

Recipe Development and Organoleptic Evaluation of Meat Pies Made from Plantain Composite Flour for Wealth Creation

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ABSTRACT

This study investigated the organoleptic / sensory evaluation of meat pies prepared from plantain / wheat flour composite. Five different blends of composite flours were formulated using plantain and wheat flour at the ratio of 10:90, 20:80, 30:70, 40:60, and 50:50. Meat pies samples were prepared from these five different blends and 100% wheat flour meat pie samples served as the control. The five blends of plantain / wheat composite and the control were coded (PWMP1, PWMP2, PWMP3, PWMP4, PWMP5, and PWMP6 respectively) and subjected to organoleptic / sensory evaluation using the 9-point hedonic scale with 5 being the cut off mark using twenty - five semi-trained judges for preference assessment in terms of general appearance, colour, texture, flavour, taste, crispness, mouth feel and overall acceptability. Experimental research design was employed in this study. Two (2) research questions were answered and Mean (X) of responses obtained. One (1) hypotheses were statistically tested using the one-way Analysis of Variance (ANOVA) to examine the significant level of all parameters that were measured. Means was separated by Least Significant Difference (LSD) Test. Significance was accepted at $P \leq 0.05$. Sensory evaluation of meat pie samples revealed that there was no significant difference in the ratings for all parameters measured up to 20% substitution except in colour which was significantly different at 20% substitution. The result also shows that up to 40% of the composite meat pie samples were generally acceptable. The researchers, therefore, concluded that wheat flour could be substituted with up to 40% plantain flour without adversely affecting the sensory properties of meat pies. Substituting meat pies and other snack products up to 40% will help to as reduce post-harvest losses, increase the food use of plantain as well and conserve foreign exchange spent on wheat importation in the country.

Keywords

Composite flour, Meat pies, Plantain flour, Wheat substitution, Wealth creation.

Introduction

In recent time, urbanization and advancing prosperity coupled with increasing population have led to a paradigm shift in the consumption of local grains in favour of wheat and based wheat products especially pastries, bread, and cakes in Nigeria and sub-Saharan Africa [1]. There has also been a large shift from consumption of indigenous foods such as grains (sorghum, maize and Millet) fruit (plantain and banana), leguminous plants and vegetable to more refined foods such as polished rice and processed wheat especially among the urban population and higher income groups in developing countries especially Nigeria and Ghana. However, the production of wheat in Nigeria is extremely low and

far below domestic requirement.

Wheat plant cannot survive in Nigeria because of climatic reasons with the exception of few areas in the northern part of the country which produce far too low a quantity to meet the demand of the country [2]. Nigerian climate is however favourable to other food including fruits (plantain and banana); cereal (maize, sorghum and millet); roots (cassava); tubers (yam, cocoyam and sweet potatoes) leguminous plant (soybean and cowpeas). These can be processed into composite flour and used commercially in the bakery industry. The addition of indigenous foods such as plantain flour to processed wheat flour would increase the nutritional and functional characteristics of wheat flour.

The need to substitute wheat flour with flour from locally available food products was prompted by the ban on the importation of wheat

and wheat products in January 1987 by the Nigerian Government. As a result of this, there was need for the utilization of some locally available foods like grains, root and tubers which can completely substitute wheat in their products without adversely affecting the quality of such product [3].

Dendy [4] described composite flours as blends of wheat and other flour for use in the production of (i) Leavened bread; (ii) unleavened baked products; (iii) porridges; (iv) pasta and (v) snack foods. Seibel [5] defined composite flour as a mixture of flour from tubers rich in starch (cassava, yam and sweet potato) and / or protein rich flour (soybean and peanut) and /or cereal (maize, rice, millet and sorghum) with or without the addition of wheat flour. Buhlar and Chittilapilly [6] notes that composite flour has better nutritional value in respect to elements of minerals, vitamins, fibers, proteins and the like than flour milled from any specific cereal alone. This can be consumed by infants, adults, the old and people of all ages.

