Evaluation of Quality attributes of Noodles Produced from Blends of Acha, Adu, mungbean and Moringa oleifera Composite Flours

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ABSTRACT

This study aimed at the evaluation of the quality attributes and sensory properties of noodles produced from composite blends of acha, adu, mungbean and moringa oleifera seed. Composite flours of acha, adu, mungbean and moringa oleifera seed were formulated by total replacement of wheat with acha, adu, mungbean and moringa oleifera seed at different graded ratios (B= (55:35:5:5), C= (55:30:10:5, D= (50:30:15:5), E= (50:25:20:5), F= (45:25:25:5) while 100% wheat flour was used as the control (sample A)). The composite flours were used to produce noodles and the noodles subjected to proximate analysis and sensory properties evaluation. Proximate analysis revealed that the noodles contained moisture content of 10.22-13.90%, 2.32-4.48% ash, 10.13-17.90% protein, 1.50-5.71% lipid, 0.48-3.68% crude fibre, 54.33-75.35% carbohydrate and 340.31-355.42Kcal/100 g energy. There was an increase in the moisture, ash, protein, lipid and crude fibre contents with a decrease in carbohydrate and energy contents as the amount of mungbean flour increases. Sensory evaluation scores showed that noodles made with 0% wheat, 55% acha, 35% adu, 5% mungbean and 5% moringa oleifera seed can favourably compare with the control. It is recommended that the beany flavour of mung beans be removed before its addition in the composite blend in order to produce noodles that can be highly accepted.
Keywords: Noodles, acha, adu, mungbean, moringa oleifera, composite flour.

Introduction

Background to the Study

Noodles quick-cooking, convenient, fast income generation, versatile, sensory appealing and satiable food. Despite the non-scientifically proven acclaimed negative effects of noodles, it has come to stay as people can hardly do without it especially among the youths and urban dwellers. Wheat has been the main raw material in the production of noodles but wheat usage in tropical regions like Nigeria is confronted with spiking import bills which is seriously depleting the economy. This has however become a blessing as it boasts the income of local farmers and motivate them for more production of native crops such as adu, acha, mungbean, rice, cowpea, maize, potato. Thus, the emphasis of composite flour blends from native crops as they are both affordable, provide optimum nutritive value and have good processing attributes to substitute for wheat flour in the food industry. Composite flour is described as a blend of varying proportions of non-wheat flour sourced from cereals, legumes, roots, and tubers, either with or without wheat flour. Indigenous peoples have access to traditional foods that they can source locally from the natural environment through farming or wild harvesting, without the necessity of purchasing them. These traditional food crops include yam tubers of different species, potatoes, cocoyam, maize, hungry rice, sorghum, millet, African yam bean, pigeon pea, mung bean, kidney red bean, chick bean, and more. Acha (*Digitaria exilis*) is an annual indigenous crop which is widely cultivated in West Africa. Acha is a cereal known as Hungry rice and is traditionally consumed whole as “tuwo”, couscous, “gwate”, acha jollof and kunun acha (Oburuoga and Anyika, 2012) in Northern Nigeria. The seeds also contain 7.9% protein, 1.8% fat, 71% carbohydrate and 6.8% fibre (Oburuoga and Anyika, 2014). Acha is considered as health grains in a sense that they are often consumed whole and are gluten-free (Jideani and Jidenai, 2011). Adu usually referred to as aerial yam (*Dioscorea bulbifera*) is among the most underutilized food crops in the world and Africa in particular where it grows and appears in both the wild and edible forms. *D. bulbifera* cultivars possess a higher content of protein, vitamin C and low lipids than *D. alata, D.* cayenensis, *D. escunlenta*, *D. rotundata* and *D. trifida* (Ezeocha and Ojimelukwe, 2012). *Orarudi* commonly known as mung bean (*Vigna radiata*) is a legume that is small, ovoid in shape and green in colour. *Orarudi* (*Vigna radiata*) possesses good quality protein and essential amino acids, though limited in methionine and cysteine. It is a good source of soluble carbohydrate and contains a high amount of crude fibre (Umunna and Anselem, 2014). The ideal strategy for fighting micronutrient deficiency is to improve the diet by including a large variety of food rich in micronutrients and to increase dietary absorption of these nutrients. Seeds and vegetables are major sources of vitamins and micro-nutrients needed for the normal functioning of the human body physiology (Umerah *et al*., 2019). Moringa oleifera (Drum stick), a member of *Moringaceae* is a fast-growing softwood tree mainly found in the Middle East and in African and Asian countries. Moringa oleifera is known as *Zogallagandi*" (Hausa), "Ewe-igbale" (Yoruba) and "Okwe Oyibo" (Igbo) (Nikkon *et al*., 2003). Moringa oleifera has traditional, medicinal and nutritional uses and also have biological and physiological activities. All parts of the Moringa tree (leaves, seeds, roots and flowers) are suitable for human and animal consumption. *M. oleifera* seed contains 26.9% crude protein, 6.3% fat, 10.12% ash, 56.3% carbohydrate and 3.0 mg 100 g^{-1} calcium and 103.1 mg 100 g^{-1} iron. Despite the fact that the demand for noodles has increased significantly over the years, much research has not been done on the use of composite flour blend from Nigerian traditional foods in noodle production. Thus, this present research is targeted at the production of nutrient-dense noodles with high acceptability from acha, adu, orarudi and moringa oleifera seed at varying proportion. The most obvious result of such blending is that the mixture will give a much more nutrient-dense noodles than the conventional counterpart.

