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Production of instant cassava noodles

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Abstract. To increase the utilization of composite flours from cassava, soybean and wheat, this paper report findings on the chemical and sensory qualities of instant noodles from cassava, soybean and wheat. Flour from cassava, wheat and soybean were used in different formulations (90:7.5:2.5; 80:15:5; 70:27.5:7.5, 60:30:10; 100:0:0; and 0:100:0 to cassava–wheat–soybean) to produce instant noodles. Chemical and sensory properties of the instant cassava-wheat-soybean samples were analyzed. The result obtained from the proximate analysis showed that increase in percentage of cassava in the noodle sample increased the carbohydrate, ash and fibre content, respectively. There were significant differences ($P<0.05$) in the sensory attributes (color, aroma, appearance, flavor, taste and texture) of the instant cassava-wheat-soybean samples. Statistically ($p<0.05$), noodles produced from 100% wheat flour were the most acceptable by the panelists, closely followed by those made from 60% cassava, 30% wheat, 10% soybean; and, 70% cassava, 27.5% wheat, 7.5% soybean, respectively.

Introduction

Noodles are long thin piece of food made from a mixture of flour, water and eggs usually cooked in soup or boiling water (Longman, 2000). They are a form of staple food very popular among the Asians (Kit Chan, 2002). It is also a quick cooking pasta that can be prepared in a microwave or by immersion in hot water for 2-3 minutes (Matz, 1991). They can be made either by hand or by machine. They are divided into "cut noodles" or "dried noodles" depending on how they are made. Made in whatever way, they may be of different width varying from ribbons to threads. As a prepared dish, they can be served warm or cold dressed with chili oil or not, eaten with fried bean sauce, pork or chicken sauce, duck chops and soup of any concoction.

Pasta is an ancient food stuff which could be defined as a type of dough extruded or stamped into various shapes for cooking. Pasta is economical, easy to prepare, have longer shelf life, and are consumed all over the world in many different ways. Pasta products are normally made from amber durum wheat which is milled into semolina and mixed with water, salt, eggs, vegetable oil, and a times vegetable coloring. Semolina is preferred to flour because less water is required to make the pasta dough, which greatly helps in the drying stage (Bernard Davis, 1988). The variety of products from pasta has increased in part through the addition of vegetable materials which provides different flavors, color and often additional nutrients (Matsuo *et. al.*, 1975; Banasik, 1975). Recently, research into processing of pasta that eliminates the need for cooking for a very longtime has resulted in the production of instant noodle snacks (Kim, 1996). There is also a variety of "Instant Noodles", which are precooked, dried and commercially packed. These are simply soaked in hot boiling water for a few minutes before they are eaten.

During the ban on the importation of wheat flour to Nigeria in 1987 for bread and other baked products, most baking industries had to close down while many bakeries had to adopt alternative solutions to stay in business (Chris, 1987). One of the solutions developed was the mixing and using of flour from other sources into wheat (Osuntogun, 1987). "Composite flour" is the name given to wheat that has been diluted with other non wheat materials like cassava, maize, and soybean. Several investigators have studied the use of composite flour in bread making (Ogunsua and Hudson, 1976; Nout, 1977; Kim *et al.*, 1978). Non wheat materials like in composite flour reduce the cost of production of bread and other baked products. To increase the utilization of composite flours from cassava, soybean and wheat. The aim of this project was to investigate the chemical and sensory qualities of instant noodles from cassava, soybean and wheat. This information is important for improving these products and therefore increasing the utilisation of composite flour.

Materials and Methods

Freshly harvested twelve months old cassava roots of (TMS, 30572 variety) were obtained from the University of Agriculture, Abeokuta, farm. Also wheat flour, soybeans and lesieur pure vegetable oil were purchased from Osiele market in Abeokuta, Nigeria. Tartrazine, iodized salt, guargum, sodium polyphosphate and calcium carbonate were bought from Kuto Market, Abeokuta, Nigeria.

