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The effect of fluted pumpkin seed floor (*Telfairia occidentalis*) supplementation on the physical, chemical and sensory properties of noodle

Wordu GO[1], Ogabu VC[2]
[1, 2] Department of Food Science and Technology, Programs on Food Science and Technology and Home Science and Management, Rivers State University, Port Harcourt, Nigeria

Abstract
This study is aimed at the potential of incorporation of fluted pumpkin flour in the production of noodle as a functional food and its overall acceptability. The noodles were prepared from different blends of wheat flour and fluted pumpkin seed flour in the respectively ration of 100:0, 95:5, 90:10, 85:15. The noodles were analysed for the physical, chemical and sensory properties using standard methods. Data obtained were subjected to analysis of variance and mean value were separated using Turkey's test. The proximate composition of the noodle made from the flour blends were determined. The result showed an increase in percentage of fluted pumpkin see flour in the noodles. The result showed a significant ($P < 0.05$) increase in protein content 12:72 to 15:30%, moisture content 8.41-9.24% ash content: 0.69-1.64%, fat content; 0.70-7.36%, crude fibre; 0.79-3.97% and carbohydrate, 63.34-75:86% for dried noodle. The sensory evaluating results revealed that dried and fried noodles with 5% substitution of fluted pumpkin seed flour were most preferable in terms of colour, taste, aroma, texture and overall acceptability.

Keywords: fluted pumpkin supplementation, flour, acceptability, noodle, functional properties

Introduction

Fluted pumpkin (*Telfaria OCcidentailis hook F*) belong to the family of plants called curcurbitacoe (Pulseglove, 1984) [13]. It is grown in southern part of Nigeria, the crop which originated from West Africa (Akoroda, 1990) [3]. It is a leafy vegetable that produces fruits (Enabulele and Uavharhe, 2001) [4]. The fruits on full maturity has a weight of 10kg and an appearance of 10 distinctive longitudinal ribs on the surface. This creapy vegetable spread low across the ground with lobbed leaves and a long twisting tendril. It can survive in the soil for 3-4 years, that is, if there is moisture in the soil (Achinewhu, 1987) [2]. It is one of the leading lead vegetables whose leaves and seeds are nutritious (Schippers, 2000) [14].

The edible part of these vegetable are the large red seeds, leaves and young shoots. The seeds are one of the relative neglected but potentially valuable as high protein oil seed for use as flavouring agent or food protein supplement in many tropical countries (Louge *et al*, 1983) [10].

It has been a challenge for food scientist in finding more nutritious and healthy substitutes to wheat flour for noodle products.

Noodles are generally classified as pasta products made from wheat flour or mixture of cereals. Instant noodles are widely consumed throughout the world and the global consumption is second only to bread. It is convenient, easy to cook low cost and have a relatively long shelf life.

One of the greatest challenges of the food scientist today is to develop affordable foods that are nutritionally acceptable and at the same time defined by the targeted consumer (IITA 1990) [8]. Noodles from wheat flour are predominantly standing with small amount of protein and other nutrient.

Therefore, the inclusion of with fluted pumpkin seed flour with the high level content of protein, the production of noodle will improve the protein content of the noodle. Therefore, the inclusion of the fluted pumpkin seed flour with high protein content to the production of noodle with improve the quality of the noodle.

Material and Methods

Materials

Matured, fresh and healthy fluted pumpkin pod was purchased from a local market in Port Harcourt, Rivers State and the commercial wheat flour was purchased from the Port Harcourt flour mills Ltd, Port Harcourt, Nigeria. All the chemicals used for the study was obtained from the Department of Food Science and Technology Laboratory and are of analytical grade.

Methods

Preparation of fluted pumpkin seed flour healthy, matured and ripe fruit of the fluted pumpkin were cut open to expose the seeds. The seeds were then manually extracted from the pods, washed with distilled water and oven dried for 48hours at 60^0c. The oven dried seeds were then crushed and milled into find powder with an electric blender and served through a muslin cloth. The flours were packed in air tight plastic container and stored in the laboratory of food science prior to analysis.

