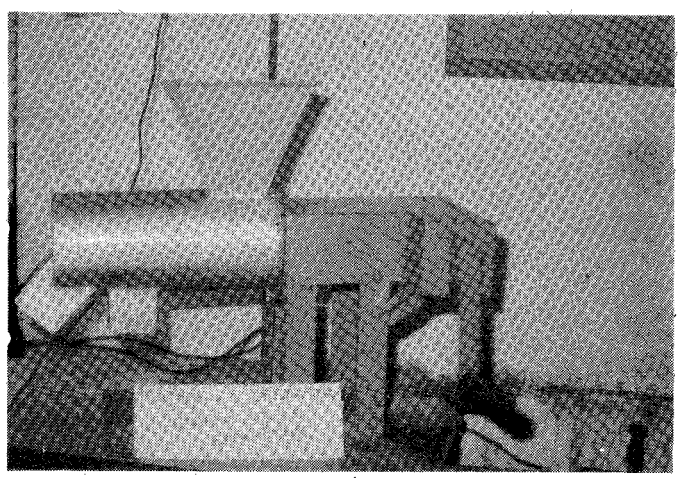
The apples were pre-treated with steam using the pasteuriser for 10, 20 and 30 minutes. The apples were allowed to cool down and the juice was extracted using the extractor. The extracted juice was sieved using muslin cloth.

Sodium benzoate (359ppm) was added as preservative and thoroughly mixed into the juice. The juice was filled into 35cl bottles and pasteurised at 80°C for 10minutes. The bottles were allowed to cool down and stored on the bench for 10 days according to the procedures by Harrigan *et. al.* (1976), for the presence of spoilage spores. Colour was determined visually. Sensory evaluation was done using twenty panelists at the Institute. Soluble solids and specific gravity of the samples were measured with the aid of Abbe refractometer and hydrometer, respectively at 20° C; titratable acidity (as % W/V citric acid) was determined according to AOAC (1980) methods.

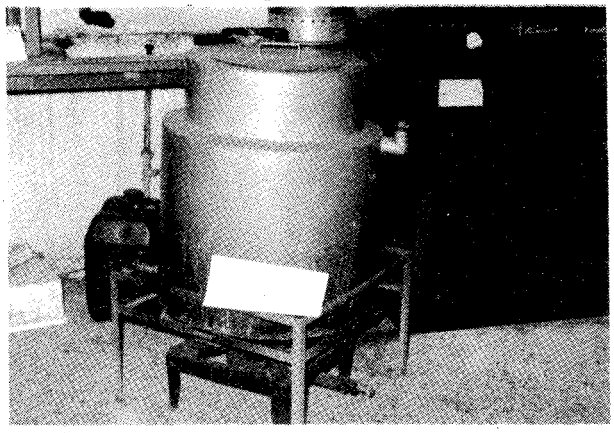
## Performance of the machine

The juice extraction capacity (kg/hr) of the machine and its extraction efficiency (%) were determined as follows:

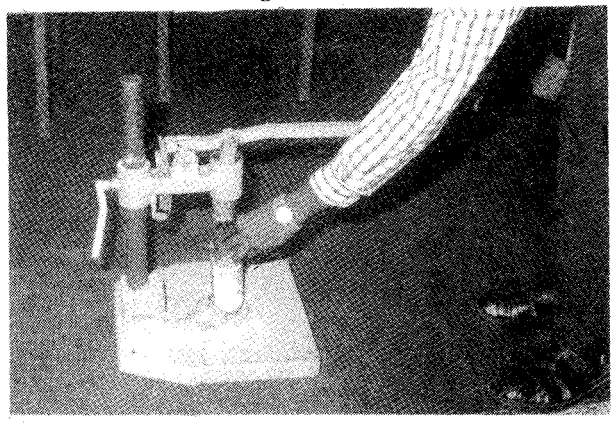
*Extractor*



*Mixer pasteuriser*



*Bottling Machine*



$$Y_1 = \frac{W_2}{1} \times 100 \longrightarrow (1)$$

$$Y_2 = \frac{W_2}{t} \times 100 \longrightarrow (2)$$

$$Y_3 = \frac{W_2}{W_3} \times 100 \longrightarrow (3)$$

Where:

$Y_1$ = percentage yield of juice/kg of apples
$Y_2$ = juice extraction capacity, kg/hr
$Y_3$ = juice extraction efficiency, %
$W_1$ = weight of cashew apples fed into the machine, kg
$W_2$ = weight of juice extracted, kg.
$W_3$ = weight of maximum extractable juice, kg
t = time spent extracting a known weight of apples, hr.

