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Evaluation of Proximate, Pasting and Sensory Properties of Complementary Food from Millet and Firm Ripe Pawpaw Flour Blends

Research Article

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Abstract

Complementary food was formulated from millet and firm ripe pawpaw flour blends. The formulations were coded 415, 514, 144, 652, 311 and 212 while 415served as control. The proximate compositions, sensory and pasting properties of the formulations were evaluated using standard methods. The result of proximate composition showed significant (p≤0.05) decrease in moisture content, increase in ash, fibre and carbohydrate content acceptable level of fat as substitution with firm ripe pawpaw flour increased. There was, however, an insignificant effect of pawpaw on the protein content of the food. Pasting properties showed variations in the pasting viscosity of the blends and little differences in pasting temperature. There was slight reduction in pasting temperature of the samples, an indication of shorter cooking time. Sensory evaluation showed no significant (p≤0.05) difference between samples 415, 514, 144, 652 and 311 for colour, texture and taste. These were significantly different from sample 212 for the attributes of colour, texture, taste, and mouth feel. Although samples 415, 652 and 212 compared favorably with the control, sample 212 containing 50/50 millet/pawpaw flour was most accepted. All the samples showed no difference in aroma. The study showed that papaw and millet flours could be used in the production of complementary food with high energy value, mineral and quality protein that could play a key role in reducing energy mal-nutrition.

Keywords: Complementary food; Sensory properties; Pasting properties; millet; Pawpaw; Flour

Introduction

Complementary food is any food other than breast milk given between the time the diet consist exclusively of mother's milk and the time when it is mostly made of family foods. Complementary feeding is giving infants foods or fluids other than breast milk. It can be specially prepared for the infants or can be the same food available for the family members, modified in other to meet the eating skills and needs of the infants [1]. Most complementary foods are made of cereals and legumes individually or in combinations as individual might not meet the nutritional needs of the infants. In view of this, there is need to have maximum utilization of commonly neglected cereals such as millet (*Pennisetum glaucum*) of high nutritional content and other plants with high vitamin and mineral content such as Pawpaw (*Carica papaya*) in the formulation of complementary foods.

Millets are a group of variable small-seed grasses widely grown around the world as cereal grains and are the major source of calories and proteins in developing country like Nigeria. They are rich in B vitamins, especially niacin, B_{12}, B_6 and folic acid [2]. The most widely grown is pearl millet which is an important crop in semi-arid and impoverished less fertile agricultural region of Africa and south East Asia [3]. Nutritionally millet is comparable and even superior to major cereals with respect to energy value, proteins, fat and minerals. It makes an important contribution to human diet due to high levels of calcium, iron, zinc, lipids and high quality proteins. Besides it is also a rich source of dietary fibre and micronutrient. The whole grain is used in soups, stews or as cooked cereals. Millet can also be popped roasted or sprouted [4].

Papaya (*Carica papaya*) is an important fruit crop throughout the tropical and sub-tropical Africa. It is favored by people in the tropics as breakfast and as ingredient in the jellies, preserves or cooked in various ways. It is rich in vitamins and minerals; the fruit has pronounced bactericidal effects [5]. Preservation of pawpaw fruit poses a big problem particularly in rural areas where there are no steady electricity supply and inadequate storage facilities like cold store room or refrigerators, as a result farmers are compelled to either let them rot away or dispose them at a giveaway prices during glut season. Dried pawpaw fruit has the potential of been incorporated into other traditional foods in Nigeria. Given its remarkable nutritional potential, there is need for utilizing it thereby reducing its wastage. Nowadays, papaya is used in baked products for weight conscious persons and the use of composite flour is advantageous in supplying carbohydrates for human nutrition and encourages better use of local or domestic agricultural products as flours [6]. Egwujeh, et al. [7] had earlier reported acceptable biscuits from blends of wheat and pawpaw flours.

Pasting properties of food can be correlated to the cooking quality and textural of the food hence a good index of textural quality in most starchy foods. The pasting temperature gives an indication of the minimum temperature to cook a food.

Food insecurity and under nutrition are more than lack of food energy but are mostly caused by micronutrient deficiency [8]. Overcoming under nutrition by the use of local resources will protect and promote the utilization of such resources against importation and as well educate or train local populace on local materials for food production and nutrition orientation. Many African mothers, especially those from low income class feed their infants with complementary foods that are inadequate in energy value poor swallow ability and deficient in micronutrient (especially Iron, zinc, calcium, vitamin A, vitamins C and B).

