

Chemical and sensory properties of spiced tigernut (*Cyperus esculentus vassativa*) drink

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Abstract. The chemical and sensory properties of spiced tiger nut drink produced from different ratios of fresh and roasted tiger nut and date palm as sugar replacer were evaluated. The result of sensory evaluation showed that sample D (490 ml:10 ml ginger: 30 g date) of the fresh drink was the most preferred in aroma, appearance, flavour, sweetness, taste, general acceptability and was significantly different ($P<0.05$) from other samples evaluated. The moisture content was higher in the unspiced (control) sample and significantly different ($P<0.05$) from others. Ash, fat, and protein content ranged from 0.25-0.34%, 0.01-0.90%, and 0.25-1.28%, for fresh tiger nut drinks and 0.39-0.63%, 1.55-3.44 and 1.28-1.71% for roasted tiger nut drink samples respectively. The carbohydrate and Energy in roasted and fresh sample were higher than the control sample.

Keywords: Tiger nut, drink, spices, chemical, sensory properties.

INTRODUCTION

Drinks are liquids specially prepared for human consumption. The primary functions of any beverage are to supply water to the body with or without nutrients but it remains a great dietary danger to many people, since mostly consumed beverage and soft drinks lack nutrients like fibre, protein, minerals, vitamins and other essentials nutrients (Lancet, 2008). The consumption of non-carbonated drinks has become increasingly important and demand largely based on their value, flavour, aroma and colour (McLellan, 1990). However, despite the increasing popularity of drinks made from plant origin, the storage stability calls for concern.

Tiger nut (*Cyperus esculentus vassativa*) is a crop that is known to produce high quality oil of about 25% of its content and 8% protein from the nut. It is valued for their nutritional content and dietary fibre. Tiger nut can be eaten raw, dried, roasted or grated and used as flour or vegetable milk. It is pressed for its juice to make beverage called "Chufa" (Belewu and Belewu, 2007).

Tiger nut milk is a very nutritive and energetic drink both for the old and young. It is high in starch, glucose and protein. Also rich in minerals like potassium, phosphorus and vitamins E and C, and has never been found to provide allergy (Belewu and Abodunrin, 2008).

Bamishaiye and Bamishaiye, (2011) reported that tiger nut drink is a rich source of unsaturated fats and some enzymes which help in digestion, while Chevalier (1996) reported that tiger nut drink contains more iron, magnesium and carbohydrate than the cow's milk.

A major challenge militating against tiger nut drink is its very short shelf life despite its numerous nutritional and health benefits. Most of the available information reveals that tiger nut is underutilized and still confined to local use only, hence the need to determine the effect of spices and date palm inclusion on the chemical and sensory properties of the tiger nut drink.

Date palm is a delicious fruit with a sweet taste and fleshy mouth feel texture that is nutritious, assimilative and

energy producing. The main component of date palm is carbohydrate (mainly sugars, sucrose, glucose, and fructose), which may constitute about 70%. The sugars in date are easily digested and can immediately be moved to the blood after consumption and can quickly be metabolised to release energy for cell activities (Barreveld, 1993). Thus with the use of date palm, underutilized nature of tiger nut for drink production and addition of various spices can be a good justification for the study.

Healthy drinks have become an issue of interest as consumer awareness is moving towards sugar free, additive free and more natural drink, considering the recent trend in most soft drinks of containing high sugar, high pesticide residue and their attendant health risk. Hence, the use of date palm as a sugar replacer, in combination with local spices. There is little or no information on the use of local spices to prepare healthy drinks despite the benefit and nutritional advantages of these local spices. Therefore, the objectives of the present study are: to prepare and evaluate the chemical and sensory properties of spiced tiger nut drink.

MATERIALS AND METHODS

Materials

Tiger nut tubers (fresh and dried) were purchased from Rumuwoji market, Port-Harcourt located on Latitude 4°46'38" N, Longitude 7°00'48"E. The spices (Ehuru, Garlic, Ginger) and date were purchased from fruit garden market, Port-Harcourt, Rivers State, Nigeria.

Chemicals

All chemicals and equipment used were of analytical grade and were obtained from the analytical laboratory, Department of Food Science and Technology, Rivers State University, Port-Harcourt.