Composite flour technology has been used as a means for extending scarce supplies of bread and other baked products in many countries including Nigeria, with the recent breakthrough in the production of 40% cassava composite bread and other bakery products in 2012. Several developing countries have encouraged the initiation of programs to evaluate the feasibility of alternative locally available flours as a substitute for wheat flour [7]. The success of compositing wheat flour with locally available food products has been reported to be desirable. Composite flour concept is considered as intermediate solution towards a maximum use of local food products in baking industry.

Meat pies are short crust pastry produced from a mixture of flour, eggs, butter or margarine, salt, meat and vegetables that is baked in the oven. Meat pies are baked products that people have fun eating. Meat pies can be eaten as snacks after lunch or dinner or in between meal with beverages. Pies plays a significant role in different occasions such as luncheon parties, traditional marriages, birthday celebrations, end of year parties, anniversaries, and baby dedication, which makes it a very important food article for wealth creation, employment generation and poverty reduction. If pies are taken in large quantity, they can suppress the appetite for the main meal. For this reason, pies with high fiber content should be developed as a supplementary diet. However, to achieve these pies must be produced using indigenous available food materials like, plantain and other local food materials to sell at reasonable price.

Plantain is an important staple food in Asia, Central and West Africa, which along with banana provides millions of people with 25% of their calories [11]. FAO (2010) reports, that for 2009, Nigeria is the 5th major plantain producing regions in the world, by production harvest quantities [11] Mepba, et al. revealed that about 35-60% post-harvest losses had been reported and attributed to lack of storage facilities and inappropriate technologies for food processing.

Plantain flour could be used in baked product such as cakes, bread and biscuits [11,13]. The major problem facing the baking industry

in the developing nations especially Nigeria is the total dependence on importation of wheat to sustain it production. Moreover, with the present depreciation exchange rate in the country, coupled with the current global economic meltdown, the colossal amount spent on wheat importation is unacceptable. Therefore, it is imperative that alternative to which is traditionally used for bakery products especially cakes and pastries can be developed either as an extension or a replacement. Nigerian market is a huge investment for composite flour technology through this approach we can reduce our import bill on wheat and also create jobs for the unemployed.

At present the cost of meat pies and other pastries is very high in Nigeria and thus gives impetus for further research into the use of composite flour for baking. Considerable efforts have been focused on the use of composite flour for bread making in Nigeria in the last three decade [11], but not much has been done on the use of plantain flour in the production of meat pies. This investigation evaluates the organoleptic properties of wheat-plantain composite flours in the production of meat pies for wealth creation

Research Questions

The following questions were answered in this study:

1. What are the mean ratings of the respondents in terms of general appearance, colour, flavour, texture, taste, crispiness, mouth feel and general acceptability among meat pies prepared with 100% wheat flour, meat pies prepared with 10%, 20%, 30%, 40% and 50% plantain / wheat composite flour?
2. In which way can composite meat pies preparation serve as an avenue for employment generation and wealth creation?

Hypothesis

The following hypotheses were tested at $P \leq 0.05$ significant level
HO1: There is no significant difference among judges in general appearance, colour, flavour, texture, taste, crispiness, mouth feel and general acceptability preference between meat pies prepared from 10%, 20%, 30%, 40% and 50% plantain / wheat composite flour and meat pies prepared from 100% wheat flour.

Purpose of the study

The main purpose of this study was to develop meat pies from plantain/wheat composite flour for wealth creation. Specifically this study addressed the following,

- Processed unripe plantain into flour;
- Formulated composite flours using 10%, 20%, 30%, 40% and 50% of the processed flour (plantain) to substitute wheat flour;
- Developed recipe from the composite flour;
- Prepared meat pies made from the composite flours;
- Conducted organoleptic evaluation of the products and also determined the level of acceptability of meat pies produced from the different composite flours using hundred percent (100%) wheat flour as control for wealth creation.