Cassava flour preparation. The cassava roots were processed immediately on arrival at the laboratory. The roots were washed, peeled, grated, pressed/dewatered, dried (65°C for 24hrs), milled and sieved (0.05mm).

Soybean flour preparation. Soybean was processed immediately on arrival at the laboratory. The soybean was sorted cleaned, blanched (20min in H_2O), soaked (6h), dehulled, dried (65°C for 7h), milled and sieved.

Instant noodle ingredient formulation. The ingredient formulations used in this study are presented in Table 1.

Production of instant cassava – wheat – soya noodles. All the ingredients were weighed out in the right proportions. The alkali mixture i.e. guargum, iodized salt, tartrazine, sodium phosphate, potassium carbonate and the appropriate amount of water were first mixed in a mixer with constant stirring for about 20minutes, they were added one after the other to prevent formation of lumps. After this, the pH was tested to ensure that it ranged from

Table 1: Ingredient formulation for instant cassava – wheat – soybean noodles (percentage composition).

Ingredients	Sample (%)					
	CWS_1	CWS_2	CWS_3	CWS_4	CWS_5	CWS_6
Cassava flour	78.59	69.86	61.13	52.40	87.33	0
Wheat flour	6.55	13.10	19.64	26.20	0	87.33
Soybean flour	2.18	4.37	6.55	8.73	0	0
Guargum	4.41	4.41	4.41	4.41	4.41	4.41
Iodize salt	5.24	5.24	5.24	5.24	5.24	5.24
Sodium phosphate	1.81	1.81	1.81	1.81	1.81	1.81
Potassium Carbonate	1.18	1.18	1.18	1.18	1.18	1.18
Tartrazine	0.02	0.02	0.02	0.02	0.02	0.02
Water	0.03	0.03	0.03	0.03	0.03	0.03

The cassava:wheat:soybeans ratio = CWS_1 = 90:7.5:2.5; CWS_2 = 80:15:5; CWS_3 = 70:27.5:7.5; CWS_4 = 60: 30:10; CWS_5 = 100:0:0; CWS_6 = 0:100:0.

10 -11. The mixture of cassava, wheat and soybean flour weighed were introduced into the mixer and the alkali mixture added in a stepwise manner in a Kenwood Mixer (Model No. Km 120mm, Kenwood limited UK). The mixer was set at higher speed for 10minutes to allow thorough mixing and softening of the dough. The dough formed was kneaded with a rolling pin to form a sheet. The sheet was then moved to the kneading section of the Marcato paster bike machine (Model No. 150mm, ATLAS, Italy) for further kneading before moving to the slitting section of the same machine where the slitter cuts the kneaded dough into strands 1.00 – 1.05mm thick each. The slitted dough was then steamed for about 2 – 4min before frying in an automatic deep fryer for about 2 minutes at the temperature of 170°C. The fried products were removed and allowed to cool and then packaged.

Cooking time determination of instant cassava-wheat- soybean noodles. The instant noodles were cooked separately by immersion in boiling water and thereafter allowed to stay for few minutes. The different times taken for each of the samples to cook were recorded.

Proximate analysis: Moisture content determination. The moisture content of cassava-wheat–soybean noodle was determined using the AOAC method (1990). Five grammes of ground samples were weighed and put in desiccators to cool. After cooling the ground samples was weighed and returned to the oven for 30minutes, cooled and weighed again. The process was repeated until constant weight was obtained. The percentage moisture content was then calculated.

Crude protein determination. Crude protein was determined by the AOAC methods (AOAC, 1990) carried out using the automated semi micro Kjeldahl method. 0.2g of samples plus 0.8g of the digestive mixture plus 10ml of concentrated H_2SO_4 were gently heated in the fuming chamber until digest was clear. The cooled digest was transferred to a 100ml volumetric flask and quantitatively diluted to the mark. 10ml of digested solution plus 15ml of NaOH and 15ml Na_2SO_3 were distilled. The distillate was collected and 10ml of boric acid with screen methyl red as an indicator and titrated with 0.1N hydrochloric acid. Crude protein was determined from %N as shown:

$$\% \text{ Nitrogen} = \frac{(\text{titre} - \text{blank}) \times \text{Nacid} \times 1.4}{\text{Weight of sample}}$$

