,Effect of Storage Time on Spiced Tiger-Nut Extract (Kunun Aya)

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ABSTRACT

***Background: :** Tiger-nut beverage is popularly known in the northern part of Nigeria as kunun aya, it is widely consumed for its thirst-quenching and nutritive properties.*

***Objective:** This study determined the effect of storage time on spiced tiger-nut extract.*

***Methods:** One kilogram of the fresh tiger nuts was blended several times into slurry with water. The slurry was pressed using muslin cloth to recover the extract. The tiger nut extract was mixed with ginger, clove, date and sugar at a varied ratio of 8:2 and 7:1:1:1, i.e. tiger nut to ginger, to clove, to date. The extract was stirred thoroughly to have the spices and sugar properly dissolved.*

***Results:** Results of the proximate analyses revealed a range of 87.4-90.0% for moisture. The crude protein ranged from 3.3-3.6% with the samples containing tiger nut and date being significantly different from the others. The fat content ranged from 2.5-4.8% while the energy and carbohydrate contents ranged between 56.6-71.7Kcal and 1.74-6.1% respectively. The bacterial count of the Kunun-aya samples ranged from 1.2-9.2×104 CFU/ml and fungal count ranged from 1.2-9.0×104 CFU/ml on days 1, 3 and 5, respectively. Bacterial and fungal counts of the samples generally increased with the storage period and the samples with 20% inclusion of clove and 10% inclusion of ginger, clove and date respectively were the most acceptable among the treated samples.*

***Conclusion:** The study revealed that samples with inclusion of 20% clove and 10% ginger, clove and date respectively were the most acceptable among the treated samples.*

Keywords: Storage Time, Spices, Proximate, Microbial and Sensory Properties

INTRODUCTION

Tiger nut (*Cyperus esculent us*) is an underutilized crop of the family Cyperaceous, which produces rhizomes from the base and tubers that are somewhat spherical, and are usually preserved by sun drying for about three months before storage (1). It can be eaten raw, dried, roasted, or grated and can be subjected to further processing. The beverage is a refreshing high nutritive, energy drink produced mainly from tiger nut, a good source of energy, fat, starch, fibre, glucose and protein (2, 3). Tiger-nut is also rich in vitamins, minerals and some digestive enzymes such as catalase, lipase and amylase (1, 3, 4). It is a cheap source of nutrition for both the rich and the poor. However, tiger-nut has been reported to contain higher essential amino acids than those proposed in the protein standard by the FAO/WHO in 1985 for satisfying children and adult needs (5).

Spices are as old as man and have been used for thousands of centuries by many cultures to enhance the flavour, taste and aroma of foods (6). Early cultures also recognized the value of using spices in preserving foods and for their therapeutic functions (6). Spices such as cloves, garlic, ginger and pepper are good sources of nutrients, minerals and phytochemicals (7). Research effort have been geared towards lesser known, underutilised cheap crops which can be easily processed to serve as source of macro or micro-nutrients for humans especially from plant sources such as tiger-nut. The underutilised crops

are also gaining strong interest from researchers as well as increasing acceptability from consumers not only because of their thirst quenching properties or stimulating effects, but also because of their nutritional and therapeutic functions. Thus, some researchers have reported the addition of spices such as ginger, garlic, cinnamon, cloves and black pepper to extend the shelf-life of tiger-nut beverage by minimum of 2-3 days (3, 8, 9). This study was, therefore, designed to determine the effect of storage time on spiced non-alcoholic beverage made from tiger-nut blends (kunun-aya) with cloves, date and ginger on its proximate, microbial and sensory properties.

Materials and Methods

Fresh tiger nuts (*Cyperus esculentus*) and spices, ginger, clove and date were purchased from Kure Ultra-modern market, Minna, Niger State.

Tiger Nut Extract Preparation

One kilogramme of the tiger nuts was steeped in distilled water for 8 hours. The tiger-nuts were drained and blanched at 70 C for 5 minutes mainly to inactivate enzymes that might cause clumping of the extract. The fresh tiger nuts were then blended several times into slurry with water made up to 6L in a Q-link auto-clean blender. The slurry was pressed using muslin cloth to get the extract. The extract was pasteurized at 72°C for 5 seconds and homogenised and rapidly cooled. The flow chart for tiger nut drink also called Kunun-aya production is shown in (Figure 1).