Methods

Tiger nut drink extraction

The method described by Udeozor (2012) was modified for the extraction of tiger nut drink from fresh and roasted tiger nuts. Roasted and fresh tiger-nut was manually sorted and cleaned to remove foreign particles and unwanted materials. The fresh tiger nut was milled into slurry and extracted to tiger nut and water at a ratio of 1:3.

Spices

The dry spices (Ehuru) was sorted, washed and roasted

in an electric oven at 105°C for 20mins before deshelling. The spices were all milled using a dry milling machine – [model GA-JBL 2002]. Spices were extracted at ratio 1:5 w/v of spices to water.

Formulation of spiced tiger nut drink

The formulation of spiced tiger nut drink was done using 10 ml each of the different spice extracts and 490 ml of tiger nut with varying quantities of date palm as sweetener ranging from 10 to 30 g. (Figure 1 to 3)

Sensory evaluation

A 20 member taste panel consisting of staff and students from department of Food Science and Technology Laboratory, Rivers State University, Port-Harcourt, were involved in the sensory evaluation of spiced tiger nut drink. The panellists were asked to assess the samples based on the following attributes; taste, colour, appearance, sweetness, flavour and general acceptability. A 9-point hedonic scale (1 = dislike extremely to 9 = like extremely) was used to score the spiced tiger nut drink. The sensory test on a hedonic scale was a means of elimination of the unwanted samples and the most preferred products (Onwuka, 2005).

Statistical analysis

Results were statistically analysed by using analysis of variance technique. Level of significance within means was calculated by using Duncan Multiple Range Test (Steel and Torrie 1980).

Chemical analysis of spiced tiger nut drinks samples

The moisture content of the sample was determined using moisture analyser AMB-ML-50 at 130°C. Fat content was determined by the method of Osborne and Vogt (1978). Ash and crude protein contents were determined according to the method described by Association of Official Analytical Chemist (2012), while total available carbohydrate (TAC) was calculated by difference. Energy in kcal was determined by the Atwater factor (4:9:4) for protein, fat and carbohydrate. %Energy = (% protein × 4) + (% fat × 9) + (% carbohydrate × 4)

RESULTS AND DISCUSSION

Table 1 shows the mean of pre-sensory scores for spiced tiger nut drink, prepared with different levels of different spice extracts namely ginger (*Zingiber officinale Rosc*),