% Nitrogen Protein = % Total Nitrogen x 6.25

Crude fat. Crude fat was determined by the method of AOAC (1990). The extraction flask was dried to a constant weight and recorded. Ground samples (5g) were accurately weighed into a filter paper, wrapped properly and placed in a thimble and transferred to the extraction barrel N-hexane that was enough to run through the duration of extraction flask. During extraction the water inlet tap remained opened and flask was heated on the regulated heating mantle for 3 hours at a condensation rate or at least 3-6 drops per second.

After extraction time was completed, the thimble was removed from the extractor barrel and distillation was continued until the estimation flask was almost dry. The flask now containing oil was detached and dried in the oven over night at 70°C to constant weight. The thimble was then removed from the oven, cool in a desiccator and weighed. Crude fat was determined as:

$$\text{Crude fat (ether extract) \%} = \frac{W_2 - W_3}{} \times 100$$

W_1 = weight of sample
W_2 = weight of flask before extraction
W_3 = weight of flask plus oil after extractor

Determination of ash content. Ash content was determined according to AOAC (1990). Two grammes of the ground sample was accurately weighed into a dish. The samples were ignited on a hot plate in a fume cupboard to get rid of the organic matter. The dishes were then placed in the muffle furnace. They

were then transferred to a desecrator, cooled and weighed immediately. Ash content (%) was determined as:

$$\text{Ash content (\%)} = \frac{\text{Weight of Ash x 100}}{\text{Weight of dry sample}}$$

Crude fibre determination. Crude fibre was determined following method described by Pearson (1991). 1g of ground sample was weight into the digestion flask and 100ml or TCA digestion reagent was added. This was placed on the heating unit of digester and the water supply to reflux condenser was opened. It was brought to boiling and refluxed for exactly 40minutes counting from the time boiling commenced. The flask was then removed from the heater, cooked a little and filter through No. 4 (15.0cm diameter). The residue was washed six times with distilled water and once with industrial spirit and then transferred to a previously ignited and pre-weighed dish dried overnight in an oven at 105°C, transferred to desiccators and weighed when cool. This was then ash in a muffle furnace 600°C for 6 hours, allowed to cool and re-weighed. Fibre content was determined as:

$$\text{\% fibre} = \frac{\text{Loss in weight on ashing x 100}}{\text{Weight of sample}}$$

Total carbohydrate determination. This was determined according to AOAC (1990). It was determined as a difference between 100 and total sum of the percentages of fat, protein, moisture, ash and crude fibre.

Chemical analysis: determination of free fatty acid. Free fatty acid was determined according to Pearson, 1991. Ten grammes of oil (i.e. 11ml) was weighed and placed in a 250ml Erlenmeyer flask and dissolved in 50ml neutral diethyether/ethanol mixture and 0.5ml of phenolphthalein indicator, added, and then titrated against 0.1N NaOH to a pink color as the end point.

$$\text{Free fatty acid} = \frac{\text{Titration (ml) x 5.61}}{\text{Weight of sample used}}$$

Determination of peroxide value. The peroxide value was determined by the Pearson (1991) method. Two and half grammes of oil was weighed into 250ml conical flask with grounded naked glass stopped 30ml of acetic acid – chloroform solution, was added, the flask was swirled until the sample was dissolved in the solution. 1ml saturated solution of iodide (Kl) was added, the solution was swirled again for 1minute and then 30ml of distilled water was added, mixed thoroughly and then stored in a dark cupboard for 30minutes. After 30 minute the solutions was then titrated with 0.1N $Na_2S_2O_3$ solution with starch as indicator to the yellow color of the solution to blue black. Peroxide value was calculated as:

$$\text{Peroxide value} = \frac{(V_a - V_b) \text{ x } 100 \text{ (mg equivalent/100g)}}{\text{Weight of sample}}$$

V_a = vol. of $Na_2S_2O_3$ solution for sample titration (ml)
V_b = vol. of $Na_2S_2O_3$ solution for blank titration (ml)
N = Normality of 0.01 $Na_2S_2O_3$ solution
W = weight of sample (g)

Sensory evaluation. A taste panel of cooked noodles prepared from various formulations was conducted, using a panel of 30 judges; who were regular noodles eaters. The judges were asked to score for color, flavor, taste, texture and appearance using a 9 point hedonic scale; where 1 and 9 represent dislike extremely and like extremely respectively.