Material and Method

Materials

Matured green plantain (*Musa paradisiaca*), wheat flour, margarine,

eggs, salt, runner beans, potatoes, carrots, seasoning and meat were procured from local market in Warri, Delta State.

Method of Sample Preparation

Plantain flour was produced using traditional method of dehydration and milling.

Preparation of Plantain Flour

A bunch of matured green (unripe) plantain were separated and washed, with clean water to remove dirt and latex, which exuded from the cut surface of the crown. The washed plantain were hand-peeled with the aid of stainless steel kitchen knife to extract the pulp and were kept in a bowl containing water where they were kept until the peeling process was completed (to reduce enzymatic reaction). Plantain pulps were manually sliced into cylindrical pieces of 2 cm thickness for easy drying, and then blanched with hot water at 80°C for 5 minutes. This was to stop enzymatic reaction on plantain pebbles and to get fairly white flour. The blanched plantain pebbles were then sun-dried for four days. The dehydrated products was milled to produce flour and then sifted with 2mm mesh kitchen sieve. The plantain flour obtained was packaged in polythene bags labeled and stored at room temperature until needed.

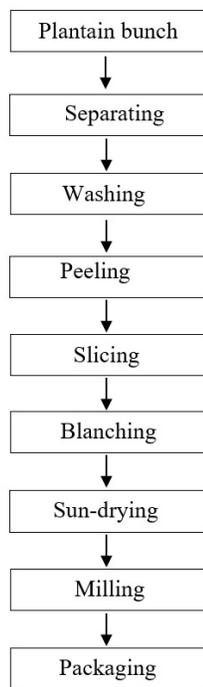


Figure 1: Flow chart for the production of composite flour. Source: Ogazi (1995).

Preparation of plantain/wheat composite flour

Composite flour samples containing wheat and plantain flours were formulated by substituting plantain flour with wheat flour at the percentage of 10%, 20, 30, 40 and 50% level of wheat flour substitutions (that is 10:90, 20:80, 30:70, 40:60 and 50:50) respectively, one hundred percent (100%) wheat flour was used as control. A total of six different samples were prepared.

Measurement for Plantain Composite Meat Pie

SAMPLES	SAMPLE NAMES	RATIO
PWMP1	Plantain Wheat Composite Meat Pie	10 : 90
PWMP2	Plantain Wheat Composite Meat Pie	20 : 80
PWMP3	Plantain Wheat Composite Meat Pie	30 : 70
PWMP4	Plantain Wheat Composite Meat Pie	40 : 60
PWMP5	Plantain Wheat Composite Meat Pie	50 : 50
PWMP6	Wheat Meat Pie (Control)	100%

Table 1: Presents the measurement of plantain composite flour.

Development of Recipe for Composite Meat Pie

Composite flour samples containing wheat and plantain flours were formulated by substituting plantain flour with wheat flour at ratio of 10:90, 20:80, 30:70, 40:60 and 50:50 wheat flour substitutions respectively. One hundred percent (100%) wheat flour was used as control. A total of six samples were prepared.

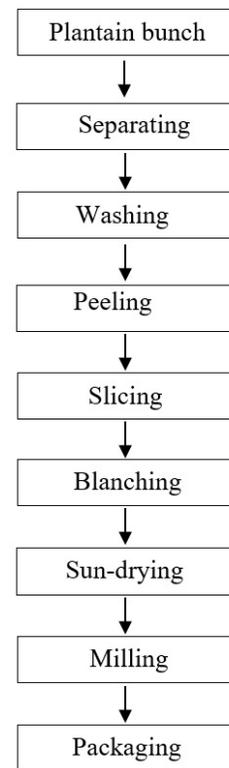


Figure 2: Flow chart for the production of composite Meat Pies.

