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Production of Instant Cassava Noodles

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Abstract: Cassava flour from cassava (*Manihot esculenta* crantz), wheat flour from wheat (*Triticum aeshuum*) and soybean flour from soybean (*Glycine max* L merri) were used in different formulation of 90:7.5:2.5; 80:15:5; 70:27.5:7.5, 60:30:10; 100:0:0; and 0:100:0 to produce instant cassava–wheat–soybean noodles. Chemical (proximate, free fatty acid, peroxide value) 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 gave an increase in 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 was the most acceptable by the panelists, closely followed by noodle samples made from 60% cassava -30% wheat-10% soybean and 70% cassava-27.5% wheat-7.5% soybean respectively.

Key words: Cassava, soybean, wheat, instant, noodles

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 from China to Indonesia and from Japan to Vietnam (Kit Chan, 2002). It is also a quick cooking pasta that can be prepared in a microwave or by immersion in hot water to 2-3 minutes (Matz, 1991).

Noodles are a variety of pasta product made available to the caterer. They can be made either by hand or by machine and, by the way they are made, are divided into "cut noodles" or "dried noodles". 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 (Chinavista.com, 2002).

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 i.e. (high gluten quality and content) 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 addition nutrients (Matsuo *et al.*, 1975 and Banasik, 1975).

Recently, research into the field of manufacturing and 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. Before eating, all one has to do is to soak the noodles in hot boiling water for a few minute (Chinavista.com, 2002).

During the ban on the importation of wheat flour in 1987 for bread and other baked products, most baking industries had to close down while so many bakeries had to adopt alternative solution to stay in business (Chris, 1987). One of the solutions developed is the use of flour from other sources which is called "COMPOSITE FLOUR"(Osuntogun, 1987). Composite flour therefore 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 and Kim *et al.*, 1978). Additional, composite flour has been of tremendous influence to the economy of Nigeria and other developing countries(Osuntogun, 1987). Non wheat materials like cassava, soybean and millet are used as composite flour to substitutes for wheat flour in bread making and also to reduce the cost of production of bread and other baked products.

To increase the utilization of composite flours, the aim of this project is to investigate the chemical and sensory qualities of instant noodles from composite flours.

Materials and Methods

Freshly harvested cassava roots of(TMS, 30572) Variety were obtained from the University of Agriculture, Abeokuta, farm. The plant was 12 months old at the time of harvest. The outer skin was brown, cortex was creamy and the pulp was white in color. Also wheat flour, soybeans and lesieur pure vegetable oil were purchased from Osiele market in Abeokuta, Nigeria. Also, tartrazine, iodized salt, guargum, sodium polyphosphate and calcium carbonate were bought from Kuto Market, Abeokuta, Nigeria.

Cassava Flour Preparation: The cassava roots purchased 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). The sieved product is referred to as cassava flour (Enwere, 1998).

Soybean Flour Preparation: The 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. The sieved product is referred to as the soybean flour.

Instant Noodle Ingredient Formulation

The ingredient formulations used in this study is presented in Table 1.

Production of Instant Cassava - Wheat - Soya Noodles: All the ingredients were weighed out in the right proportion. Calculated amount of water was collected. A single stage mixing was used in all cases. The alkali mixture i.e. guargum, iodized salt, tartrazine, sodium phosphate, potassium carbonate and water were first mixed in a mixer with constant stirring for about 20 minutes, they were added one after the other to prevent formation of lumps. After this, the pH was tested to ensure it is within 10 -11. The mixture of the cassava flour, wheat flour 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 Kenwood major mixer was set at higher speed for 10minutes to allow thorough mixing and soften 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 having a thickness of 1.00-1.05mm each. The slitted dough was then steamed for about 2-4min before frying in an automatic deep fryer condition for about 2 minutes at the temperature of 170°C. The fried products were removed and allowed to cool and then packaged in the chosen packaging material.

