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NUTRITIONAL EVALUATION OF UNRIPE *CARICA PAPAYA* UNRIPE *MUSA PARADISIACA* AND *MUCUNA COCHICHINENSIS*, WEANING FOOD FORMULATION

Odom T.C [1] Udensi E.A. [2] and Iwe M.O[3]

[1] Department of Food Science and Technology Abia State polytechnic, Aba
[2] Department of Food Science and Technology, Abia State University, Uturu
[3] Department of Food Science and Technology Micheal Okpara University of Agriculture Umudike

Abstract: *Unripe Carica papaya, unripe Musa paradisiaca and Mucuna cochichinensis were processed into flour and formulated into diets MPPA, MPPB, MPPC, MPPD and MPPE used for preparing weaning food. The proximate composition, anti-nutritional factors, biological evaluation through feeding trial alongside a standard diet with nutrend infant formula was determined. Results shows that the formulated weaning diets MPPA, MPPB, MPPC, MPPD and MPPE had protein value of (16.50-20.50%), fat (2.89-4.02%) ash (2.47-2.84%) crude fibre (1.16-1.22%), moisture (9.60-9.80%) and carbohydrate (62.4-66.87%). The formulated diets have more protein than the control nutrend. Anti-nutritional values revealed oxalate (0.21-0.24%), polyphenol (0.31-0.41%) trypsin inhibitor (27.6-43.8 tu/g), HCN (4.4-4.9mg/Kg), phytate (0.02-0.07%). Values were according to standard recommendation for complementary food. The biological evaluation of the formulated diets were significantly different (P<0.05) than that of the standard. Based on the performance of MPPB on the rats, it is recommended for use in household to prevent and restore normal health in children suffering from kwashiorkor and should be manufactured commercially by Food industries.*

Keywords: Carica papaya, Musa paradisiaca, Mucuna Cochichinensis, weaning food

INTRODUCTION

Protein malnutrition is a major public health problem in developing world. Diet in these parts is predominantly starchy, the major food crops being roots and tubers (Aberoumand and Deokule 2009). The current high cost of animal protein in Nigeria has contributed to the problem of protein malnutrition (Udensi, 2001). One solution to the problem is to obtain protein from plant source which is of high quality, cheap and available as an alternative source to animal protein (Duke 1981).Many brands of preparatory weaning food have been developed and marketed in most developing countries including Nigeria.

Most children in Nigeria are weaned into a porridge prepared from cereal flour such as maize as the prices of commercial weaning products are too expensive for many mothers. The food is usually inadequate in other nutrients leading to wide spread protein energy malnutrition and its complication during the weaning period (WHO, 1998).

There is need to have maximum utilization of commonly neglected legume and other plant food with high protein, high fibre, high vitamin and mineral content. One of such infant weaning food can be made from a combination of *Mucuna Cochchinensis* (velvet beans), unripe plantain(Musa paradisiaca) and unripe pawpaw(Carica papaya).

Velvet beans is one of the lesser known legumes yet to be utilize as a plant protein source in Nigeria Udensi *et al.,* (2001), Ukachukwu and Obioha (1997) observed that the seeds are rich in protein, low in oil and contained a fair amount of crude fibre and mineral matter.
Plantain *(Musa paradisiaca)* is a perennial plant with almost world wide distribution. The nutritional content of plantain makes it stand out as a very important addition to any health giving diet plan. The food is low in fat, high in fiber and starch. It is rich in potassium and other minerals.

Pawpaw(*Carica Papaya)* is rich in vitamin and mineral, the fruit have pronounce bacteriocidal activity (Barry, 2000). Giving it, remarkable nutrition potential there is need for detailed physical characterization and quality nutritional evaluation of *Mucuna Cochichinensis ,Musa Paradisiaca* and *carica papaya* .The purpose of the study was to produce a low cost weaning food that is nutritionally adequate, acceptable and easily available from velvet beans, unripe plantain and unripe pawpaw .

MATERIALS AND METHODS
Mucuna cochichinensis, *Carica papaya* and *Musa paradisiaca* were purchased from Ahiaohuru market in Aba. *Mucuna Cochichinesis* were sorted, weighed, washed, boiled at 100^{0}c for 90 minutes, dehulled, dried at 65^{0}c to a constant weight, milled and sieved into flour. *Musa paradisiaca* were washed, weighed, peeled, sliced, blanched for 4 minutes, dried at 70^{0}c to a constant weight, milled and sieved into flour. Carica papaya were washed, weighed peeled, sliced, blanched for 4 minutes, dried at 70^{0}c to a constant weight, milled and sieved into flour.
6 different experimental diet samples were formulated with a total of 100g per diet.