Sensory Evaluation

Instrument- Hedonic Scale

The samples were evaluated on a 9-point hedonic scale (1- dislike extremely, 2- dislike very much, 3- dislike moderately, 4- dislike slightly, 5- neither like nor dislike, 6- like slightly, 7- like moderately, 8- like very much, and 9 – like extremely), scores from 5 to 9 point is like, below 5 is dislike. The cut-off mark was 5. The samples were tested for general appearance, colour, texture, flavour, taste, crispness, feeling in the mouth and overall acceptability.

Panel of Judges

Twenty-five semi-trained panelists, who were familiar with meat pie quality attributes, were randomly selected from staff and students of the Delta State College of Education, Mosogar. The tasting was carried out in the Food and Nutrition Laboratory, Department of Home Economics, Delta State College of Education, Mosogar. (This environment enabled easy access to twenty - five panel of judges). Each judge (panel member) was seated in individual compartment free from noise and distraction.

Statistical Analysis

Data collection techniques

The samples were assigned four digits – codes and presented to judges on clean white plates in a fluorescent – lighted sensory evaluation laboratory. The order of presentation of samples to the panel was randomized. The test was performed at 12 p.m. in the afternoon. Clean bottled water was provided for each of the judges to rinse their mouths between evaluations. Sensory evaluation was done on the same day that the meat pies were prepared.

Statistical Analysis of Results

The data obtained from the scores of the 9- point hedonic scale by the respondents of different blends of each plantain/wheat composite meat pie samples (10%, 20%, 30%, 40%, and 50%) and 100% wheat flour meat pies were calculated and divided by number of respondents, and 5 (neither like nor dislike) being the cut-off point. All scores from 5 to 9 were regarded as like while below 5 was regarded as dislike. The results were expressed as mean values. Statistical analysis was done using the One-Way Analysis of Variance (ANOVA) to examine the significant level of all parameters that were measured. Turkey Test was used to find out where the significant difference of all the samples in each parameter lies. The means were separated by Least Significant Difference (LSD) Test. Significance were be accepted at $P \leq 0.05$. [14,15]. A structured questionnaire was also used to find out from respondents on how composite meat pies can be use as avenue for wealth creation and employment generation. Data collected were analyzed and recorded as percentage (%).

Results and Discussion

Research Question: What are the mean ratings of the respondents (judges) in terms of general appearance, colour, texture, flavour, taste, crispness, feeling in the mouth and overall acceptability among meat pies prepared with 100% (PWMP6) wheat flour and meat pies prepared with 10% (PWMP1), 20% (PWMP2), 30% (PWMP3), 40% (PWMP4), and 50% (PWMP5) plantain / wheat composite flour?

Parameters	PWMP6 (100%)	PWMP1 (10:90)	PWMP2 (20:80)	PWMP3 (30:70)	PWMP4 (40:60)	PWMP5 (50:50)
General Appearance	8.88a	8.84a	8.84a	8.64a	8.40a	8.20b
Colour	8.84a	8.72a	8.04ab	6.96b	4.92d	4.36d
Flavour	8.84a	8.68a	8.12a	7.36b	6.72c	6.16d
Texture	8.96a	8.80a	8.16a	7.28b	6.28c	5.60d

Taste	8.96a	8.80a	8.20a	7.28b	6.56c	6.16c
Crispness	8.80a	8.56a	8.40a	7.28b	5.72c	4.88c
Feeling in the Mouth	8.80a	8.76a	8.12a	7.08b	5.28c	4.84c
Overall Acceptability	8.84a	8.76a	8.40b	7.40b	5.32c	4.72d

Table 2: Mean ratings of all meat pie samples.

*Samples with different superscripts are significantly different ($P < 0.05$).

*Key: 1- Dislike extremely; 2- Dislike very much; 3- Dislike moderately; 4 - Dislike slightly; 5 - Neither like nor dislike; 6 - Like slightly; 7- Like moderately; 8- Like very much; 9 - Like extremely.

*Dislike extremely being lowest (1) scale and like extremely (9) being the highest scale.