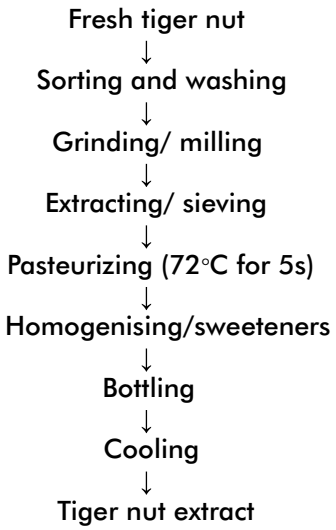

Fig.1. Flow chart for Tiger nut drink *kunun-aya* production

Preparation of Tiger nut (kunun-aya) with added spices

The tiger nut extract was mixed with ginger, clove, date and sugar at a varied ratio of 8:2 and 7:1:1:1, i.e. tiger nut to ginger, to clove, to date. The extract was stirred thoroughly to have the spices and sugar properly dissolved. The resulting tiger-nut extract samples obtained were pasteurized at 70°C for 30 minutes in a water bath with continuous stirring. The samples were allowed to cool and a representative sample was taken from each sample for analysis while the remaining portions of each sample were stored in a refrigerator at 4°C for further analysis. The flow chart for tiger nut extract with spices production is shown in figure 2.

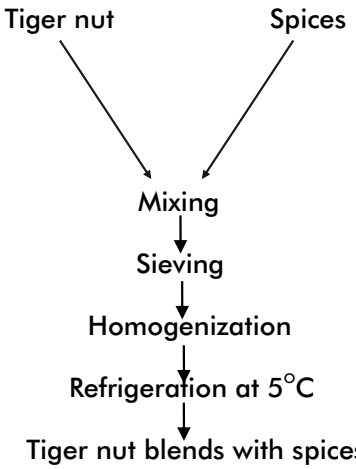

Fig. 2. Flow diagram showing the spiced tiger nut.

Proximate Composition

Moisture, crude protein, total ash, crude fibre and carbohydrate contents were determined using standard methods as outlined by AOAC (10). Briefly, oven drying method at 105°C for 5h for moisture determination, micro -Kjeldahl method for crude protein, total ash was obtained by igniting 2g sample at 550°C for 4h using muffle furnace. Crude fibre was determined using digestion method and carbohydrate was estimated by the difference [100 - (% water + % protein + % fat + % ash + % crude fibre)]. Crude fat was determined using standard soxhlet extraction method with diethyl ether as the solvent as specified by AOAC (10).

Microbial Plate Counts

Total bacterial and fungal plate counts of the kunun-aya samples were carried out according to the method of (11). The Nutrient Agar (NA) and

the Potato Dextrose Agar (PDA) used for the isolation of bacteria and fungi, respectively were prepared according to the manufacturer's instructions and the counts were expressed in cfu/ml.

Sensory Evaluation

The sensory quality attributes including taste, appearance, texture, aroma and overall acceptability of the five kunun-aya samples were evaluated by 40 member panelists comprising of students and staff members of the Department of Food Science and Technology, Federal University of Technology, Minna. The panelists were instructed to score the coded samples based on a 9-point hedonic scale with 1 as disliked extremely and 9 as liked extremely as described by (12).

Statistical Analysis

All evaluation tests were conducted in triplicates. Data obtained for the proximate composition, microbial plate counts and sensory evaluation were subjected to one way Analysis of Variance (ANOVA) and differences among the means were determined using Duncan multiple range test (DMRT). Statistical Package for Service Solution (SPSS) Version 23.0 was used to analyze the data and $p < 0.05$ was considered to be statistically significant. Results were expressed as mean ±standard deviation.

Results and Discussion

Proximate composition of spiced tiger nut drink (kunun-aya

The effect of adding different spices on kunun-aya is presented in (Tables 1). The effect varied among the parameters. The results indicated that the moisture content which ranged from 87.38% in kunun-aya treated with spices to 87.7% in the control formed the major component of the Kunun-aya samples and consequently, made it a good alternative to soft drinks in the supply of water to human body. The values obtained were comparable to 81.7 - 86.4% and 92.4% reported by (3, 13, and 14) respectively but were higher than the 62.8-82.5% reported by (11) for tiger-nut extract. There was significant difference (p 0.05) between moisture content of the control and the treated samples with the treated samples having significantly higher values.

The high moisture content of the kunun-aya got from the present study could be responsible for its poor storage quality as high moisture content is reported to encourage microbial growth during storage (3).

The kunun-aya treated with date had the highest protein content of 3.6% while the lowest value of 3.3% was recorded for ginger spiced Kunun-aya. The crude protein obtained was comparable to the value range of 2.7-3.3% reported by (11) but was higher than 0.8% and 1.0% reported by (8, 14) respectively. This may be due to the high protein content of the spices as was reported by (7). The ash content which is the measure of mineral elements ranged from 0.2- 0.6 % in cloves and ginger spiced kunun-aya, respectively. Earlier researchers had reported comparable values of 0.2 - 0.5% for ash content of tiger-nut extract (14, 15, & 16). With the exception of kunun-aya treated with cloves, the ash contents of the treated samples were lower than the control. It was observed that addition of spices generally increased the fat content of the samples. The values were within the minimum values of 3.0 as prescribed by Codex Alimenterius for extract products.

