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Preparation and Production of Pasta Using Composite Cassava Flour as a Substitute of Wheat Flour

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Abstract: **Cassava, the chief source of dietary food energy for the majority of the people living in the lowland tropics, and much of the sub-humid tropics of West and Central Africa has been used by generation of homes in Africa for years and it has also been used as a food source by many cultures for centuries. The wide scale adoption of high yielding varieties and the resulting increase in yield have shifted the problem of the cassava sector from supply (production) to demand issues, such as finding new uses and markets for cassava. The main aim of this research was to use cassava flour in the production of pasta. To accomplish this, best and wholesome cassava were selected and prepared into cassava flour for the production of the pasta. A sensory evaluation was conducted to ascertain its potential acceptability. The sensory evaluation team was made up of lectures of the hospitality management department, student of hospitality management and mathematics department of Takoradi polytechnic on the taste, flavor, colour, appearance and consistency. The researcher used experimental research to obtain the information required whereby the product was compared and displayed for respondents to taste and give comments. To make cassava more relevant as pasta, it is recommended among other things, to introduce some innovations which may be necessary to increase acceptability and nutritional content of locally prepared cassava-based composite flour pasta, in our indigenous industries.**

Keywords: **High Quality Cassava Flour (HQCF), Cassava flour Pasta.**

1. INTRODUCTION

Cassava appears to have originated from Brazil and Paraguay, but had spread throughout the tropical areas of South and Central America long before the arrival of Columbus. It is now one of the most important food crops in the tropical countries throughout the world. Cassava ranks as the 6th most important food crop worldwide, even though in western countries it is little known or used (Salick, Cellinese, & Knapp, 1997). In countries such as Brazil, Ghana and Nigeria, more than 70% of the daily consumption of calories by the population comes from cassava. Cassava became firmly established in most areas after the serious drought of 1982/83 when all other crops failed completely to yield (Korang-Amoakoh, Cudjoe, & Adams, 1987).

Today, the amount of food available per person on a global basis is about 18 percent higher than 30 years ago. Most developing countries benefited from this development with the result that their nutrition has witnessed very tremendous improvement. As impressive as this improvement is, about 800 million people worldwide still suffer from chronic hunger; and one quarter of this population resides in Africa. The situation gets worse every year and can lead to a catastrophe if it is not possible to increase food supply at a rate faster than that at which the world population increases(Adeleke, 2013).

Cassava being the chief source of dietary food energy for the majority of the people living in the lowland tropics, and much of the sub-humid tropics of West and Central Africa (Ola-Mudathir & Maduagwu, 2015) , need to increase production and utilization technical efficiency in production as a result of weak access to external inputs such as fertilizers and herbicides(C Ezedinma et al., 2006; Ezedinma, Okafor, Asumugha, & Nweke, 2006). The wide scale adoption of high yielding varieties and the resulting increase in yield have shifted the problem of the cassava sector from supply (production) to demand issues, such as finding new uses and markets for cassava. The government of Ghana considers a transition from the present status of usage to the level of industrial raw material and livestock feed as a development goal that can spur growth with increase in employment. This consideration underscores the various research and policy initiatives in cassava improvement, production, and processing.

To Kormawa & Akoroda, (2003) an estimates of industrial cassava use in Africa suggest that approximately 16 percent of cassava root production was utilized as chips in animal feed, 5 percent was processed into a syrup concentrate for soft drinks and less than 1 percent was processed into high quality cassava flour (HQCF) used in biscuits and confectionery, dextrin, adhesives, starch, and hydrolysates for pharmaceuticals and seasonings. At present, a wide range of traditional processed cassava forms (such as gari, fufu, starch, tapioca, in Ghana, etc) are produced for human consumption. (Kormawa & Akoroda, 2003) is of the view that cassava flour which is an innovative substitute for wheat flour enables the production of gluten-free baked goods with virtually the same taste, texture, crumb and baking characteristics as those made with wheat flour and when processed into flour, can be used in making breads, biscuits, salad dressings, custard powder, ice cream powder, flakes and also used in variety of paste products such as spaghetti and macaroni.