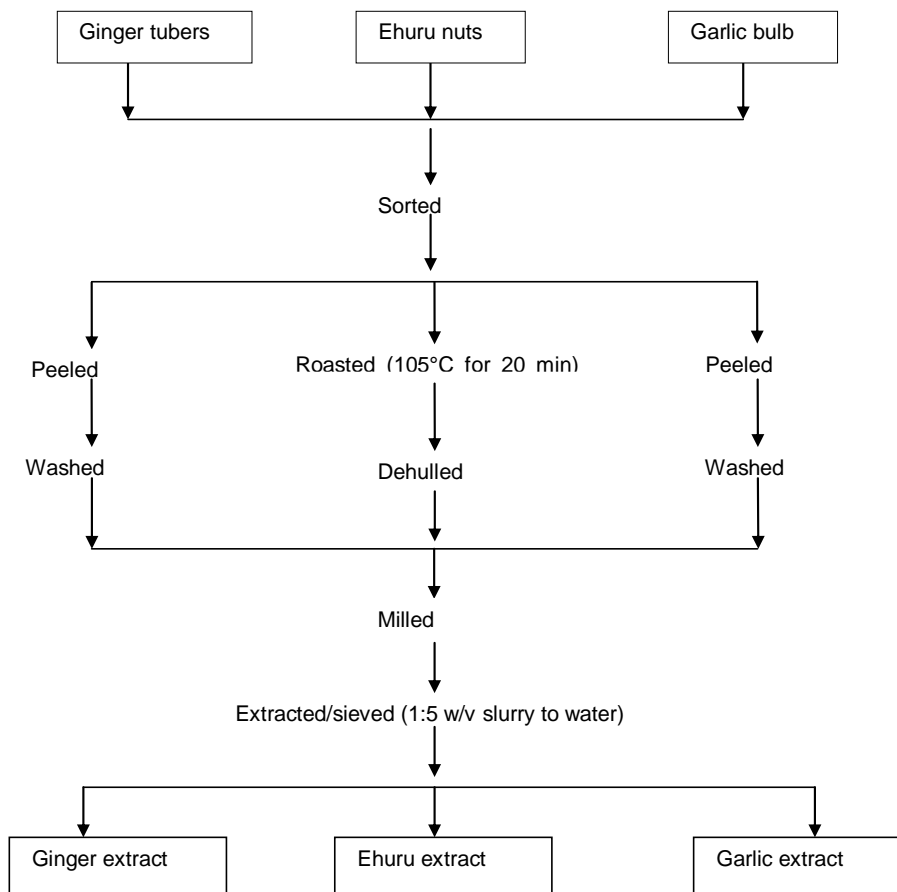


Figure 1. Flow chat for the extraction of different spices. Source: Eke-Ejiofor *et al.* (2016).

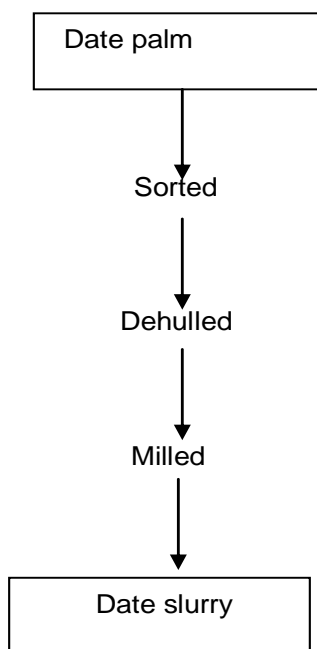


Figure 2. Flow chat for date slurry production. Source: Udeozor (2012).

ehuru (*Monodora myristica*) and garlic (*Allium sativa*). Aroma ranged between 4.45 and 6.25, colour ranged from 4.40 to 6.35, Flavour ranged from 4.20 to 5.75, sweetness ranged from 4.20 to 6.60, while taste from 4.07 to 6.65 and general acceptability ranged from 4.30 to 6.46. This was to determine the most preferred sample in terms of spice concentration. Result showed that 10ml inclusion of spice was most preferred and therefore used in subsequent drink formulation with varying quantities of date palm

Tables 2 and 3 shows the mean sensory scores for spiced tiger nut drink, prepared from roasted and fresh tiger nut with different spice extracts and date palm inclusion. Aroma ranged between 3.95-7.00 and 3.80-6.65 for roasted and fresh tiger nuts drinks respectively, with sample D (490 ml tiger nut: 10 ml ginger: 30 g date palm) having the highest value and significantly different ($P \leq 0.05$) from other samples, while colour ranged between 3.55 and 7.60 for roasted tiger nut drink and 5.15 to 7.15 for fresh tiger nut drink respectively, with sample A (control) been preferred in the roasted drink and sample D (490 ml tiger nut: 10 ml ginger: 30 g date palm) for fresh tiger nut and significantly different ($P \leq 0.05$) from other fresh samples. The colour difference was expected in the roasted samples as they had a chocolate

