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ASSESSMENT OF MINERAL COMPOSITION AND SENSORY PROPERTIES OF COOKIES AND MEAL MADE FROM CYPERUS ESCULENTUS AND COCOS NUCIFERA L FLOUR

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Abstract

The aim of this research was to assess the mineral and sensory properties of cookies and meal made from coconut and tiger-nut flour. The tiger-nuts and coconut seeds were bought from Oghwagbe market (Oja Ikoko). The tiger-nut were sorted, milled into flour, sieved, and then packaged in a polyethylene bag prior to baking of cookies while coconut was cracked, shelled and grated to form flour. The tiger-nut flour was mixed with coconut and oat flour with different ratios: tiger-nut-40%:coconut-40%:oat-20% as sample A, tiger-nut-60%:coconut-20%:oat-20% as sample B. The mineral composition and the sensory properties were carried out using AOAC. The result of the sensory evaluation shows no significant difference between all the samples at P-value ≤ 0.05. As regarding mineral composition, only magnesium and manganese showed homogeneity of variance as assessed by Levene's Test for equality of variance among all the mineral tested, with sample A (mean = 17.26± 0.006) having significantly higher magnesium than sample B (mean = 16.8± 0.225), t(4) = 3.07, p-value = 0.037. Sample B has a higher manganese (mean = 1.04± 0.038) than sample A (mean = 0.92± 0.002), t(4) = -5.39, p-value = 0.006. Conclusively, this study found that composite flour derived from coconut and tiger nut flour blends might be used to make nutritious and acceptable cookies and flour meal no matter the ratio of combination. It was, therefore, recommended that cookies and meals made from tiger nut and coconut should be encouraged for consumption.

Keywords: Cookies, Tiger nut, Coconut, Mineral composition, Sensory properties

Introduction

Cookies (also known as biscuits in some countries) are convenient food items that can be fortified with proteins for malnourished people (Mepba, Ebo, Aron and Ukpabi, 2009). They are baked flour confectionery dried down to low moisture content (Akajiaku, Kabuo, Alagbaoso, Orji and Nwogu, 2018). Cookies contain many of the same ingredients as cakes except that they have a lower proportion of liquid with a higher proportion of sugar and fat to flour. Making cookies is the process of transforming simple components into amazing things. Cookie recipes are likely to be more varied than those for any other form of baked product (Akajiaku et al., 2018). They have high sugar content, with some containing up to 37.5% sugar. Cookies' calories are derived from basic ingredients such as refined flour, sugar, baking powder, salt, and the butter or oil used in the cooking process (Maltz, 1996). Cookies can be made in a variety of shapes, flavors, and textures, and they can also be decorated. Every country appears to have a preference, such as chocolate chip in North America, shortbread in the United Kingdom, sables and macarons in France, and biscotti in Italy.

Cyperus esculentus(Tiger-nut), also known as sedge, chufa, earth-almond, nut grass, and nut sedge, is a sedge family crop found in many parts of the world. In Nigeria, it is referred to as Aya, immumu, Ofio, and Aki by the Hausas, Yorubas, Efiks, and Igbos, respectively (Bamshaiye, Adegbola and Bamishaiye, 2011). It is an underutilized crop that belongs to the Magnoliophyta division, class Liliopsida, order Cyperales, and family Cyperaceae and was discovered to be a worldwide perennial crop of the same genus as the papyrus plant (Odoemelam, 2003). Tiger-nut is a well-known plant food that is popular in West Africa, particularly Nigeria, Mali, Niger, Ghana, and Togo, where it is primarily consumed raw as a side dish (Omode, Fatoki and Olaogun, 1995). It is also used to make horchata in Florida. According to Temple, Ojobe and Kapu (1990), although tiger-nut is underutilized, its high crude lipid and carbohydrate contents, as well as its relatively good amino acid composition, makes it a desirable source of sustenance for humans.

Cocos nucifera L (Coconut) has been described as the most significant and widely developed palm tree, providing complete nourishment to a vast number of people, particularly in tropical and subtropical areas. The Philippines, Ceylon, India, Malaysia, Oceania, and areas of West Africa, notably Ghana and Nigeria, are among the major coconut producing countries (Prades, Dornier, Diop and Pain, 2012). All elements of the plant are valuable and sustain human life in numerous ways (Chan and Elevitch, 2006; Bourdeix, Konan and N'cho, 2005). Coconut is not only recognized for its meat, milk, and oil, but it is also a good source of flour and is frequently used as a substitute for wheat flour. Coconut flour is a fine flour-like substance derived from coconut mash that is a by-product of the coconut milk manufacturing process. Coconut flour, like wheat flour, can be used to make a wide variety of delicious breads, pies, cakes, nibbles, and sweets. It provides more calorie-free fiber than other wheat options and serves as a potential source of protein with significant dietary benefit (Fife, 2005; Djidjor, Opoku, Mohammed and Karikari, 2020).