This study is therefore significant in formulating food from commonly and available crops that are affordable, easily prepared by any African woman locally from family foods that could meet the characteristic standard of complementary food for infants. Information on the effects of pawpaw supplementation on complementary food from millet is lacking. The objective of this study therefore was to produce complementary food from millet and firm ripe pawpaw flour blends and to evaluate the proximate compositions, pasting and sensory properties of the complementary food.

Materials and Methods

Source of material

Millet *(Pennisetum glaucum)* was purchased from a main market of Anyigba town, Kogi State Nigeria while pawpaw *(Carica papaya)* fruit was obtained from the garden of Kogi State University, Anyigba. Equipment including knife, trays, buckets, hammer mill, weighing balance, sealer, fan driven hot air oven and sieves were provided by from laboratory of the Department of Food, Nutrition and Home Science, Kogi State University, Anyigba Nigeria.

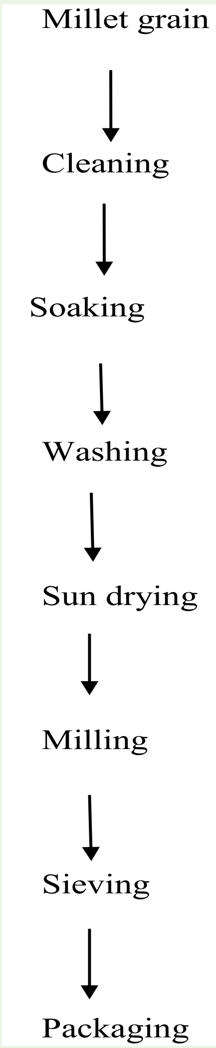

Figure 1: Flow diagram for the production of millet flour.

Preparation of millet flour

The millet grains were cleaned of dirt, stones and other extraneous material, and soaked in clean water for 8hours. The soaked grains were washed, sundried, milled with locally fabricated hammer mill, sieved using a 40 mesh size sieve and packed in a polyethylene bag. The flow chart for the production of millet flour is shown in [Figure 1].

Preparation of firm ripe pawpaw flour

Firm ripe pawpaw fruit were plucked, cleaned, peeled manually and the seeds removed. Thereafter the mesocarp was washed and sliced into thin slices (about 1mm). The sliced mesocarp was dried using fan driven hot air oven to fairly constant weight. The dried sample was milled using hammer mill, sieved using a 40 mesh sieve and packaged in polyethylene bag as shown in [Figure 2].

Formulation of complementary food

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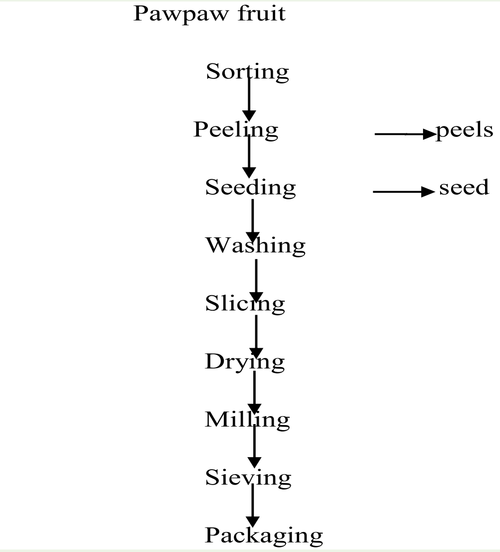

Figure 2: Flow diagram for the production of pawpaw flour.

The complementary food was formulated using millet and pawpaw flour blends as shown in the Table 1 below.

Chemical analysis

The moisture, crude protein, ash, crude fibre and fat content of the complementary food samples were determined following the procedures described by AOAC [9], while carbohydrates was calculated by difference according to Onwuka [10]. Energy was calculated using Atwater factors (9 X fat + 4 X protein + 4 X carbohydrates) as described by Yusufu [11].

Determination of pasting properties

In this study, the pasting properties of the formulated complementary food were determined with Rapid Visco Analyser (RVA) (model RVA 3D± New port scientific Australia) [12]. Sample of fine powder was milled, and the moisture content was determined. Three gram (3g) of flour (on 100% dry matter basis) was weighed into a canister, fitted with paddle and the canister was inserted into the instrument, the measurement cycle was initiated by depressing the motor tower of the instrument when the computer says ‘‘press down the tower’’. Finally the canister was removed on completion of test.

Sensory evaluation

The formulated complementary food was evaluated on the attributes of colour, aroma, texture, taste, mouth feel and general acceptability using a 9 point Hedonic scale (9-like extremely, 1-dislike extremely). The panellist drawn from staff and students (nursing mothers) in Kogi State University, Anyigba were served with the complementary food samples in a randomised order. The scores obtained were subjected to statistical analysis using multiple comparisons Test and the means was evaluated using one way Analysis of variance (ANOVA) and difference established using T-test [13].