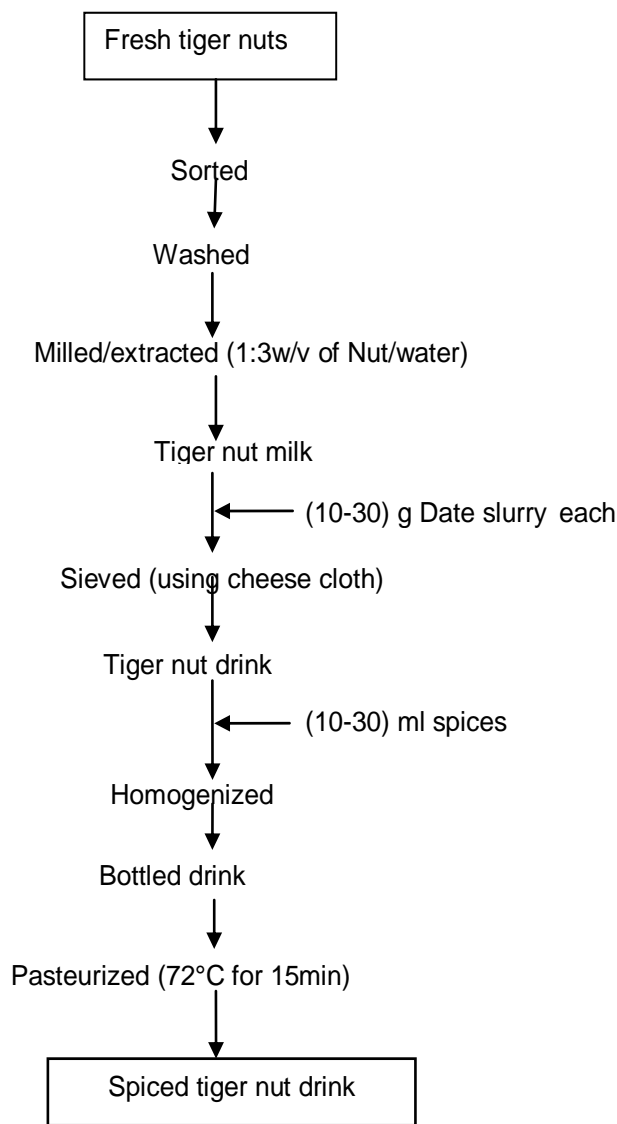


Figure 3. Flow chat for spiced tiger nut formulation. Source: Udeozor (2012).

colour as against the fresh sample that appeared creamy. Flavour ranged between 3.20 and 7.35 for roasted tiger nut sample and 4.45 and 7.05 for the fresh sample, with samples A and D as most preferred respectively. Sweetness varied between 3.50-7.30 and 3.35-8.10 for roasted and fresh tiger nut drinks respectively. Taste of the roasted and fresh spiced tiger nut drink ranged between 3.35-7.30 and 4.05-7.90 respectively. Overall acceptability of both drinks ranged from 3.00-7.80 and from 4.08-7.80 for roasted and fresh tiger nut drinks respectively. In the roasted samples, the control (sample A) was most preferred, while in the fresh tiger nut drinks sample D (490 ml tiger nut: 10 ml ginger: 30 g date palm) was the most preferred. The result from sensory evaluation reveals that formulating spiced tiger nut with roasted tiger nut, ginger extract and date palm at a ratio

of (490 ml tiger nut: 10 ml ginger:30 g) was generally accepted by the panellists.

Tables 4 and 5 shows the percentage mean chemical analysis result for drinks produced from roasted and fresh tiger nuts with inclusion of different spice extract and varying quantities of date palm. Moisture content ranged between 70.98 – 82.42% and 91.10 - 95.45%, for roasted and fresh tiger nut drinks respectively. The moisture content of the roasted samples were lower than the fresh samples as a result of the concentrated nature of the roasted tiger nut. In both cases, the control had a higher value which was expected as inclusion of date palm which increased the viscosity of the drinks. Ash content of drinks ranged between 0.39- 0.63%, for the roasted tiger nut drink and 0.25 - 0.34% for the fresh samples. Ash refers to the inorganic materials such as minerals

Table 1. Mean preliminary sensory scores of spiced tiger nut drink.

Samples	Aroma	Colour	Flavour	Sweetness	Taste	General acceptability
A	5.30 ^e	5.70 ^{be}	5.45 ^a	5.40 ^b	5.55 ^d	55.5 ^c
B	6.05 ^b	6.07 ^a	5.75 ^a	5.95 ^b	5.95 ^b	6.35 ^b
C	4.70 ^e	5.50 ^e	5.57 ^a	5.35 ^b	5.20 ^d	5.50 ^c
D	6.25 ^a	5.35 ^e	5.60 ^a	6.60 ^a	6.65 ^a	6.45 ^a
E	5.00 ^e	5.05 ^f	5.10 ^b	5.05 ^c	5.10 ^d	5.25 ^d
F	5.95 ^c	6.25 ^c	5.55 ^a	5.70 ^b	5.70 ^d	5.95 ^c
G	4.45 ^e	4.40 ^e	4.20 ^c	4.20 ^d	4.07 ^e	4.30 ^e
H	5.15 ^e	5.80 ^e	5.10 ^b	5.10 ^c	4.85 ^e	5.25 ^d
I	5.50 ^d	5.30 ^e	5.45 ^a	5.45 ^b	5.80 ^c	5.85 ^c
J	5.70 ^c	6.35 ^b	5.25 ^a	5.20 ^b	5.10 ^d	5.65 ^c
LSD	0.97	0.77	0.95	0.96	1.03	0.86

Means with different superscript in the same column are significantly different ($p \leq 0.05$),

Key:

