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Production and Acceptability of Tit-Bits Made From Wheat and Tiger Nut Flour Blends

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Abstract: *The study sought to produce tidbits from a blend of wheat and tigernut flour at varying proportions 100:0, 80:20, and 50:50. Three different samples were produced and a three digit code was assigned to the products. Product 'ABC' contained only 100% wheat flour, DEF 80% wheat flour and 20% tigernut flour and GHI 50% wheat flour and 50% tigernut flour. Proximate composition and sensory properties of the product were carried out. The results of the proximate composition shows an increasing level of Moisture 3.33±13.38, ash 0.19 ±0.34, crude protein 8.01±14.16, crude fat 29.79± 37.03 and carbohydrates 40.38± 52.89. Sensory evaluation showed that acceptable Tidbit with qualities similar to 100% wheat. Data were subjected to analysis of variance (ANOVA) and means were separated by least significant different (LSD) procedure, using the statistical package for social sciences (SPSS) version 20.0. Tidbit could be produced with 20% tiger nut flour replacement. Again, the result obtained indicated that pastries made from tiger-nut flour has good nutritional profile with protein, fat, carbohydrate and other nutrients comparable with that of cookies made from wheat flour. Tidbits Sample GHI (80% WF: 20% TNF) was most preferred. The result for tidbits showed no significant difference (P<0.05) in all the samples, substitutions up to 20% were generally acceptable for tidbits*

Keywords: Tidbit, wheat flour, tigernut flour, composite flour, proximate composition, sensory properties.

1 INTRODUCTION

Wheat, the essential ingredient in bread and pastry making is imported into the country [1] which involves huge expenditure of foreign exchange resulting in high cost of bakery products. Efforts are being made to make tidbits very affordable to the majority of the populace who are low income earners. In spite of this idea, there is the need to use innovative means to partially replace wheat flour with tigernut (TN) flour for the production of baked products in order to make it affordable to consumers. With the constant increasing in consumption of tidbits and alternative baked products in several countries, attempt are being made to save substantial amount of foreign exchange thereby providing nutritious food to more people at a lower cost. It has been confirmed that the entire grain is rich in nutrients such as minerals, protein, fat and fiber while the refined grain is generally starch [2]; [3]. Wheat is the most typical energy grain for the production of confectionary items, on account of the remarkable properties of its protein (gluten) which is required in bread and baked goods production [3]; [4].

Tigernut (*Cyperus esculentus*) is an underutilized crop rumored to be high in dietary fibre that can be used to treat many diseases such as carcinoma, coronary diseases, obesity, diabetics and gastro enteric dis-orders [5] (Anderson et al., 1994). Tigernut flour has been incontestable to be an upscale supply of quality oil and contains moderate quantity of protein. Additionally, tigernut is a wonderful source of some helpful minerals like iron and metallic element that are essential for body growth and development [6]. Tigernut has been said to cure flatulence, stomach upset, diarrhoea, dysentery, and excessive thirst [7]. Moreover, tiger-nut has been incontestable to contain higher essential amino acids than those planned within the protein standard by the FAO/WHO (1985) for satisfying adult wants [8].

Tiger nut (*Cyperus esculentus*) is a lesser- known and underutilized crops that are potentially valuable as human and animal food. It is used to maintain a balance between population growth and agricultural productivity particularly in the tropical and sub-tropical areas of the world [9] with reference to Ghana. It has been reported to contain high amount of carbohydrate, moderate protein, oleic acid, mineral, vitamin C and E contents [10]; [11]. Tiger nut produces about 25% oil of high quality and protein about 8% of the nut, where valued for their nutritious content, and dietary fibre. Tigernut can be eaten raw, dried, roasted or grated and used as flour, vegetable milk, cosmetics and fuel. The idea of subbing a part of wheat with alternative nut is not new. Many researchers have administrated analysis designed to search out ways of subbing flour with alternative sources of flour to reduce the cost of importation [12].

Composite flour is a combination of flours, starches and different ingredients used to supplant wheat flour absolutely or halfway in pastry making and dough items. Along these lines, the expansion of tigernut to wheat flour to produce tidbits will improve the dietary and tangible properties of the product [13]. Therefore, the purpose of this paper was to produce and evaluate composite tidbits from wheat and tigernut flour blends.

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2 MATERIALS AND METHODS

2.1 Source of raw material

Wheat flour, tigernut and other ingredients such as sugar, margarine, salt, nutmeg and baking powder were obtained from the Tafo market, Kumasi.