Results and discussion

Proximate composition

The Proximate compositions of the complementary food are presented in Table 2. Differences ($p \leq 0.05$) existed between the control (sample 415) and those containing pawpaw flour in terms of moisture, ash, fibre, protein and fat. There was a general increase in carbohydrates, ash and fibre with increasing levels of pawpaw flour. On the other hand, protein content of the food decreased with increasing addition of pawpaw flour. The low moisture content (13-

Table 1: Formulation of complementary food from millet and firm ripe pawpaw flours.

Sample codes	millet (g)	pawpaw (g)
415	100	0
514	90	10
144	80	20
162	70	30
311	60	40
212	50	50

415 = control sample (100% millet flour) 514 = (90% millet, 10% pawpaw flour) 144 = (80% millet, 20% pawpaw flour 652 = (70% millet, 30% pawpaw flour) 311 = (60% millet, 40% pawpaw flour) 212 = (50% millet, 50% pawpaw flour)

Table 2: Chemical composition of the formulated complementary foods.

Samples	Analytical parameter						
	Moisture	ash	fibre	protein	fat	carbohydrate	energy
	(%)	(%)	(%)	(%)	(%)	(%)	(kcal)
415	18.80±0.04^{f}	0.50±0.02^{a}	0.80±0.02^{a}	6.17±0.02^{d}	5.40±0.0^{a}	68.33±0.02^{b}	346.60
514	16.60±0.02^{e}	0.55±0.02^{b}	0.88±0.02^{b}	6.39±0.02^{e}	7.80±0.05^{c}	67.78±0.09^{a}	366.88
144	16.20±0.02^{d}	0.65±0.02^{c}	1.24±0.02^{c}	7.44±0.02^{f}	6.20±0.02^{b}	68.27±0.02^{b}	358.64
652	15.00±0.02^{c}	1.00±0.02^{f}	1.30±0.02^{c}	6.04±0.02^{c}	6.18±0.02^{b}	70.48±0.02^{c}	361.70
311	13.40±0.02^{b}	0.85±0.02^{e}	1.32±0.02^{d}	5.99±0.04^{b}	5.60±0.02^{b}	72.84±0.02^{d}	365.72
212	13.00±0.02^{a}	**0.70±0.02^{d}**	1.28±0.02^{d}	5.86±0.02^{a}	5 40±0.02^{a}	73.76±0.02^{e}	367.08

Mean in a column with the same superscript are not significantly different at 5% level of probability ($p \leq 0.05$), 415 = control sample (100% millet flour), 514 = (90% millet, 10% pawpaw flour), 144 = (80% millet, 20% pawpaw flour), 652 = (70% millet, 30% pawpaw flour), 311 = (60% millet, 40% pawpaw flour) and 212 = (50% millet, 50% pawpaw flour)

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Table 3: Pasting properties of the complementary foods.

Samples codes	Analytical parameter						
	Peak 1	Trough 1	breakdown	final visc	setback	peak time	pasting
	temperature						
415	72.50	68.75	3.75	252.75	184.00	7.00	94.75
514	231.42	114.00	117.42	145.25	31.35	4.47	75.15
144	44.67	39.42	5.52	110.17	70.75	7.00	94.20
652	66.08	62.08	4.00	235.42	173.33	6.93	94.52
311	69.92	67.25	2.67	250.00	182.75	6.93	94.75
212	74.75	70.58	4.17	262.50	191.92	7.00	94.15

415 = control sample (100% millet flour), 514 = (90% millet, 10% pawpaw flour), 144 = (80% millet, 20% pawpaw flour), 652 = (70% millet, 30% pawpaw flour), 311 = (60% millet, 40% pawpaw flour), 212 = (50% millet, 50% pawpaw flour).

Table 4: Effects of firm ripe pawpaw flour on sensory properties of complementary foods from millet.

Samples	Analytical parameter					
	Colour	aroma	texture	taste	mouth feel	general acceptability
415	6.5±1.08[a]	6.35±1.18[a]	6.40±1.66[a]	6.10±0.71[a]	6.30±1.03[a]	6.65±1.03[b]
514	6.50±1.63[a]	6.15±1.49[a]	6.45±1.57[a]	6.00±1.37[a]	6.20±1.10[a]	6.55±0.94[b]
144	5.60±1.09[a]	5.90±1.02[a]	6.00±1.12[a]	5.95±1.44[a]	5.25±1.71[a]	6.25±0.96[a]
652	6.05±1.39[a]	6.05±1.31[a]	5.65±1.75[a]	5.90±0.85[a]	5.70±0.97[a]	6.65±1.13[b]
311	5.85±1.30[a]	5.90±1.33[a]	5.75±1.68[a]	5.95±1.43[a]	5.95±1.27[a]	6.35±1.08[a]
212	6.95±1.65[b]	6.65±1.30[a]	7.40±0.75[b]	6.95±1.27[b]	6.80±1.28[b]	7.25±1.16[b]