A (100% tiger nut) (control), B (490 ml tiger nut: 10 ml ginger: 10 g date palm), C (490 ml tiger nut: 10 ml ginger: 20 g date palm), D (490 ml tiger nut: 10 ml ginger: 30 g date palm), E (480 ml tiger nut: 20 ml Ehuru: 10 g date palm), F (480 ml tiger nut: 20 ml Ehuru: 20 g date palm), G (480 ml tiger nut: 20 ml Ehuru: 30 g date palm), H (470 ml tiger nut: 30 ml garlic: 10 g date palm), I (470 ml tiger nut: 30 ml garlic: 20 g date palm), J (470 ml tiger nut: 30 ml garlic: 30 g date palm). The most preferred samples is D (490 ml tiger nut: 10 ml ginger: 30 g date palm)

Table 2. Mean sensory scores of roasted spiced tiger nut drink.

Samples	Aroma	Colour	Flavour	Sweetness	Taste	General acceptability
A	6.95 ^a	7.60 ^a	7.35 ^a	7.30 ^a	7.30 ^a	7.80 ^a
B	5.35 ^d	6.15 ^c	6.40 ^c	5.90 ^b	6.20 ^c	6.25 ^c
C	6.65 ^b	6.80 ^b	6.55 ^c	6.65 ^b	6.80 ^c	7.20 ^b
D	7.00 ^a	6.75 ^b	6.95 ^b	7.15 ^a	7.20 ^b	7.20 ^b
E	6.10 ^c	6.25 ^c	6.30 ^c	6.75 ^b	6.30 ^c	6.60 ^c
F	5.85 ^c	4.95 ^d	4.01 ^d	4.10 ^c	4.60 ^d	4.05 ^d
G	6.95 ^a	5.50 ^d	6.35 ^c	6.75 ^b	6.65 ^c	6.60 ^c
H	4.45 ^e	3.80 ^e	3.25 ^e	3.50 ^c	3.60 ^e	3.90 ^d
I	3.95 ^e	3.55 ^e	3.60 ^e	3.60 ^c	4.00 ^e	3.85 ^e
J	4.10 ^e	3.55 ^e	3.20 ^e	3.65 ^c	3.35 ^e	3.00 ^e
LSD	1.05	0.95	0.83	0.87	0.92	0.90

Means with different superscript in the same column are significantly different ($P < 0.05$)

KEY:

A (100% Tigernut) – Control. B (490 ml tigernut: 10 ml ginger: 10 g date palm), C (490 ml tigernut: 10 ml ginger: 20 g date palm), D (490 ml tiger nut: 10 ml ginger: 30 g date palm), E (490 ml tiger nut: 10 ml Ehuru: 10 g date palm), F (490 ml tigernut: 10 ml Ehuru: 20 g date palm), G (490 ml tiger nut: 10 ml Ehuru: 30 g date palm), H (490 ml tiger nut: 10 ml garlic: 10 g date palm), I (490 ml tiger nut: 10 ml garlic: 20 g date palm), J (490 ml tiger nut: 10 ml garlic: 30 g date palm).

present in food. It can include both compounds with essential minerals such as calcium and potassium and toxic materials such as mercury (Nielson, 2010). According to Nielson (2010), any natural food will be less than 5% ash in content. The result for ash showed no significant difference ($p \geq 0.05$) between the samples of the fresh tiger nut, while sample B and J were significantly different ($P \leq 0.05$) in the roasted tiger nut drink. However, the values were lower than that reported by Udeozor (2012) for tiger nut-soy milk drink.

Fat content ranged between 1.55 - 3.44% in the roasted

tiger nut drink and between 0.10 - 0.90% for the fresh sample. In both cases, the ginger containing drink (sample H) had more fat content. The fat content of the drinks produced with fresh tiger nut were lower than the fat content of drink from the roasted tiger nut. The quantity of fat in the drink samples were lower than the minimum (3%) level requirement of Codex Alimentarius standards (Passmore and Eastwood, 1986) with the exception of sample H which had 3.44% and was significantly different ($p \leq 0.05$) from other samples.

Protein ranged from 1.28 to 1.71% and from 0.25 to

Table 3. Mean sensory scores of fresh spiced tiger nut drink.

