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Quality Characteristics of Biscuits Produced From Tiger Nut and Wheat Composite Flour

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***Abstract*— The effect of addition of tiger nut flour to wheat based biscuit was studied. Tiger nut and wheat flours were mixed in the ratio of 0:100%, 10:90%, 20:80%, 30:70%, 40:60%, 50:50% and 60;40% respectively and used to produced biscuits. Chemical, sensory analysis and physical properties were carried out on the biscuits. The addition of tiger nut flour significantly increased (P<0.05), the fat, crude fibre and ash contents of the biscuit ranged between 9.29% to 14.98%, 0.88% to 2.23% and 0.99% to 1.13% respectively.There was a significant decrease (P<0.05) in terms of moisture, protein and carbohydrate content of the biscuits ranging from 8.39% to 7.19%, 10.12% to 6.96% and 70.60% to 67.70% respectively. Although significant differences (P<0.05) existed in terms of the colour, taste, flavor/aroma, texture and overall acceptability of the biscuits. Generally, acceptable biscuits were obtained at up to 20% levels of tiger nut flour substitution. Spread ratio of the different formulation differed significantly (P<0.05) from 8.63 t0 11.94, while the break strength of the biscuit decreased significantly from 295.30Kg to 149,20Kg respectively. However, the addition of tiger nut flours led to significant increase in the spread ratio with concomitant decrease in the breaking strength of wheat biscuit.**

***Index Terms*— Tiger Nut, Wheat Composite Flour .**

I. INTRODUCTION

The idea of compositing was started by Food and Agriculture Organization (FAO), due to increased demand for wheat flour after World War II even in countries where soil climates are not suitable for wheat production. It is inherent to seek raw materials that could compliment wheat in the production of baked goods and this compliment requires the formation of flour mixture from indigenous raw materials that can combine optimal nutritive value with good processing characteristics. Emphasis was however put mainly on the use of ingredients that were already being produced or could be produce in the country of origin. It was reported that hard biscuits, soft biscuits and cookies could be produced with entirely non-wheat composite, and was also reported that 100% of non-wheat flour can be used to produce biscuit which do not depend on gluten for structure, such as cookies, wafers and short cakes (Nwosu, 2013).

In our country (Nigeria), Wheat flour is the major flour used in biscuit production because of its unique protein contents. However, wheat production is limited and its flour being imported to meet local demand for confectionary industries. The use of composite flour for biscuit production will not only cut down cost and reduce our independence on imported wheat but will also improve the quality of the biscuit. It will also stimulate local production and processing of agricultural crops in developing countries such as ours (Sramkova*et al*., 2009). Nigeria being one of the tropical countries cannot grow the wheat in commercial quantity due to the country climate condition. Only three percent of the country's total consumption of this grain can be produced locally, therefore the industry can only survive by utilization of this available of local grains which can either partially or completely substitute wheat in the product without adversely affecting the quality of such product (Sramkova*et al*., 2009)). Tiger nut shall be used as supplement in wheat in varying ratio for baking of biscuit as local alternative flour in biscuit production. In the past, research has been carried out on biscuit production using tiger nut but the quality attributes of the product have not been ascertained hence the study

Biscuits may be regarded as a form of confectionary dried to very low moisture content. They are stable foods and have advantages on long shelf life and good eating quality. Biscuit has also become a post weaning food in many homes especially for the children of nursery and primary age. Biscuit is normally produced from wheat flour, although non wheat flour such as cassava, cereal or their blend could be used. Nutritional quality of biscuit can be enhanced by blending tigernut flour with wheat flour. Tigernut, though low in protein (4.99%), but rich in fibre and other minerals could be good composite flour in production of biscuit.

Tigernut(*Cyprus esculentus*) have been cultivated both as a live as a livestock and for human consumption of the tubers, eaten raw or baked. The tubers are about the size of peanuts and are abundantly produced. Eaten raw, they make a very acceptable snack and have flaour and texture reminiscent of coconut (David, 2005).Tigernut with the inherent nutritional advantages could serve as a good composite with wheat in baking of biscuits. This study was aimed at producing biscuit from tigernut and wheat composite flours and analyzing both physical and sensory properties of the biscuit.

II. STATEMENT OF THE PROBLEMS

The need for this research arises as a result of researcher own observation on the needs to conserve natural food items and make use of local available food materials within the locality in order to enhance food security and conserve foreign exchange. This has resulted in the need to determine through findings on the possibility of blending tiger nut flour with wheat flour in the production of biscuit.

Therefore, it is hoped that when composite flour of tiger nut and wheat are used in the biscuit production, it would go a long way to enhance the nutritional quality of biscuit, reduce

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ingredient quantity of baked goods and to save foreign exchange, ensure food security and elicit the interest of developing countries and Nigeria in particular.