Table 1. Proximate composition of spiced tiger nut drink

Sample	MC%	ASH%	FAT%	CP%	CHO%	EV (Kcal)
A	89.50 ± 0.01^{a}	0.60 ± 0.01^{a}	4.80 ± 0.01^{a}	3.30 ± 0.01^{c}	1.70 ± 0.01^{e}	63.6 ± 0.00^{b}
B	90.00 ± 0.01^{a}	0.20 ± 0.01^{c}	3.50 ± 0.02^{b}	3.40 ± 0.01^{b}	2.80 ± 0.01^{d}	56.6 ± 0.01^{e}
C	87.40 ± 0.01^{b}	0.60 ± 0.01^{a}	2.50 ± 0.01^{c}	3.60 ± 0.01^{a}	6.10 ± 0.01^{a}	60.6 ± 0.01^{c}
D	87.90 ± 0.01^{b}	0.30 ± 0.01^{b}	2.50 ± 0.01^{c}	3.50 ± 0.01^{a}	5.80 ± 0.01^{b}	58.8 ± 0.01^{d}
Control	87.70 ± 0.01^{b}	0.30 ± 0.01^{b}	4.70 ± 0.01^{a}	3.40 ± 0.01^{b}	4.00 ± 0.01^{c}	71.7 ± 0.01^{a}

Values are mean ± standard error. Means on the same column with different superscript letter are significantly different ($p<0.05$) while those with the same superscript letter are not significantly different ($p>0.05$)

KEY:

Sample A=80% Tiger nut and 20%Ginger
Sample B=80% Tiger nut and 20%Clove
Sample C=80% Tiger nut and 20%Date
Sample D=70% Tiger nut, 10%Ginger, 10%Clove and 10%Date

Spices such as cloves, ginger and garlic had been reported to contain considerable amounts of fat (3, 7). Fat contributes substantially to the energy value of food. Interestingly, the carbohydrate content of the *Kunun-aya* in the present study generally increased with the addition of individual spices which made most of the values higher than the 1.7 - 2.5% and 5.8% reported by (13, 14) respectively. Carbohydrate is known to serve as a primary source of energy in diets (17).

Microbial loads of kunun-aya treated with different spices

Time in days on the bacterial and fungal counts of kunun-aya treated with different spices are represented in Tables 2 and 3. It was observed that microbial growth increased throughout the storage period. The presence of some of these microorganisms may be due to storage time of the product at ambient temperature which is a factor that may result in spoilage. The presence of microbial growth in the sample can be caused by contamination that that occur from the raw materials, non-aseptic handling, processing method, utensils and water used in the production and packaging. This agrees with the report by (11) who determined the presence of microorganism in local beverages. Microbial counts of samples A, B, C, D and control at day 0 and 1 for bacteria were lower than that of day 2 and 3 because of the effect of spices which tend to decrease the microbial count of the samples which correlates with work of (3).

Microbial counts for bacteria of sample A, B, C, D and control increased during the storage period with control having the lowest microbial count during storage while the microbial count increased at day 2 and 3 but were too numerous to count in some plates (Table 3). This can also be attributed to the storage environment of the samples at ambient temperature as reported by (18). The presence and increase in bacteria and fungi counts can be as a result of the natural spices which tend to deteriorate as the storage period increased. The presence of microorganisms in the samples can also be attributed to the low concentration of the spices used in their perseveration.

The presence and increased bacterial count observed in all the samples may be due to bacteria that survived at low temperature. In the spices all the bacteria counts observed were indicators of contamination while bacteria in the drink are considered as an indication of bacteria pollution by human origin that may be introduced during processing or packaging. The presence of the bacteria in the present produced *Kunun-aya* may pose a special health risk on susceptible populations such as infants, young children and people with compromised immune systems as observed by (19).

The fungi found on these drinks may be linked to contamination through air or dust, packaging material or processing environment (Table 3). Other sources of contamination of the *Kunun - aya* are mostly through water, handling, storage practices and the tiger nuts. Growth of fungi can occur over a wide range of temperature and pH and some of these fungi can produce mycotoxins

Table 2. Total bacterial count (cfu/ml) of *Kunun-aya* fresh and stored samples with spices

