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STUDIES ON PROXIMATE AND MINERAL CONTENTS OF EXTRUDED *Nakiya* FROM BLENDS OF RICE AND GROUNDNUT

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ABSTRACT
Nakiya which is a locally prepared snack was made from various blends of (90:10, 85:15 and 80:20) rice flour: groundnut paste, at moisture content of 18 %, 20 % and 22 %, by extruding at varied temperature of 80°C,100 °C and 120°C. The Nakiya was extruded through a pilot scale co-rotating twin screw food extruder. The raw samples and extrudates were subjected to proximate and some minerals content determination. Moisture content, Ash and Fat, crude fiber and crude protein and minerals including Calcium, Sodium, Magnesium, Potassium and Phosphorus content were evaluated. It was found out that at 80: 20 % substitution level of groundnut; protein, ash and fat were high. The products have a protein content of 7.54- 12.27 %, a low moisture content of 2.83-10.33 %, low carbohydrate at 100°C and 120°C high temperature. The mineral were increased upon extruded at 80°Cand at 20% level of groundnut substitution.
Key: Nakiya, proximate, mineral and twin screw extruder

INTRODUCTION

Snack has been defined as a portion of food eaten between meals, which come in varieties of forms; packaged and processed (Dictionary. Com,2011). Snack foods are often subjectively classified as junk food because they typically have little or no nutritional value, high in calorie, fat and low in proteins, vitamins and micronutrients, its serves calories satisfying short-term hunger and often eaten in a hurry (Ocheme *et al.,* 2011). For the promotion of good health it is therefore recommending that people should make effort ineating more healthy snacks while avoiding low-nutrient junk food.

Nakiya is a cereal based traditional product made from rice. It can also be produce from maize flour with the use of honey instead of sugar, the honey and water need to be boiled followed with the addition of maize flour, as if one is going to prepare *tuwonsemo*, this type of *Nakiya* is common in areas like Adamawa, Taraba and Yobe States of Nigeria (Oral interview, 2014).

Most cereal/legumes in Northern Nigeria are processed traditionally as snacks like *Dakuwa, Nakiya, Gugguru, Alkaki* etc*.* Cereal grains are used for the production of different classes of foods; these include breakfast cereals such as corn flakes, breads, and pastries, brewing of both alcoholic and non-alcoholic drinks. Malting and extrusion methods have proven to increase the nutrient densities of many foods as well as means of processing traditional foods (Obatula, 2002).

Extrusion is a processing operation, which utilizes highly expanded, low-density products with unique textural properties which combines several units operations including mixing, cooking, kneading, shearing, shaping and forming to produce a product with unique characteristics (Riaz, 2013). The research aimed at determining the proximate composition and mineral content of *Nakiya* extrudate produced from various blends of rice and groundnut.

MATERIALS AND METHODS

Samples Collection

The materials used for this study are Groundnut, Rice, Ginger, Clove and sugar and were obtained from Jimeta Modern market, Yola, Nigeria.

Sample preparation

The rice flour was prepared by winnowing the rice, washing and drying, followed by milling using attrition mill modified method described by (Folake *et al.,* 2015).

The groundnut was also cleaned, roasted at 240^{o}C for 30min; skins were removed by rubbing between palms, cooled, ground into paste by attrition mill(Ayo *et al.*, 2012) with modifications. The spices which included ginger and clove were sorted, cleaned, dried and milled into powder using mortar and pestle, followed by sieving. Formulated flour (1.5 kg) of rice/groundnut paste at three levels of substitution with 150g of ground sugar and 2 g of ginger were used in the production of *Nakiya,* extruded at varied temperature.

Experimental Design

A 3 factor 3 level (3x3x3) full factorial experimental designswas use, in which 3 represent the feed moisture, 3 for barrel temperature and the last 3 represent the feed composition. The Experimental Layout was shown in Table 1.

