NUTRITIONAL COMPOSITION AND SENSORY EVALUATION OF PEANUT COATED WITH COMPOSITE FLOUR (WHEAT AND SORGHUM) AND DATE SYRUP.

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Abstract

Snack foods are inexpensive, easy to prepare, and widely accessible in public places including streets, shops, and schools. The main goal of the study was to determine the effects of coating peanut with composite flour of wheat, sorghum and date syrup on the proximate composition, mineral content, and sensory qualities of the peanut snacks. The formulations of the mixes used to make the coated peanuts were 90: 0: 10%, 80: 10: 10%, 70: 20: 10%, 60: 30: 10%, and 50: 40: 10% (wheat flour, sorghum flour, and date syrup respectively). The moisture, ash, fat, crude fiber, crude protein, and carbohydrate content of the coated peanut ranged from 3.51 to 5.30%, 3.37 to 5.28%, 18.13 to 29.64%, 4.14 to 5.88%, 24.90 to 32.48%, and 23.19 to 44.15% respectively. As the addition of sorghum flour and date syrup increased, the protein, crude fiber, and carbohydrate contents of the coated peanuts increased, but the moisture, lipids, and ash contents decreased. Increased in sorghum flour and date syrup also resulted into increased in potassium, phosphorus, iron, and magnesium content of the coated peanut snacks. For sensory analysis, there were no significant differences ($p > 0.05$) between the peanut samples in terms of color, appearance, taste, aroma, crunchiness, overall acceptability, and willingness to buy. The 80:10:10 blend gave coated peanuts that were the most preferred for all the parameters. The coated of peanuts with wheat flour, sorghum flour and date palm increased the nutritional and sensory quality of the product.

Keywords: Peanuts; snacks; proximate composition; date palm syrup

Introduction

Snacks are inexpensive, easy to prepare, and widely consumed in between meals in public places. Rapid population growth and urbanization are among major reasons the demand for nutritious snacks has gained research attention in both developed and developing countries (Ugwuanyi, et al., 2020). Snacks contribute an important part of many consumers' daily nutrient and caloric intake (Awoyale et al., 2011). Snacks are usually low in calorie foods and micronutrients. Health promoting nutritious snacks would help reduce the risk of many preventable life-style related diseases.

Peanuts (*Arachis hypogaea*) as a legume originate from South America but are now widely cultivated throughout the world. Peanuts are frequently used to create new and improved culinary products (Adeboye et al. (2018). According to Asibuo et al. (2018) peanut kernels contain roughly 50–55% oil, 25–28% protein, and 19–21% carbohydrates. Peanuts are high in energy due to their high fat contents, but are also prone to rancidity and off-flavor development. In addition to serving as a vehicle for flavoring agents and additives like antioxidants, edible coatings on roasted peanut may also prevent moisture loss and oxygen diffusion and increase consumer acceptability of flavoring applications (Babalola, et al., 2021). The distinct flavor of roasted peanut products contributed to their high level of customer acceptability. A fairly easy crunchy snack is a peanut burger. Although some Nigerians refer to this food as "coated peanut" or "groundnut burger," it is just dusted with flour and sugar. Addition of nutrient-dense cereals, grains, and pulses to peanut burgers, will not only prevent rancidity and so extend the shelf life of the peanuts but also safeguarding the consumer's health.

Wheat flour is one of the cereal flours that is frequently used to make quite a number of snacks. About 20% of the food calories consumed by individuals worldwide come from wheat, which is a staple in many nations. The majority of breads, cookies, biscuits, cakes, macaroni, spaghetti, and many other hot and cold morning dishes are also made from wheat. With the exception of lysine, tryptophan, and methionine, wheat grains provide a good source of all important elements and appropriate levels of all essential amino acids. Albumins, globulins, gliadins, and glutenins are all components of wheat protein (Shittu & Tanimu, 2012).

Sorghum (*Sorghum bicolor*) is an industrially under-utilised crops in sub-Saharan Africa. According to Elemo and Okafor (2011), sorghum grain is a significant staple in many African nations as well as India and China. For millions of the most vulnerable people in these areas, it serves as their primary source of calories, protein, vitamins, and minerals (Abdelghafor et al. 2011). It is ranked third among cultivated cereals for human consumption. It is the grain of choice when making traditional African brews. In comparison to un-malted sorghum, malted sorghum has higher levels of metabolizable energy, protein, soluble sugar, and lysine. Sorghum contains anti-nutrients; however, soaking, malting, and fermentation processing procedures have been shown to limit the presence of anti-nutrients in legumes, grains, roots, and tubers (Ogbonna et al., 2012).