## Results and Discussion

The average capacity of the machine was 27.64 kg/hr. Though the value was rather small, it was reasonable enough to cope with for cottage industry. That is, the total production for a shift of 8 hours was 83.62% (**Table 1**).

Pearson correlation analyses of the data obtained from performance of the machine and cashew fruit characteristics was as shown in **Table 2**. The mass of fruits extracted was positively correlated with a significant difference at 5% probability with the mass of fruits extracted, capacity and efficiency of the machine. The juice extraction efficiency of the machine was on the other hand significantly different at 5 % probability with positive correlation with the capacity of the machine and percent yield of the juice.

However, the average % yield (67.88%) of the juice extracted by the machine was rather lower than the range of values (77-83%) obtained by Akinwale and Aladesua (1999) manual one.

The physico-chemical and microbiological characteristics of the processed juice are as shown in **Tables 3** and **4** respectively. The duration of heat treatment of the apples affected the colour of the juice hence the different shades of the colour obtained. Longer heat treatment time gave darker juice colours. The brownish colour obtained from the juice of the apples treated for 30 minutes could be attributed

**Table 1**. Machine Extraction Capacity and Efficiency

| | Parameters | Trials | | | | | Average |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | (Mean) |
| 1 | Mass of fruits used (Kg) | 17.25 | 14.40 | 18.00 | 17.00 | 25.70 | 18.47 |
| 2 | Mass of juice extracted (Kg) | 11.15 | 10.60 | 12.48 | 12.00 | 18.20 | 12.90 |
| 3 | Time taken for extraction (Min) | 25.00 | 20.00 | 25.00 | 20.00 | 40.00 | 26.00 |
| 4 | Mass of extractable juice (Kg) | 13.80 | 11.52 | 14.40 | 13.60 | 20.57 | 14.80 |
| 5 | Juice extraction capacity (KG/hr) | 26.50 | 35.30 | 29.70 | 40.00 | 27.60 | 31.82 |
| 6 | Juice extraction efficiency | 80.80 | 92.0 | 86.70 | 88.00 | 88.50 | 87.20 |
| 7 | % yield of juice/ kg of apple (W/W) | 64.60 | 73.60 | 59.80 | 70.60 | 70.80 | 67.88 |

**Table 2**. Relationship between machine performance and cashew fruit characteristic using Pearson Correlation Analysis

| | | Mass of fruit | Mass of juice | Time taken for extraction | Mass of extractable juice | Juice extraction capacity | Juice extraction efficiency | % yield of juice |
|---|---|---|---|---|---|---|---|---|
| 1 | Mass of fruits | - | 0.98* | 0.97* | 1.00* | $(0.51)^{NS}$ | $(0.05)^{NS}$ | $0.020^{NS}$ |
| 2 | Mass of juice | 0.98 | - | 0.95* | 0.98* | $(0.40)^{NS}$ | $0.13^{NS}$ | $0.13^{NS}$ |
| 3 | Time taken for extraction | 0.97* | 0.95* | - | 0.97* | $(0.65)^{NS}$ | $(0.063)^{NS}$ | (0.008) |
| 4 | Mass of extractable juice | 1.00* | 0.98* | 0.97* | - | $(0.51)^{NS}$ | $(0.046)^{NS}$ | $(0.017)^{NS}$ |
| 5 | Juice extraction capacity | $(0.51)^{NS}$ | $(0.39)^{NS}$ | $(0.65)^{NS}$ | $(0.51)^{NS}$ | - | 0.57* | $0.51^{NS}$ |
| 6 | Juice extraction efficiency | $(0.046)^{NS}$ | $0.13^{NS}$ | $0.063^{NS}$ | $(0.064)^{NS}$ | 0.57* | - | $0.64^{NS}$ |
| 7 | % yield of juice | $0.017^{NS}$ | $0.13^{NS}$ | $0.0085^{NS}$ | $0.017^{NS}$ | $0.51^{NS}$ | 0.64* | - |