Pasta is an ancient foodstuff 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 sometimes vegetable colouring. In recent days, pasta formulations including non-wheat ingredients like sweet potato flour and tapioca starch have been reported and the dough is made into different shapes and sizes then dried and stored (Haggblade et al., 2012). Cassava, a high energy root crop, has limited utilization options which include; boiling the fresh root, grilling the fresh root, deep-frying the fresh root, and preparing porridge from cassava flour. Most of these utilization options do not fit well in the life style of modern-day societies and most people in developing countries like Ghana do not utilize fully the available staple foods, like cassava. This anomaly has been partly attributed to the limited utilization options and limited processing and/or preservation options. Cassava is cheap and readily available in most areas in Ghana, does not require high rain fall and it needs little inputs and care. There is less use of cassava flour in pasta production in general and especially in Ghana, hence the use of cassava in this research.

Cassava, which can grow well on marginal lands, is one of the most important staple foods in Ghana. According to the statistics of Ministry of Food and Agriculture (MOFA), the production of cassava roots has increased by almost 40% from 2007 to 2011. On the international front in 2006, the cassava production of the world stood at 200 million tons a year with Nigeria and Democratic Republic of Congo being the biggest producers after Brazil and Thailand.

Food insecurity is one characteristic of most developing countries and Ghana is not exempted. Cassava flour of acceptable organoleptic and nutritional quality is easily produced from dried cassava roots. Despite this fact, many people in Ghana do not commonly utilize this crop in their diets. Pasta is traditionally made from wheat flour; however cassava flour has some similar attribute as wheat flour and some peculiar desirable sensory and nutritional properties. This has necessitated the use of cassava flour in the production of pasta to substitute wheat flour. The main purpose of the study was to prepare and produce pasta using composite cassava flour as a substitute of wheat flour. To achieve the objectives of the research, questionnaire was used to find out the possibility of using cassava flour in preparing pasta, which is to determine if the taste, colour, texture and appearance of the cassava pasta were acceptable to consumers and then assess the preference

There are two varieties of cassava – sweet and bitter. Both contain Prussic acid (hydrocyanic acid), which can cause cyanide poisoning. Cooking or pressing the root thoroughly removes the poison. Cassava should never be eaten raw because bitter, or wild, cassava contains enough acid that it can be fatally poisonous if eaten raw(Wilson & Dufour, 2002).

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Source: field 2015

Figure 1: Harvested Cassava Root

Common uses of cassava in Ghana are Tapioca Fufu, Gari, Agbelima, Agbelikaklo and Yakeyake. In all these preparations, apart from Fufu, the roots undergo a fermentation process for some days. The dried fragments possess a distinctive, pleasant taste due to the fermentation that takes place. In the case of fufu the peeled cassava is cooked and pounded into Fufu. For the purpose of this work, cassava flour as a product of cassava was focused on. Cassava also has medicinal uses.

Cassava Flour (High Quality Cassava Flour); High quality cassava flour (HQCF) is simply unfermented cassava flour. HQCF is made within a day of harvesting the root. It is very white, has a low fat content; not like the traditional fermented cassava flour, does not give a bad smell or taste to food product and can be mixed very well with wheat flour for use in bread or cake (Eddy, Udofia, & Eyo, 2007). Good-quality cassava flour should be white and have a good smell (IF, Olaniyan, Adebayo, & Ademola, 2015), and wheat flour is known for its consistency in the way it behaves in recipe, but cassava flours have a slightly gritty texture and are incredibly fine textured(Adeyeye & Akingbala, 2015).

High quality cassava flour has been shown to have both the technical and economic potential to succeed in Ghana as a partial substitute for wheat flour in food products,(Cock, 1985)

The current evaluation of the acceptability of cassava flour in the production of products shows that if the flour was available then acceptability would not be a problem (Haggblade et al., 2012).This according to (Haggblade, Hazell, & Kisamba-Mugerwa, 2010) shows that cassava can be used to substitute up to 50% maize flour in products without compromising on colour, taste, aroma and texture. The main limiting factor to utilization of cassava flour for products is therefore likely to be availability and not acceptability of the cassava flour. This implies that ones the products are on market, consumers will accept them. To (Haggblade et al., 2012) , adoption and production of the high yielding cassava varieties in coastal Africa have the potential to increase food production in the region. Substitution of 50% maize flour with cassava would lead to a further increase in food security.

2. METHODS AND MATERIALS

The various materials, methods and procedures were adopted by the researcher in carrying out the study are as follows.