Analyses

The moisture content, Ash, and Fat were determined by the AOAC method (2006), crude protein and crude fiber by AOAC (1990) while carbohydrate by difference, by the method of AOAC (2006).

Calcium, sodium, magnesium, potassium were determined by atomic absorption spectrophotometric method, while phosphorous was determined by AOAC (2000).

Table 1 Experimental Layout with the Coded and Natural Values

Design point	Coded variables			Natural values		
	X_1	X_2	X_3	X_1(%)	X_2(%)	X_3(^{o}C)
1	1	1	1	10	22	80
2	1	1	2	10	20	80
3	1	1	3	10	18	80
4	1	2	1	10	18	100
5	1	2	2	10	22	100
6	1	2	3	10	20	100
7	1	3	1	10	18	120
8	1	3	2	10	20	120
9	1	3	3	10	22	120
10	2	1	1	15	20	80
11	2	1	2	15	22	80
12	2	1	3	15	18	80
13	2	2	1	15	22	100
14	2	2	2	15	20	100
15	2	2	3	15	18	100
16	2	3	1	15	18	120
17	2	3	2	15	20	120
18	2	3	3	15	22	120
19	3	1	1	20	20	80
20	3	1	2	20	22	80
21	3	1	3	20	18	80
22	3	2	1	20	20	100
23	3	2	2	20	18	100
24	3	2	3	20	22	100
25	3	3	1	20	22	120
26	3	3	2	20	20	120
27	3	3	3	20	18	120

The experiment was randomised. X_1= Feed composition X_2 = Feed moisture content X_3 = Barrel temperature

RESULT AND DISCUSSION

Proximate composition of raw samples, showed the moisture content ranges from 7.67 -8.50%, protein from 7.84-11.20 %, Fat with a value of 10.82-12.83, Ash have a value of 0.53-0.73, Fiber from 0.35-0.60 while carbohydrate with a value of 66.14-72.79% as indicated in Table 2

Table 2 Proximate Composition of Raw Samples

	Composition (%)					
Samples	Moisture	Protein	Fat	Ash	Fiber	CHO
A	7.67 ±0.88^{ab}	7.84 ±0.5^{4c}	10.82 ±1.96^{ab}	0.53 ±0.01^{c}	0.35 ±0.01^{c}	72.79 ±0.01^{a}
B	8.33 ±0.44^{ab}	9.64 ±0.01^{b}	11.63 ±4.14^{ab}	0.63 ±0.01^{b}	0.53 ±0.00^{b}	69.24 ±1.72^{b}
C	8.50 ±0.00^{a}	11.20 ±0.29^{a}	12.83 ±0.79^{a}	0.73 ±0.03^{a}	0.60 ±0.00^{a}	66.14 ±1.06 ^{c}

Superscript represent level of significant at 5 % across the column, superscripts with the same alphabets are not significant while those with different subscripts are significance at 5 %, where a, b and c designate the amount of the proximate composition as: a› b› c

Key: A = 90:10 (rice/groundnut Paste), B = 85:15 (rice/ groundnut paste), C = 80:20 (rice/ groundnut paste)

The results of the proximate analysis of the raw samples shows that the fat, protein and moisture content of flour blends tends to increase as the groundnut flour is added, that is sample B (15 % of groundnut) and C (20 % groundnut) had high fat, protein and moisture content in contrast with sample A (10 % groundnut substitution) due to high in groundnut content as it is high in oil and protein (Mukthar, 2009 and Ayoola *et al.* 2012). Sample A was found to be high in carbohydrate due to high rice content, which goes in line with the report of (Yousaf, 1992) and also cereals are generally high in carbohydrate (they store starch as source of energy) . Alsofiber content increased with respect to the groundnutlevel substitution in the formulationat 20 %.