* Values significant at 5% probability
NS Not Significant
Values in parenthesis are negative

Table 3. Physical chemical characteristics of cashew juice (treated and non-treated by steam)

| | Sample | Colour and texture | pH values | % total soluble | Specific gravity | Titratable acidity %W/W citric acid | Vitamin C (mg/100ml) of juice |
|---|---|---|---|---|---|---|---|
| 1 | Non-steam treated apples | Yellowish, unstable with lamps when mixed | 4.20a | 11.50a | 1.048 | 0.67a | 195.80a |
| 2 | 10min steam-treated apples | Yellow, cloudy and mixed evenly | 4.10a | 11.50a | 1.045a | 0.58a,b | 152.40b |
| 3 | 20 min steam-treated apples | Dark yellow, cloudy and mixes evenly | 4.10a | 12.00a | 1.050a | 0.50b | 150.00b |
| 4 | 30 min treated apples | Brownish, cloudy, chick and mixes evenly | 4.20a | 13.50a | 1.57a | 0.65a,b | 120.60c |

a,b,c means in the columns with different letters are significantly different ($P < 0.05$).

Table 4. Microbiological quality of the juice incubated at 55°C for 10 days

| | Samples | Number of C on Nutrient Agar |
|---|---|---|
| 1 | Non steamed apples | 0 |
| 2 | Steam treated apples for 10 min | 0 |
| 3 | Steam treated apples for 20 min | 0 |
| 4 | Steam treated apples for 30 min | 0 |

Table 5. Summary of ANOVA for sensory evaluation of juice extracted from steam treated apples

| | Parameters | F-results | Significant level 0.05% |
|---|---|---|---|
| 1 | Colour | 4.462 | Significant |
| 2 | Taste | 2.794 | NOT significant |
| 3 | Mouth feel | 1.747 | Not significant |
| 4 | Overall acceptability | 2.160 | Not significant |

to the caramelization of the sugar as a result of overheating.

However, the pH, soluble solids and specific gravity of the apples were not affected by heat treatment. This observation was similar to those of Akinwale and Aladesua (1999); Aderiye *et al.*, (1991) and Jagtani (1980). Total acidity (as % citric acid) and vitamin C content of the juice were affected by heat treatment with the value decreasing with increased duration of heat for vitamin C. The apples treated for 10, 20, 30 minutes had 152.4 mg, 141.0 mg and 120.5mg/100ml of juice, respectively. High temperature and oxidation had been reported to affect ascorbic acid degradation (Smooth and Naggy 1980). However, the level was higher than the value obtained when the apples were pretreated at about 5 lbs pressure (Aderiye *et al.*, 1991).

Absence of growth observed for all the samples incubated at 55°C indicated that the pasteurisation (though manually carried out) was effective and the samples were microbiologically safe.

Results obtained from the sensory evaluation of the product (**Table 5**) indicated a significant difference between the colour of juice, that is, the panelists were able to perceive different shades of colour of the product as a result of heat treatment. Only the sample treated for 10 minutes was acceptable to the panelists. However, no significant differences were obtained for taste, mouthfeel and overall acceptability of the products.

## Conclusion

Cashew apple, a highly perishable fruit cannot be transported over a long distance but can now be processed at the cottage level using manually operated set of equipment for apple juice extracted. The average percentage yield was 67.88% while the extraction capacity and extraction efficiency were 31.82kg/hr and 87.20, respectively. These machines will serve the small holders farmers to process the apples hygienically and bring in more income thereby improving the general well being of the family.

The apples will require only 10 minutes of steam treatment to obtain an acceptable product in terms of physical and nutritional quality.

## References

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