

# Quality Evaluation Of Noodles With Cowpea Substitution

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*Abstract: Noodles are known for their widely consumption throughout the world. Wheat flour which is usually used to make instant noodles has low fibre and protein contents (lysine). Legumes are becoming popular in various food applications as it is rich in fibre and protein. This study was carried out to establish the proportions of cowpea flours that would produce good quality noodles, in composite with soft wheat flour. Up to 50% cowpea flour substitutions were made. The following parameters were investigated on the flours: functional properties and proximate composition. For the preferred noodle by the sensory panels; cooking qualities and proximate composition were determined. Sensory evaluation was conducted to assess the acceptance preference of the products. The results showed that moisture content of flours affects the final quality of noodles. Wheat and cowpea at 70:30 had high cooking weight (37.00g). From the sensory analysis, no significant difference ( $P > 0.01$ ) existed between noodles made from 100% wheat flour and also among wheat and cowpea at 70:30 in terms of taste and overall acceptability. In terms of flour substitutions, 70% wheat and 30% cowpea was the most acceptable. The results obtained from this study give a scientific basis upon which processors can modify noodle formulations in order to meet the preferences of particular consumers for noodles*

**Keywords:** Sensory evaluation, amino acids, moisture content

## I. INTRODUCTION

Noodles are nutritious wheat foods made from common wheat flour, water and other additives depending on the type of noodles (Sui, et al., 2006). In 2008, it was reported that the annual consumption of instant noodles in the world averaged about 94 billion cups (World Instant Noodles Association, 2008). The consumptions of instant noodles per capital vary among countries, ranging from 0.57 - 5.54 kg (approximately 10-100 packages) (Most, 2008), however these figures tend to increase every year. Instant noodles are normally consumed by people of all socioeconomic status. Instant noodles mainly consist of wheat flour whose protein quality is inadequate to provide essential amino acids such as lysine and threonine (Tongpun, 2006). The absence of lysine makes the body difficult to synthesize protein, hormones, enzymes and antibodies, which are needed for growth and other functions (Flodin, 1997). A growing demand for functional plant proteins has been identified and their properties customized

for specific applications and formulations as food ingredients (Wasche et al., 2001). Consequently, legumes are nutritionally complementary (Duranti, 2006). The output of this research involves the collation of data on the functional properties and proximate composition of cowpea flours. This would provide useful information to food scientist and others alike on the subsequent incorporation of cowpea into food products to produce natural, cheap and adaptable functional foods. The objective of this study therefore was to produce consumer acceptable protein fortified noodles from proportions of cowpea flour in composite with soft wheat flour.

## II. MATERIALS AND METHODS

### A. EXPERIMENTAL LOCATIONS

Proximate, functional and the new product developed were all carried out at the Biochemistry Department of the

Crop Research Institute of the Council for Scientific and Industrial Research at Fumesua, Kumasi Ghana.

*a. SAMPLE COLLECTION AND PREPARATION*

Cowpea (Asomdwee variety) seeds were obtained from the Crop Research Institute of the Council for Scientific and Industrial Research at Fumesua, Kumasi Ghana. The commercially available soft wheat flour was purchased from local suppliers at Kajetia market in Kumasi.

*b. FLOUR PREPARATION*

The cowpea seeds were cleaned of foreign materials and milled into flour in a hammer mill and sieved through 75  $\mu$ m. The cowpea flours were packaged in air-tight plastic containers prior to analyses.