Samples	Aroma	Colour	Flavour	Sweetness	Taste	General acceptability
A	4.40 ^f	6.00 ^c	4.70 ^d	3.35 ^g	4.05 ^f	4.08 ^e
B	6.40 ^b	5.90 ^c	6.25 ^b	6.10 ^c	6.15 ^b	6.50 ^b
C	5.50 ^c	5.65 ^d	6.00 ^b	7.15 ^b	6.75 ^b	6.50 ^b
D	6.65 ^a	7.15 ^a	7.05 ^a	8.10 ^a	7.90 ^a	7.80 ^a
E	4.75 ^e	6.20 ^b	5.45 ^c	4.95 ^d	4.90 ^d	4.45 ^d
F	5.00 ^d	5.75 ^d	5.75 ^b	4.95 ^d	4.05 ^c	5.30 ^d
G	5.45 ^c	6.25 ^b	5.95 ^b	6.05 ^c	6.15 ^b	6.35 ^c
H	3.80 ^g	5.65 ^d	4.45 ^e	3.95 ^f	4.05 ^f	4.60 ^e
I	4.20 ^f	5.20 ^e	4.60 ^d	4.40 ^e	3.95 ^f	4.35 ^f
J	4.40 ^f	5.15 ^f	4.65 ^d	4.95 ^d	4.80 ^e	4.70 ^e
LSD	1.05	0.87	0.84	0.94	0.88	0.94

Means with different superscript in the same column are significantly different ($P < 0.05$).

KEY:

A (100% Tiger nut) – Control, B (490 ml tiger nut: 10 ml ginger: 10 g date palm), C (490 ml tiger nut: 10 ml ginger: 20 g date palm), D(490 ml tiger nut: 10 ml ginger: 30 g date palm), E (490 ml tiger nut: 10 ml Ehuru: 10 g date palm), F(490 ml tiger nut: 10 ml Ehuru :20 g date palm), G (490 ml tiger nut: 10 ml Ehuru: 30 g date palm), H (490 ml tiger nut: 10 ml garlic: 10 g date palm), I (490 ml tiger nut: 10 ml garlic: 20 g date palm), J (490 ml tiger nut:10 ml garlic: 30 g date palm).

Table 4. Proximate composition (%) of roasted/spiced tiger nut drink.

Samples	Moisture	Ash	Fat	Protein	CHO	Energy (Kcal)
A	82.42 ^a	0.54 ^b	2.24 ^e	1.29 ^d	13.52 ^f	79.35 ^e
B	79.31 ^c	0.57 ^a	2.16 ^e	1.62 ^b	16.34 ^e	91.30 ^c
C	81.52 ^b	0.51 ^b	2.49 ^b	1.71 ^a	13.77 ^f	84.31 ^d
D	80.01 ^c	0.53 ^b	2.43 ^c	1.31 ^d	16.94 ^d	83.89 ^d
E	77.44 ^d	0.52 ^b	2.15 ^e	1.28 ^d	19.69 ^b	93.50 ^c
F	75.46 ^e	0.50 ^b	1.55 ^f	1.49 ^c	21.80 ^a	100.05 ^b
G	70.98 ^b	0.39 ^c	2.61 ^b	1.28 ^d	16.05 ^e	80.99 ^d
H	74.57 ^f	0.50 ^b	3.44 ^a	1.33 ^d	21.88 ^a	108.29 ^a
I	75.22 ^e	0.52 ^b	2.08 ^f	1.71 ^a	21.52 ^a	102.21 ^b
J	77.66 ^d	0.63 ^a	1.95 ^f	1.58 ^b	19.15 ^c	91.68 ^c
LSD	2.57	0.18	0.20	0.22	3.01	2.57

Means with different superscript in the same column are significantly different ($p \leq 0.05$),

KEY:

A (100% Tiger nut) – Control, B (490 ml tiger nut: 10 ml ginger: 10 g date palm), C (490 ml tiger nut: 10 ml ginger: 20g date palm), D (490 ml tiger nut: 10 ml ginger: 30 g date palm), E (490 ml tiger nut: 10 ml Ehuru: 10 g date palm), F (490 ml tiger nut:10 ml Ehuru: 20 g date palm), G (490 ml tiger nut: 10 ml Ehuru: 30 g date palm), H (490 ml tiger nut: 10 ml garlic: 10 g date palm), I (490 ml tiger nut: 10 ml garlic: 20 g date palm), J (490 ml tiger nut: 10 ml garlic : 30 g date palm).