The Arecaceae family of plants includes the date palm (*Phoenix dactylifera*), which is a multifunctional tree that provides fiber, carbohydrates, minerals, and vitamins in addition to having certain therapeutic characteristics (Al-Farsi et al., 2005). One of the most popular fruits, dates include an incredible array of vital vitamins, minerals, and elements needed for healthy growth, development, and general wellbeing. The body receives rapid energy from sources of natural sugar like glucose, fructose, and sucrose. According to El-Sohaimy and Hafez (2010), the protein in dates comprises 23 different types of amino acids, some of which are absent from the most common fruits like oranges, apples, and bananas.

Majority depends on snack foods because of the urbanized lifestyle of recent years. Nutritional deficits that have health consequences results from over-reliance on snack for calorie intake (Olusanya et al., 2023). More also, due to the food industry's heavy reliance on wheat imports, it is necessary to find an alternative flour that may be utilized in place of wheat flour. The utilization of composite flour is necessary to simultaneously boost local crops production and money generating, this study activity will promote the utilization of underutilized tropical crops (sorghum and date palm). This study focused on the nutritional and sensory evaluation of peanuts coated in composite flour (wheat and sorghum) and date syrup.

MATERIALS AND METHODS

Source of materials

Sorghum grain and date palm used were obtained from Mile 12 market in Lagos, Lagos State. Wheat flour, fresh groundnut, granulated sugar, egg and salt were purchased in a retailer store in Ilaro, Ogun State.

Sample Preparation

Malted-sorghum flour

The method outlined by (Bolarinwa et al., 2015) was used to produce the malted-sorghum flour. To get rid of extraneous objects like sand and dirt, the sorghum grains (2 kg) were sorted and cleaned with potable water. The clean grains were steeped in water for 12 hours and then given four days to germinate. The seeds that did germinate were dried at 60^0C in a cabinet dryer to a moisture content of 10-12% while the non-germinated grains were discarded. The malted grains were dried, milled, sieved, and packaged in zip-lock prior to use.

Date Palm syrup

Date syrup was prepared using the technique outlined by Al-Farsi et al. (2005). The seeds were removed by opening fresh date palm. The date flesh was ground into a fine paste, and then the desired components were separated from the unwanted ones using a centrifuge at 300 rpm. Debris was gathered near the tube's bottom, while date skins and other fibrous materials are above it. The layer above this one is lighter in color, followed by a clear liquid that contains sugar and other soluble solids, and then there is a thin film of materials that may contain fat.

Table 1: Coating mixes proportion (%)

	Samples				
Flour	**A**	**B**	**C**	**D**	**E**
Wheat flour	90	80	70	60	50
Sorghum flour	0	10	20	30	40
Date syrup	10	10	10	10	10

SAMPLE KEY**:**
A = 90% wheat and 10% date syrup
B = 80% wheat, 10% sorghum and 10% date syrup
C = 70% wheat, 20% sorghum and 10% date syrup
D = 60% wheat, 30% sorghum and 10% date syrup
E = 50% wheat, 40% sorghum and 10% date syrup

Production of Peanuts coated with Composite Flour (Wheat-Sorghum-Date Syrup)

The ingredients for the peanut burger were peanut, wheat flour, sorghum flour, date syrup, egg, and salt. Christina (2016) described a modified method for making peanut burgers. Fresh peanuts were cleaned, sorted, blanched for 15 minutes at 100°C, filtered, and air-dried for 24 hours at room temperature (20°C - 27°C). As previously mentioned, 100 grams of date syrup were blended with whisked eggs, 3 grams of iodized salt, and various amounts of sorghum and wheat flour before being dusted on the peanuts. The process was repeated until all the peanuts were uniformly coated, then the coated peanuts were deep fried at 180 ^{0}C to golden brown colour. The peanut snacks were cooled and packed in airtight containers prior to use.

Proximate Analysis

The proximate analysis was performed on peanut snacks coated with flour blends made of wheat, sorghum flour and date syrup. The coated peanuts tested for protein, crude fiber, crude fat, ash and moisture using AOAC, 2012 methods. The amount of carbohydrates was calculated as [100 - (protein, moisture, ash, fiber, and fat contents)] difference.

