

Full Length Research Paper

Development and quality evaluation of defatted groundnut and melon kernel flour based ethnic product “Robo”

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This study was carried out to develop a pepper-spiced flour based ethnic product “Robo” from melon and groundnut kernel with the aim of determining its nutritional quality and acceptability. Functional properties of defatted flours of groundnut and melon kernels were also determined. Crude protein (39.17 - 39.93%) and crude fat (16.80 - 17.53%) were found in groundnut “Robo” while crude protein (40.30 - 41.80%) and crude fat (17.70 - 17.73%) were found in melon “Robo”. Pepper spiced “Robo” generally had higher fibre (7.70 - 8.00%) and ash (6.23 - 7.10%) content. Results indicate that pepper spiced “Robo” from groundnut and melon can be regarded as a nutritious snack as it contains appreciable amount of protein, fat, minerals and fibre, this could enhance the achievement of millennium development goals on nutrition in the ethnic locality. Sensory evaluation results indicate a better acceptance of pepper spiced “Robo” from groundnut based of taste, texture, crunchiness and overall acceptability. Defatted flours of groundnut and pepper were found to have high water absorption capacity (270.40 - 274.70%), oil absorption capacity (213.90 - 235.20%) and fat emulsion capacity (28.20 - 29.50%) which indicate their potential use in food formulation for bakery products where water and oil retention is critical.

Key words: Robo, defatted groundnut flour, defatted melon flour, pepper, nutritional quality, functional properties.

INTRODUCTION

Oil seeds refer to all class of seeds from which oil is derived. Many oil seeds are industrially-grown to produce oil for consumption. They include legumes (soya seed, groundnut seed, etc) grains (corn, sunflower seed, etc) and nuts (oil palm seed, coconuts, etc). Once the oil is extracted, the remaining cake is generally used as a source of protein for animal feed except for certain seeds

such as castor beans and ting nuts which are toxic and are used as fertilizer rather than feed. Defatted residues of oilseeds are also used to prepare food for children, pregnant women, lactating mother and old people; it is also used as dietary supplement in food system such as biscuit and snacks in Nigeria (Akano and Atanda, 1990; Oladimeji and Kolapo, 2008).

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Groundnut (*Arachis hypogea*) and melon seed (*Citrullus vulgaris*) are among the most popularly consumed plant foods that are oilseeds (Wokoma and Aziagba, 2001; Oluba et al., 2008). They are processed and prepared in different ways by virtually all-ethnic groups in Nigeria and they form part of many of the Nigerian traditional food products (Ejoh, 2013). Melon is widely cultivated and grown in all regions of Nigeria. The seed is popularly called “Egusi” (Yoruba), “Ogili” (Ibo), “Iguana Agushi” (Hausa) and Dende (Fulani) in the local markets (Girgis and Said, 1968). It contains about 53% oil, 28% protein and some other important mineral nutrients (Oyolu, 1977; Abaelu et al., 1979). Groundnut is a crop with almost every part having a commercial value. It is regarded as the third most abundantly cultivated oil seeds in the world. The seeds have high nutritional value due to the presence of oil, protein, minerals and vitamins. There is versatility with respect to the groundnut seed consumption as it is consumed in cooked or roasted form.

Residue obtained from oil extraction of oil seeds are often made into flours. Flours from leguminous food have found application in many food products due to their nutritional qualities. Defatted soy flour has been used in fortification of food product like garri, yam flour and ogi (Sanni and Sobamiwa, 1994; Kolapo and Sanni, 2005; Jimoh and Olatidoye, 2009). “Robo”, Kulikuli and Donkua are traditional snacks produced from tropical legumes which are high in dietary protein and could be a source of protein for a large segment of population in Nigeria. “Robo” is a ready to eat snacks produced from residue obtained from oil extraction of groundnut and melon. It is commonly consumed with high carbohydrate rich meal like garri (cassava product) and ogi (cereals product). However, snacks are often subjectively classified as junk foods probably because they typically have little or no nutritional value and are not seen as contributing toward general health and nutrition. “Robo” being a snack produce from nutrient rich legume could contain nutrients that could complement energy given cereal and tuber products commonly eaten with it. In recent time, “Robo” is spiced with pepper probably for astringency reasons. Information on comparative analysis of the nutrient composition of “Robo” produced from crops (groundnut and melon) and influence of spiced (pepper) on its quality is scanty, hence this work is designed to develop and evaluate the quality of traditional snacks, Robo spiced with pepper.