MATERIALS AND METHODS

The acha, adu, orarudi and moringa oleifera samples were purchased from New market in Enugu, Enugu, Nigeria. Each of the sample was manually sorted to remove the microbial infected and decayed seeds, weighed before processing.

Preparation of sample flours

Par-boiled acha flour was produced using the method described by Adekunle and Abiodun, (2018) with slight modification. The methodology described by Okechukwu *et al*. (2023) was adopted for the preparation of boiled adu flour. The boiled mung bean flour will be prepared according to the method described by Onwurafor *et al.,* (2019). *Moringa oleifera* seed flour was produced using the method described by (Umerah *et al*., 2019).

Formulation of flour blends

The acha, adu, orarudi and moringa oleifera flours were thoroughly mixed at predetermined ratios using a Panasonic MX-AC 2105 blending machine to obtain homogenous samples of each composite blend. The flour ratios were; A= (100 % wheat flour/control), B= (55:35:5:5), C= (55:30:10:5, D= (50:30:15:5), E= (50:25:20:5), F= (45:25:25:5). Each composite blend was sieved using a sieve with mesh size 212 μm to obtain a homogenous mixture. The composite flour blends produced were separately packaged in lidded plastic containers labeled and stored in a freezer until needed for analysis. The whole wheat flour without any substitution served as control.

Noodle Production

Noodles were produced according to the method described by Causgrove (2004) with some modifications. Flour sample were mixed with 2% cooking salt (NaCl) and 40% water to form strong dough. The dough was allowed to rest for 15 minutes, and rolled into sheet of about 5 mm thick. With continuous rolling, the dough sheet was gradually reduced into 1.3-1.0 mm thickness, and extruded into noodle strands using a pair of cylindrical slitter. The noodles were cooked in steam for 5 minutes, dried at 80 ^{O}C for 6 hours, cooled to 20 ^{O}C and packed in polyethylene pouches.

Determination of Proximate Composition of the Noodle Samples

The moisture content, ash, crude fibre, crude protein and fat content of the noodles produced acha, adu, orarudi and moringa oleifera were determined using the method of AOAC (2010). Total carbohydrate was calculated by difference.

Sensory Evaluation

The noodle samples were presented to a 20-member panel of Judges that comprised of the students and staff of the Department of Food Science and Technology, Institute of Management and Technology (IMT) Enugu, Enugu State, Nigeria. The samples were assessed for crust appearance, crumb colour, crumb texture, aroma, and overall acceptability using a nine-point hedonic scale, where 9 indicated "liked extremely" and 1 indicated "dislike extremely" according to Ihekoronye and Ngody (1985).

Statistical analysis
The data generated will be subjected to one-way analysis of variance (ANOVA) using Special Package for Social Science (SPSS Version 20) software. Duncan's New multiple range test will be used to separate significant difference at $p<0.05$.