Mineral Determination

The mineral elements were identified using the AOAC (2010) technique. A 125 ml Erlenmeyer flask that had already been cleaned with acid and distilled water was used to weigh 1.0 g of the sample, which was baked dry at 60°C. Under a fume hood, 4 ml of perchloric acid, 25 ml of conc. HNO_3, and 2 ml of conc. H_2SO_4 were added. It was heated continuously until thick, white vapors appeared. Allow the flask to cool, add 1-2 ml of concentrated HNO_3, and digest once more to the fuming stage if any traces of carbon are still present. Lastly, it was heated vigorously (medium to high heat) for 30 seconds. After allowing it to cool, 40–50 ml of distilled water was added. On the same dish, it was then allowed to a boil for 30 sec. over medium heat. With the use of a wash bottle and a 100ml pyrex volumetric flask, totally cool and filter the solution. The amounts of phosphorus, magnesium, potassium, and iron in the peanut snacks following digestion were measured using an atomic absorption spectrophotometric (Thermo scientific S Series Model GE 7123454).

Sensory Evaluation

Twenty-five (25) semi-trained panelists carried out the sensory evaluation of the peanut snacks for customer acceptance and preference. Using a 9-point Hedonic scale, where 1 denotes "extremely dislike" and 9 denotes "extremely like," they were required to assess the sensory attributes based on taste, color, texture, flavor, aroma, and overall acceptability. Water was used by the panelists to rinse their mouths after each sample evaluation during the sensory evaluation in order to clear their palates.

Method of Data Analysis

The data obtained were statistically analysed for means and standard deviation and Analysis of Variance (ANOVA) were done for test of level of significance. Duncan's Multiple Range Test was used to compare and separate means. Significant difference was evaluated at 5% probability level.

Results and Discussion

Discussion on the proximate composition of the peanut snacks coated with composite flour (wheat and sorghum) and date palm syrup

The proximate composition of the peanut snacks coated in composite flour (wheat and sorghum) and date palm syrup is shown in Table 2. All of the parameters showed a significant difference. The coated peanuts' moisture content varied from 3.51 to 5.30%. The peanuts with the highest moisture contents were sample B (80% wheat, 10% sorghum, and 10% date syrup) and sample C (70% wheat, 20% sorghum, and 10% date syrup), with values of 5.30% and 4.84%, respectively. It has been found that increasing the amount of sorghum flour also increases the moisture content. While samples D (60% wheat, 30 % sorghum, and 10 % date syrup) and E (50% wheat, 40% sorghum, and 10% date syrup) had the lowest moisture content—3.51% and 3.93%, respectively. Many foods' moisture content serves as an index for their water activity. The high moisture level of the samples could make the foods less dense in nutrients and calories. According to Gebrezgi (2018), the moisture content of ready-to-eat foods varied from 6.71 % to 8.90%, and the findings of this study's moisture content were consistent with that information. The mixed flour's moisture level is within the FAO/WHO recommended range (10%). According to Makine and Ladipo (2012), moisture has an impact on the consistency and microbiological quality of food. Foods that are ready to consume should not have any microbial contamination that could cause diarrhea in youngsters. According to Olaoye et al. (2006), food with less moisture in it may be protected against microbial infection. The peanut snacks' protein content ranged from 24.90 % to 32.48%. Sample D had the highest protein content (60% wheat, 30% sorghum, and 10% date syrup), while sample B (80% wheat, 10% sorghum, and 10% date syrup) had the lowest protein amount.

In sample D, the protein content increased significantly as the %age of sorghum flour increased from 24.90% to 32.48%. This might be as a result of the substitution effect brought on by the high protein content of sorghum flour. The protein content discovered in this study is higher than the 6.59 to 16.93% protein content found in ready-to-eat foods made from maize flour, soybean flour, and pea nut by Nwosu et al. (2014). The samples of peanuts ranged in fat content from 18.13 to 29.64%. The maximum fat content was found in sample D (60% wheat, 30% sorghum, and 10% date syrup), whereas the lowest fat content was found in sample B (80% wheat, 10% sorghum, and 10% date syrup). Abraham et al., (2013) noted that when the amount of sorghum grew, the amount of fat in the samples of ready-to-eat meals also increased. The range of the crude fiber content in the sorghum and peanut-coated food samples was 4.14 % to 5.88%. The sample with the most fiber was sample D, while the one with the least fiber was sample B (80% wheat, 10% sorghum, and 10% date syrup). The amount of sorghum flour substituted enhanced the amount of fiber in the peanut food samples. Although crude fiber does not provide the body with nutrients, it gives meals more volume, which promotes peristalsis and guards against many gastrointestinal illnesses in people (Shiriki et al., 2015).