*Cut off mark = 5 (Neither like nor dislike).

Discussion on sensory evaluation of judge's (respondents) preference in terms of general appearance, colour, texture, flavour, taste, crispness, mouth felt and overall acceptability.

Findings indicates that PWMP1(10% plantain substitution) and PWMP2 (20% plantain substitution) were very much liked by the judges among the plantain/wheat composite meat pie samples in all the organoleptic attributes (parameters) measured, and had no significant difference with the 100% wheat meat pie samples. The implication of this is that plantain flour possesses similar sensory characteristics with wheat flour [16]. As the level of substitution increases judges preferences also decreases. There was no significant difference among judges in the general appearance preference among all the samples.

All the plantain/wheat composite meat pie samples rises equally in appearance (shape and form) and there were no significant difference with PWMP6 (100% wheat meat pie) (control) up to 40% substitution. All meat pie samples were very much like by the judges even though the PWMP6 was still preferred to all the composite meat pies in appearance. This result was expected as it has been shown that meat pie pastry does not require high gluten flour for its preparation. This is in agreement with Dendy [4]; Olusanya Eyisi, Anfano-Joe, Ogunjide & Egbuchulam who stated that pastry flour of low gluten is considered the most satisfactory in pastry making.

Crust colour of composite meat pies did not show a consistence pattern for all the samples and there was significant difference among the composite meat pie samples and control samples from 30% substitution. The darker colour of crust of plantain/wheat composite products has been reported by several authors in their experiments on bread and biscuits [20-23]. The brownish samples appearance could be directly related to the enzymatic reaction, ascorbic acid of the pulp before dehydration as well as method of dehydration used [14].

The sensory evaluation result also shows that PWMP1 was more preferred among the plantain/wheat composite meat pie samples in colour attributes even though both PWMP1 were very much liked, the colour of PWMP6 (control) was still rated higher than

all composite meat pies samples. PWMP3 was slightly liked by judges. This was not surprising as it has been shown that appearance of food evoke the initial response [25]. This result was in agreement with the result of Mepba, et al. [11] in colour rating and appearance who experimented on composite biscuit at an acceptable level of 30% of plantain flour. PWMP4 and PWMP5 were slightly disliked by judges in terms of colour, and PWMP5 had the least score in colour attribute. This is because PWMP4 and PWMP5 had darker colour than the rest of the samples. Perez-Sira; Golan, Kahn & Sadvski [23,24] revealed that the browning potential of various fruits and vegetables has been shown to be directly related to the ascorbic acid level and polyphenoloxidase activity. However, colour and oxidative stability of plantain flour could be enhanced by blanching slices in 1.25% NaHSO₃ solution [11]. There was no significant difference among judges colour preference.

Flavour is another attribute that influences the acceptance of baked good even before they are tasted. Flavour is the main criterion that makes the product to be liked or disliked. The mild pleasant flavour of meat pie appeals to people of all age groups. Sensory organoleptic score for the flavour of the meat pies revealed there was no significant difference ($P < 0.05$) in flavour of composite meat pies up to 20% of substitution, but there was significant difference as substitution increases among different treatments. With respect to the flavour, the judges accepted plantain/wheat composite meat pies from all the treatments even though they still prefer PWMP6 (100% wheat flour meat pie). Although both PWMP1 and PWMP2 were very much liked in flavour preference by the judged and had no significant difference with PWMP6 (control), but PWMP1 had the highest mean score among the composite samples. PWMP3 was moderately liked while PWMP4 was slightly liked by judges. PWMP5 was neither liked nor disliked. This could be due to the meat and vegetable fillings which tend to increase the flavour of pastry [25,26]. The result was in agreement with Chinma, Igbabul & Omotayo [27] who experimented on cakes. The analysis also revealed that there were significant differences among judges flavour preference among all the samples.