RESULTS AND DISCUSSION

Table 1: Proximate composition of the composite flour noodles

Samples/ Parameters	Moisture	Ash	Crude Protein	Lipid	Crude fibre	Carbohydrate	Energy (Kcal)
A	$10.22^{f}\pm0.001$	$2.32^{f}\pm0.001$	$10.13^{f}\pm0.001$	$1.50^{f}\pm0.001$	$0.48^{f}\pm0.001$	$75.35^{a}\pm0.001$	$355.42^{a}\pm0.001$
B	$12.14^{e}\pm0.001$	$2.65^{e}\pm0.001$	$13.81^{e}\pm0.001$	$4.33^{e}\pm0.001$	$2.41^{e}\pm0.001$	$64.66^{b}\pm0.001$	$352.85^{b}\pm0.001$
C	$12.42^{d}\pm0.001$	$3.70^{d}\pm0.001$	$15.03^{d}\pm0.001$	$4.80^{d}\pm0.001$	$2.65^{d}\pm0.001$	$61.40^{c}\pm0.001$	$348.92^{c}\pm0.001$
D	$13.13^{c}\pm0.001$	$3.88^{c}\pm0.001$	$16.90^{c}\pm0.001$	$5.48^{c}\pm0.001$	$2.82^{c}\pm0.001$	$57.79^{d}\pm0.001$	$348.08^{d}\pm0.001$
E	$13.51^{b}\pm0.001$	$4.18^{b}\pm0.001$	$17.50^{b}\pm0.001$	$5.55^{b}\pm0.001$	$3.46^{b}\pm0.001$	$55.80^{e}\pm0.001$	$343.15^{e}\pm0.001$
F	$13.90^{a}\pm0.001$	$4.48^{a}\pm0.001$	$17.90^{a}\pm0.001$	$5.71^{a}\pm0.001$	$3.68^{a}\pm0.001$	$54.33^{f}\pm0.001$	$340.31^{f}\pm0.001$

Means with the same letters within the same column are not significantly different ($p > 0.05$). A = 100% wheat, 0% acha, 0% adu, 0% mungbean and 0% moringa oleifera seed, B = 0% wheat, 55% acha, 35% adu, 5% mungbean and 5% moringa oleifera seed, C = 0% wheat, 55% acha, 30% adu, 10% mungbean and 5% moringa oleifera seed, D = 0% wheat, 50% acha, 30% adu, 15% mungbean and 5% moringa oleifera seed, E = 0% wheat, 50% acha, 25% adu, 20% mungbean and 5% moringa oleifera seed, F = 0% wheat, 45% acha, 25% adu, 25% mungbean and 5% moringa oleifera seed.