Production of wheat/fluted pumpkin noodles

The preparation of the noodle product was done from wheat flour with a composition of fluted pumpkin seed flour according to the method of (Omeire *et al*, 2014) [12]. The ingredients used were 40% warm water and 5% CMC carboxymethly colladose, it is a cellulose gum/hydrocolloid which is aimed at proving dough with viscosity and volume and the noodle with texture and durability (Ding and Young, 2013) [7]. The ingredients were weighed separately. The flour blends were mixed with the CMC and 50ml of water/100g weight of flour to form dough. The wheat flour and fluted pumpkin seed flour were mixed at proportions (100:0%, 95:5%, 90:10%, 85:15%) as samples DN1, DN2, DN3, and DN4 for dried noodles and FN1, FN2, FN3, and FN4 for fried noodles (wheat-fluted pumpkin seed flour). The dough was allowed to rest for 20 minutes, kneeled and rolled with a rolling pin to form sheets. The dough sheet were then extruded with a pastry cutter (Eurosonic Globe 150 model) and slitted into noodle strands using a knife. The noodles were put in a clean aluminum tray and oven dried at 60^0c for 12 hours.

After during, the noodles were divided into 2 parts. One part was steamed for 1 minute and deep fried in vegetable oil 140^0c – 160^0c for about 2 minutes. The fried product was removed and cooled at room temperature.

Chemical Analyses

Physico-Chemical Analysis

The proximate analysis of samples for moistures, ash, protein, crude fibre and fat content were carried out on the flours and were developed using the A.O.A.C (1990) [1]. Carbohydrate content was determined by difference.

Determination of moisture content

The moisture content of the samples was determined using A.O.A.C (1990) [1] procedure. Aluminum moisture cans were weighed and dried in an oven (DHG-9140A, China), transferred to a desiccators, cooled for 20 minutes and weighed. 5 grams of each test sample will be weighed into the cans and the weight note, the cans and its content were heated at 105^0c for 4 hours. The cans at the end of the heating was cooled in the desiccators and weighed. The moisture content was calculated using the formular -

$$\text{Moisture (\%)} = \frac{\text{weighted loss}}{\text{Weight of sample}} \times \frac{100}{1}$$

Determination of ash content

2g of the sample was weighted into previously ignited and cooled porcelain crucible. The crucible and sample was heated in a heating mantle (Gehardt, Germany) until smoking ceases. The crucible and content was transferred into a muffle furnace (S x L, China) and was ashed for 3 hours at 550^0c.

The crucible and ash was removed from the furnace and cooled in a desiccators and weighed again. The ash content was calculated as:

$$\text{Ash (\%)} = \frac{\text{weighted of ash}}{\text{Weight of sample}} \times \frac{100}{1}$$

Determination of crude protein content 0.5g of the sample was weighed into a 250ml digestion flask. And 2 tablet of kjedahl catalyst and 12ml of concentrated sulphuric acid was added to the digestion flask. The content of the flask, was placed on a digest furnace set at 420^0c and digested for 1 hour. The digest was allowed to cool and made up to 100ml using distilled water. And 20ml of the digest was introduced into a 250ml kjedahl distillation flask and 20ml of 45% sodium hydroxide was added.

The flask was placed on the kjedahl distillation unit and the ammonia liberated distilled into 10ml boric acid indictor. The distillate was titrated against 0.1 NHCL solution pink end point.