Composition of the experimental diet on dry weight basis 9/100g

Ingredient	samples					
	MPPA	MPPB	MPPC	MPPD	MPPE	F
Mucuna	40	50	30	50	40	-
Musa paradisiaca	40	30	50	40	40	-
Carica papaya	20	20	20	10	10	-

F is the control (nutrend)

Proximate analysis
Moisture content, crude fibre and ash were determined according to AOAC (1990), crude protein by Kjeldhal method, fat content by solvent extraction and carbohydrate content was by difference. Calcium, sodium, magnesium and potassium were determined by flame photometry AOAC(1990). Iron was determined after wet digestion with a mixture of perchloric and nitric

acid using atomic absorption spectrophotometer. Phosphorous was determined colorimetrically by ammonium molybdate method.

(Anti-nutritional factors)

The method of Harbone (1973) were used to determine qualitatively and quantitatively the presence of cyanogenic glycoside. Oxalate, phytate, trypsin inhibitor and polyphenol.

Nutritional or biological evaluation

The quality of the weaning food was evaluated using rat feeding trial.

Statistical analysis

Data obtained was subjected to analysis of variance (ANOVA) Duncan New Multiple Range Test was used to determine difference among means (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Table 1. Proximate composition of formulated breakfast blend

Sample	Moisture	Crudefibre	Protein	Ash	CHO	Fat
MPPA	9.60 ^{a}	1.19^{a}	18.70^{b}	2.84^{a}	63.80^{a}	3.87^{a}
MPPB	9.70^{a}	1.22^{a}	20.50^{a}	2.53^{a}	62.4 ^{a}	4.02^{b}
MPPC	9.80^{a}	1.16^{a}	16.80^{c}	2.47^{b}	66.87^{a}	2.89^{a}
MPPD	9.60^{a}	1.20^{a}	20.10^{a}	2.53^{a}	62.54^{a}	4.01^{b}
MPPE	9.60^{a}	1.20^{a}	18.50^{b}	2.50^{a}	64.50^{a}	3.90^{a}
Nutrend	4.00^{b}	4.93 ^{b}	16.50^{c}	2.50^{b}	63.79^{a}	8.99^{c}
LSD	0.16	0.90	O.40	0.30	0.29	0.44

Means on the same row with the same superscripts are not significantly different ($p<0.05$)

Table 1: Shows the proximate composition of velvet beans (*Mucuna cochichinesis)* unripe Pawpaw (*carica papaya)* and unripe Plantain *(Muca paradisiaca)* flour blends. The potential of a food is determined primarily by its nutrients composition. The mean moisture contents as shown in Table 1 were found to range from 9.6 to 9.8% which are higher than the moisture content of the control (nutrend) which has 4.10%. There was no significant difference among the samples at $P<0.05$, but significantly different from the control. High moisture content affects storability of the products. The products had relatively low moisture. This is an indication that the products would have good storage stability if properly packaged. Since water does not add energy value to food but rather affects the keeping quality, it is necessary to reduce it as much as possible by commercial producers. The moisture content of any food is an index of its water activity as

reported by Frazer and Weshoff (1978) and is used as a measure of stability and susceptibility to microbial contamination (Davey 1989).

Fibre is an indigestible component of plant material that helps in improving roughage and bulk as well as contributes to a healthy condition of the intestine (Potter and Hotchkiss 2004). Fibre increases stool bulk and decreases the time that waste materials spend on in the gastro intestinal track. Fibre helps in the maintenance of human health and has been known to reduce cholesterol level in the body (Bello *et al.,* 2008). A low fibre diet has been associated with heart disease, cancer of the colon and rectum, Obesity, appendicitis, diabetes and even constipation (Saldanha 1995: Lajide *et al.,*2008). The fibre content ranges from 1.16 to 1.22%.

These values are lower than the fibre content of the control 4.93%. Geddes and Stewart (1973) reported that the fibre content of infant cereals should be between the range of 0.3% to 2.5%. The fibre content of the blends fall in the range required for infants. There were no significant differences ($P<0.05$) in the fibre content of the formulation.