Proximate Composition
Table 1 shows the proximate composition of noodles produced from acha, adu, mungbean and moringa oleifera flour blends while whole wheat flour noodle served as control. Crafting noodles without wheat poses a difficulty as wheat contains a distinct protein, gluten, that is crucial for creating the desired elasticity in noodles. Moisture content of the noodles from composite blends and the control ranges from 10.22-13.90. Moisture content of the noodles increased with an increase in the proportions of acha, adu, mungbean and moringa oleifera flours such that sample F (0% wheat, 45% acha, 25% adu, 25% mungbean and 5% moringa oleifera seed) had the highest value (13.90) whereas the control sample A has the least value (10.22), respectively. There was a significant ($p<0.05$) difference among the different regimes. Moisture contents of all the noodles were below the Codex standard moisture specification (14.0% maximum) for instant non fried noodles (Falade and Okafor, 2014). The low moisture content of the noodles is preferable because it helps to extend its shelf life. Ash content of the noodles from composite blends and the control ranges from 2.32 – 4.48. Ash content of the noodles increased with the increase in acha, adu, mungbean and moringa oleifera substitution such that sample F (0% wheat, 45% acha, 25% adu, 25% mungbean and 5% moringa oleifera seed) had the highest value (4.48) whereas the control sample A has the least value (2.32), respectively. Ash content is an indication of the amount of minerals contained in foods (Akubor and Fayashe, 2018). Ash values of the noodles from this study falls within the range (1.88-2.73%) reported by Akonor et al. (2017) and Mepba *et al.* (2021) for root and tuber composite flour noodles. Crude protein content of the noodles from composite blends and the control ranges from 10.13 – 17.90. Crude protein content of the noodles increased with the increase in acha, adu, mungbean and moringa oleifera substitution such that sample F (0% wheat, 45% acha, 25% adu, 25% mungbean and 5% moringa oleifera seed) had the highest value (17.90) whereas the control sample A has the least value (10.13), respectively. It is also due to attendant synergistic effects of protein complementation as reported by Iwe et al. (2016). The fat content of the composite noodle samples from this study ranged from 1.50 to 5.71%. Fat content of the noodles increased with an increase in the proportions of acha, adu, mungbean and moringa oleifera flours such that sample F (0% wheat, 45% acha, 25% adu, 25% mungbean and 5% moringa oleifera seed) had the highest value (5.71) whereas the control sample A has the least value (1.50), respectively. There was a significant ($p<0.05$) difference among the different regimes. Similar result was obtained by Mepha *et al.* (2021) on fat content of wheat-acha-Bambara-cocoyam composite noodles (1.25-7.51%). The increase could be probably due to the incorporation of adu and mungbean flours. Fat content of the noodles from this study is low when compared to the values (10.0-16.54%) for fried noodles made from soybean-wheat composite flour (Gulia *et al.*, 2014). Crude fibre content of the composite noodle samples from this study ranged from 0.48 to 3.68%.

Crude fibre content of the noodles increased with an increase in the proportions of acha, adu, mungbean and moringa oleifera flours such that sample F (0% wheat, 45% acha, 25% adu, 25% mungbean and 5% moringa oleifera seed) had the highest value (3.68) whereas the control sample A has the least value (0.48), respectively. The increased in the fiber content of composite noodle samples could be attributed to the high fibre content of acha, adu and mungbean. Carbohydrate content of the noodles ranged from 54.33% to 75.35% with the control having the highest carbohydrate (75.35%) while sample F (0% wheat, 45% acha, 25% adu, 25% mungbean and 5% moringa oleifera seed) had the lowest carbohydrate content (54.33%). There was a significant difference ($p \leq 0.05$) in the carbohydrate content of the noodles. In line with Iwe et al. (2016), the carbohydrate content of the products of these composite flour samples is an indication that they can serve as good sources of energy. The low carbohydrate content of the composite flour noodles has several benefits, as it aids digestion in the colon and reduces constipation often associated with products from refined wheat flour (Elleuch *et al*., 2011). The decreased carbohydrate content of the noodles would also be useful to people who need low carbohydrate foods leading to enhanced health for overweight and obese persons.

Table 2: Sensory properties of the dried composite flour noodles

Cooked composite noodles	Colour	Aroma	Taste	Texture	Overall acceptability
A	$8.5^a \pm 0.001$	$8.5^a \pm 0.001$	$8.3^a \pm 0.001$	$8.7^a \pm 0.001$	$8.5^a \pm 0.001$
B	$7.5^b \pm 0.001$	$6.8^b \pm 0.001$	$7.5^b \pm 0.001$	$7.0^b \pm 0.001$	$7.5^b \pm 0.001$
C	$7.0^c \pm 0.001$	$6.6^c \pm 0.001$	$6.5^c \pm 0.001$	$7.0^c \pm 0.001$	$6.5^c \pm 0.001$
D	$6.5^d \pm 0.001$	$6.3^d \pm 0.001$	$6.8^d \pm 0.001$	$6.5^d \pm 0.001$	$6.5^d \pm 0.001$
E	$6.0^e \pm 0.001$	$6.0^e \pm 0.001$	$6.0^e \pm 0.001$	$6.0^e \pm 0.001$	$6.0^e \pm 0.001$
F	$6.0^f \pm 0.001$	$5.7^f \pm 0.001$	$6.0^f \pm 0.001$	$5.5^f \pm 0.001$	$5.8^f \pm 0.001$

Mean & std of 20 panelists' score. Means with the same letters within the same column are not significantly different ($p > 0.05$). A = 100% wheat, 0% acha, 0% adu, 0% mungbean and 0% moringa oleifera seed, B = 0% wheat, 55% acha, 35% adu, 5% mungbean and 5% moringa oleifera seed, C = 0% wheat, 55% acha, 30% adu, 10% mungbean and 5% moringa oleifera seed, D = 0% wheat, 50% acha, 30% adu, 15% mungbean and 5% moringa oleifera seed, E = 0% wheat, 50% acha, 25% adu, 20% mungbean and 5% moringa oleifera seed, F = 0% wheat, 45% acha, 25% adu, 25% mungbean and 5% moringa oleifera seed.