*c. NOODLES PREPARATION*

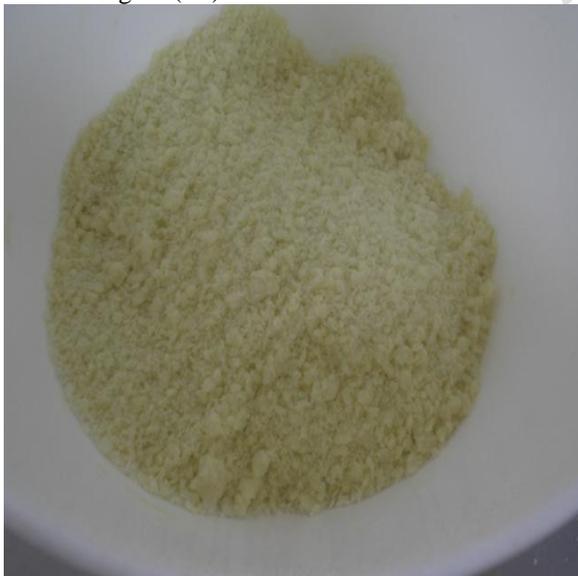
The traditional wheat flour was replaced with 10%, 20%, 30%, 40% and 50% substitutions of cowpea flour. The flour proportions were mixed with common salt (2 g/100 g flour) and tap water (33 mL/100 g of total weight). The samples were extruded in the form of 1.2 mm diameter noodle strands using a single screw extruder (La Monferrina P3, Italy). The noodle strands were cut into approximately 20 cm lengths and folded into block shapes. Each of the samples was prepared in triplicate. The noodles were steamed for 15 minutes at 100°C followed by cooling to 25°C and deep fried in vegetable oil at 140-150°C for one minute (Owen, 2001). Finally, the noodles were cooled to room temperature and packed in polyethylene bags. Noodles prepared from 100% soft wheat flour served as the control sample. The noodles processing stages are illustrated in Figure (a-f).



*(b) shows dough sheeting*



*(c) shows sheeting and cutting of noodles*



*(a) shows flour mixing*



*(d) shows noodle samples*



(e) shows steaming of noodles



(f) shows frying of noodles

## B. FUNCTIONAL PROPERTIES DETERMINATION

Bulk density of the flour samples was determined as described by (Appiah et al., 2011). Water and oil absorption capacity was determined by the methods described by [10]. Foam capacity was determined using (Brown, 1991) method. Solubility and swelling power were determined based on a modification of the method of (Leach et al., 1959).

## C. PROXIMATE COMPOSITION DETERMINATION

Moisture content was determined by hot air oven drying at 50°C for 18 hours (Owen, 2001). Ash Content of flours were determined by ignition of flours for 2 hours at 600°C (Owen, 2001). Crude fiber and fat (solvent extraction) were determined by the AOAC (AOAC, 2002) methods. Crude protein content was determined by digestion and distillation of samples. The distillate was titrated against 0.1N hydrochloric

acid (HCl) solution until the solution changed from bluish-green to pink (AOAC, 2002). Carbohydrate content was calculated by the difference methods

## D. NOODLES COOKING QUALITIES

### a. MEASUREMENT OF OPTIMUM COOKING TIME

Samples of instant noodles (approximately 10 g) were cooked in 300 mL distilled water. The cooking period began as soon as the noodles were put into the boiled water and were cooked until no white/yellow core was observed after compressing corresponding to a uniform colour and appearance being observed upon squeezing. The optimum cooking time for each sample was established after repeating the test at least three times (AACC, 2000)

### b. MEASUREMENT OF COOKING WEIGHT AND COOKING LOSS

Cooked weight and cooking loss were determined by (AACC, 2000) methods of Tap water (about 1 litre) was brought to a boil in a two-litre saucepan with the lid on to prevent any water loss. When the water started boiling each noodle sample (10 g) were added. The cooking temperature was maintained at 98-100°C throughout the cooking process. The cooking period began as soon as the noodles were put into the boiled water and were cooked. The cooked noodles were then rinsed with distilled water and left to drain for 2 min at room temperature prior to reweighing. Results were reported as percentage (%) increase with respect to the original noodle sample weight. The residual cooking water was dried in an oven at 110 °C and results reported as percentage (%) weight lost during cooking.

## E. SENSORY EVALUATION

Fifteen (15) trained panelists with previous experience in sensory analysis of noodles, evaluated samples of cooked noodles by comparison with a reference standard. The panel members were recruited from the final year undergraduate students of Post Harvest Technology Unit, Kwame Nkrumah University of Science and Technology, Kumasi. Sensory evaluation was carried out on the various final products. Sensory characteristics (colour, flavor, appearance, texture, taste and overall acceptability) were evaluated to find out the optimum acceptable level of cowpea flour incorporation in the instant noodles. A 5-point hedonic scale was used in scoring the individual treatments as follows; 1-Like very much; 2-Like slightly; 3-Neither like nor dislike; 4-Dislike slightly and 5-Dislike very much (Chinma et al., 2007).

