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Effect of Storage Time on Spiced Non-Alcoholic Beverage Made from Tiger-Nut Blends *(Kunun Aya)*

Maxwell YMO[1], Alabi MO[2], Tazan RO[1], Jiya MJ[1], Audu Y[3] and Wada AC[4]*

[1]Department of Food Science and Technology, Federal University of Technology, Minna, Nigeria

[2]Department of Nutrition & Dietetics, Federal Polytechnic Bida, Niger State

[3]Department of Animal Production, Federal University of Technology, Minna, Nigeria

[4]Department of Crop Production, Federal University of Technology, Minna, Nigeria

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***Corresponding author:** Wada AC, Food Science and Technology, Federal University of Technology, Minna, Nigeria; E mail: drwada2013@gmail.com/y.maxwell@futminna.edu.ng

Abstract

Kunun-aya is a traditional non-alcoholic beverage widely consumed in Northern Nigeria especially during the dry season. The beverage was prepared from tiger nut with the addition of spices such as cloves, date and ginger at different ratio of blends. The samples were stored at 4°C for 5 days and the effects of spices on their proximate, microbial and sensory properties were evaluated. Fresh tiger nuts and spices were purchased from Kure Ultra-modern market in Minna, Niger State. The tiger nut seeds were sorted and foreign materials, bad/cracked nuts, which may affect the taste and keeping quality of the drink were removed, washed and rinsed with portable water then soaked overnight to soften the fibre and to remove off-flavour. 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. A 9-point hedonic scale was used to assess the sensory attributes of the spiced drink based on mouth feel, texture, taste, aroma, appearance and general acceptability. Five samples of the spiced drink were analyzed for total energy, crude protein, fat, carbohydrate, ash, crude-fibre and moisture contents. Results of the proximate analyses revealed a range of 87.4-90.0% for moisture which was high. 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 56.6-71.7 and 1.74-6.1 respectively. The bacterial count of the *Kunun-aya* samples ranged from 1.2 - 9.2×10^4 CFU/ml and fungal count ranged from 1.2-9.0×10^4 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. No significant differences existed among the treated samples in terms of mouth feel, aroma, taste, consistency and appearance. The study revealed a nutritious and acceptable spiced drink from tiger-nut which can serve as a substitute to alcoholic and carbonated beverages.

Keywords: Tiger-Nut; Storage Time; Spiced; Proximate; Microbial and Sensory Properties

Introduction

Tiger nut (*Cyperus esculentus*) is an underutilized crop of the family Cyperaceae, 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 Milk 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 extract the milk. The extract was pasteurized at 72°C for 5 seconds and homogenised and rapidly cooled. The flow chart for tiger nut milk drink (TMD) also called *Kunun -aya* production is shown in (Figure 1).

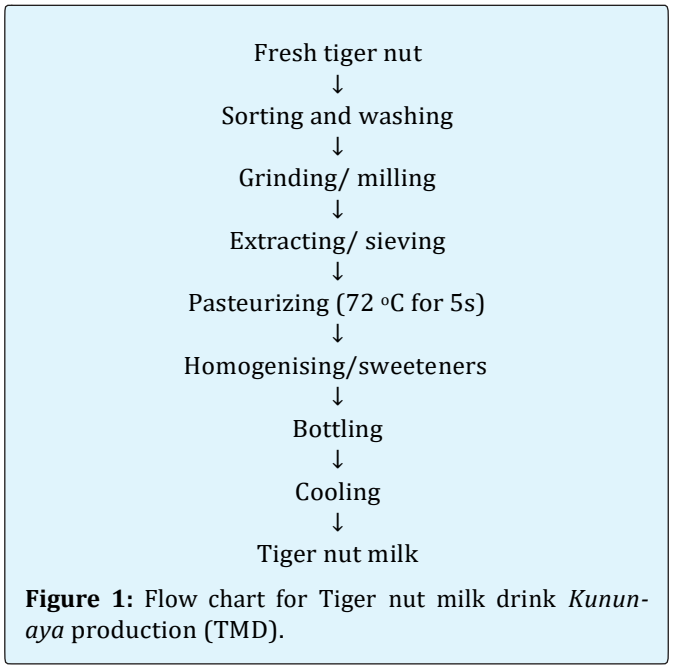

Figure 1: Flow chart for Tiger nut milk drink *Kunun-aya* production (TMD).

Preparation of Tiger Nut Milk (*Kunun-Aya*) with Added Spices

The tiger nut milk 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 milk was stirred thoroughly to have the spices and sugar properly dissolved. The resulting tiger-nut milk 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 milk with spices production (TMDS) is shown in (Figure 2).

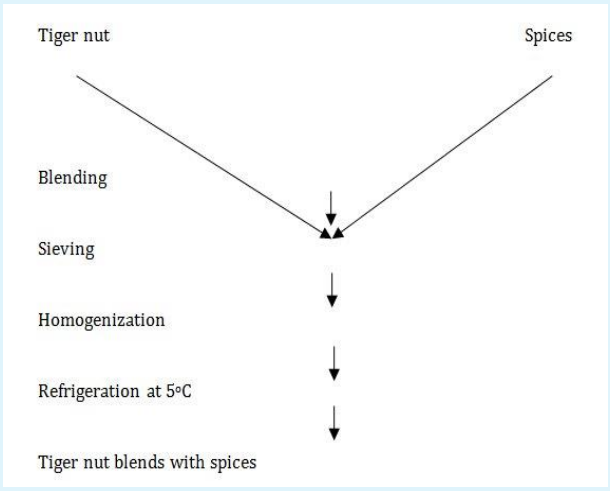

Figure 2: Flow diagram showing the blends of tiger nut with powdered spices.