Product Development:

The cassava was dried and further processed into flour for the preparation of the cassava pasta. This was done at the small scale kitchen (Laboratory) at the Catering Department at the Takoradi Polytechnic.

Sample One:

100% Cassava flour

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Sample Two:

50% Cassava flour and 50% Wheat flour

Sample Three:

75% Cassava flour and 25% Wheat flour

Sample Four:

25% Cassava flour and 75% Wheat flour

Sample Five:

100% Wheat Flour

3. FLOW CHAT FOR PREPARING CASSAVA FLOUR

Source: field 2015

Figure 2: SAMPLE OF CASSAVA FLOUR

Recipe for Home Made Cassava Pasta:

Ingredients;

Cassava flour	-	400g
Wheat flour	-	% of composite flour
Eggs	-	4 large eggs
Salt	-	2 tsp
Olive Oil	-	2 tsp

Mix Cassava Flour/Composite Flour

Mix and Knead the Dough

Cut/Use Pasta Machine to cut the Dough

Dry the pasta

Cassava Pasta

Pack the Dried Cassava Pasta

Cooking Cassava Pasta:

i. Put water on fire and allowed to boil to 100°c.
ii. Add a pinch of salt to the boiling water.
iii. Add 1 tsp. oil to the boiling water.
iv. Put cassava pasta into the boiling water.
v. Allow to cook for 3 minute.
vi. Strain and put under running water.
vii. Serve, accompany with sauce, gravy or bolognaise sauce.

NB: Accompanying sauce can be varied.

For variety of taste, cheese can be added.

Source: field 2015

Figure 3: COOKED CASSAVA PASTA (sprinkled with parsley)

4. ANALYTICAL MEASUREMENTS

Samples from the product were displayed for the respondents to taste and comment on it. The sensory indicators were taste, aroma, colour, appearance and texture. The edited information was analyzed by qualitative means of data analyses and the results were presented by means of frequency distribution tables, bar charts alongside discussion for easy presentation.

5. RESULTS AND DISCUSSIONS

Knowledge of Pasta and Substitution of Wheat Flour with Cassava Flour in Pasta Production:

The study sought to find out if the respondents knew what pasta was and if they were aware that cassava flour could be used to produce pasta as a substitute for wheat flour. The result of the analysis is presented in Table 1 and discussed below.

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Table 1: Knowledge of Pasta and Substitution of Wheat Flour with Cassava Flour in Pasta Production

	Substitution of wheat flour with cassava flour in pasta production					
	Yes		No		Total	
Knowledge	Frequency	Percent	Frequency	Percent	Frequency	Percent
Yes	27	47.4	27	47.4	54	94.7
No	0	0.0	3	5.3	3	5.3
Total	27	47.4	30	52.6	57	100.0

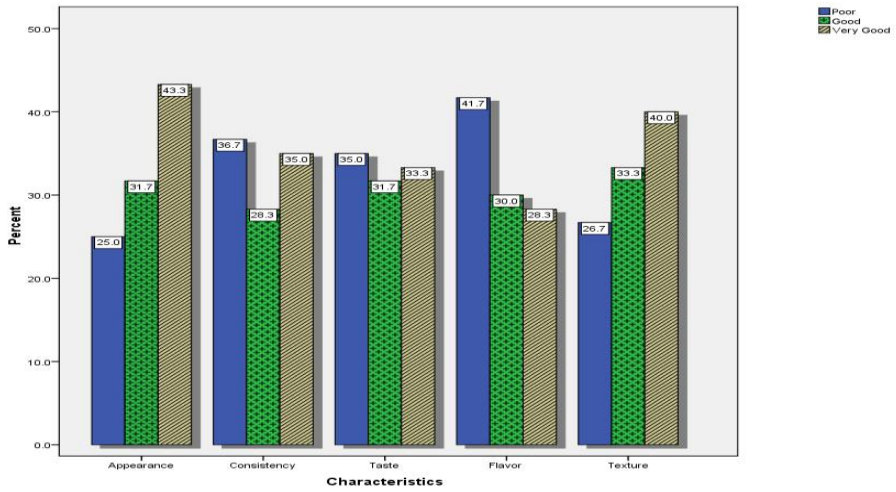
Source: Field Work, 2015

From Table 1, it can be observed that 54 out the 57 respondents, representing about 95%, indicated that they knew what pasta was. Out of this, half of them (27) indicated that they were aware that cassava flour could be used solely or be blended with other flour kinds to produce pasta. It can also be seen that a few (about 5%) of the respondents indicated that they had no knowledge on pasta. This supports (Kormawa & Akoroda, 2003), who was of the view that cassava flour being an innovative substitute for wheat flour enables the production of gluten-free baked goods with virtually the same taste, texture, crumb and baking characteristics as those made with wheat flour and when processed into flour, can be used in making breads, biscuits, salad dressings, custard powder, ice cream powder, flakes and also used in variety of paste products such as spaghetti and macaroni.