## F. DATA ANALYSIS

All data collected for physical measurements, chemical analysis and sensory evaluation was analyzed using Statistix 9 statistical Package. Mean separation was done using Lsd at 1% confidence intervals.

### III. RESULTS AND DISCUSSION

Flour Type	Crude protein	Crude fibre	Moisture content	Ash	Fat	Carbohydrate
Soft Wheat	10.23	0.51	3.33	1.00	1.33	83.60
Cowpea	24.53	3.21	10.90	3.00	1.00	57.35
LSD <sub>0.01</sub>	0.75	0.42	1.06	0.20	0.71	1.28
CV	1.66	8.67	4.98	3.95	13.69	0.58

Table 1: Proximate composition of Asomdwee cowpea and Soft wheat flour (on dry basis)

#### A. PROXIMATE COMPOSITION OF FLOURS

##### a. MOISTURE CONTENT

The moisture content of the flours (Soft wheat and Asomdwee cowpea) varied between 3.33% and 10.90% as shown in Table 1. The moisture content of Asomdwee cowpea was the highest and was significantly ( $P < 0.01$ ) different from soft wheat flour. The moisture content in this study for cowpea was higher than the (9.20%) for cowpea flours in Nigeria by (Arawande et al., 2013). The moisture content of wheat flour was lower than 11.60% and 13.29% recorded for buckwheat flour and refined wheat flours (Baljeet et al., 2010) as well as 13.3% for wheat flour as reported by (Ahmed et al., 2012). The moisture content for cowpea flour in this study was slightly higher than the 9.15- 9.83% for Nhyira, Tona and Adom cowpea varieties in Ghana reported by (Appiah et al., 2011). Moisture content of foods is influenced by type, variety and storage condition (Enwere, 1998). The low moisture content of wheat flour would enhance its storage stability by avoiding mould growth and other biochemical reactions (Omimawo et al., 2012). Appiah et al., (2011), reported moisture content of 7.75% for wheat flour which was quite higher than the moisture content in the soft wheat flour in this research. This assertion explains why they have longer shelf life and also confirms their used in both noodles and bakery products.

According to Fu (2008), high quality noodles should have an adequate shelf life without any microbiological deterioration and therefore the low moisture content of the soft wheat flours will in the end extend the shelf life of the final product

##### b. CRUDE PROTEIN CONTENT

The crude protein content of the flour samples ranged between 10.23% and 24.53% (Table 1). The protein content of asomdwee cowpea (24.53%) was found to be between 20-27% reported by Henshaw (2008) for some cowpea varieties and also close to 21.63- 25.28% for four advanced lines of cowpea reported by (Asare et al., 2013). However, the crude protein content of asomdwee cowpea was lower than the 27.88% reported for cowpea by (Butt et al., 2010). The protein content of wheat flour reported in this study was found to be lower than the 14.70% (Adams et al., 2002) and 12.86% (Mepba et al., 2007) for wheat flours. The crude protein content differences can be attributed to the geographical location. Since soils with high nitrogen levels can influence protein levels (Blumenthal et al., 2008). Proteins are increasingly

being utilized to perform functional roles in food formulations. Therefore, the protein content of the flours in this study suggests that they may be useful in food formulation systems especially with the Asomdwee cowpea variety.

##### c. CRUDE FAT CONTENT

Cowpea flour had 1.00% representing the lowest fat content. Appiah et al., (2011), reported fat content of 4.24-4.80% for Nhyira, Tona and Adom cowpea varieties in Ghana. Reference [14] also reported fat content of 4.37% for cowpea seed flours found in Nigeria. These values were higher than the value obtained for asomdwee cowpea in this research. Differences in fat content of flours may be due to varietal differences (Moorthy et al., 1996). Islam et al., (2012) had 2.80% and 1.80% fat content for brown rice and refined wheat flours respectively. The fat content of wheat flour from this study was found to be lower than 1.5% reported for wheat flour (Akubor et al., 2013). The differences in fat content may be due to location and varietal differences (Moorthy, 1996). Diets with high fat content contribute significantly to the energy requirement for humans. High fat content of soft wheat flour would make it a better source of fat than the cowpea flour. High fat flours are also good for flavour enhancers and useful in improving palability of foods in which it is incorporated (Aiyesanmi et al., 1996).