Statistical analysis. All data were subjected to analysis of variance [ANOVA] using SPSS [Version 10.2, 2002] statistical package. Means were separated with Duncan Multiple Range Test (DMRT). Pearson's correlation matrix was determined between the results of chemical composition of all the noodles using the same statistical package.

Results and Discussion

Proximate composition of instant cassava-wheat-soybean noodles. Table 2 presents the proximate composition of instant cassava-noodles. The moisture content of the noodle samples ranged from 2.1 to 3.7, with noodle sample CWS_2 (Cassava-wheat-soybean in the ratio 80:15:5) having the highest moisture content of 3.7. There are no significant difference between the moisture content of the noodle sample at ($P>0.05$). The values were within expected moisture level according to Enwere (1998).

Generally, there were significant differences ($P<0.05$) in the carbohydrate, protein, fat, ash and fibre contents of the noodle samples. The carbohydrate content of these noodle sample ranged from 64.7 to 79.7. The noodle samples CWS_5 (cassava-wheat- soybean in the ratio 0:100:0) had the highest carbohydrate content of 79.7 while the noodle sample CWS_6 (cassava- wheat-soybean in the ratio 100:0:0) had the lowest CHO content. This may be as a result of the high contents of carbohydrate in cassava flour (Oguntona and Akinyele, 1995). The percentage protein content of the instant noodles ranged from 5.8 to 12.1. The noodle sample CWS_6 had the highest protein content while the noodle sample CWS_5 had the lowest protein content. This is attributed to the high protein content in wheat and soybeans (Enwere, 1998). The fat content ranges from 11.1 to 18.4 with noodle sample CWS_6 having the highest fat content and sample CWS_5 the lowest. This may be as a result of the absorption of the fat during frying. The ash content ranged from 0.7 to 1.2 with noodle sample CWS_5 having the highest ash content and noodle sample CWS_2 with lowest. This is attributed to the high percentage of ash in cassava. The fibre content ranged from 0.2 to 0.8 with noodle sample CWS_6 having the highest fibre content most probably due to high fibre in cassava (FAO, 1972).

Chemical composition of the instant cassava-wheat-soybeans noodle. The free fatty acid and peroxide values for cassava-noodles are presented in Table 3. The FFA values ranged from 0.3 to 0.5 with CWS_5 recording the highest. The free fatty acid is a measure of the extent to which the glycerides in the oil have been decomposed by lipase or other action (Pearsons, 1991). Rancidity is accompanied by free fatty acid formation i.e. spoilage of the oil and is used as a condition for the edibility. The higher the FFA value, the more prone the oil is to spoilage.

The peroxide value ranged from 4.0 to 6.2 with CWS_5 recording the highest value. There were no significant differences between the noodle samples at ($P>0.05$). The peroxide value is a measure of the peroxides contained in the oil. During storage, peroxide formation is slow at first but latter increases. This shows that the more the peroxide value the higher the rate at which the oil decomposes, thereby leading to the spoilage of the sample. From our results, the peroxide values are low in comparison to the minimum values reported

Table 2: Proximate composition of instant cassava – wheat – soybean noodles.

Sample code	Ash %	Cho %	Fat %	Moisture %	Fibre %	Protein %
CSW_1=148	0.9ab	72.0a	15.9bc	3.6a	0.7b	6.9bc
CSW_2=213	0.6b	72.0a	16.5bc	3.7a	0.5c	7.2b
CSW_3=317	0.9ab	70.3a	16.8b	3.7a	0.5c	8.0b
CSW_4=425	0.7b	71.0a	17.2b	2.5a	0.4c	8.4b
CSW_5=579	1.2a	79.1a	11.1d	2.1a	0.8a	5.8c
CSW_6=614	0.9ab	64.6b	18.4a	3.5a	0.2d	12.4a

Mean values followed with different alphabet within column are significantly different ($p<0.05$).

previous by authors (Pearsons, 1991). Therefore, the noodle sample can be stored for a very long time without getting spoiled.