In evaluating whether the cassava flour could be used to make pasta wholly or blended with wheat flour, in doing so a 100% cassava flour (Product A); 50% Wheat flour, 50% Cassava flour (Product B); 25% Wheat flour, 75% Cassava flour (Product C); 75% Wheat flour, 25% Cassava flour (Product D) and 100% Wheat flour (Product E) were used. It should be noted that the experiment on using 100% cassava flour could not produce a significant result and thus, there was no analysis on it. Again Product E which is 100% wheat flour is already a known product so the analysis is also not presented in this research.

Product B (50% Wheat flour, 50% Cassava flour):

Product B was made up of an equal amount of wheat and cassava flour. The result of the analysis is depicted in Figure 4.



Source: Field Work, 2015

Figure 4: Characteristics of 50% Wheat Flour and 50% Cassava Flour Pasta

It can be observed from Figure 4 that a good number of the respondents did not like the taste (about 35%), consistency (about 38%) and the flavor (about 42%). A good number of them, however, indicated they liked the appearance (about 48%) and texture (about 40%). This indicates that the respondents had mixed opinions about the pasta made from a 50-50 blend of wheat and cassava flour. This result proves (Haggblade et al., 2012), that wheat flour is known for its consistency; it's consistent in the way it behaves in recipes, consistent in its look, and consistent in taste. That's where cassava flour has an advantage since it helps to vary in taste, texture and appearance.

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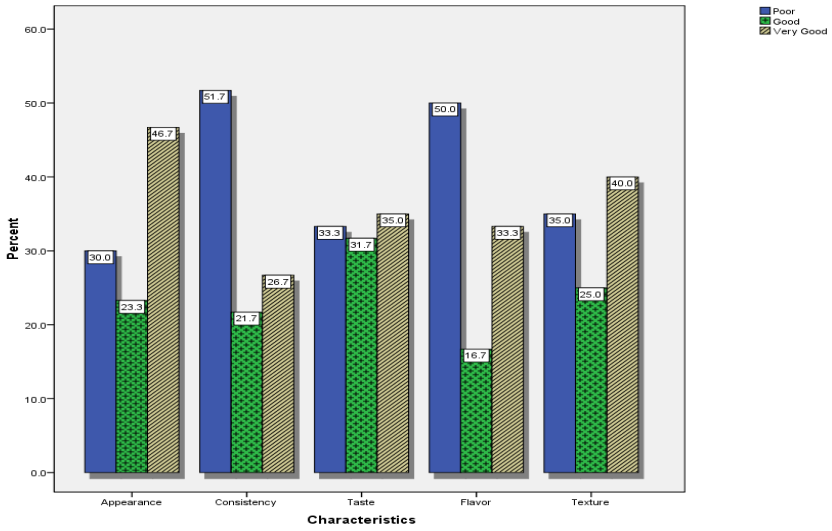
Product C (25% Wheat Flour, 75% Cassava Flour):

Figure 5 depicts a cluster bar chart of the result of the analysis on the composite cassava flour which is made of 25% wheat flour and 75% cassava flour.