##### d. ASH CONTENT

The ash content of the flours ranged between 1.00 and 3.00% (Table 1). The ash content for wheat flours in this study was lower than the 2.53% for mung bean flour and 2.53% for chickpea flour reported by (Kaur et al., 2004) as well as 6.51%, 4.58%, 4.73% and 3.25% for Jack bean, Pigeon pea, cowpea and mucuna bean flour respectively (Arawande et al., 2010). The ash content (1.40%) of refined wheat flour (Islam et al., 2012) was close to 1.00% wheat flour reported for these studies. Ash content is an indication of mineral content of a food. This therefore suggests that Asomdwee cowpea flour could be important sources of minerals.

##### e. CRUDE FIBER CONTENT

Asomdwee cowpea flour had the highest crude fibre content (3.21%). Butt et al., (2010), reported crude fiber content of 8.19% for pigeon pea, 9.58% cowpea, 4.61% mungbean and 6.83% for pea's flour. These were all higher than the crude fibre obtained for the two flours in this research. Crude fibre helps in the prevention of heart diseases, colon cancer, diabetes etc. Crude fibre range of 0.97 to 1.10% reported by Arawande et al., (2010) for Jack bean, Pigeon pea and cowpea were all within the ranges (0.51 -3.21%) reported from this study. Asomdwee cowpea flour would be a better source than wheat flour since it had significantly higher crude fibre content and hence can be used in food to help relieve constipation. Islam et al., (2012), reported 1.23% for brown rice flour and 0.85% refined wheat flour. The crude fibre content of 0.51% recorded for wheat in this research was quite close to the 0.85 % reported by Islam et al., (2012).

f. CARBOHYDRATE CONTENT

The carbohydrate content of the flours varied from 57.35% to 83.60%. Wheat flour had the highest carbohydrate content (83.60%). The carbohydrate content of the flours for cowpea and wheat flours was comparable to 57.17% for cowpea, 74.22% for wheat; reported by (Ahmed et al., 2012). Eshun, (2012), recorded lower range (34.97 to 39.86%) carbohydrate content for three soya bean varieties. It can be observed that the flours used for these studies had higher carbohydrate content. The high carbohydrate contents of these flour samples suggest that these flour samples could be used in managing protein-energy malnutrition since there is enough quantity of carbohydrate to derive energy from in order to spare protein so that protein can be used for its primary function of building the body and repairing worn out tissues rather than as a source of energy. Carbohydrates are good sources of energy and that a high concentration of it is desirable in breakfast meals and weaning formulas. In this regard therefore, the high carbohydrates content of the wheat flour would make it a good source of energy in breakfast formulations (Brown, 1999).

Parameter	Asomdwee Cowpea flour	Wheat flour	LSD <sub>0.01</sub>	CV
BD (g/cm <sup>3</sup> )	0.82	0.71	0.04	2.10
OAC (%)	1.48	1.00	0.13	3.33
WAC (%)	2.27	1.50	0.63	13.58
FC (%)	19.00	13.20	1.97	4.38
SOLB (%)	27.26	15.91	4.19	7.40
SP (%)	12.11	7.50	2.04	6.89

Note: BD- Bulk density; OAC – Oil absorption capacity, WAC – Water absorption capacity; FC- Foam capacity; SOLB – Solubility; SP – Swelling power