A blank determination was carried out and was subtracted from the sample reading. The %N and the % crude protein was calculated as follows:

$$\text{N\%} = \frac{\text{(Titre – Blank) x normality of acid x 1.4}}{\text{Weight of sample}}$$

Crude protein (%) = %N x 6.25

Determination of crude fat

The crude fat was determined using a micro-extraction unit. And 0.5g sample was weighed, wrapped in a what man number 1 filter paper and placed in thimble, the thimble was placed inside the extraction flask and 40ml of hexane poured into the 50ml extraction flask. The flask and its content was placed on a multifunction shaker and oscillated for 3 hours. At the end the extraction process, the thimble was removed and solvent evaporated and the flask was dried in an air oven for 30min at 105^0c, cooled and weighed. The difference in weight in the extraction flask before and after extraction was recorded as the amount of fat. The fat was calculated as follows:

$$\text{Crude fat (\%)} = \frac{\text{weighted of fat}}{\text{Weight of sample}} \times \frac{100}{1}$$

Determination of crude fibre

About 0.5g of the sample was weighed and placed in a 100ml beaker, 24ml of 1.25% w/v sulphuric acid was added and covered with a watch glass. The content of the beaker was then heated gently on a hot plate 10 minutes. The content of the beaker was then filtered through a hunchner funnel and filtered with filter paper (whatman No. 1) and washed with boiling water until the washings are no longer acid to litmus.

The residue was then washed back into the beaker with 25ml of 1.25% sodium hydroxide. This was then heated for 10 minutes covered with water glass. The resulting insoluble material was then transferred to a dried pre-weighed ashless filter paper and washed through with hot water until the washings was no longer alkaline to litmus. The filter paper with insoluble materials was dried at 105^0c to a constant weight for 1 hour. The dried filter paper and its content was incinerated to an ash at 500^0c for 1 hour, cooled and weighed fiber was calculated as follows:

Fibre = weight of insoluble material – weight of ash

$$\text{Crude fibre (\%)} = \frac{\text{weighted of fat}}{\text{Weight of sample}} \times \frac{100}{1}$$

Determination of carbohydrate content

This was calculated by difference. i.e. 100 – (% moisture + % ash + % fat + % crude protein % fibre).

Water Absorption Rate

The water absorption rate was measured after cooking 20g of noodles in 300ml water for a suitable cooking time (wheat flour noodle 8mins) cooling for 1 minutes cold water and removing the water for 30 secs.

$$\% = \frac{\text{weight of cooked noodle} - \text{weight of fresh noodle}}{\text{Weight of fresh noodle}} \times \frac{100}{1}$$

Determination of cooking loss

It was measured after drying at 105^0c for 24 hrs with the remaining water after measuring the water absorption rate

$$\% = \frac{\text{remaining solid content after drying}}{\text{Weight of fresh noodle}} \times \frac{100}{1}$$

Determination of volume increase rate (swelling power)

The volume increased rate was measured by filling 300ml distilled water in a 500ml mass cylinder and adding 200 of fresh noodle and cooked noodle respectively.

$$\% = \frac{\text{volume of cooked noodle (ml)} - \text{volume of fresh noodle (ml)}}{\text{Volume of fresh noodle}} \times \frac{100}{1}$$

Determination of cooking time

This was measured for a product by adding 20g portion of the noodle sample to a beaker containing 300ml of building distilled water. The cooking time started counting when the sample was put into the boiled water and after each minute of cooking for the first 2 minutes noodles was removed and squeezed between clear glass slides. It was cooked until no white/yellow core was observed every 30sec. the sample was compresses to a uniform colour and its appearance was observed (Chillo, *et al*; 2008) [6].

Sensory evaluation of noodles

Sensory attributes of the noodle such as colour, texture, aroma, taste and overall acceptability was evaluated by 20 finalist using a 5 point hedomic scale based on their degree of likeness from like extremely – 5, like moderately – 4, neither like nor dislike – 3, dislike moderately – 2, dislike extremely–1.

Statistical Analysis

All analysis was conducted in triplicate, mean scores of the result was reported. Data collected were subjected to analysis of variance (ANOVA) using the minitab version 16, software and Turkeys test was used to separate the mean.

Results

Proximate composition of dried and fried wheat – fluted pumpkin noodle. The proximate properties such of moisture, ash, protein, fat crude fiber and carbohydrate of the dried noodle and fried noodle were analysed and the results are present in tables 3 and 4.