Objective of the study

Major objective:

The main objective of this study is to produce biscuit from wheat and tiger nut flour blends.

Specific objective:

The specific objectives of the study are:

1. To create some sensitization and also look into the prospect of using tiger nut as composite in the production of biscuit
2. To determine the acceptability of tigernut as a supplement for biscuit based on it sensory attributes
3. To determine the proximate composition and quality parameter of the biscuit such as break spread ratio and keeping quality.

Significance of the study

One of the major problems in tropical Africa, Nigeria in particular, is the problem of finding inexpensive, naturally and nutritionally adequate foods that is easy to get, keep and prepare for feeding the growing population. To offset this problem, different forms and type of foods such as snacks and biscuit are imported from foreign countries for this purpose. The finding of this study will reveal the potential of using tiger nut flour as composite in production of biscuit and other baking products.

The result of this study will assist the government and the baking industries to realize that inclusion of tiger nut flour at certain percentage level with wheat flour could result in production of acceptable and good quality biscuits. Also, the economic implication of the study is that biscuit of high quality could be produced at reduced cost and the baking industries can produce at high profit and more foreign exchange will be conserved on the importation of wheat. The study also aimed at increasing the biscuit consumption of Nigerians.

III. Literature Review

Biscuit may be regarded as a form of confectionary dried to a very low moisture content. According to Agu*et al*., (2007), biscuit is defined as a small thin crisp cake made from unleavened dough. Aliyu and Sanni, (2001) described the production of biscuit as fat, sugar and other ingredients mixed together into dough. Biscuit may classified either by the degree of enrichment and processing or the method adopted in shaping them. Based on the enrichment criterion, biscuit may be produced from hard dough, soft dough or from batters (Agu*et al*., 2007).

History and Distribution of Tiger Nut

Tiger nut (*Cyprus esculentus)*, is a weed from Cyprus. It is Otherwise Known as earth tiger nut and is an underutilized crop almond. There are two types; the dark or black type and the light brown or yellowish type. Each type may be eaten raw or roasted or processed into a drink commonly referred to as "Kunuaya" in Northern Nigeria.

Tiger nut is not really a nut but a small tuber, first discovered some 4,000 years ago. It has many other names like zulu nut, yellow grass nut, ground almond, edible rush and nut. The genus name Cyprus is from Cyprus, the ancient Greek name for this genus. The species name esculentus is Latinand mean edible. Tiger nut have been cultivated both as a livestock food and for human consumption of tubers, eaten raw or baked. The tubers are abundantly produced, eaten raw and they make a very acceptable snack and have flavor and texture reminiscent of coconut.

Chemical composition of tiger nut

Tiger nut has long been recognized for their health benefits as they are high in fibre, protein and natural sugars. They have high content of soluble glucose. They are rich in minerals such as phosphorus and potassium and in vitamin E and C. It is believed that they help to prevent attack, thrombosis and cancer especially of colon. They are thought to be beneficial to diabetic and those seeking to reduce cholesterol or loss of weight. They very high fibre contents combined with delicious taste make them ideal for healthy eating. Typically, 100% of tiger nut contain 386 kcal (1635 Kj), it has 7% protein, 26% fats (oil), 31% starch, 21% glucose. They contain 26% fibre of which 145 is non-soluble and 12% soluble (Adejuyitan, 2011)

Wheat (*Triticumaestum*) History and Distribution

Wheat is one of the first cereals known to have been domesticated. It is found at the medium and high altitudes in the tropics and it is primarily classified a temperate crop. Wheat has been cultivated and used as source of food for more than 6,000 to 8,000 years. Man developed milling and baking techniques since 3,000 to 4,000 BC in Mesopatamia and Egypt (Bibiana et al., 2014). Today, the baking industries are producing many diverse products worldwide, including biscuits and when dried biscuit can be stored for a relatively long period of time (Shewry, 2009).

Nutritional composition of wheat

100g of hard red winter wheat contain about 12.6g of protein, 8.33g of dietary fibre, and 3.2g of iron (17% of daily requirement); the same weight of hard red spring wheat contain about 15.4g of protein, 1.9g of total fat, 68g of carbohydrate (by difference), 12.2g of dietary fibre and 3.6mg of iron (20% of daily requirement) (Dhingra and Jude, 2007).

Utilization of wheat

Wheat is widely cultivated as a cash crop because it produces a good yield per unit area, grow well in a temperate climate even with a moderately short growing season, and yield a versatile, high quality flavor that is used mainly to produce wheat for the formulation of animal feeds and semolina. Farinha flour and semovita from wheat are used for other preparation purposes such as bread, biscuit, pies, rolls, doughnuts, crackers etc. Wheat is also used as an ingredient in breakfast cereal, macroni, adhesive and other products (Dhingra& Jude, 2007)

Importance of composite flour products

As reported by Sanchez-Zapata *et al.,* (2012), composite flour may be used in a variety of baked products for the following reasons

- To reduce ingredient cost
- To improve the use of non-wheat flour plants operating beyond capacity
- To boost nutritional quality of baked goods

- To save foreign exchange and elicit the interest of developing countries (FAO, 2010).