MATERIALS AND METHODS

Materials

Shelled groundnut seeds and melon seeds were purchased from Sango Market, Saki, Oyo state.

Production of Groundnut “Robo” and Melon “Robo”

Traditional method for processing “Robo” was employed with a little

modification. Shelled seeds (groundnut and melon) were sorted separately to remove extraneous materials. Sorted seeds were subjected to roasting in aluminium pot over charcoal fire and stirred at interval to ensure proper roasting (20 - 25 min). Roasted seeds were allowed to cool and divided into two equal parts.

Capsicum annum (chilli pepper) household measure (1 tin milk) was added to one part (10 tin milk) of roasted seeds and milled in laboratory attrition mill while the other part (10 tin milk) was milled separately without adding *Capsicum annum* (pepper) in attrition mill. The milled flour was made into paste and kneaded continuously with wooden stirrer until oil began to flow out of the paste. The residue was shaped into small round ball and fried in the extracted oil.

Determination of proximate composition

Analytical methods of the Association of Official Chemist (AOAC, 1990) were used for proximate analysis. Moisture content was determined by weighing into crucible 5 g of sample in an air drying oven at 105°C until a constant weigh was obtained. Soxhlet extraction method was used to determine the fat content. Kjeldhal method was used to determine the crude protein content and the crude fibre was determined by digestion method. Carbohydrate was calculated by difference.

Functional properties of defatted Melon flour and Groundnut flour

The modified method of Kolapo et al (2012) was used to remove oil by cold solvent extraction of ground sample using n-hexane. Shelled seeds were sundried for 72 h and ground in the laboratory mill. One kilogram of sample mixed with 600 ml of n-hexane was vigorously shaken and left for 72 h to settle. The supernatant was decanted and defatted residue obtained was dried in an oven at 40°C for 4 days. The defatted cake was made into flour by grinding in a laboratory mill. Water absorption capacity and emulsification capacity of flours were determined by the procedure of Beuchat et al. (1975). Bulk density was determined by the method of Wang and Kinsella (1976). Least generation capacity was determined by the method of Coffman and Garcia (1977). The oils absorption capacity of the flours was determined by the procedure of Sosulki (1962).

Microbial analysis

The method described by Omafuvbe et al. (2004) was adopted to enumerate microbial population. Content of bacteria and fungi were expressed as colony unit per gram (cfu/g) of samples. Means of triplicate plate were recorded.

Sensory evaluation

The organoleptic assessment of the defatted cake samples “Robo” was carried out using panelist familiar with consumption of “Robo”. A 9 points hedonic scale ranging from 1 (dislike extremely) to 9 (like extremely) was used.

Statistical analysis

All analyses were conducted in triplicates and the mean score of the data was recorded. Data were subjected to analysis of variance and Duncan multiple range test was used to separate the means.

Table 1. Proximate composition of defatted fried cake "Robo"

Sample	Moisture content (%)	Crude protein (%)	Crude fat (%)	Ash (%)	Crude fibre (%)	Carbohydrate (%)
MWPC	8.92 ^a	40.30 ^b	17.10 ^b	7.10 ^a	7.70 ^b	18.28 ^d
MW _t PC	8.56 ^b	41.00 ^a	17.73 ^a	6.10 ^b	7.10 ^d	19.51 ^c
GWPC	8.93 ^a	39.17 ^{cd}	16.80 ^c	6.23 ^b	8.00 ^a	20.87 ^b
GW _t PC	8.43 ^b	39.93 ^c	17.53 ^a	5.43 ^c	7.40 ^c	21.29 ^a

Mean with the same superscript along the same column are not significantly different at 5% level. MWPC: Melon spiced with pepper cake. MW_tPC: Melon without pepper cake. GWPC: Groundnut spiced with pepper cake. GW_tPC: Groundnut without pepper cake.

RESULTS AND DISCUSSION

Proximate composition of defatted fried cake "Robo" prepared from melon seeds and groundnut seeds are presented in Table 1.