2.2 Preparation of Tiger Nut Residue Flour

Tigernut flour was prepared using [6] methods. Seeds were sorted to remove imperfect seeds and carefully washed. Two (2kg) kilograms freshly washed tigernut seeds were crushed, blended and milk extracted leaving the residue. The residue was dried in a pre-heated Nasco oven at 60 ^{o}C for 24 hours. Dried tigernut residue was milled into flour using Binatone blender, BLG-675ss model. The powder was sieved through a 50mm laboratory sieve to obtain flour of constant size. These formulations were stored in a plastic air-tight container with lid at room temperature (37 ^{o}C) for further usage.

2.3 Sample formulation

Three samples of flours were formulated and coded as ABC, DEF, and GHI. The control sample ABC contained (100% wheat flour), sample DEF comprised of 50% wheat flour and 50% Tiger nut flour and sample GHI was made from 80% wheat flour and 20% of Tiger nut flour respectively.

Table 1: Recipe formulation for the production of wheat-tigernut (TidBits)

INGREDIENTS	SAMPLE ABC (100 Wheat)	SAMPLE DEF (50:50)	SAMPLE GHI (80:20)
Wheat flour (all-purpose) (g)	100	50	80
Tiger nut flour (g)	0	50	20
Baking powder (g)	2	2	2
Sugar (g)	20	20	20
Margarine (g)	50	50	50
Salt (g)	1	1	1
Nutmeg (g)	2	2	2
Water (ml)	150	150	150

Pastry product (tidbit) was prepared rubbing-in method adopted by [14] with some minor changes. The flour was sifted and weighed separately together with the sugar, margarine and baking powder. The margarine was incorporated into the flour and was rubbed-in to resemble breadcrumbs. Baking powder, salt and nutmeg were added to the mixture and completely mixed together to a uniform mixture. Sugar was diluted in 150ml water and incorporated into the flour mixture to form soft dough. The dough was then turned into a lightly floured surface and rolled out into a desirable thickness. After this, the desired thickness was cut into strips and again, into squares. It was placed into greased baking sheets and baked in an oven at 200^{o}C. Pastry was checked and removed from the oven, allowed to cool, package in a plain polythene bags waiting for proximate analysis and sensory evaluation.

2.4 Physiochemical parameters

Moisture determination

Five grams of flour or gum were weighed and transferred into a previously dried and weighed glass crucible and placed in a hot air oven to dry for 105°C for 24 hours. Samples were cooled in a desiccator, weighed, and returned to the oven to dry to constant weight. Loss in weight was calculated as percentage moisture [15].

Calculations

$(A + B) – A = B$

$(A + B) – (A + C) = B - C = D$ % Moisture = D/B x 100

Where A = crucible wt., B = sample wt., C = dry sample wt., D = moisture wt.

Ash determination

Five grams of sample were transferred into a pre-ignited and pre-weighed porcelain crucible and combusted in a muffle furnace at 550°C for 4 hours. The crucibles in the furnace containing ash was cooled below 200^{o}C and maintained for 20 minutes. Crucible was then removed from furnace, placed in a desiccator to cool totally and re-weighed. Loss in weight was calculated as percentage ash content [15].

Calculations

$(A + B) – A = B$

(A + C) - A = C

% Ash = C/B x 100 where A = crucible weight, B = sample weight, C = ash weight.

Crude fat (Ether Extract) determination

A 500 ml round bottom flask was oven dried for about 5mins at 110°C then cool and weighed. Five grams of sample was transferred into a 22 x 80 mm filter paper and wrapped with a second filter folded in a form of thimble and a piece of cotton placed at the top which evenly distributed the extraction solvent as it dropped on the sample when extracted. The sample packet was then placed in the butt tubes of the Soxhlet extraction apparatus. 200 ml petroleum ether was used for the extraction for 3 hours without interruption by gentle heating. The whole set-up was allowed to cool and the extraction flask dismantled. The petroleum ether used for the extraction was then evaporated on a steam until no odour of ether remained. It was cooled afterwards at room temperature and the extraction flask and its extract re-weighed for the evaluation of the crude fat (Ether extract) [15].

Protein determination

1g of plant material was oven dried and ground to pass through a 0.5mm sieve and weighed into a 500 ml long – necked Kjeldahl flask. 10 ml distilled water was added and allowed to stand for 10 minutes to moisten. One spatula full of Kjeldahl catalyst [mixture of l part Selenium + 10 parts $CuSO_4$ + 100 parts Na_2SO_4] and 10 ml of conc. H_2SO_4 were added to the mixture. This was then digested for 1-11/2 hours and flask cooled afterwards. The digest was the decanted into a 50 ml volumetric flask. An aliquot of 10 ml of digest was transferred by means of pipette into the Kjeldahl distillation apparatus with 90 ml of distilled water as well as 20 ml of 40 % NaOH added. Distillate was collected over 10 ml of 4 % Boric acid and three (3) drops of mixed indicator in a 500 ml conical flask for 5 minutes, after which a total of about 100 ml of distillate collected and titrated with 0.l N HCl.