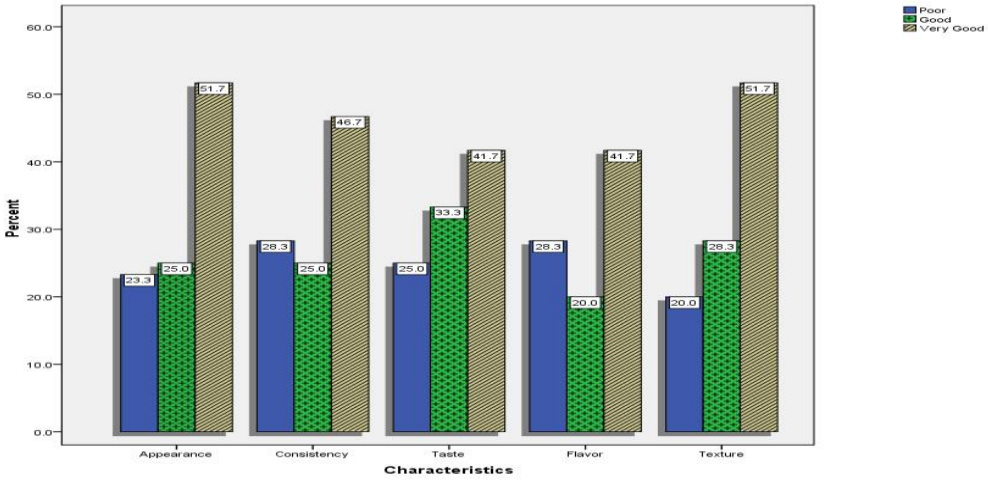
Source: Field Work, 2015

Figure 5: Characteristics of 25% Wheat Flour and 75% Cassava Flour Pasta

Figure 5 shows that at least about 50% of the respondents indicated that the consistency (about 52%) and the flavor (about 50%) of the pasta made from 25% wheat flour and 75% cassava flour were generally poor. Like Product B, it can also be seen that about 47% and 40% of the respondents indicated that they liked very much the appearance and texture respectively of the pasta. This also suggests that the respondents had mixed preferences regarding the characteristics of the 75% wheat flour and 25% cassava flour pasta. This is in line with Kormawa & Akoroda, (2003) that, cassava flour proved effective as a partial substitute for imported wheat flour in biscuits. High quality cassava flour can substitute for up to 30% of wheat flour in sweet dough biscuit and 40% in hard dough biscuit, without consumers being able to detect any adverse change in colour, taste or texture when compared to 100% wheat flour control

Product D (75% Wheat Flour, 25% Cassava Flour):

The result of the analysis on the production of pasta from 75% wheat flour and 25% cassava flour is presented in Figure 6.



Source: Field Work, 2015

Figure 6: Characteristics of 75% Wheat Flour and 25% Cassava Flour Pasta

It can be observed from Figure 6 that about 42% of the respondents indicated that they liked very much the taste and flavor of the pasta made from 75% wheat flour and 25% cassava flour. About half (about 52%) of the respondents also indicated that they liked very much the appearance and texture of the pasta product. A good number of them (about 47%) also indicated they liked very much the consistency of the pasta products. This suggests that a good number of the respondents reported that they generally liked the product very much.

6. CONCLUSIONS

Based on the findings, it can be concluded that most of the respondents had come across the most popular cassava food products such as Gari, Fufu, Kokonte, Tapioca and starch.It was also found out that cassava flour made pasta was not possible and that only a composite flour of cassava and wheat could be used. From this, it was found out that the respondents had mixed opinions about the pasta made from a 50-50 blend of wheat and cassava flour. They also indicated their lack of preference or mixed preference regarding the characteristics of the 75% cassava flour and 25% wheat flour pasta. On the other hand, it was found that the respondents liked it very much when an appreciable amount of wheat flour (that is, about 70% or more) was added to the cassava flour to produce the pasta. Also, close to about 33% of the respondents indicated that they enjoyed the pasta which were made from 50% Wheat flour and 50% Cassava flour (32.2%) and 75% Wheat flour, 25% Cassava flour (33.9%).

Finally, it was found out that before the composite wheat and cassava flour made pasta is produced onto the Ghanaian market, more wheat flour should be added and encouraged due to its tasty, healthy and inexpensive nature.

7. RECOMMENDATIONS

Based on the findings and conclusions of the study, the following recommendations were made:

- More wheat flour should be added to the composite flour of wheat and cassava to improve its consistency and flavour.
- The production process regarding drying, cooking and preservation should be consciously improved to make it appealing.
- Cassava flour should be produced in large quantities and made available in the market.
- Much education should be given to caterers about the health benefits of gluten free diets so as to incorporate the use of cassava flour instead of wheat flour in food production.
- Finally, it has been tested and proven that cassava flour is good but cannot be a perfect substitute for the wheat flour in the preparation of any flour products.

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