Several years ago, the idea of substituting wheat flour in cookies was suggested and indigenous non-wheat flours have been utilized to replace percentages of wheat flour in the manufacture of biscuits (Tigernuts Traders, 2009). Despite some success, consumer acceptance of these composite-flour biscuits has been lacking.

The untapped commercial potential of tiger-nut has inspired a significant interest in its flour selection for cookies production. Although there have been many studies on finding alternatives to wheat in the manufacturing of cookies, there has been no study on the use of coconut and tigernut as composite flour in the production of cookies, thus this research was carried out to assess the mineral and sensory properties of cookies and meal made from coconut and tigernut flour.

Materials and methods

Flour preparation

Coconut, tigernut and oat were purchased from Oghwagbe Market (Oja Ikoko) in Owo, Owo Local Government Area, Ondo State, Nigeria. The tiger-nuts were sorted to remove dirt, stone and bad seeds. The brown variety had initial moisture content of about 32% (wb), until it was further reduced to desired rate and was used for the flour.

The dried brown tiger-nuts were weighed, and put into already heated oven at a temperature of 105C for 25min. Total weight before drying was1.5kg and after drying, it decreased by 5g. The resultant tiger-nuts were milled into flour. The flour was packaged into a polyethylene bag prior to baking of cookies and meal.

Coconut (Cocos nucifera) purchased from Oja Ikoko which was 10–12 months of age was cracked and shelled. Then, it was grated with grater made by Nhat Minh Thanh Ltd. and the particle size of grated coconut meat was 1 mm. Approximately, from 3 coconut fruits, 1,000 gram of grated coconut was obtained. Water was added to the grated coconut meat with ratio of grated coconut meat to water being 1:1 (w:w) and was washed to remove any dirt. The grated coconut was sundried for 3 days and was milled into flour and the coconut flour was dried by hot air at 60oC in 3 hours in cabinet dryer with 1 cm of thickness. From 1,000 grams of grated coconut meat, 450 grams of coconut flour (50.1 % w/w of moisture) was recovered.

Dough preparation

Tiger-nut flour was mixed with coconut flour and oat flour with different ratios: tiger-nut-40%:coconut-40%:oat-20% as sample A, tiger-nut-60%:coconut-20%:oat-20% as sample B.

Then, the mixture of flour was mixed with the other ingredients as in Table 1.

Table 1: Mixture of flour with other ingredients

Ingredients	(grams)
Tiger-nut flour	100
Coconut flour	80
Oat flour	50
Margarine	80
Sugar	30
Milk flavour	5
Egg	44
Salt	1.4

Source: Field Experimentation, 2023

The mixture was kneaded for 2 minutes. It was then cut into different shapes and baked for 10 minutes then cooled.

Tiger-nut, coconut and oat flour
↓
Weighing
↓
Mixing
↓
Kneading
↓
Cutting
↓
Baking
↓
Cooling

Sensory evaluation

Larmond (1977), sensory evaluation method was adopted, using a twenty-member panel (10 males, 10 females) consisting of students from the Department of Nutrition and Dietetics, Rufus Giwa Polytechnic, Owo. The selection was based on their knowledge and consumption of cookies. The selected students were asked to evaluate the samples using a 5-point hedonic scale method; (that is 1 = dislike very much, 2 = dislike slightly, 3 = neutral, 4 = like slightly, 5 = like very much). The sensory evaluation was based on appearance, colour, aroma, flavour, taste and general acceptability. The panellists were instructed to taste the samples and rinse their mouth with water after each sample taste and then expressed their feelings on a 5-point hedonic scale.

Determination of Minerals Content

Samples of cookies (2.5g) were weighed out into beakers and ashed at 550°C overnight. The resulting white-ash residue was dissolved in 4 ml of concentrated hydrochloric acid and filtered into a 10 mL volumetric flask to volume made up with distilled water. The resulting extract was then subjected for the analysis of their content of specific major minerals. Analyses were performed in triplicate. Iron (Fe) was determined with an ICP-OES (Skunjins, 1998).

The experimental conditions of the ICP-OES were: instrument ICP-OES (Varian-Vista), RF Power 0.7 - 1.5 kw (1.2 - 1.3 kw for Axial), Plazma gas flow rate (Ar) 10.5 - 15 L/min (radial) 15 L/min (axial), auxiliary gas flow rate (Ar) b1.5 L/min, Viewing height 5 - 12 mm, copy and reading time 1 - 5 s (max 60 s), copy time 3 s (max 100 s). The other elements Na, K, Mn, Mg, Ca, Zn and Cu were determined by atomic absorption spectrophotometer (Pharmacia biotech Ultraspec 4000) American Association of Cereal Chemists (AACC 1995). For the determination of selenium content, the mineralization of the powder (1g) in closed system was carried out by acid digestion [2 mL, HNO3 + HCl (1/1)] in a furnace microwave and the solutions obtained were analyzed for selenium content with a ICP-CCC equipment

(Varian vista) equipped with the Coupled Charge Device detector (Skunjins, 1998). Standard curves made from known concentrations of selenium were used for this purpose.