Calculation

$$\% N = \frac{(a - b) \times 1.4 \times N \times V}{S \times t}$$

Where:

a = ml HCl used in the sample titration

b = ml HCl used in the blank titration

N = Normality of standard HCl

V = total volume of digest

S = mass of oven dried sample taken for digestion

t = volume of aliquot taken for distillation (10ml)

therefore;

% Crude Protein (CP) = Total Nitrogen (N_T) x 6.25(Protein factor)

Crude fibre determination

A defatted sample of about 2.0 g was transferred into a 750 ml Erlenmeyer flask containing 200 ml of boiling 1.25% $H_2SO_4$and refluxed for about 45 minutes with add anti-foaming agent. Digestion flask was connected immediately with condenser and heated. At the end of 30 minutes, flask was removed, filtered immediately through linen and wash with boiling water until washings are no longer acid. NaOH solution was heated to boiling point and kept at this temperature under reflux condenser until used. Residue was washed back into flask with 200 ml of the boiling NaOH solution and flask connected with reflux condenser and boiled for exactly 30 minutes. After 30 minutes, flask was removed and immediately filtered through a Gooch crucible. Thorough washing was done with boiling H_2O, and again with about 15ml of 95% ethanol. Crucible and contents was dried at 110°C to constant weight, cooled in a desiccator and weighed. Contents of crucible were then incinerated in muffle furnace at 550°C for 30mins until the carbonaceous matter was consumed. Cooled in a desiccator and weighed. Loss in weight was thus recorded as crude fibre [15]

Calculation

$$\% \text{ crude fibre} = \frac{A - B}{C} \times 100$$

where A = wt. of dry crucible and sample

B = wt. of incinerated crucible and ash, C = sample weight.

Carbohydrate (NFE) determination

The calculation of available carbohydrate (nitrogen-free extract-NFE) was made after completing the analysis for ash, crude fibre, ether extract and crude protein. The calculation was made by adding the percentage values on dry matter basis of these analysed contents and subtracting them from 100%.

Calculation

NFE (%) on DM basis = 100% - [%ash on DM basis + % crude fibre on DM basis + % ether extract on DM basis + % protein on DM basis}

2.5 Sensory evaluation

The 2 samples of composite tidbits as well as the control were served to a 50 semi-trained panelists made up of a population of second cycle students. These students were familiar with the sensory attributes - taste, aroma, texture, colour, of the samples. A 9-point hedonic scale was designed to measure the degree of preference of the samples. The samples were offered in indistinguishable containers, coded with 3- digit random numbers served simultaneously to ease the possibility of the panelists to re-evaluate a sample. The groupings were altered to numerical scores ranging from 1 to 9, with 1 as the highest and 9 at the lowest level of preference [16] (Bushman and Stack, 1996; [17] Christenso, 1992; [18] Iwe, 2002. Panelists were given medium sized bottle water for rinsing their mouths after each stage of sensory evaluation.

2.6 Statistical Analysis

Data were subjected to analysis of variance (ANOVA) and means were separated by least significant different (LSD) procedure, using the statistical package for social sciences (SPSS) version 20.0.

3 RESULTS AND DISCUSSION

Sensory Evaluation

Table 2: Sensory evaluation of titbits produced

Product	Food characteristics				
	Colour	Taste	crispiness	Hardness	Overall acceptance
ABC	6.6±0.27	6.1±0.41	6.1±0.37	6.1±0.23	5.9±0.13
DEF	6.1±0.27	5.5±0.41	5.6±0.37	5.6±0.23	6.0±0.13
GHI	6.5±0.27	6.3±0.41	6.4±0.37	5.7±0.23	6.2±0.13
LSD	0.76	1.03	0.95	0.54	0.44

*ABC= Control (100% WF) *DEF = (50% WF: 50% SF) *GHI = (80% WF: 20% TNF); WF = Wheat flour, TNF =Tigernut flour*