1.28%, for the roasted and fresh samples respectively. The present result showed higher protein content in the roasted tiger nut drink than the fresh tiger nut drink, with sample C and I having the highest level of 1.7%. The protein of the drink was however lower than the value reported by Udeozor (2012) for tiger nut-soy milk drink. The protein content of a plant based beverage made from bambara nut, tiger nut and coconut were reported to range between 4.13-6.28% while the fat content ranged between 2.04 and 4.30% which was considered to be the major component apart from moisture (Adesokan *et al.*, 2013). The high values of samples C and I could be

attributed to the presence of ginger and garlic.

Total available carbohydrate ranged from 13.52-21.88% and from 4.72 -11.50% with sample A (100% tiger nut) having the least value in both cases, while samples H (470 ml tigernut: 30 ml garlic: 10 g date palm) and J (490 ml tigernut: 10 ml garlic: 30 g date palm) had the highest values respectively. Carbohydrate content of the drinks increased with a corresponding increase in date palm inclusion as seen in samples (C, F and I). This is in agreement with an earlier report that date palm contains a high percentage of carbohydrate (total sugars of 44-88%) (Walid and Richards, 2003).

Table 5. Proximate composition (%) of fresh spiced tiger nut drink.

Samples	Moisture	Ash	Fat	Protein	CHO	Energy (Kcal)
A	95.45 ^a	0.25 ^a	0.61 ^b	0.33 ^d	4.72 ^f	25.73 ^e
B	94.53 ^b	0.25 ^a	0.73 ^a	0.53 ^c	6.47 ^e	34.56 ^d
C	93.45 ^d	0.31 ^a	0.12 ^d	0.25 ^d	6.65 ^e	28.64 ^e
D	91.10 ^f	0.34 ^a	0.10 ^d	0.44 ^c	9.07 ^c	38.91 ^c
E	94.51 ^b	0.30 ^a	0.62 ^b	1.28 ^a	7.58 ^d	41.02 ^b
F	93.17 ^d	0.31 ^a	0.70 ^a	0.65 ^c	9.00 ^c	44.94 ^b
G	92.08 ^e	0.29 ^a	0.82 ^a	0.86 ^b	7.92 ^d	42.55 ^b
H	92.58 ^e	0.29 ^a	0.92 ^a	0.65 ^c	8.18 ^c	43.64 ^b
I	94.11 ^c	0.20 ^a	0.55 ^c	0.51 ^c	11.07 ^b	51.28 ^a
J	92.08 ^e	0.29 ^a	0.54 ^c	0.46 ^c	11.50 ^a	52.71 ^a
LSD	0.94	0.24	0.01	0.46	3.24	8.85

Means with different superscript in the same column are significantly different ($p \leq 0.05$),

KEY:

A (100% Tiger nut) - Control, B (490 ml tiger nut:10 ml ginger: 10 g date palm), C (490 ml tiger nut: 10 ml ginger: 20 g date palm), D (490 ml tiger nut: 10 ml ginger: 30 g date palm), E (490ml tiger nut: 10 ml Ehuru:10 g date palm), F(490 ml tiger nut: 10 ml Ehuru: 20 g date palm), G (490 ml tiger nut: 10 ml Ehuru:30 g date palm), H (490 ml tiger nut:10ml garlic:10 g date palm), I (490 ml tiger nut: 10 ml garlic: 20g date palm), J (490 ml tiger nut : 10 ml garlic: 30 g date palm).

Energy in kcal/100 g ranged between 79.35 and 108.29 for the roasted tiger nut drink and 25.73 to 52.71 for the fresh drink with sample A (100% tiger nut) having the least value while samples H (490 ml tigernut:10 ml garlic:10 g date palm) and J (490 ml tigernut:10 ml garlic: 30 g date palm) having the highest value. The drinks made from the roasted tiger nut had more energy density than the fresh drinks.

CONCLUSION

This study showed that spiced tiger nut drink can be produced and consumed as a refreshing healthy drink without any artificial additives. The result from sensory evaluation reveals that formulating spiced tiger nut with roasted tiger nut at a ratio of 490 ml tiger nut: 10 ml ginger: 30 g date palm was generally more acceptable by the sensory panel. Chemical result in the present study showed that the inclusion of spices and date improved the nutrient composition in fat, protein, carbohydrate and total energy.

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