Table 2: Functional properties of flours of cowpea and soft wheat

B. FUNCTIONAL PROPERTIES

a. BULK DENSITY

The bulk densities of the flours are comparable with 0.69-0.80 g/cm<sup>3</sup> obtained for Tona, Adom and Nhyira cowpea varieties (Appiah et al., 2011). The bulk densities obtained in this research were lower than those reported by Brown (1991) for three soya beans varieties in Ghana (1.56 to 2.09g/cm<sup>3</sup>) however; the bulk densities obtained were also found to be higher than six improved commercial chicken pea cultivars in India with bulk densities ranging from 0.55 to 0.57g/cm<sup>3</sup>. Bulk densities of 0.85±0.01 and 0.68±0.00 g/cm<sup>3</sup> reported by Islam et al., (2012) for brown rice flour and refined wheat flour were similar to the results obtained from this research. According to Appiah et al., (2011), bulk density is a function of particle size, particle size being inversely proportional to bulk density. Particle size differences may be the cause of variations in bulk density of the flours. The particle size also influences the package design and could be used in determining the type of package material required. The bulk density of the flours could be used to determine their handling requirement, because it is the function of mass and volume (Oladunmoye et al., 2010). Since soft wheat flour was the least dense it would occupy greater space and therefore would require more

packaging material per unit weight and so could have high packaging cost (Osundahunsi et al., 2002) however, soft wheat flour would be easier to transport as it was lighter. The low bulk density of wheat flour would be an advantage in the use of the flour for preparation of complementary foods (Akubor et al., 2013). The low bulk density of soft wheat flour could be attributed to the relatively lower protein content and moisture content (Oladunmoye et al., 2010).

b. OIL ABSORPTION CAPACITY

The Oil absorption capacity of cowpea flour in this study was lower than that (1.95 to 2.14ml/g) reported for Nhyira, Tona and Adom cowpea varieties Appiah et al., (2011) , however cowpea protein isolate had oil absorption capacity of 1.45ml/g which was quite close to cowpea value obtained from this research (Butt et al., 2010). Singh et al., (2005), reported oil absorption capacity of 1.05 to 1.17 ml/g for six improved commercial chicken pea cultivars. Oil absorption capacity values of 1.13, jack bean, 1.48 pigeon pea and 1.13ml/g cowpea were in accordance with the results obtained in this research (Arawande et al., 2010). Higher oil absorption capacity of 1.96 and 1.61 ml/g were reported for brown rice flour and refined wheat flour (Islam et al., 2012). These values were found to be higher than those obtained in these studies. Oil absorption capacity is attributed mainly to the physical entrapment of oils. It is an indication of the rate at which the protein binds to fat in food formulations (Omimawo et al., 2012). The lower oil absorption capacity of soft wheat could be due to low hydrophobic proteins which show superior binding of lipids (Appiah et al., 2011). The relatively high oil absorption capacity of cowpea flour suggests that it could be useful in food formulation where oil holding capacity is needed such as sausage and bakery products (Adejuyitan et al., 2009). This shows that cowpea flour would be useful in this respect than wheat since it had significantly higher oil absorption capacity.

c. WATER ABSORPTION CAPACITY

The water absorption capacities of the flours were comparable to that of full fat flours in six mucuna species (1.2 to 2.00 g/g) reported by Adebowale et al., (2005) and 1.89 to 2.13 g/g for Nhyira, Tona and Adom cowpea varieties reported by (Appiah et al., 2011). The water absorption capacities of the flours under study were found to be higher than 0.32 g/g for wheat, 1.68 g/g maize and 0.89 g/g cowpea reported by (Oladunmoye et al., 2010). The results reported by Arawande et al., (2010) were 1.28, 1.89, 1.88 g/g for Jack bean, Pigeon pea and cowpea respectively. Adelek et al (2010), reported water absorption capacity value of 2.45g/g for wheat flour, which was higher than the one under study. Singh et al., (2005), reported water absorption ranges of 1.34 to 1.47g/g in some chicken pea cultivars. Water absorption capacity represents the ability of the products to associate with water under conditions when water is limiting such as doughs and pastes. The result of this study suggests that cowpea would be useful in foods such as bakery products which require hydration to improve handling features (Akubor et al., 2013).

d. *FOAM CAPACITY*

Foam capacity is the ability of substance in a solution to produce foam after shaking vigorously proteins foam when whipped because they are surface active (Singh et al., 2005). The foaming properties are used as indices of the whipping features of protein isolates (Appiah et al., 2011). This explains why cowpea had higher foam capacity; since it recorded the highest crude protein content (Table 1). The foam capacity of wheat flour obtained in this research (3.00%) was lower than the 4.12% for wheat flour reported by (Adelek et al., 2010). The foam capacity (19.00%) obtained for cowpea flour was higher than cowpea protein isolate (6.95%) reported by Butt et al., (2010). However, higher foam capacity (21.00%) was recorded for Nhyira cowpea variety by Appiah et al., (2011).