IV. MATERIALS AND METHODS

Sources of raw materials

Wheat flour, tigernut (light brown variety), baking powder, baking fat (margarine), granulated sugar, salt and flavor that were used for this research were obtained purchased at Okene central market, Okene, KogiState, Nigeria.

Sample preparation

The tiger nut was sorted to remove the unwantedmaterials like pebbles, stone and all foreign seeds and then washed in a clean tap water. The cleaned nuts were then spread in a tray and oven dried at 60^{o}C for six hours to a moisture content of 13%. The dried tiger nut was milled and the flour obtained was sieved using 0.0006um aperture size. The biscuits were produced by blending 10, 20,30,40, 50 and 60% of tiger nut flour with 90,80,70,60, and 40% wheat flour respectively. While reducing baking fat in the same ratio, other ingredients remain constant.

Baking Biscuit

The various blends formulated from the mixture of wheat and tiger nut flour was mixed separately with the same quantity of other ingredients (sugar, baking powder, water, baking fat, salt and food colour). The fat was creamed with sugar until fluffy, the other ingredients were added. Water was added until the desired texture of the batter was obtained. The batter was kneaded on a table with a rolling stick until the desired thickness was acquired. The batter was cut to round shape with the aid of biscuit cutter. It was baked in the oven at 200^{o}C for 10 minutes, cooled and packaged.

Analyses

The moisture content, crude protein, crude fibre, crude fat and ash content of biscuit were all determined by the method of AOAC (2010); while carbohydrate was determined by difference (Ihekoronye&Ngoddy, 1985). Spread ratio was determine according to (Gomeaz*et a*l., 1997). Break strength was determined by method of (Okaka&Isiel, 1999).

Data analysis

All data obtained were subjected to analysis of variance (ANOVA) and separation of means using pre-packaged computer software (MINTAB 15).

V. RESULTS AND DISCUSSION

Table: 1Effect of addition of varying tiger nut flour on the proximate composition of tiger nut/wheat based biscuits (%)

Sample	Moisture	Protein	Crude Fat	Crude	Fibre Ash	Carbohydrate
A	8.39^{a} ± 0.43	10.12^{a}± 0.16	9.29^{b} ± 0.43	0.88^{d} ± 0.04	0.99^{d} ± 0.04	70.60^{a} ± 1.62
B	8.13^{a}± 0.15	9.97^{a}± 0.07	9.46^{b} ± 0.37	0.95^{d} ± 0.08	1.03^{d} ± 0.02	70.46^{a} ± 1.43
C	8.00^{a}± 0.23	9.92^{a}± 0.05	9.96^{b} ± 0.01	1.24^{c} ± 0.01	1.05^{d} ± 0.02	69.83^{a} ± 1.39
D	7.85^{b} ± 0.22	9.24^{a}± 0.09	10.35^{a} ± 0.23	1.97^{b} ± 0.07	1.08^{d} ± 0.15	69.57^{a} ± 1.64
E	7.61^{b} ± 0.14	8.00^{b}± 0.00	12.94^{a} ± 0.34	2.06^{ab} ± 0.08	1.10^{e} ± 0.05	68.29^{a} ± 0.06
F	7.35^{b} ± 0.35	7.40^{b}± 0.74	14.17^{a} ± 0.32	2.08^{ab} ± 0.09	1.11^{e} ± 0.06	67.83^{a} ± 2.06
G	7.19^{b} ± 0.21	6.96^{b}± 0.41	14.98^{a} ± 0.32	2.24^{a} ± 0.07	1.13^{e} ± 0.08	67.70^{a}± 0.91
LSD	0.36	0.98	1.24	0.15	0.14	0.05

Values are means + standard deviations of duplicate determine. Means with the same superscript within the same column are not significantly (P>0.05) different

Keys: A= 100% wheat flour, B = 90% wheat flour + 10% tigernut, flour C = 80%wheat flour + 20% tiger nut flour, D = 70% wheat flour + 30% tiger nut flour, E = 60% wheat flour + 40% tiger nut, Flour F = 50% wheat flour + 50% tiger nut flour, G = 40% wheat flour + 60% tiger nut flour

Table 2 : Effect of addition of varying tiger nut flour on the physical properties of tiger nut/wheat based biscuit

Sample	Spread Ratio (D/M)	Break Strenght (g)
A	8.63^{b}	159.3^{a}
B	9.71^{a}	238.9^{b}
C	10.23^{a}	209.1^{c}
D	11.28^{a}	198.6^{a}
E	11.24^{a}	180.5^{c}
F	11.42^{a}	169.5^{f}
G	11.94^{a}	149.2^{e}