SAMPLES	Fresh	1	2	3	4
A	$2.5x10^4$	$3.2x\ 10^4$	$4.6x\ 10^4$	$5.3x\ 10^4$	$2.6\ x10^5$
B.	$1.2x10^4$	$1.9\ x10^4$	$2.0x\ 10^4$	$2.7\ x\ 10^4$	$1.2x10^5$
C.	$1.5x10^4$	$5.0x\ 10^4$	$7.9x\ 10^4$	$9.8\ x\ 10^4$	$1.4x10^5$
D.	$2.3x10^4$	$2.8x\ 10^4$	$3.8x\ 10^4$	NM	NM
Control	$4.8x10^4$	$7.6x\ 10^4$	$9.2x\ 10^4$	$1.04x10^5$	$4.32x10^5$

NM = numerous

KEY

Sample A =80% Tiger nut and 20%ginger
Sample B = 80%Tiger nut and 20%cloves
Sample C = 80%Tiger nut and 20%date
Sample D = 70%Tiger nut and 10%ginger, 10%cloves and 10%date
Control = 100% Tiger nut

Table 3. Total fungal count (cfu/ml) of *Kunun-aya* fresh and stored samples with spices

SAMPLES	Fresh	1	2	3	4
A	$9.0x\ 10^6$	$1.3x10^7$	$2.1x10^7$	$4.6x\ 10^7$	$1.7x10^8$
B	$5.0x10^7$	$2.2x10^7$	$2.3x10^7$	$2.7\ x10^7$	$2.4x10^8$
C	$2.1x10^7$	$2.1x10^7$	$3.2x10^7$	$1.2x10^8$	$1.5x10^8$
D	$2.1x10^7$	$2.1x10^7$	$2.2x10^7$	$2.6\ x\ 10^7$	$1.7x10^8$
Control	$7.0x10^6$	$1.8x10^7$	$3.0x10^7$	$2.8\ x\ 10^7$	$1.2x10^8$
KEY					

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Sample A =80% Tiger nut and 20%ginger
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Sample C = 80%Tiger nut and 20%date
Sample D = 70%Tiger nut and 10%ginger, 10%cloves and 10%date
Control = 100% Tiger nut

Table 4. Sensory analysis of spiced tiger nut-extract drink

Sample	Mouthfeel	Aroma	Taste	Consistency	Appearance	General Acceptability
A	2.93 ± 0.16^{d}	2.53 ± 0.15^{d}	3.10 ± 0.17^{b}	2.73 ± 0.13^{cd}	2.13 ± 0.13^{c}	2.95 ± 0.17^{bc}
B	3.98 ± 0.15^{b}	3.20 ± 0.18^{c}	4.20 ± 0.13^{a}	3.45 ± 0.12^{b}	3.38 ± 0.20^{b}	3.70 ± 0.15^{b}
C	1.55 ± 0.12^{e}	2.00 ± 0.16^{e}	1.63 ± 0.14^{c}	2.03 ± 0.12^{d}	1.78 ± 0.14^{d}	1.60 ± 0.13^{d}
D	3.05 ± 0.13^{c}	3.90 ± 0.12^{b}	3.38 ± 0.11^{b}	2.95 ± 0.12^{c}	2.85 ± 0.15^{c}	3.05 ± 0.11^{b}
Control	4.45 ± 0.15^{a}	4.40 ± 0.14^{a}	4.45 ± 0.13^{a}	4.63 ± 0.14^{a}	4.18 ± 0.15^{a}	4.43 ± 0.15^{a}

Values are mean ± standard error of duplicate determination. Means on the same column with different letter superscript are significantly different ($P<0.05$) while does with the same letters are not significantly different ($P>0.05$).

KEY:
Sample A=80% Tiger nut and 20%Ginger
Sample B=80% Tiger nut and 20%Clove
Sample C=80% Tiger nut and 20%Date
Sample D=70% Tiger nut, 10% Ginger, 10%Clove, and 10%Date
Control=100% Tiger nut extract

which can cause mycotoxicosis in humans as reported by (20). Extreme care should, therefore, be taken to avoid contamination from any of these sources in the production of *Kunun- aya*.

Sensory analysis of spiced tiger nut-extract drink

The effect of storage time of spiced beverage on the sensory attributes of *kunun-aya* is shown in Table 4. There were significant differences ($p<0.05$) between the organoleptic properties of the treated *kunun-aya* samples compared with the control having the highest mean scores for mouth feel, aroma, taste, consistency, appearance and overall acceptability. The low sensory mean scores of the treated samples may be due to the addition of the spice powders which might have caused a deviation in the sensory attributes that the panelists are used to. However, the results showed that the sample having 20% inclusion of clove and 10% inclusion of ginger, clove and date respectively were the most acceptable among the treated samples. In terms of mouth feel, aroma, taste, consistency and appearance, no significant differences existed among the treated samples. Thus, the present study has shown a simple and cheap source of a rich and non-alcoholic beverage which can serve the family with all the needed nutrients at the door step of each household.

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