e. *SOLUBILITY*

Solubility values of 14.31 and 17.99% reported by Eshun, (2012) on three soya bean varieties as well as 7.30% and 11.5% for fermented and unfermented *A. altilis* by (Appiah et al., 2011) were all within the range of the flours under study. According to (Asare et al., 2013), solubility of protein isolate for cowpea was 6.54%. This was quite lower than the solubility reported for cowpea flour in this research. Adeke et al., (2010), reported solubility of 8.63% for wheat flour in contrast to the 15.91% obtained in this work. The presence of lipids could result in reduced water absorption capacity of flours which may lead to reduced swelling and consequently reduced solubility (Appiah et al., 2011). This assertion explains the reason for the high solubility in cowpea flour than wheat flour. The high solubility of asomdwee cowpea flour suggests that it was more digestible and therefore could be suitable for use as ingredient in infant food formulations.

f. *SWELLING POWER*

The swelling power of the flours varied between 7.50 and 12.11%. The observed values were lower than wheat flour (12.75%) reported by Adelek et al., (2010), however; the values obtained were also higher than (4.25 to 4.66%) reported by (Eshun, 2012) on some soya bean varieties. The values in this research were higher than the ranged 2.65 to 2.68% reported for Tona, Nhyira and Adom respectively by (Appiah et al., 2011). (Islam et al., 2012) reported higher swelling power values of 16.04 and 16.98% for brown rice flour and refined wheat flour respectively. The gelatinization and swelling power test provided suitable predictive method for identifying noodle-quality flours (Moriss et al., 1999). Formation of protein-amylose complex in native starches and flours may be the cause of decreased in swelling power. The extent of swelling depends on the temperature, availability of water, species of starch and other carbohydrates and proteins (Enzema, 1989). According to (Enzema, 1989), increase in water absorption capacity increases the swelling power leading to an improved solubility. This is in agreement with the high swelling power in the cowpea flour than the others. The high swelling power suggests that cowpea flours could be useful in food systems where swelling is required.

Noodles Preferred	Cooking Loss (g)	Cooking time (min)	Cooking Weight(g)
Wheat: Cowpea (70-30%)	1.00	7.33	37.00
Wheat (100%)	2.86	5.00	29.00
LSD <sub>0.01</sub>	0.54	2.74	2.24
CV	9.40	16.22	2.71

Table 3: *Cooking Qualities of Preferred Noodles*

C. *COOKING QUALITIES*

a. *COOKING LOSS*

Cooking loss indicates the ability of the noodles to maintain structural integrity during the cooking process. The solid leaching during cooking may not have an effect on nutrient quality as instant noodles are mostly eaten along with the boiling water. However, solid leaching from the noodles into the boiling water may have an effect on the sensory properties and texture of the cooked product. The results reveal that wheat and cowpea 70:30 had the lowest cooking loss (1.00g), thus will lose fewer solids during cooking. Increased protein content resulted in decreased cooking loss for wheat noodles (Moss et al., 1987). Oh et al., (1985), reported that low protein content causes noodles have soft texture and are easily broken during the drying process which leads to high cooking loss.

b. *COOKING TIME*

Wheat and cowpea 70:30 recorded (7 min: 33s) and was regarded as the highest cooking time. This may be attributed to the low peak viscosity of wheat flour and the high bulk density of the cowpea flours. Generally, cowpea has high bulk density and hence has an influence on the product blends. The bulkiness makes it's heavier, thus will generally take a longer period for cooking. Cooking time of 5.00min was recorded for 100% wheat. This implies that its takes a very short time for it to be cooked. This may also be due to low protein content of wheat flours (Table 1). Low protein products speeds up the rate of water penetration into noodles (Kaur et al., 2004). This situation makes the noodles absorb water quicker hence the cooking time is shortened. The particle sizes (bulk density) are not heavier and hence will easily boil at any given time when heated and this may be attributed to its low bulk densities Tables 1. It will therefore be good for weaning foods because weaning food should have low bulk density and low water absorption capacity in order to produce a more nutritious and suitable weaning food (Appiah et al., 2011).