The study's results for fiber content ranged from 2.96 to 11.12%. This is consistent with what Shiriki et al. (2015) investigation found. The ash content of the peanut snacks varied from 3.37 to 5.28%, with sample D (60 % wheat, 30 % sorghum, and 10 % date syrup) having the highest level and sample B (80 % wheat, 10 % sorghum, and 10 % date syrup) having the lowest level. According to Fusman et al., (2017), the ash content of a food material can serve as a proxy for the food's mineral composition. The value of ash content (0.56-2.00%) in composite food made from fermented maize, soybean, and carrot flours reported by Barber et al. (2017) is greater than the ash content discovered in this investigation. The range of the carbohydrate content was between 23.19 and 44.15%, with sample B having the highest and sample D having the lowest. As the percentage of sorghum flour substitution rose, the amount of carbohydrates in the food significantly ($p<0.05$) decreased. The presence of carbohydrates in sorghum flour may be the cause of the variances seen.

Table 2: Proximate Composition of peanuts enrobed with composite flour (Wheat-Sorghum-Date syrup).

Samples	Moisture (%)	Ash (%)	Fat (%)	Crude Fibre	Crude Protein (%)	Carbohydrate (%)
A	4.14±0.05^{c}	4.52±0.04^{c}	23.40±0.02^{c}	4.93±0.03^{c}	27.94±0.04^{c}	35.05±0.02^{c}
B	5.30±0.03^{a}	3.37±0.05^{e}	18.13±0.07^{e}	4.14±0.04^{e}	24.90±0.03^{e}	44.15±0.24^{e}
C	4.84±0.02^{b}	4.08±0.04^{d}	20.74±0.03^{d}	4.60±0.03^{d}	26.03±0.02^{d}	39.68±0.06^{d}
D	3.51±0.02^{e}	5.28±0.04^{a}	29.64±0.33^{a}	5.88±0.00^{a}	32.48±0.03^{a}	23.19±0.21^{a}
E	3.93±0.07^{d}	5.09±0.02^{a}	26.62±0.05^{b}	5.25±0.09^{b}	30.80±0.11^{b}	28.20±0.20^{b}

Values are mean of triplicate determinations with standard deviation. Values with different superscripts within the same column are significantly different ($p<0.05$).

SAMPLE KEY**:**
A = 90% wheat and 10% date syrup
B = 80% wheat, 10% sorghum and 10% date syrup
C = 70% wheat, 20% sorghum and 10% date syrup
D = 60% wheat, 30% sorghum and 10% date syrup
E = 50% wheat, 40% sorghum and 10% date syrup

Discussion on the mineral composition of the peanut snacks coated with composite flour (wheat and sorghum) and date palm syrup

The mineral composition of the peanut snacks coated in composite flour (wheat and sorghum) and date palm syrup is shown in Table 3. With higher substitution of sorghum flour, the coated peanut gains more potassium, phosphorus, iron, and magnesium. The samples' increased mineral content attests to the supplementation's positive effects (Lutter & Rivera, 2013). The coated peanut samples' potassium level ranged from 524.81 to 620.07 mg/100g. Coated peanuts from 70% wheat, 20% sorghum and 10% date syrup had the lowest potassium concentration, while sample from 50% wheat, 40% sorghum and 10% date syrup had the highest potassium content (50 % wheat, 40 % sorghum, and 10 % date syrup). Compared to the potassium level (124.81 to 220.07 mg/100g) reported by Bolarinwa et al. (2016), the potassium content of the food obtained in this study ranges from 524.81 to 620.07 mg/100g. The formulations' phosphorus concentration differed between the samples. The range of the phosphorus level was 308.60 to 322.31 mg/100 g for sample C and sample E respectively. However, phosphorus is essential for healthy kidney function and nerve impulse transmission. The amount of phosphorus in this study was higher than the amount of phosphorus in the *Biden pilota*, which was 0.31 mg/100g as reported by Alikwe et al. (2014). The samples of coated peanuts with iron ranged from 3.97 to 4.51 mg/100g. Samples A and D have different iron contents, with sample D having the most iron. As the amount of sorghum flour increases, the iron content of the coated peanut samples rises. According to Fusman et al. (2017), the increase in the iron content with level of inclusion is an evident that iron is high in the included crops. The dietary samples' magnesium concentrations ranged from 130.96 to 188.45 mg/100g. Sample D had the highest magnesium while Sample C had the least.

Table 3: Mineral Composition of peanuts coated with composite flour (Wheat-Sorghum-Date syrup) in mg/100g.