Mean in a column with the same superscript are not significantly different at 5% level of probability ($p \leq 0.05$), 415 = control sample (100% millet flour), 514 = (90% millet, 10% pawpaw flour), 144 = (80% millet, 20% pawpaw flour), 652 = (70% millet, 30% pawpaw flour), 311 = (60% millet, 40% pawpaw flour), 212 = (50% millet, 50% pawpaw flour).

16.6%) of formulations was an indication that the products would have better storage stability than the control. The moisture content of a food predicts its shelf life as it may encourage microbial activities, enzymatic and none enzymatic reactions leading to spoilage [14]. The ash content gives an indication of the mineral composition preserved in foods [15,16]. The ash contents of the formulations range from 0.55-1.00%. Higher ash content in the formulation was an indication of higher mineral contents than the control.

Fibre is an indigestible component of plant material that helps in improving roughage and as well contributes to a healthy condition of the intestine [17]. Fibre helps in the maintenance of human health and has been known to reduce cholesterol in the body [18]. The fibre content ranges from 0.88-1.30% showing higher values than the control 0.80%. It has been reported that infant cereal should be 0.3-2.5%. Values obtained in this study are within this range indicating that the formulations could be adopted in infant feeding.

Although the protein content of the formulated complementary foods were lower than the 13-14g RDA recommended for infants up to one year, they meet 40-50% (1.38 to3.15 g/100g) reported by Anigo et al. [19]. The low fat (5.4-7.8%) content of the samples could be an advantage for prevention of obesity and as well support the stability of the food during storage. The carbohydrate contributes the bulk of energy of the formulations. High carbohydrate contents of the blends make them ideal for babies since they require energy for their growth. The energy values of the complementary foods ranged from 346.6kcal in the control (sample 415) to 367.08kcal in sample 212. This showed that the formulations might supply enough energy for the infants to grow.

Pasting properties

The pasting properties of the complementary formations are shown in Table 3. The Peak viscosity ranged from 44.46-231.42 RVU reducing as substitution with pawpaw increased. The difference in the peak viscosity may be attributed to different rates of water absorption and swelling of starch granules of the flours during heating which would have been influenced by the increase in sugar content of the food. High sucrose ties up water molecules making them unavailable for starch thereby inhibiting normal swelling of starch. Breakdown viscosity is regarded as a measure of the degree of disintegration of starch granules or paste stability during heating. The implication of this observation is that sample 311 flour blend with the lowest breakdown value (2.67 RVU) was more resistant to heat and shear force during heating and that there was less starch granule rupture which could therefore guarantee a more stable cooked paste [20,21]. Chinma et al. [22] had equally reported similar observations for full fat soybean and cowpea starches.

Final and setback viscosities reduced in most cases. The low final viscosity observed in the samples indicated low tendency of the samples to retrograde [23]. Since setback viscosity is an indication of the stability of cooked paste against retrogradation it can be used

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to predict the storage life of a product prepared from the flours [24]. The low setback values observed in the samples indicated low rates of starch retrogradation and syneresis tendencies hence the formulated products will have long storage life. Higher values of setback had earlier been reported for full fat soybean and cowpea starches [22]. The pasting temperature is the temperature when viscosity first by at least 2RVU over a 20s period [25]. The similarities in pasting temperatures of the blends indicate the substitution of pawpaw at these levels had little or no effect on initial pasting temperature of the flour blends [24].

Sensory analysis

The sensory attributes of the complementary formulations are shown in Table 4. Statistical analysis showed that there were no significant ($p \leq 0.05$) difference among the samples in all the attributes evaluated except over all acceptability. Panellists showed preference for samples containing 10%, 20% and 30% pawpaw flour which were not significantly different($p \leq 0.05$) from the control. However, these were significantly different from those containing 15% and 25% pawpaw flours respectively.

Conclusion

The study had showed that complementary food of acceptable quality and energy could be prepared from millet and firm ripe pawpaw flour blends. Although the incorporation of pawpaw resulted in reduced protein content of the samples, other nutrients as well as content energy, pasting properties and sensory attributes were significantly improved upon. The technology involved in this work were simple, millet and pawpaw are readily available in Nigeria at an affordable price hence a good choice in regions were the available complementary foods are expensive.

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