c. *COOKING WEIGHT*

The cooking weight indicates the amount of water absorbed by the noodles during cooking process. 100% wheat had cooking weight of (29.00g). It was revealed that wheat and cowpea at 70-30% level had the highest weight gain (37.00 g). This may be attributed to the high bulk density nature of both cowpea and wheat flours as shown in Table 2. The noodle samples from wheat and cowpea at 70-30% level increased its weight from (10 g) uncooked to (37.00 g) cooked. From this research it can be observed that there was

an uncooked to cook weight ratio of 2. This result is in agreement with that of (Hummel, 1966), who reported that good quality macaroni products should absorb at least twice their weight after boiling in water.

Sensory parameter	WC 50:50	WC 60:40	WC 70:30	WC 80:20	WC 90:10	W 100	LSD <sub>0.01</sub>
Appearance	3.86	3.5	2.13	4.20	3.66	1.86	0.96
Colour	3.66	3.2	2.00	3.93	3.33	1.80	1.01
Flavour	3.46	3.20	1.93	3.80	3.26	1.80	0.85
Texture	4.28	4.06	1.93	4.10	3.66	1.80	0.85
Taste	3.86	3.46	1.80	3.73	3.20	1.73	0.91
Overall acceptability	4.40	3.86	1.80	4.13	3.26b	1.66	0.95

Key: 1 – like very much; 2- like slightly; 3- neither like nor dislike; 4- dislike slightly; 5- dislike very much.

Table 4: Sensory score for noodles at different substitution of cowpea flour

The sensory evaluation results have been presented in Table 4. Generally, there was no variation in taste among the treatments samples with the exception of the control sample and wheat and cowpea (70:30). Wheat 100% was the most accepted with a score of (1.73). For the flour substitutions wheat and cowpea at 70-30 % was generally accepted whiles wheat and cowpea at 90-10 % was the next preferred. The bulky nature of cowpea flour had a positive impact on the noodles produced from cowpea since it contributed to its meaty nature. Wheat 100% (1.80) was the most accepted in terms of colour. However texture likeness decreased significantly with cowpea flour addition above 30%. Hence cowpea flour can be substituted in instant noodles up to 30% level without any deteriorating effect on its sensory quality. The high moisture content of cowpea flour as shown in Table 1 may have an influence on its poor texture. Noodles from wheat 100% was the most acceptable in reference to its appearance.

Noodles Preferred	Crude protein	Crude fibre	Moisture content	Ash	Fat	Carbohydrate
Wheat: Cowpea (70:30)	12.57	2.60	8.33	1.50	8.15	66.83
Wheat (100%)	8.66	0.66	4.66	1.66	9.00	75.50
LSD	1.75	0.96	1.81	1.12	3.96	3.66
CV	6.32	30.21	12.80	30.62	13.56	1.87

Table 5: Proximate composition of noodles from preferred combination of cowpea in composite with wheat flour and control sample

#### D. PROXIMATE COMPOSITION OF NOODLES

##### a. CRUDE PROTEIN

The crude protein content of the noodles ranged from 8.66% to 12.57%. The results obtained from this research were similar to the minimum of 8% protein content for all noodles reported by (Fu, 2008). Wheat and cowpea at 70-30% level had the highest protein content (12.57%). This may be attributed to high protein content of the Asomdwee cowpea

flours as indicated in Table 1. According to (Yayasena et al., 2008), the protein content of 100% wheat flour increased from 10.50% to 16.50% when 30% of sweet lupin flour was replaced with wheat flour. This finding is in agreement to that observed in this research by replacing only 30% of soft wheat flour with Asomdwee cowpea flour; leading to an increase from 8.66 to 12.57%. The high protein content of noodles from wheat and cowpea at 70-30% level makes it's a good substitute for other noodles in the market and also good sources of protein and therefore could be useful in combating high malnutrition especially in most developing countries. Studies on the protein content of commercial instant noodles show that the protein levels ranged from 8.5 to 12.50% (Fu, 2008).