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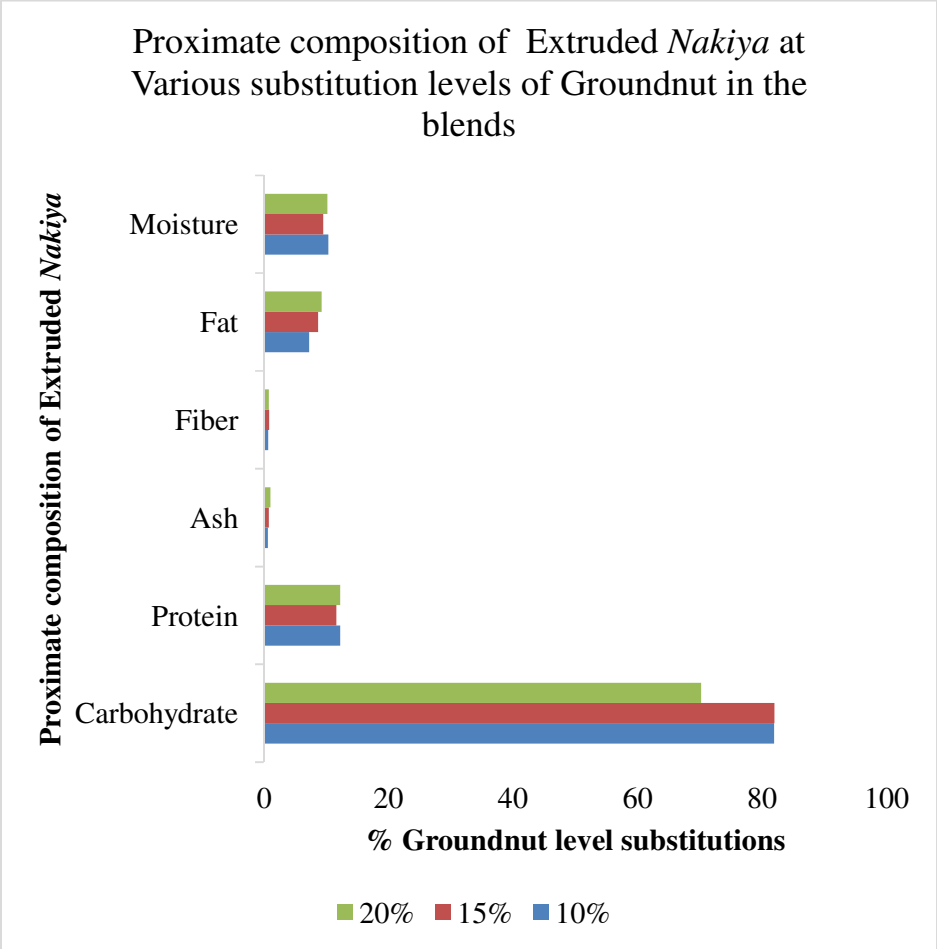

Fig 1 Proximate composition of extruded *Nakiya*

The products were shown to have high level of carbohydrates content with a range of (69-64-82.03) %due to high rice content in the formulation, which goes with the report of James and Nwabeuze (2013),that carbohydrates can be reduced or increased upon extrusion, which depends on raw materials and extrusion variables. The carbohydrates were high in compared with the result of Oluwole *et al*. (2013).

In the protein content, the values varies significantly on the feed composition, temperature but insignificant on the moisture content of the feeds at ($P<0.05$). At high groundnut level up to 20 %, high protein content were found in the products, with a ranged of 7.54±0.23 to 12.27±0.00 percent protein as depicted in table 3. The result corresponds with the finding of Shivendra*et al.* (2007) that extrusion can adversely or otherwise improve protein content of products.Wani and Kumar (2015) and Nwabueze (2006) obtained high protein content in an extruded ready to eat snacks. The addition of legume to cereal enriches a product(Obatula, 2002 and Filli*et al*. 2012). The amount was slower than that of Oluwole *et al.* (2013) a value of 13.31 and 14.20 % of protein.