Samples	Potassium	Phosphorus	Iron	Magnesium
A	568.09±2.06^{b}	312.86±0.01^{c}	4.19±0.01^{a}	153.32±0.08^{c}
B	575.88±2.34^{b}	310.98±0.01^{d}	4.09±0.02^{b}	145.53±1.44^{d}
C	524.81±4.52^{c}	308.60±0.16^{e}	4.36±0.16^{e}	130.96±0.04^{e}
D	586.58±4.29^{b}	319.17±0.72^{b}	4.86±0.00^{e}	164.65±0.26^{b}
E	620.07±2.75^{a}	322.31±0.02^{a}	4.51±0.02^{d}	188.45±0.06^{a}

Values are mean of triplicate determinations with standard determination. Values with different superscripts within the same column are significantly different ($p<0.05$).

SAMPLE KEY:
A = 90% wheat, and 10% date syrup
B = 80% wheat, 10% sorghum and 10% date syrup
C = 70% wheat, 20% sorghum and 10% date syrup
D = 60% wheat, 30% sorghum and 10% date syrup
E = 50% wheat, 40% sorghum and 10% date syrup

Discussion on the sensory properties of the peanut snacks coated with composite flour (wheat and sorghum) and date palm syrup

Table 4 depicted the sensory characteristics of the peanut snacks coated with composite flour (wheat and sorghum) and date palm syrup. The peanut snacks were evaluated for colour, appearance, taste, crunchiness, aroma, overall acceptability and willingness to buy. Sample B (coated with 80 % wheat, 10 % sorghum and 10% date syrup) was rated highest for colour, appearance, overall acceptability and willingness to buy. Sample A (90% wheat, and 10% date syrup) and sample E (50% wheat, 40% sorghum and 10% date syrup) had the highest score for crunchiness. No significant difference ($p > 0.05$) was observed for crunchiness, aroma and consumers' willingness to buy.

Table 4 Sensory properties of peanuts coated with composite flour (Wheat-Sorghum-Date syrup).

Sample	Colour	Appearance	Taste	Crunchiness	Aroma	Overall acceptability	Willingness to buy
A	7.40 ± 1.78^{ab}	7.30 ± 0.98^{b}	8.00 ± 0.97^{a}	8.10 ± 1.11^{a}	7.40 ± 1.93^{a}	7.30 ± 1.68^{a}	7.50 ± 0.94^{a}
B	8.15 ± 0.93^{a}	8.20 ± 0.89^{a}	7.20 ± 1.05^{b}	7.95 ± 1.14^{a}	7.75 ± 1.16^{a}	7.90 ± 0.91^{a}	7.80 ± 1.05^{a}
C	7.65 ± 0.87^{ab}	7.40 ± 0.59^{b}	7.50 ± 1.14^{ab}	7.80 ± 0.89^{a}	7.35 ± 1.18^{a}	7.45 ± 0.92^{a}	7.35 ± 0.98^{a}
D	7.25 ± 1.11^{b}	7.35 ± 1.04^{b}	7.45 ± 1.35^{ab}	7.70 ± 1.62^{a}	7.30 ± 1.41^{a}	7.45 ± 0.94^{a}	7.55 ± 0.68^{a}
E	7.85 ± 1.18^{ab}	7.55 ± 1.05^{b}	7.90 ± 0.91^{ab}	8.10 ± 1.02^{a}	8.00 ± 0.91^{a}	7.45 ± 0.99^{a}	7.20 ± 1.15^{a}

Values are mean of 9-point hedonic scale scoring by panelists with standard determination.

SAMPLE KEY:
A = 90% wheat, and 10% date syrup
B = 80% wheat, 10% sorghum and 10% date syrup
C = 70% wheat, 20% sorghum and 10% date syrup
D = 60% wheat, 30% sorghum and 10% date syrup
E = 50% wheat, 40% sorghum and 10% date syrup

CONCLUSION

According to this study, peanuts can be made by coating them in a composite flour made of wheat, sorghum, and date syrup. With an increase in the substitution level of sorghum flour, the proximate and mineral analyses revealed that the peanut food samples included considerable amounts of nutrients needed by the body. Peanut snacks coated with 60% wheat, 30% sorghum, and 10% date syrup have higher levels of fat, protein, and fiber than other samples. In conclusion, the findings of the sensory evaluation showed that there were significant differences in color, flavor, and overall acceptability at the 5% confidence level. Therefore, sample B (80% wheat, 10% sorghum, and 10% date syrup) was shown to have the highest overall acceptability of the food samples. Meanwhile, it is clear from the study that acceptable peanut snack can be made from wheat flour mixed with sorghum flour and date syrup and have better nutritional advantages, high dietary fibre, and protein. Therefore, consuming more date and high-fiber peanuts has various health advantages.

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