##### b. CRUDE FIBRE CONTENT

The crude fiber content of the noodles ranged between 0.66% and 2.60%. The observed values were lower compared with some seaweeds puree substitution into wheat flours (2.00-2.25%) reported by Oladunmoye et al., (2010). According to Yayasena et al., (2008), the crude fibre content of 100% wheat flour increased from 2.7% to 12.8% when 40% of sweet lupin flour was replaced with wheat flour. Crude fibre content of 100% soft wheat flour increased from 0.08 to 3.4% by replacing with 20% cowpea flour (Ahmed et al., 2012). These finding is in pattern to that observed in this research by replacing 30% of soft wheat flour with Asomdwee cowpea flour; leading to an increase from 0.51 to 2.60%. The high crude fibre content of noodles from wheat: cowpea (70:30) may be attributed to high fibre content of the cowpea flour as shown in Table 1.

##### c. MOISTURE CONTENT

The moisture content of the noodles ranged between 4.66 and 8.33%. The high moisture content recorded in the noodle formulations may be attributed to absence of gum in the formulation process hence water that was added to the existing moisture content in the flours was not bound making water easily available. The high moisture content of wheat: cowpea (70:30) noodles are likely to reduce their shelf life. Noodles from 100% wheat recorded the least (4.66 %) moisture content and this was due to its low moisture content of the flours (Table 1). Moisture content of bread increased from 28.5 to 31.1% when soft wheat flour was replaced with 15% cowpea flour (Ahmed et al., 2012). The addition of cowpea flour in this research also led to an increase in the moisture content of the final product. This may be due to the high moisture content of cowpea flour (Table 1).

##### d. ASH CONTENT

Noodles produced from wheat: cowpea (70:30) had the lowest (1.50%) ash content. The ash content of noodles from soft wheat flour (100%) although high (1.66%) was lower than bread produced from substitution of wheat flour with 5% of cowpea flour (3.4%) and substitution of wheat flour with 30% of sweet lupin flour (10.57%). The low ash content of the noodles produced from this research suggests that the noodles

would have relatively low mineral content (Appiah et al., 2011).

e. *CRUDE FAT CONTENT*

The crude fat content of the noodles varied between 8.15% and 9.00% with wheat and cowpea at 70-30% level recording the lowest (8.15%). This may be as a result of the low fat content present in the cowpea flour (Table 1). The high fat content of noodles from 100% wheat suggests that it has a good flavour. According to Ahmed et al., (2012), a decrease from 1.7 to 0.9% was observed when wheat flour was replaced with 20% of cowpea flour in bread production. This was in agreement with a reduction of 100% wheat flour fat content from 9.00% to 8.15% when 30% of cowpea flour was replaced in this study.

g. *CARBOHYDRATE CONTENT*

The carbohydrate content of the noodles varied from 66.83 to 76.00%. The high carbohydrate content of the noodles produced suggests that it could be important sources of energy for consumers (Appiah et al., 2011).

IV. CONCLUSION AND RECOMMENDATIONS

The research revealed that noodle production from proportions of cowpea flours in composite with wheat flour is possible. Up to 50% of cowpea flour substitutions were made. Noodles from proportions of wheat and cowpea (70: 30) were preferred by the sensory panelists with noodles from wheat and cowpea attaining the highest protein content (12.57%). The wide prevalence of protein-calories malnutrition in developing countries justifies the need for consumers shifting into the consumption of plant proteins such as cowpea. This research project supports and demonstrates the utilization of legumes for instant noodle manufacturing. This research provide a basis for noodle processors to select from an extended range of flours of varying qualities to produce instant noodles having textural and colour characteristics that appeal to consumers. It was observed that enhancement of noodles with cowpea flour produced a high protein product that can be used as protein-rich food for the relief of malnutrition in the poor countries. Based on the findings, some suggestions have been made. [A] Different drying methods such as air and oven drying can be used to assess their effect on the nutritional composition of noodles produced. [B] Gum should be added in the noodle production process so that it can absorb the water in the flour during the production process so as to reduce the moisture content of the final product and also make the dough sticky.

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