Table 3: Sensory Attributes of tiger nut/wheat based biscuit

Sample	Taste	Texture	Appearance	Aroma	Overall Acceptability
A	$7.41^{a} \pm 0.20$	$7.10^{a} \pm 0.10$	$7.60^{a} \pm 0.10$	$7.80^{a} \pm 0.10$	$7.71^{a} \pm 0.10$
B	$7.20^{a} \pm 0.20$	$6.81^{a} \pm 0.25$	$7.12^{a} \pm 0.10$	$7.20^{a} \pm 0.10$	$7.40^{a} \pm 0.05$
C	$7.20^{a} \pm 0.25$	$6.91^{a} \pm 0.15$	$6.10^{b} \pm 0.20$	$7.30^{b} \pm 0.10$	$6.50^{b} \pm 0.10$
D	$6.80^{b} \pm 0.25$	$6.80^{a} \pm 0.10$	$6.91^{b} \pm 0.10$	$6.80^{c} \pm 0.15$	$6.31^{b} \pm 0.05$
E	$6.32^{b} \pm 0.15$	$6.22^{b} \pm 0.15$	$6.51^{b} \pm 0.10$	$6.60^{c} \pm 0.05$	$5.91^{c} \pm 0.00$
F	$5.90^{c} \pm 0.10$	$5.90^{c} \pm 0.05$	$5.30^{b} \pm 0.10$	$5.66^{c} \pm 0.14$	$5.60^{c} \pm 0.05$
G	$6.00^{ab} \pm 0.10$	$6.00^{ab} \pm 0.05$	$6.30^{ab} \pm 0.10$	$6.00^{ab} \pm 0.14$	$6.22^{ab} \pm 0.05$

Means in the same column bearing different superscript are significant difference P<0.05

Key

Sample A: 100% wheat flour to 0% tiger nut flour
B: 90% wheatflour to10% tiger nut flour
C: 80% wheat flour to 20% tiger nut flour
D: 70% wheat flour 30% tiger nut flour
E: 60% wheat flour 40% tiger nut flour
F: 50% wheat flour 50% tiger nut flour
G: 40% wheat flour 60% tiger nut flour

Table 1 shows the effect of addition of varying tiger nut flour on the proximate composition of Tiger nut/wheat based biscuit while table 2 and 3 shows the physical properties and sensory attributes Of tiger nut/wheat based biscuit. The 10% and 20% tiger nut and as well as 90% and 80% wheat flour Biscuit compared positively with 100% wheat flour only biscuit. The addition of tiger nut flour Significantly increased (P>0.05) the fat, crude fibre and ash content of the biscuit from 9.92% to 14.98%0.88% to 2.23% and 0.99% to 1.13% respectively. Although, significant differences (P>0.05) existed in terms of colour, taste, flavor, texture and overall acceptability of the biscuit. Generally, acceptable biscuitwere obtained at up to 20% levels of tiger nut flours substitution. Spread ratio of the differentformulations differred significantly (P<0.05) from 8.63 to 11.94 respectively while the break strengthof the biscuit decreased significantly (P<0.05) ranging from 259.30Kg to 149.2okg respectively. However, the addition of tiger nut flour led to significant increases in the spread eatio with concomitants decreasein the breaking strenght of tiger nut/wheat based biscuit.

VI. Conclusion and Recommendation

Conclusions

From the results of this study, it is inferred that acceptable and good quality biscuits could be produced from composite blends of wheat and tiger nut flour, since the biscuit competed favourably with biscuit from 100% wheat flour (control) in terms of proximate composition, physical characteristics and sensory properties. Therefore, substituting wheat flour with 10% to 20% tiger nut flour gives better and more acceptable biscuits in term of sensory attributes.

Inclusion of tiget nut flour in wheat flour at level of 10 to 60% resulted in a notable increase in fibre and ash content while protein content defreased. The significant increase in the fibre content could be nutritionally advantageous in Nigeria where biscuits is one of the commonest staple among all classes of people.

The economic implication of this study, is that biscuit of good quality could be produced ata reduced cost and made available to consumers at affordable price. The biscuit producer however can produce at high profit margin and more foreign exchange can be conserved on the importation of wheat because tiger nut are available in higher quantities. More so, Nigerians are good consumer of biscuits, therefore tigrnut /wheat based biscuit will serve as a means for increasing their biscuit consumption.

Recommendations

- From the result of this study, it could be suggested that tiger nut flour might find useful application in baking industries in Nigeria and therefore should be encouraged.
- Substitution of tiger nut flour at 10% and 20% level should be embarked on by biscuit industries.
- Since quality biscuits can be produced from composite flour of tiger nut and wheat flour blends, the biscuit industies should embarked in the use of the composite flour to help conserving foreign exchange used in importation of wheat flour.

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