Cooking Time Determination of Instant Cassava-Wheat- Soybean Noodles: Instant cassava-wheat-soybean sample (90:7.5:2.5, 80:15:5, 70:22.5:7.5, 60:30:10, 100:0:0, 0:100:0) 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

Table 1: Ingredient Formulation for Instant Cassava - Wheat - Soybean Noodles (PercentageComposition)

Ingredients	Sample (%)					
	CWS_1	CWS_2	CWS_3	CWS_4	CWS_5	CWS_6
Cassava flour	60.22	53.53	46.84	40.15	87.90	0.0
Wheat flour	5.0	10.04	15.06	20.08	0.0	87.90
Soybean flour	1.7	3.35	5.02	6.69	0.0	0.0
Guargum	3.35	3.35	3.35	3.35	3.35	3.35
Iodize salt	1.4	1.4	1.4	1.4	1.4	1.4
Sodium phosphate	4.0	4.0	4.0	4.0.	4.0	4.0
Potassium Carbonate	0.9	0.9	0.9	0.9	0.9	0.9
Tartrazine	0.01	0.01	0.01	0.01	0.01	0.01
Water	2.44	2.44	2.44	2.44	2.44	2.44

CWS_1	=	90:7.5:2.5	Cassava	wheat	soybeans ratio
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	"	"	"

the AOAC method (1990). 5g of ground sample was weighed accurately and put inside a Petri dish of a known weight. The sample was removed and put in desiccators to cool. After cooling the ground samples was weighed and retuned to the oven for 30 minute, cooled and weighed again. It was repeated until constant weight was obtained. The percentage moisture content was calculated as follows

$$\%\text{Moisture Content} = \frac{\text{Weight loss}}{\text{Original weight of sample}} \times 100$$

Crude Protein Determination: Crude protein was determined by the AOAC (1990). This was 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.

Calculation

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

% 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 sample (5g) was 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.

Calculation

$$\text{Crude fat (ether extract) } \% = \frac{W_2 - W_3}{W_1} \times 100$$

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). 2g of the ground sample was accurately weighed into a dish which has been previously ignited and weight. The samples were ignited on a hot plate in a fume cupboard to clear the organic matter. The dish was them placed in the muffle furnace completely a sheet. This was then transferred to a desecrator, cooled and weighed immediately.

Calculation

$$\text{Ash content } \% = \frac{\text{weight of Ash}}{\text{Weight of dry sample}} \times 100$$

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.

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

Total Carbohydrate Determination: This was determined by difference using the AOAC (1990). It was determined by difference between 100 and total sum of the percentage of fat, protein, moisture, ash and crude fibre.

Total Carbohydrate % = 100%-[%fat + %protein + %moisture + %ash + %crude fibre]

Chemical Analysis

Determination of Free Fatty Acid: Free fatty acid was determined according to (Pearson, 1991). 10g of oil (i.e. 11ml) sample was weighed and placed in a 250ml Erlenmeyer flask, which was then dissolved in 50ml neutral diethyether/ethanol mixture and 0.5ml of phenolphthalein indicator, was added, and then titrated with 0.1N NaOH to a pink color as the end point.

Calculation

$$\text{Free fatty Acid} = \frac{\text{Titration (ml)} \times 5.61}{\text{Wt of sample used}}$$

Determination of Peroxide Value: The peroxide value was determined by the Pearson(1991) method. 2.5g of oil sample 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 (KI) 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. Blank titration was also carried out.

Calculation

$$\text{Peroxide Value} = \frac{(v_a - v_b) \times 100 \text{ (mg equivalent/100g)}}{\text{Weight of sample}}$$

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 obtained 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 2.1to 3.7, with noodle sample CWS_2 (Cassava-wheat-soybean in the ratio 80:15:5) have 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 *et al.*(1995).