All composite meat pie samples were like by the judges in textural quality except PWMP5. This result was not surprising because it has been reported that plantain flour had similar character with wheat flour [16]. The texture rating of composite meat pie samples decreases as plantain substitution increases. PWMP1 was rated higher than all the other composite samples even though PWMP6 (control) was still preferred. Both PWMP1 and PWMP2 were very much liked and had no significant difference with PWMP6, while PWMP3 was moderate liked by the judges. PWMP4 was neither liked nor disliked by the judges while PWMP5 was slightly disliked by judges. The texture of PWMP5 was a bit harder than the rest of the composite samples, but not hard enough to be totally disliked. The hard texture may be due to the high fibre content of plantain flour which may lead high water absorption rate as reported by Akubor [28] in biscuit production. Adepoju, Sunday and Folaranmi; Maldonado and Pacheco-Delahaye and Fagbemi [29-31] all experimented on the physical and proximate

composition of plantain flour and reported that plantain flour is high in fibre content. Oloyede, Ocheme, Nurudeen [20] experimented on bread with plantain / wheat composite flour and reported 40% acceptability in textural quality. The analysis also revealed that there were significant differences among judges textural preference among all the samples.

Sensory evaluation result shows that all the meat pie samples have a high mean rating in taste preference. PWMP1, PWMP2 were very much liked and had no significant difference with PWMP6 (control). PWMP3 was moderately liked while both PWMP4 and PWMP5 were slightly liked and are significantly different with PWMP6 at $p \leq 0.05$. The high taste rating was not surprising as the tasty filling greatly had a positive effect on the taste of the meat pie samples. The high taste preference was also observed by [21,32] in plantain /wheat composite breads. Ibeanu, Onyechi, Ani and Ohia and Chinma, Igbabul & Omotayo [27,33] also recorded high taste preference in plantain/ wheat composite cake. The analysis also revealed that there was no significant difference among judges texture preference among all the samples.

Crispness is a desirable quality of baked products, expressed in terms of hardness and fracturability. In this study, there was no significant difference ($p \leq 0.05$) in crispiness between the different control and samples with different composite meat pies up to 20% plantain substitution. PWMP3 (30% plantain substitution) was moderately liked, while PWMP4 (40% plantain substitution) was neither liked nor disliked, PWMP5 was disliked slightly by judges. This observation may be due to small percentage of wheat flour substitution in the composite meat pie formulation, which did not affect the gluten network in the dough nor the development of an open internal structure upon baking. The high fat content of meat pie may be obviously responsible for the higher scores of crispness. The effect of fat on cookies crispness and other baked products is well known. There was no significant difference among judges general crispness among all the samples

Sensory evaluation result revealed that both PWMP1 and PWMP2 were very much liked by judges in terms of mouth feel and had no significant difference with PWMP6. PWMP1 was rated higher than all the other composite samples even though PWMP6 was still preferred. PWMP3 was moderately liked by the judges, while PWMP4 was neither liked nor disliked by the judges. The result also revealed that PWMP5 was slightly disliked by judges in mouth feel preference.

Sensory evaluation revealed that all the composite meat pie samples were highly rated in overall acceptability, even though PWMP6 was still preferred. PWMP1 and were very much liked by the judges. This could be attributed to the close resemblance with the control. PWMP3 was moderately liked by the judges. Some of the judges commented that PWMP3 was more filling and taste good and will make a good choice for afternoon snack when one is very hungry. This finding was noted by pregnant individuals among the judges PWMP4 (40% plantain substitution) was slightly liked while PWMP5 was disliked slightly by judges.