From table 3, the ash concentration range from 0.48-1.03 %. The Ash content of 1.03 % was found in product with 80:20 rice/groundnut at 80^{o}C while 0.48 % from a product containing90:10 ratio of rice/groundnut. This shows that at high groundnut level substitutions, ash content increases upon extrusion which agrees with Atasie *et al*. (2009) that ash content of groundnut was 3.8% greater than Ash content of rice.James and Nwabueze (2013), Filli*et al*. (2012) and Oluwole*et al*.(2013) reported an increase in ash content of 2.85-5.15%, 1.7 -2.0 % and 13.31-14.20 % from an extruded snacks respectively, though the values were high in disagree with 0.48-1.03 % from this research, this might be due differences in substitution levels of feed composition and barrel temperature.

Extrudates have a fiber content of 0.24± 0.23 to 0.83 ± 0.00; high fibercontent in the products than in raw samples. The result obtained goes in line with the finding of Wani and Kumar (2015) where an increase in fiber content where found.

Fat content of the products were low in contrast to the raw samples, with a fat content of (4.77 - 9.25 %). High fat content were determined in products with high groundnut content of 20 %. Low fat in products with low levels of groundnut levels, the low fat content may beprobably due to the fact that lipids act as lubricant during extrusion (Guy, 2001).

A moisture content of 2.83% -10.33 % was revealed which agrees with the report of Shivendra*et al.* (2007) thatextrudates usually have low moisture content of less than 15 %. Nwabueze (2006) obtained a moisture range of 4.00-5.80 %. Dibyakanta*et al*. (2015) a moisture content of 12 % and James and Nwabueze (2013) a reduced in moisture content from 21.00 to 9.70 % in a snack, which is closer to the highest obtainable moisture of *Nakiya*extrudate. All the moisture content mentioned were less than 15 % asreported by Shivendra *et al*. (2007).

Table 3: Mineral Composition of Raw samples

Samples	Mineral (mg/kg)				
	Calcium	Magnesium	Sodium	Potassium	Phosphorus
A	70.83±0.07^{c}	25.00 ± 2.89^{b}	8.33±0.88^{b}	37.50±0.29^{bc}	13.68±0.39^{c}
B	104.17±0.01^{a}	29.17± 0.67^{a}	8.33±0.88^{b}	38.02±0.01^{b}	18.68±0.10^{a}
C	75.00±5.77^{b}	29.17± 0.67^{a}	9.72±0.12^{a}	47.40±0.11^{a}	15.00±2.89^{b}

Superscript represent level of significant at 5 %, across the column, superscripts with the same alphabets are not significant while those with different subscripts are significance at 5 %, a, b and represent the quality of minerals as a› b› c

Key

A = 90:10 (Rice: groundnut paste)

B = 85:15 (Rice: groundnut paste)

C= 80:20 (Rice: groundnut paste)

The result of the mineral content in (Table 3) of raw samples depicted high amount of Calcium in Sample B a value of 104.17 mg/kg (containing 15 % groundnut) than in sample A and C. The value was lower than 440 – 1340 mg/kg of calcium depicted by Asibuo *et al.* (2008).

High Magnesium content in sample B and C (samples having 15 % and 20 % groundnut) with a value of 29.17 mg/kg than A (25.00mg/kg), probably due to high percentage level of groundnut in the blend, implying that groundnut contain more magnesium than rice as reported by Nuts, Healthy and Tasty (2011) and Asibuo*et al.* (2008).

Sample C had the highest amount of sodium (9.72 mg/kg) and potassium (47.40 mg/kg) than in A and B, which was a sample with 20 % groundnut, the high concentrations these minerals relates to the finding of (Mukthar, 2009). But in terms of phosphorus content sample B was with the highest value (18.68 mg/kg).