Sensory Evaluation of Cooked Composite Flour Noodle Samples

The mean sensory scores of noodles produced from acha, adu, mungbean and moringa oleifera flour blends while whole wheat flour noodle served as control. were shown in Table 2. The average sensory scores for colour of the cooked composite noodles ranged from 6.0 to 8.5. Average sensory scores for colour of the noodles decreased with an increase in the proportions of acha, adu, mungbean and moringa oleifera flours such that sample F (0% wheat, 45% acha, 25% adu, 25% mungbean and 5% moringa oleifera seed) had the least value (6.0) whereas the control sample A has the highest value (8.5), respectively. The colour of the noodles varied significantly ($p \leq 0.05$) among all the treatments. This could be probably due to the mild attractive colour of the cooked noodle which was attributed to the colour of dull colour of adu and mungbean flours. The sensory score for aroma of the noodle samples ranged from 5.7 to 8.5. Average sensory scores for aroma of the noodles decreased with an increase in the proportions of acha, adu, mungbean and moringa oleifera flours such that sample F (0% wheat, 45% acha, 25% adu, 25% mungbean and 5% moringa oleifera seed) had the least value (5.7) whereas the control sample A has the highest value (8.5), respectively. Anggraeni and Saputra (2013) reported of having an improved aroma on cooked noodles with dried unripe banana composite flour. The taste scores of the noodles varied significantly ($p \leq 0.05$) across the treatments, and ranged from 6.0 (0% wheat, 45% acha, 25% adu, 25% mungbean and 5% moringa oleifera seed) to 8.3 (control). There was a significant different ($p \leq 0.05$) among the samples. The variation in taste could be probably due to variation in the composition of noodle flour. This is quite explainable because wheat has been the major flour for noodle making therefore influencing the sensory judgment of the panelists. Taste is the desirable quality of the foods. This is also where the judges sample the food orally. The values for the texture of the noodle samples ranged between 5.0 and 8.7. Average sensory scores for texture of the noodles decreased with an increase in the proportions of acha, adu, mungbean and moringa oleifera flours such that sample F (0% wheat, 45% acha, 25% adu, 25% mungbean and

5% moringa oleifera seed) had the least value (5.0) whereas the control sample A (100% wheat) has the highest value (8.7), respectively. The relatively low texture values obtained when mungbean constituents exceeded 10% could be probably due to interference the composite flour constituents in gluten development. Overall acceptability (OA) scores ranged from 5.80 to 8.50. There was significant difference ($P<0.05$) among the samples such the control sample (100% wheat bread) had the highest score (8.50) whereas sample F (0% wheat, 45% acha, 25% adu, 25% mungbean and 5% moringa oleifera seed) had the least value (5.8). This signified that acceptable noodle produced by total replacement of wheat with acha, adu, mungbean and moringa oleifera seed was acceptable.

CONCLUSION

This study has showed that total replacement of wheat flour with flours of acha, adu, mungbean and moringa oleifera will improve the food use of these currently underutilized Nigerian crops, encourage mass cultivation of these crops and ultimately improve Nigerian food security status. The research study also showed that acceptable noodles with good shelf stability, improved nutritional and sensory qualities can be produced from acha, adu, mungbean and moringa oleifera composite flour blends. This depicts that these indigenous crops will be very beneficial to pasta, pastry, baking and confectionary industries, and helps reduce cost of wheat importation in Nigeria. It is therefore recommended that the both partial substitution and total replace of wheat flour with acha, adu, mungbean and moringa oleifera flour blends can be used for the production of noodles with a high potential of acceptability.

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