There was a significant difference ($P < 0.05$) in the crude protein content of all the samples investigated. "Robo" prepared from melon without spice (pepper) had the highest level of protein (41.00%). The value was found to be higher than the crude protein level of melon ball "Robo" reported by Aletor and Ojelabi (2007). Crude protein content of groundnut without pepper was found to be lower than crude protein content of defatted seed cake of two cultivars of groundnut investigated by Fekria et al. (2012), but higher than crude protein content of groundnut seed cake reported by Aletor and Ojelabi (2007). Varietal difference could be responsible for difference observed in the protein content. "Robo" samples of melon and groundnuts (with pepper) were found to have lower protein content as compared to unfried cake sample reported by Fekria et al. (2012). Denaturation of proteins during frying could be responsible for lower protein content observed in the fried groundnut and melon "Robo".

The mean crude fat (CF) content of samples were melon without pepper (17.73%), groundnut without pepper (17.53%), melon spiced with pepper (17.10%) and groundnut spiced with pepper (16.80%). There was no significant difference in the crude fat content of groundnut and melon samples without pepper.

Crude fat of melon with pepper "Robo" was lower than that of "Robo" as reported by Aletor and Ojelabi (2007), crude fat content of "Robo" prepared from groundnut (16.80-17.53%) was found to be higher than that of groundnut cake (9.87%) and flour (7.76%) as reported by previous authors (Kolapo et al., 2012; Fekiria et al., 2012). The higher fat content of groundnut "Robo" over its cake and flour could be as a result of deep frying which was a major unit operation in the product preparation.

There was a significant difference ($P < 0.05$) in the crude fibre contents of the samples investigated. Crude fibre content of "Robo" spiced with pepper (8.00%) was found to be higher than other samples, result indicates that the

fibre content of groundnut "Robo" were higher than that of melon "Robo". Fibre content of groundnut "Robo" investigated was lower than that of cakes as reported by Fekria et al. (2012) but was higher than that reported by Kolapo et al. (2012) and Aletor and Ojelabi (2012). Crude fibre content of melon derived cake samples (7.10% - 7.70%) was found to be higher than that of melon cake reported by Abiodun and Adeleke (2010), Bankole et al. (2005). Generally, result indicated that pepper spiced "Robo" were richer in crude fibre for both groundnut and melon than unspiced "Robo". This might have been caused by the presence of non starchy carbohydrates (cellulose, hemicelluloses, etc) present in the spice (pepper). Crude fibre is known to aid the digestive system of human (Ayinde et al., 2012) and there is an inverse relationship between fibre consumption and risk of coronary heart disease and general types of cancer (Lattimer and Haub, 2010).

The ash content of defatted melon spiced with pepper "Robo" (7.10%) was significantly higher than other samples investigated, although defatted groundnut with spice followed the same trend. This indicates that the spice added increased the mineral content of "Robo", the result is in agreement with those reported for kulikuli, groundnut cake and palm kernel cake (Aletor and Ojelabi, 2007; Kolapo et al, 2012).

Carbohydrate content of samples was found to be 18.28%-21.29%. Moisture content of samples was found to be 8.43-8.93%. There was no appreciable difference between the moisture levels of spiced sample produced from groundnut and melon seeds flour. Moisture content of unspiced sample was lower than that of the spiced samples.

The results of the functional properties of defatted flour (melon and groundnut) are shown in Table 2. There was a significant difference ($P < 0.05$) in the water absorption capacity of defatted flour of melon and groundnut. Similar observation was recorded in the oil absorption capacity of the two samples. Data shows that defatted groundnut flour had a higher water absorption capacity but lower oil absorption capacity when compared with melon flour. High WAC observed in groundnut flour is in agreement with previous result of Abdel Rhamon et al. (2011). Lawal and Adebawale (2004)

Table 2. Functional properties of defatted flours

Properties	Defatted melon flour	Defatted groundnut flour
Water absorption capacity (%)	270.40 ^b	274.10 ^a
Oil absorption capacity (%)	235.20 ^a	213.90 ^b
Bulk density (g/cm ³)	0.83 ^a	0.60 ^b
Least Gelation capacity (%)	2.90 ^b	4.02 ^a
Emulsification capacity (m/g)	28.20 ^b	29.50 ^a

Means with the same superscript along the same row are not significantly different at 5% level.

Table 3. Microbial status of fried defatted cakes "Robo" samples.

Sample	Bacteria (cfu/g) x 10 ³	Fungi (cfu/g) x 10 ³
MWPC	2.40 ^a	2.60 ^d
MWtPC	2.20 ^b	2.30 ^c
GWPC	2.38 ^a	2.80 ^a
GWtPC	2.22 ^b	2.35 ^c

Means with the same superscripts along the same column are not significantly different at 5% level. MWPC: Melon spiced with pepper cake. MWtPC: Melon without pepper cake. GWPC: Groundnut spiced with pepper cake. GWtPC: Groundnut without pepper cake.

reported the major chemical compositions that enhance water absorption capacity of flours to be protein and carbohydrates since these constituents contain polar parts such as polar or changed side chain.