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 5 h for moisture determination, micro -Kjeldahl method for crude protein, total ash was obtained by igniting 2g sample at 550°C for 4 h 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 Musa & Hamza [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 Ihekoronye & Ngoddy [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-Milk Drink (*Kunun-Aya*)

The effect of adding different spices on *Kunun-aya* is presented in (Tables 1&2). 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 Awonorin & Udeozor [13] and Bristone, et al. [14], Kayode, et al. [3] respectively but were higher than the 62.8-82.5% reported by Musa & Hamza [11] for tiger-nut milk. 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 Musa & Hamza [11] but was higher than 0.8% and 1.0% reported by Bristone, et al. [14] & Nwobosi, et al. [8], respectively. This may be due to the

high protein content of the spices as was reported by Otunola, et al. [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 milk [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 milk products.

Sample	MC%	ASH%	FAT%	CP%	CHO%	EV (Kcal)
A	89.5±0.01^{b}	0.6±0.01^{a}	4.8±0.01^{a}	3.3±0.01^{e}	1.7±0.01^{e}	63.6±0.00^{b}
B	90.0±0.01^{a}	0.2±0.01^{d}	3.5±0.02^{c}	3.4±0.01^{c}	2.8±0.01^{d}	56.6±0.01^{e}
C	87.4±0.01^{e}	0.6±0.01^{b}	2.5±0.01^{e}	3.6±0.01^{a}	6.1±0.01^{a}	60.6±0.01^{c}
D	87.9±0.01^{c}	0.3±0.01^{e}	25±0.01d	3.5±0.01^{b}	5.8±0.01^{b}	58.8±0.01^{d}
Control	87.7±0.01^{d}	0.3±0.01^{c}	4.7±0.01^{b}	3.4±0.01^{d}	4.0±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
Control=100% Tiger nut milk

Table 1: Proximate composition of spiced tiger nut-milk drink

Sample	MC%	ASH%	FAT%	CP%	CHO%	EV (Kcal)
A	89.50±0.01^{b}	0.64±0.01^{a}	4.81±0.01^{a}	3.32±0.01^{e}	1.74±0.01^{e}	63.58±0.00^{b}
B	90.01±0.01^{a}	0.21±0.01^{d}	3.52±0.02^{c}	3.43±0.01^{c}	2.83±0.01^{d}	56.57±0.01^{e}
C	87.38±0.01^{e}	0.55±0.01^{b}	2.48±0.01^{e}	3.56±0.01^{a}	6.05±0.01^{a}	60.64±0.01^{c}
D	87.92±0.01^{c}	0.25±0.01^{e}	2.54±0.01^{d}	3.53±0.01^{b}	5.75±0.01^{b}	58.88±0.01^{d}
Control	87.65±0.01^{d}	0.29±0.01^{c}	4.71±0.01^{b}	3.37±0.01^{d}	3.98±0.01^{c}	71.71±0.01^{a}

Values are mean ± standard error. Means in the same column with different superscript letters are significantly different ($p<0.05$) while those with the same superscript 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 milk

Table 2: Proximate composition of spiced tiger nut-milk drink

Spices such as cloves, ginger and garlic had been reported to contain considerable amounts of fat Otunola, et al. [7], Kayode, et al. [3]. 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 Awonorin & Udeozor [13] and Bristone, et al. [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 3and 4. 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

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 Musa & Hamza [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 Kayode, et al. [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 Tembo, et al. [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.

Samples	Fresh	1	2	3	4
A	2.5x104	3.2x 104	4.6x 104	5.3x 104	2.6 x105
B	1.2x104	1.9 x104	2.0x 104	2.7 x 104	1.2x105
C	1.5x104	5.0x 104	7.9x 104	9.8 x 104	1.4x105
D	2.3x104	2.8x 104	3.8x 104	NM	NM
Control	4.8x104	7.6x 104	9.2x 104	1.04x105	4.32x105

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

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 Obire, et al. [19].

The fungi found on these drinks may be linked to contamination through air or dust, packaging material or processing environment (Table 4).

Samples	Fresh	1	2	3	4
A	9.0x 106	1.3x107	2.1x107	4.6x 107	1.7x108
B	5.0x107	2.2x107	2.3x107	2.7 x107	2.4x108
C	2.1x107	2.1x107	3.2x107	1.2x108	1.5x108
D	2.1x107	2.1x107	2.2x107	2.6 x 107	1.7x108
Control	7.0x106	1.8x107	3.0x107	2.8 x 107	1.2x108

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

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 which can cause mycotoxicosis in humans as reported by Oluwadara, et al. [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-Milk Drink

The effect of storage time of spiced beverage on the sensory attributes of *Kunun-aya* is shown in (Table 5). 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.

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

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 milk

Table 5: Sensory analysis of spiced tiger nut-milk drink.

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