The samples were labeled DN signifying dried noodle with ratios DN1 (100:0), DN2 (95:5), DN3 (90:10), DN4 (85:15) and FN signifying fried noodle, FN1 (100:0). FN2 (95:5), FN3 (90:10), FN4 (85:15).

Moisture content of the dried noodle varied from 8.41% - 9.34%. Sample DN1 with 100% wheat flour 9.24%, DN2 8:92%, samples DN3 and DN4 9.34% and 8:41% respectively.

The moisture content for fried noodle varied from 7.12% to 8:19% FN2 has the highest moisture content with value of 8:19% followed by FN4 8:15% and FN3 7:15% and FN1 7:12%.

The ash content of the dried noodle sample varied from 0.69% to 1.64% sample DN1 having the lowest ash content and DN4 having the highest ash content.

The protein content of the dried noodle sample ranged from 12.67% with DN2 to 15.30% with DN4. The protein content of the fried noodle varied from 10.54% to 12.57%.

The crude fibre content in dried noodle sample range from 0.79% to 3.97% with 100% wheat having the lowest value of 0.79% and DN4 3.97%, having the highest value.

Sensory evaluation of dried and fried wheat–fluted pumpkin noodle.

The result of the sensory evaluation of that dried and fried noodle sample produced from wheat-fluted pumpkin blend are presented in table 1 and 2.

The colour of dried and fired noodle samples ranged from 3.30%-4.55% with DN1 and DN2 significantly different from DN3 and DN4, 3.75%-4.65%. The texture ranged from 3.30%-4.45% with DN1 and DN2 significantly different from DN3 and DN4, 3.15-4.25%. The aroma ranged from 3.45%-4.25% with DN1 and DN2 significantly different from DN3 and DN4, 3.3, -4.35% respectively. The overall acceptability ranged from 3.29%-4.43% with DN1 and DN2 were significantly different from DN3 and DN4, 3.33%-4.35%, with FN1 and FN2 were significantly different from FN3 and FN4 respectively.

Table 1: Sensory evaluation of wheat-fluted pumpkin noodle (dried noodle)

Sample	Colour (%)	Texture (%)	Aroma (%)	Taste (%)	Overall acceptability (%)
DN1	$4.55^a \pm 0.61$	$4.55^b \pm 0.61$	$4.25^a \pm 0.88$	4.4,$^a \pm 0.68$	$4.43^a \pm 0.45$
DN2	$4.70^a \pm 0.57$	$4.40^a \pm 0.60$	$4.25^a \pm 0.64$	$4.35^a \pm 0.75$	$4.43^a \pm 0.49$
DN3	$3.55^b \pm 0.89$	$3.45^b \pm 0.69$	$3.55^b \pm 0.69$	$3.30^b \pm 0.80$	$3.46^b \pm 0.51$
DN4	$3.30^b \pm 1.09$	$3.30^b \pm 0.73$	$3.45^b \pm 0.69$	$3.10^b \pm 0.91$	$3.29^b \pm 0.57$

Values are means of triplicate determination ± SD

ab Means having the same letter within a column are not significantly different (P>0.05).

Key

DN1 = 100% wheat flour
DN2 = 95% wheat flour, 5% fluted pumpkin seed flour
DN3 = 90% wheat flour, 10% fluted pumpkin seed flour
DN4 = 85% wheat flour, 15%, fluted pumpkin seed four

Table 2: Sensory evaluation of wheat-fluted pumpkin noodle (fried noodle)

Sample	Colour (%)	Texture (%)	Aroma (%)	Taste (%)	Overall acceptability (%)
FN1	$4.65^a \pm 0.49$	$4.25^a \pm 0.55$	$4.35^a \pm 0.75$	$4.15^a \pm 0.88$	$4.35^a \pm 0.40$
FN2	$4.60^a \pm 0.60$	$3.80^{ab} \pm 0.77$	$4.15^a \pm 0.67$	$3.95^{ab} \pm 0.69$	$4.13^a \pm 0.48$
FN3	$3.85^b \pm 0.59$	$3.35^b \pm 0.88$	$3.35^b \pm 0.81$	$3.20^{bc} \pm 0.89$	$3.44^b \pm 0.51$
FN4	$3.75^b \pm 0.79$	$3.15^b \pm 1.09$	$3.45^b \pm 0.95$	$2.95^c \pm 1.15$	$3.33^b \pm 0.74$

Values are means of triplicate determination ± SD

ab Means having the same letter within a column are not significantly different (P>0.05).