The study indicates that sample C which is from a composition of 80:20 rice/groundnut flour is rich in Magnesium, sodium and potassium while Sample B (15 %) was high in calcium and phosphorus than sample A(10 % of groundnut). This collaborates with the result of Asibuo*et a ./* 2008, Mukthar, 2009 and Ayoola *et al.* 2012). Variation exist in the mineral contents of the samples due to groundnut substitution and was significant at (P<0.05).

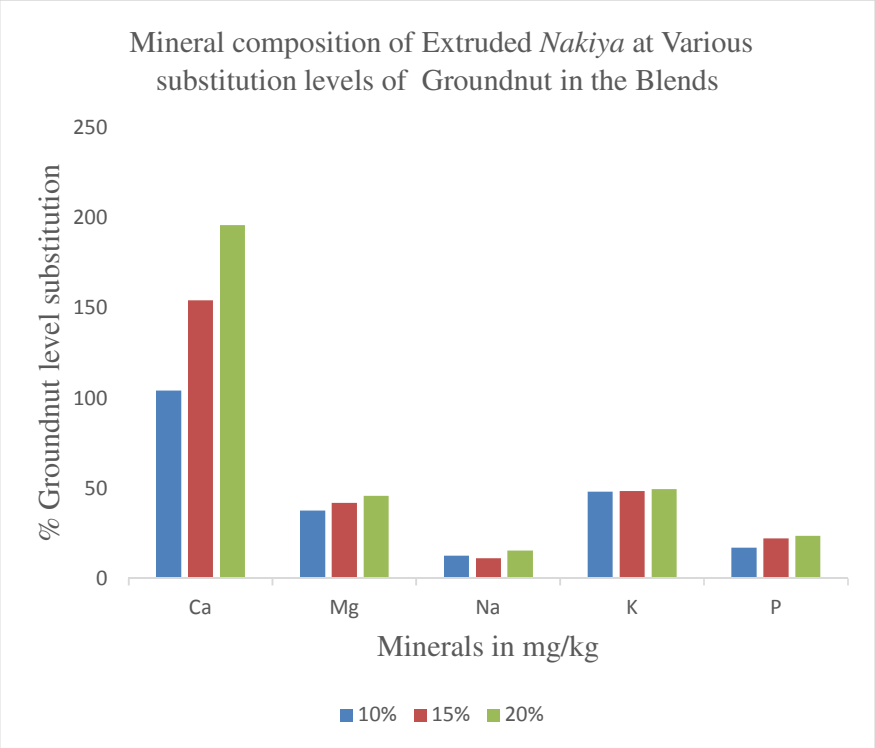

Fig 2 Mineral composition of Extruded *Nakiya*

Figure1 shows that the minerals content were high in extrudates containing high level of groundnut at 20 % substitution levels. The Calcium content of the product ranged from 50 -195 mg/kg, Magnesium of 20.45 - 45.83mg/kg, Sodium with a value 5.56 -15.29mg/kg, Potassium have25.52-49.48 mg/kg and Phosphorus content of 7.50- 23.55 mg/kg.

The highest calcium content of 195.83 mg/kg was from 80:20 flour blend of rice/groundnut, with 18% moisture content extruded at 80^{o}C, the value obtained was in contrast to the finding ofby Omwamba and Mahungu (2014) but in line with the report ofOluwole*et al.*, (2013).The value of Magnesium and Phosphorus was low in disagreement with 326 mg/kg and 2552 mg/kg found by James *et al.* (2016)

The high concentration of Magnesium, sodium, potassium and phosphorus were also high in extrudates with 20% groundnut substitution of groundnut, this goes in line with the finding of Camira(2001) and Alonso*et al.* (2000) that most of the Macro minerals are those that are affected upon extrusion.

CONCLUSION

It was discovered that the *Nakiya* extrudates were significantly high in protein with a decrease in carbohydrate at 20% substitution level of groundnut, low fat content in constrast to raw samples at P>0.05. The minerals were also high at 20 % levels of groundnut substitution, that is 80:20 rice/ groundnut blends.

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