Table 2 shows the sensory evaluation result of tidbits from wheat/tigernut composite flour. Colour for tidbits ranged from 6.1-6.6 with sample ABC (100%WF) as most preferred and sample DEF (80%WF: 20%TNF) least preferred in both cases. The decrease in colour may be credited to the creamy colour of tiger nut residue flour. The result for tidbits indicated significantly difference (P<0.05) for attribute for the control sample ABC (100% WF) and the composite sample DEF (50% WF and 50% TNF). The taste of the tidbits ranged from 5.5-6.3 with composite sample GHI (80% WF: 20% TNF) as most preferred followed by the control ABC (100%WF). The taste could be attributed to the incorporation of composite flour. The taste of the tidbits show no significant difference (P<0.05) for the control and composite samples. Crispiness refers to how brittle and dry the tidbits presented were. The results of the crispiness ranged from 5.6-6.4 with sample (80% WF: 20% TNF) rated as the most preferred and followed by the control sample ABC (100% WF). All samples were not significantly different (at P < 0.05) from each other. The hardness food trait gives an implication of the easiness with which the tidbit could be broken into bits. Per the mean estimations of the example in Table 2 demonstrated that respondents enjoyed the hardness of the tidbits produced from (80% WF: 20% TNF), particularly as indicated by the hedonic scale compared with different ones produce from the soy-wheat composites. In any case, at P < 0.05 level of likelihood indicated that there was no huge contrast between the 100%WF tidbits and the composite ones which were likewise modestly enjoyed by respondents according to the hedonic scale measures. In conclusion, it implies that, tidbits produced per this study have its hardness very satisfactory. General acceptability of tidbits ranged from 5.9-6.2. Sample GHI (80% WF: 20% TNF) was most preferred. The result for tidbits showed no significant difference (P<0.05) in all the samples, substitutions up to 20% were generally acceptable for tidbits

Proximate composition

Table 3: Proximate composition

Samples	Moisture %	Ash%	Fat%	Protein%	Carbohydrate%
ABC	3.33±0.33	0.34 ± 0.16	29.79 ±0.17	10.40 ± 0.38	43.21±0.28
DEF	5.64 ± 0.12	2.63 ±0.08	35.00±0.07	14.16 ±0.05	46.31 ±0.02
GHI	13.38 ± 0.16	1.19 ± 1.33	37.03 ± 0.50	8.01 ± 0.06	40.38 ±2.41

Values are averages of duplicates readings (Mean ±SD). Means with different data
**ABC= Control (100% WF) *DEF = (50% WF: 50% SF) *GHI = (80% WF: 20% TNF); WF = Wheat flour, TNF =Tigernut flour*

The values from table 3 showed that the moisture content of the samples ranged from 3.33% - 13.38%. The pastry made with 80% tiger-nut flour and with 20% wheat flour (sample GHI) had the highest value of 13.38 while the pastry made with 100% wheat flour (sample ABC) had the least value of 3.33%.There was significant ($p<0.05$) difference among all the samples. The value is in agreement with the findings of whitely (1971) who reported that moisture content of pastries will be below 5% after baking. Pastries differ from other baked products such as cakes by having low moisture content. Pastries have 1-5% moisture. This low moisture of Pastries ensures that pastries are generally free from microbiological spoilage and have long shelf life if they are protected from absorbing moisture from damp surroundings or atmosphere.

The ash content of the pastries ranged from 0.34%-2.63%. Pastries made with wheat flour + tiger-nut (sample B 50:50) had the highest while that made with 80% tiger-nut flour and with 20% wheat flour (sample GHI) had the lowest (0.019%) ash composition. Sample (GHI) differed significantly ($p<0.05$) from all other sample. The ash content of any food material represents the inorganic elements obtained after the combustion of the organic materials in the food and these inorganic materials are composed of mineral element (calcium, magnesium, iron, phosphorus, etc) which are important for building rigid structures and regulatory functioning of the body.

The fat content in table 14 showed that the values ranged from 35.00% - 37.03%. Significant difference ($p<0.05$) existed among all the samples. Nutritionist commonly classifies dietary fat as either saturated, mono saturated or poly saturated based on the number of double bonds that exist in the fat's molecular structure.

The crude protein values ranged from 8.01% - 14.16%. Sample A had the highest value (14.16%) while sample GHI had the least (8.01%). Thus sample DEF differed ($p<0.05$) significantly from other samples

The % composition of carbohydrate in the pastries samples showed that the values ranged from 40.38% - 52.89% with sample (ABC) having the highest value of 52.89%.

The sample made with tiger-nut flour and wheat flour (DEF) and (GHI) had no significant ($P>0.05$) difference between them but differed significantly ($p<0.05$) from samples (ABC) and (DEF) which had no significant ($p>0.05$) difference between them. Carbohydrates are the most abundant of all organic compounds in the biosphere and this class of compound is literally tagged "hydrate of carbon".

CONCLUSION

The result obtained indicated that pastries made from tiger-nut flour has good nutritional profile with protein, fat, carbohydrate and other nutrients comparable with that of cookies made from wheat flour. Thus, the utilization of tiger nut flour as a baking flour in the industries will reduce the over dependence on conventional baking flour notably wheat flour and will also create a cheap alternative (gluten free product) for people who cannot consume gluten in their diets. Sample GHI (80% WF: 20% TNF) was most preferred. The result for tidbits showed no significant difference ($P<0.05$) in all the samples, substitutions up to 20% were generally acceptable for tidbits

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