Key:

FN1 = 100% wheat flour
FN2 = 95% wheat flour, 5% fluted pumpkin seed flour
FN3 = 90% wheat flour, 10% fluted pumpkin seed flour
FN4 = 85% wheat flour, 15%, fluted pumpkin seed four

Noodle cooking quality for dried and fried wheat fluted pumpkin noodle.

The noodle cooking qualify of the noodle sample are given

in table 3 and 4 are the dried noodle the value ranond from 151% to 195% DN3 (10% fluted pumpkin seed flour), having the highest value with 195%. The values for DN1, DN1 were 179% - 185% respectively.
The cooking lost of the dried noodle ranged from 7.11% to 8.05% DN4 had the highest percentage cooking loss and DN3 having the lowest percentage cooking loss.
The swelling power ranged from 16% to 23%, with 100% wheat flour having the lowest value for percentage swelling power and DN2 (5% fluted pumpkin seed flour) having the highest value.

Cooking Time

The fried noodle, 8 percentage absorption rate ranged from 137% to 215%, FN2 (5% fluted pumpkin seed flour) had the highest percentage water absorption rate and FN3 had the lowest percentage water absorption rate.
The percentage cooking loss ranged from had the lowest value of percentage cooking loss and FN2 (5% fluted pumpkin seed flour) had the highest percentage water absorption rate and FN3 had the lowest to percentage water absorption rate.
The percentage cooking loss ranged from 9.74% to 11.87%. The 100% wheat flour had the lowest value of percentage cooking loss and FN2 (5% fluted pumpkin seed flour) had the highest value of percentage water absorption rate.
The percentage cooking loss ranged from 9.74% to 11.87%. The 100% wheat flour had the lowest value of percentage cooking loss and FN2 (5% fluted pumpkin seed flour) had the highest of percentage cooking loss.
The percentage swelling power varied from 17% to 45%, with FN2 (5% fluted pumpkin seed flour|) had the highest percentage swelling power and FN4 (15% fluted pumpkin seed flour) had the lowest percentage swelling power.

Table 3: cooking properties of wheat-fluted pumpkin noodle (fried noodle)

Samples	Water absorption (%)	Cooking loss (%)	Swelling power (%)	Cooking time (min)
DN1	185.04^a±38.74	7.44^a±1.28	16.49^b±1.00	6.00^d±0.00
DN2	179.24^a±30.46	7.33^a±1.10	23.56^a±0.05	8.00^c±0.00
DN3	151.52^a±33.35	7.11^a±1.14	21.72^a±0.39	9.00^b±0.00
DN4	195.65^a±52.57	8.05^a±1.29	20.75^a±1.06	10.00^a±0.00

Values are means ± standard deviation of triplicate samples
^{abcd} Means values bearing different superscript in the same column differ significantly (P<0.05).

Key:
DN1 = 100% wheat flour
DN2 = 95% wheat flour, 5% fluted pumpkin seed flour
DN3 = 90% wheat flour, 10% fluted pumpkin seed flour
DN4 = 85% wheat flour, 15%, fluted pumpkin seed four

Table 4: Cooking properties of wheat-fluted pumpkin noodle (fried noodle)

Samples	Water absorption (%)	Cooking loss (%)	Swelling power (%)	Cooking time (min)
FN1	155.55^a	9.74^a±1.80	17.24^c±0.21	5.00^c±0.00
FN2	215.75^a±17.500	11.87^a±0.10	45.22^a±0.32	4.00^d±0.00
FN3	137.23^a±13.34	10.55^a±1.34	42.10^a±3.00	5.00^b±0.00
FN4	197.56^a±37.57	10.72^a±1.19	33.16^a±0.23	8.00^a±0.00

Values are means ± standard deviation of duplicate samples
^{abc} Means values bearing different superscript in the same column differ significantly (P<0.05).