Statistical Analysis

The data were analyzed using SPSS version 26.0. The mean and standard error of mean (SEM) of the duplicate analysis was calculated. Independent T-test was performed to determine the significant differences between mean at significant level of P = 0.05.

Results and Discussion

Results

Sensory properties of cookies and meal produced from coconut and tiger-nut flour

The result of the sensory properties of cookies and meal produced from tiger-nut, coconut and oat flour is presented in table 2.The result shows no significant difference between all the samples at P-value ≤ 0.05.

Table 2: Sensory properties of cookies and meal produced from tiger-nut, coconut and oat flour

Samples	Appearance	Taste	Flavor	Texture	Aroma/smell	Overall Acceptability
CK	4.27±0.704	3.87±0.915	3.80±1.082	3.53±0.99	4.00±0.845	3.70±1.059
ML	4.2±0.775	3.87±1.187	4.13±1.06	3.6±1.183	3.60±0.737	3.80±0.789

Values with the same superscript are insignificant at P-value = 0.05, values with different superscript are significantly different at P-value =0.05.

Key:
CK= Cookies 40:40:20
ML= Meal 60:20:20

Mineral Composition of Cookies and Meal produced from Tigernut and Coconut

Table 3 presents the result of the mineral composition of cookies and meal produced from coconut and tigernut. From the result, only magnesium and manganese showed homogeneity of variance as assessed by Levene's Test for equality of variance among all the minerals tested, with sample A (X = 17.26, SD = 0.006) having significantly higher magnesium than sample B (X = 16.8, SD = 0.225), t(4) = 3.07, p-value = 0.037 while sample B has a higher manganese than (X = 1.04, SD = 0.038) than sample A (X = 0.92, SD = 0.002), t(4) = -5.39, p-value = 0.006. However, all other minerals measured showed non-homogeneity of variance as assessed by Levene's Test for equality of variance.

Table 3: Mineral composition of cookies and meal produced from tigernut, coconut and oat flour (mg/kg)

Samples	Na(mg)	Ca(mg)	K(mg)	Fe(mg)	Mg(mg)	Cu(mg)	Mn(mg)	Zn(mg)
CK	79.80±0.100	102.35±0.150	315.45±0.150	0.41 ± 0.001	17.26 ± 0.006	0.21± 0.001	0.92±0.002	0.22±0.000
ML	72.45±0.050	106.60 ± 0.100	219.35 ± 0.150	1.32 ± 0.001	16.80 ± 0.255	0.22 ± 0.002	1.04±0.038	0.25±0.005

CK= 40%coconut-40%tigernut-20%oat, ML = 60%coconut-20%tigernut-20%oat

Key:
CK= Cookies 40:40:20
ML= Meal 60:20:20

Discussion

The result of the sensory properties of the composite cookies in this research showed that there is no significant difference in all the sensory properties examined at P-value ≤ 0.05. This implies none of the samples is significantly preferred in terms of any organoleptic characteristics assessed by the panelists. This

could be because the cookies are made up of the same primary ingredients containing similar nutrients and phytochemicals (although in different quantities) so the change in proportion of the constituent ingredients had not caused considerable change in organoleptic sensations towards the CK. McCrickerd and Forde (2016) argued that a food sensory appeal is largely determined by the physical and chemical properties that are sensed before and during consumption, which informs initial acceptance and the degree to which a food will be consumed.

This result is in agreement with the work of Akujobi (2018) who did not see significant difference in the sensory properties of cookies produced from coconut and tiger-nut flour blend. The concentration of micronutrients on all the tested samples ranges between potassium (315.45) in CK and cupper (0.22) in ML respectively. The result showed a significant homogeneity of variance in magnesium and manganese composition of the cookies and meal at P-value ≤ 0.05. This is an indication that varying mineral composition are in the ingredients used to produce the cookies. Akujobi (2018) and Alebiosu et al. (2020), in their separate work had reported significant changes in cookies mineral content with the addition of tigernut and coconut respectively. Further, the result showed that CK have significantly higher amount of magnesium, than ML while ML on the other hand have significantly higher manganese quantity than CK. It may be because of the difference in proportion of coconut in the samples. However, the insignificant difference in other mineral measured among the two samples could be an indication that both coconut and tigernut are both having high mineral content. This corroborates the claims of Akujobi (2018) and Alebiosu et al. (2020) who had both in their different work, claimed that both tigernut and coconut account for increase in mineral content of cookies.

Conclusion and Recommendation

This study found that composite flour derived from coconut and tiger nut flour blends could be used to make nutritious and acceptable cookies and flour meal no matter the ratio of combination. The usage of such composite flour might lessen Nigeria's reliance on wheat flour, which is typically imported. This research also implies that incorporating tiger nut and coconut flour into other starchy roots and tubers-based staple meals might significantly boost their protein and energy contents which invariably ease Nigerian protein energy malnutrition problem. Sensitization should be done by the government and its agencies on the importance of local ingredients to the populace especially the poor citizens who cannot afford the exotic flour products.

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