This result was in agreement with Ibeanu, Onyechi, Ani & Ohia [33], who experimented on cakes and reported 50% overall acceptability. Onwuka & Onwuka [34]; Adeniji and Empere [35] also investigated on the use of 100% cooking banana flours in making cake, which were acceptable to representatives of consumers in Nigeria. Oloyede, et al. [21]; Cameroon Tribune [36] reported using up to 80:20 and 60:40 ratios of wheat/:plantain flour as maximum acceptable levels of substitution for breads and biscuits, respectively. Ogazi [36] reported 50% acceptable levels of

substitution for plantain/wheat composite breads. Chinma, Igbabul & Omotayo [27] experimented with plantain / wheat composite flour, also reported that acceptable cakes could be produced from wheat flour substituted up to 50%. Muranga, Mutambuka, Nabugoomu & Lindhauer [11]. Mepba, et al. reveals that colour, taste and crispness and aroma were generally highly rated for all biscuits samples containing up to 70% plantain flour. The analysis also revealed that there was no significant difference among judges in overall acceptability preference among all the samples.

S/N	Questions	Yes	%	No	%
1	Teaching youths and women in the production composite snacks especially meat pies is a way of empowering them for wealth creation and employment generation.?	25	100	-	-
2	Creating awareness about the nutritional composition of meat pies among the general public will increase sales and income?	24	94	1	4
3	Teaching people in making snacks from plantain flour Is a way of emphasis on entrepreneurship in composite snack in schools and colleges?	25	100	-	-
4	The making of plantain flour snacks will encourage rural farmers especially women and youths to plant more plantain. Thereby reducing the money government would have used to import wheat flour?	23	92	2	8
5	The opening of more plantain flour processing factories will generate income to workers?	25	100	-	-

Table 3: In which way can composite meat pies preparation serve as an avenue for employment generation and wealth creation?

Findings revealed that 100% of the respondents agreed that teaching youths and women in the production of composite snacks especially meat pies are a way of empowering them for wealth creation and employment generation. This is in agreement with Akpomi & Ogbonyomi [37,38] who stated that there is need to equip learners with basic skills in snacks production as this would help them to be self-employed, self-sufficient and independent. 96% agreed that creating awareness about the nutritional composition of meat pies among the general public will increase sales and income while only 4% responded negative. 100% of the respondents reacted positively to the fact that teaching people in making snacks from plantain flour is a way of emphasis on entrepreneurship in composite snack in schools and colleges. 92% agreed that the making of plantain flour snacks will encourage rural farmers especially women and youths to plant more plantain, thereby reducing the money government would have used to import wheat flour, while 8% disagreed. 100% affirmed that the opening of more plantain flour processing factories will generate income to workers this is agreement with [4,10]. Researches on composite biscuits and breads revealed that composite flour concept is considered as intermediate solution towards a maximum use of local food products in baking industry [1,11,21].

Conclusion and Recommendations

The result of this study has shown that Plantain flour can be incorporated into wheat flour to produce acceptable meat pies up to 40% substitution without adversely affecting the organoleptic properties of the products. However, as the level of plantain flour incorporation increases beyond 20%, there was a significant difference in sensory attributes of meat pie samples. Although all the meat pie samples were rated from slightly disliked to liked very much by judges only colour attribute was compromised from 30% substitution, but even so, research revealed that the colour of plantain flour can be enhanced by blanching slices in 1.25% NaHSO₃ solution before drying. None of the meat pie samples

was totally disliked.

In conclusion, the result shows the possibility of substituting wheat flour with unripe plantain flour for meat pie production up to 40 % level of substitution. This will help to diversify the food use of plantain as well as reduce post-harvest losses and conserve foreign exchange spent on wheat importation in the country. This will accrue in great savings in the scarce resources of most developing countries, where wheat cultivation does not thrive for climatic reasons.

- The researchers therefore recommend up to 20% plantain substitution in meat pie production. This will help to diversify the use of plantain as well as reduce post-harvest losses and conserve foreign exchange spent on wheat importation in the country.
- Due to the comments of some of the respondents, the researcher also recommends up to 40% plantain composite meat pie for pregnant women and those suffering from diabetes.
- There should be adequate exposure of learners to entrepreneurship skills, knowledge and attitude essential to acquire self-reliance for occupational roles within and outside school environment, this will help to develop strong foundation that will enable them move into job creation.

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