The oil absorption capacity of melon flour was found to be higher than that of groundnut flour. Difference in oil binding capacity of flour has been reported to be possibly due to the presence of non-polar side chains which might bind the hydrocarbon side chains of oil among the flours (Adebowale and Lawal, 2004).

High water and oil absorption capacities obtained in the defatted melon and groundnut samples indicate their potential use for food formulation especially in baked product and pastries where water and oil retention is critical. The bulk density of defatted melon (0.83 g/cm³) was found to be higher than that of defatted groundnut (0.60 g/cm³). The value obtained for the defatted groundnut flour is within the range of values reported for Bembara groundnut and its protein isolate (0.55-0.62 g/ml) (Abdel Ralman et al., 2011). Difference in the bulk density could be due to varietal differences among the groundnut investigated.

High fat emulsion capacity has been reported to be an important attribute to be considered in the production of mayonnaise, milk, committed meats and salad dressing (Adeyeye, 2004). Defatted Melon and Ground flour could have application in these products due to their relatively high emulsification capacity. Result of emulsification capacity of the samples investigated (defatted Melon and Groundnut flour) shows values (28.20 - 29.50 ml/g) that are higher than those reported for peanut flour by Singh

and Singh (1991). Least gelation capacity indicates ability of proteins to form gel and provide a structure matrix for holding water, flavour, sugar and food ingredients. Result of least gelation capacity shows defatted melon flour having least gelation capacity (2.90%), while that of defatted groundnut flour is 4.02%. The values obtained for the sample were lower than that of Soy bean cake reported by Aletor and Ojelabi (2007).

Table 3 shows the results of microbial loads of defatted fried melon and groundnut cake samples. The total aerobic counts show a significant difference between the spiced "Robo" with pepper and unspiced "Robo". Highest bacteria load was found in melon spiced with pepper sample. Similarly, fungi counts recorded highest loads in the spiced "Robo" with pepper. The increase in the microbial loads of sample spiced with pepper could be from the pepper added. Chillies (pepper) are reported to be contaminated with moulds and their toxic metabolites in several cases (Scott and Kennedy, 1973).

The result in Table 4 shows the sensory evaluation of fried defatted cake "Robo" sample. The result revealed that "Robo" from groundnut spiced with pepper was rated high in terms of taste, texture, colour, crunchiness and overall acceptability. This is expressed in the significant difference ($P < 0.05$) observed in the sensorial quality variables for all the samples except for colour which showed relatively same level of acceptability in all the samples. Result also indicated that samples spiced with pepper were generally rated higher for taste than unspiced samples.

Conclusion

The results of the functional analyses carried out on defatted groundnut flour and melon flour reveal their potential use in food formulation due to their high water capacity, oil absorption capacity, emulsion capacity and gelation capacity. It could also be concluded that fried defatted cake "Robo" obtained from the two crops "groundnut and melon" is a nutritious snacks as it contains appreciable amount of protein, fat and carbohydrate. Apart from contributing to fibre and minerals level of "Robo", *Capsicum* spp. (pepper) improve the taste, texture, crunchiness and overall acceptability of "Robo" as shown in the sensory evaluation results.

Table 4. Sensory evaluation of “fried defatted cake “Robo” sample.

Sample	Taste	Texture	Color	Crunchiness	Overall Acceptability
MWPC	7.20 ^a	6.40 ^b	7.70 ^a	7.20 ^b	7.20 ^b
MWtPC	5.20 ^c	6.40 ^b	7.60 ^a	7.00 ^b	6.50 ^c
GWPC	7.80 ^a	7.60 ^a	7.70 ^a	8.00 ^a	7.80 ^a
GWtPC	6.50 ^b	7.20 ^{ab}	7.70 ^a	7.00 ^b	7.20 ^b

Means with the same superscript along the same column are not significantly different at 5% level. MWPC: Melon spiced with pepper cake. MWtPC: Melon without pepper cake. GWPC: Groundnut spiced with pepper cake. GWtPC: Groundnut without pepper cake.

Conflict of Interests

The author(s) have not declared any conflict of interests.

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