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 noodles sample ranges from 64.7 to 79.7. The noodle samples CWS_5 (cassava- wheat- soybean in the ratio 0:100:0)has the highest carbohydrate content of 79.7 while the noodle sample CWS_6 (cassava- wheat- soybean in the ratio 100:0:0) has the lowest CHO content. This may be as a result of the high contents of carbohydrate in cassava flour as reported by Oguntona and Akinyele (1995).

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 ($p < 0.05$).

CWS_1	=	90:7.5:2.5	Cassava	wheat	soybeans ratio
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	"	"	"

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 ($p < 0.05$)

CWS_1	=	90:7.5:2.5	Cassava	wheat	soybeans ratio
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	"	"	"

It is known that carbohydrate gives energy in the body, the noodle sample CWS_5 will produce high energy to the body when consumed. The percentage protein content of the instant noodles ranges from 5.8 to 12.1. The noodle sample CWS_6 has the highest protein content while the noodles sample CWS_5 has the lowest protein content. This is as a result of the high protein content in wheat and in soybeans (Enwere, 1998). The fat content ranges from 11.1 to 18.4 with noodle sample CWS_6 has the highest fat content while the noodle sample CWS_5 has the lowest content. This may be as a result of the absorption of the fat during frying. The ash content ranges from 0.7 to 1.2 with noodle sample CWS_5 has the highest ash content while the noodle sample CWS_2 (Cassava-wheat-soybean in the ratio 80:15:5) has the lowest ash content and this might be as a result of high percentage of ash in cassava. The fibre content ranges from 0.2 to 0.8 with noodle sample CWS_6 has the highest fibre content which may be due to high fibre in cassava then wheat(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 (Cassava-wheat-soybean in the ratio 0:100:0) 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 of the high. The higher the FFA value, the more prone is the oil to spoilage. From the result obtained, the lower FFA value obtained is an indication for long storage period of the noodle samples produced.

The peroxide value ranged from 4.0 to 6.2 with CWS_5 (Cassava-wheat-soybean in the ratio 90:7.5:2.5) recording the highest. There are no significant difference between the noodle sample 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 increased. 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 the result obtained from the analysis, the peroxide value is low to a considerable limit when compared to the minimum value previous authors (Pearson's 1991). Therefore, the noodle sample can be stored for a very long time without getting spoilt.

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	-0.460	-.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	Original Acceptance
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.

CWS_1	=	90:7.5:2.5	Cassava	wheat	soybeans ratio
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	"	"	"

Correlation Matrix of Proximate and Chemical Properties: Table 4 presents the 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 and it is significant at the 0.05 level. The carbohydrate content also correlates directly with its fibre content and is significant at the 0.01 level. The peroxide value does not correlate with any of the proximate while FFA correlates inversely/indirectly with the fat, fibre and carbohydrate contents at 0.05 level of significant.

Sensory Evaluation: 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) has the highest level of acceptance while noodle sample 579 (cassava- wheat- soybean in the ratio 100:0:0) has the lowest level. In terms of taste, noodle sample 614 has the highest level of acceptance and noodle sample 148 (cassava- wheat- soybean in the ratio 90:7.5:2.5) and 579 (cassava- wheat- soybean in the ratio 100:0:0) have the lowest level of acceptance. The noodle sample 614 (cassava- wheat- soybean in the ratio 0:100:0) has the overall acceptance in terms of the entire attribute in question while the noodle sample has the lowest level of acceptance in terms of all the attributes in question. This might be due to the presence of high cassava content in the noodle. Sample sensory analysis of the noodle showed that all the samples were of significant difference at ($P<0.05$) in terms of color, texture, flavor, aroma, appearance and taste.

Conclusion

From the research work, instant noodles were produced from composite flour which were of significant different from each other. It was observed that as cassava in the noodle samples increase, there is also increase in their carbohydrate and fibre content and decrease in its protein and fat content. The noodle sample with 100% wheat was highly accepted and followed closely by noodle samples 425 (60:30:10 cassava: wheat: soybean) and 317 (70:27.5:7.5 cassava: wheat: soybean)

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