Key:
FN1 = 100% wheat flour
FN2 = 95% wheat flour, 5% fluted pumpkin seed flour
FN3 = 90% wheat flour, 10% fluted pumpkin seed flour
FN4 = 85% wheat flour, 15%, fluted pumpkin seed four

Discussion

According to the result of the moisture content of the dried noodle ranged from 8.41% to 9.34%. The dried noodle produced from wheat-fluted pumpkin blend at 10% had the highest moisture content while the noodle produced from wheat-fluted pumpkin blend at 15% had the lowest moisture content. Significant differences were not observed between the moisture content of the noodle.
The moisture content value for the dried and fried noodles were less than that of wheat bread fruit blend reported by Tijani *et al*, (2017) [15] which ranged from 2.50-3.50% but were in close range to the of Nnam (2002) [11]. He also reported that the lower the moisture content of a product the longer shelf life. Moreover, apart from providing longer shelf life, it is also brings smaller space requirement for storage and light mass or shipping.
The ash content of the sample has generally higher than that of the control. The indicates that the sample mineral content of higher than the control.
The ash content of the sample was generally higher than that of the control. This indicates that the sample mineral content is higher than the control.
The ash content of the dried noodle ranged from 0.69% to 1.64%. The values for the dried noodle were lower and also within the range with fluted pumpkin bread reported by Kin-kabar (2015) [9], with values 0.8 to 2.3%.
The fat content of the dried noodle varied from wheat/fluted pumpkin flour blend at 15% having the highest fat content and noodle produced at 100% wheat flour having the least fat content.
The protein content of the dried noodles ranged from 12.70% to 15.30%, as the substitution of fluted pumpkin increased, the protein content in the dried noodle also increased. This was one of the aims of the study to produce noodle with high protein profile. As children are the main consumers of noodles. The protein content of the dried noodles was within the range with that of instant noodle produced from wheat/breadfruit blends reported by Tijani and Oke (2017) [15]. The in-vitro protein digestibility also increased in wheat-fluted pumpkin in the study of Wordu, (2016) [16].
The crude fiber content of the dried noodle varied between 0.79% to 3.97% crude fibers content increased as the fluted pumpkin substitution increase. The dried noodle with wheat had the lowest crude fiber content and the highest was the wheat-fluted pumpkin blend at 15%.
The carbohydrate content of the dried noodle varied between 63.34% to 75.86%. The dried noodles produced from wheat-fluted pumpkin blend at 15% had the lowest carbohydrate content, the wheat 100% had the highest carbohydrate content. The dried and fried noodle carbohydrate content was within (61.81-75.93%) reported by Bellow (2018) [5].
The physicochemical characteristics of the blend also showed different results.
There was no significant difference (P > 0.05) in the water absorption rate among the blends. The results was observed with cooking loss there were no significant difference (P

>0.05) among the blends.

The swelling power of the blends showed no significant different (P > 0.05) among the blends the same results was observed on the cooking time.

Sensory evaluation was performed on the noodle produces. The overall acceptability for dried noodle had no significant difference (P >0.05) with DN1 and DN2. The 100% wheat and 5% fluted pumpkin addition had the highest overall acceptability.

In conclusion, supplementation of wheat flour with fluted pumpkin in dried noodle production at the level of 5% was the most acceptable to the consumers, indition, this level contains higher protein level than the 100% Wheat fluted pumpkin noodles are rich in protein and energy. Thus, fluted pumpkin incorporated into wheat flour as an ingredient has potential in a healthy noodle.

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