Correlation matrix of proximate and chemical properties. Table 4 presents Pearson's correlation matrix of proximate composition and chemical properties of instant cassava-wheat – soybeans noodles. From the result, the carbohydrate content of the instant noodle samples correlates inversely with its moisture, fat and protein content, respectively. The carbohydrate content also correlates positively with fibre content. The peroxide value does not correlate with any of the proximate values while FFA correlates inversely with the fat, fibre and carbohydrate contents.

Sensory qualities of noodles. The result of the sensory evaluation of instant cassava-wheat-soybean noodles are shown in Table 5. In terms of appearance, aroma, color, flavor and texture, noodle sample 614 (cassava-wheat- soybean in the ratio 0:100:0) was the most acceptable. Sample 579 (cassava-wheat- soybean in the ratio 100:0:0) was the least acceptable. In terms of taste, noodle sample 614 was the best noodle samples 148 and 579 the worst. Overall, sample 614 (cassava- wheat- soybean in the ratio 0:100:0) was the best. This might be due to the presence of high cassava content in the noodle.

Conclusion

From this work, instant noodles produced from composite flour were different from each other. It was observed that as cassava in the noodle samples increased, there was an increase in their carbohydrate and fibre

Table 3: Chemical composition of instant cassava – wheat – soybean noodles.

Sample code	FFA %	Peroxide % (ns)
CSW_1=148	0.4b	6.2a
CSW_2=213	0.4b	4.2b
CSW_3=317	0.3b	5.0a
CSW_4=425	0.3b	5.5a
CSW_5=579	0.5a	4.0b
CSW_6=614	0.3b	4.4b

Mean values followed with different alphabet within column are significantly different ($p<0.05$).

Table 4: Pearson's correlation matrix of proximate composition and chemical properties of instant cassava- wheat – soybeans noodles.

	Moisture	Ash	Fat	Fibre	Protein	CHO	P-value	FFA
Moisture	1.000							
Ash	-.216	1.000						
Fat	.528	-.599*	1.000					
Fibre	-.261	.398	-.857**	1.000				
Protein	.287	-.220	.707*	-.803*	1.000			
Cho	-.5938	.408	-.925**	.850**	-.892**	1.000		
P-value	-.175	-.276	.204	.072	-.079	-.027	1.000	
FFA	-.164	-0.46	-.594*	.618*	-.431	.537	-.150	1.000

* Significant at $p < 0.05$. **Significant at $p = 0.01$.

Table 5: Mean score of sensory evaluation of instant cassava–wheat–soybean noodles.

Sample code	Appearance	Aroma	Colour	Flavour	Taste	Texture	Overall acceptability
CSW_1=148	6.2b	6.0b	6.6a	5.6b	4.9c	5.7b	5.5bc
CSW_2=213	6.3b	5.9b	6.2a	5.8b	5.9b	5.8b	5.9b
CSW_3=317	6.0b	5.8b	6.0a	5.9b	5.9b	5.8b	6.0b
CSW_4=425	5.6b	5.9b	5.7b	5.8b	5.6b	6.0b	6.1b
CSW_5=579	3.3a	5.2b	3.9c	5.2b	5.0b	5.0b	4.8c
CSW_6=614	6.5b	7.1a	6.9a	7.3a	7.4a	7.2a	7.5a

Mean values followed with different alphabet within column are significantly different ($p<0.05$). n = 30.

content and a decrease in protein and fat content. The noodle sample with 100% wheat was highly accepted closely followed by noodle samples 425 (60:30:10 cassava: wheat: soybean) and 317 (70:27.5:7.5 cassava: wheat: soybean).

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