There were significant differences ($P<0.05$) in the protein content of the flour blend. The protein content ranges from 16.50 to 20.5% with B and D having the highest amount of protein. The crude protein of sample MPPB compared favourably with the value recommended by FAO (1996) that a protein of 20% is designated for any weaning food. Comparing it with the control (nutrend popular weaning food in Nigeria) having a protein content of 16.00%, sample MPPB seems to be better. The % protein is enough to prevent protein energy malnutrition in an adult who depends on it as its protein source. The diet MPPB may be another cheap source of plant protein for the marginal resource communities of Nigeria. Effiong *et al.,(*2009) stated that any plant foods that provide about 12% of the caloric value from protein are considered good sources of protein. Therefore the blended flours meet this requirements.

The ash content gives an indication of the mineral composition preserved in the food materials (Omotoso 2005: Nnamani *et al.,* 2009). The ash content ranged from 2.47 to 2.84%. Higher ash content indicates a higher mineral content The ash content was higher when compared with the control (nutrend) which implies that individual feeding on the flour blends will not be mineral deficient.

Carbohydrate content contributes to the bulk of the energy of the formulation. The carbohydrate content ranges from 62.6 to 67.4%. There were no significant differences in the carbohydrate content ($p<0.05$) The high carbohydrate yield of these food blend makes them ideal for babies since they require energy for their rapid growth. The carbohydrate content was comparable to that of the control (nutrend).

The fat content ranged from 2.89 to 8.9%. There were significant differences in the fat content ($p<0.05$). The fat content of the formulations were lower than that of the control (nutrend) which was 8.9. The fat content obtained are lower than the recommended 10% (FAO) 1996 for weaning food formulation. This low fat content is an advantage for people suffering from obesity (Lintas 1992) and also implies that the storage life of the flour blends may increase due to their low fat content resulting in low susceptibility to oxidative rancidity (Ihekoronye and Ngoddy, 1985). Dietary fats function in the increase of palatability of food by absorbing and retaining flavours (Antia *et al.*,2006). A diet providing 1-2% of its caloric of energy as fat is said to be sufficient to human beings. Excess consumption of fat have been implicated in certain cardiovascular disorders such as atherosclerosis, cancer, and aging (Antia *et al*., 2006). Therefore, these flour blend diets should be encouraged to reduce the risk of above diseases in man.

Table 2 **Mineral composition of formulated flour blend (mg/kg)**

Mineral	**MPPA**	**MPPB**	**MPPC**	**MPPD**	**MPPF**	**NUTREND**	**LSD**
Iron	12.91^{a}	15.49^{b}	10.33^{c}	11.81^{d}	10.34 ^{c}	10.00^{c}	0.03
Calcium	64.12^{b}	72.14^{a}	48.09^{c}	63.45^{d}	60.24^{c}	390.00^{b}	0.06
Phosphorus	119.04^{c}	170.48^{a}	123.30^{b}	117.08^{c}	115.09^{C}	260.00^{d}	0.05
Magnesium	24.32 ^{b}	29.18^{a}	19.45^{a}	23.21^{b}	22.01^{c}	22.00^{c}	0.06
Zinc	17.59^{b}	14.98^{a}	15.03^{a}	16.58^{a}	15.42^{a}	14.01^{a}	0.08
Sodium	346.00^{b}	351.00^{b}	336.00^{c}	326.00^{c}	310.00^{c}	220.00^{a}	0.2
Potassium	444.00^{d}	584.00^{a}	435.00^{b}	420.00^{c}	4100^{c}	570.00^{a}	0.01

Means on the same row with the same superscript are not significantly different ($p<0.05$)

Table 2 shows the result of the mineral composition of the flour blends. The flour blends show high level of phosphorus, potassium, magnesium, sodium, iron and low level of zinc and calcium respectively. There were significant differences in the mineral composition of the flour blends ($P<0.05$)

The values are within the required daily intake (RDI) for infant as reported by the dietary guidelines of the Food and Nutrition Board of the Institute of Medicine National Academy of Science (1997 – 2001).

Sample MPPB has higher mineral content and thus individual feeding on sample MPPB will not be mineral deficient. Minerals are vital for the overall mental physical well-being and are important constituents of bones, teeth, tissues, muscles, blood and nerves cells (Soetan *et al.*, 2010).

They generally help in maintenance of acid base balance, response of nerves to physiological stimulation and blood clotting (Hanif *et al.*, 2006).

Table 3 **Anti-nutritional composition of the breakfast flour blends**

Sample	**oxalate**	**Phylate**	**trypsin inhibitor**	**HCN**	**Polyphenol**
MPPA	0.21^{a}	0.05^{a}	39.5^{b}	4.9^{a}	0.32^{a}
MPPB	0.23^{a}	0.07^{a}	43.8^{a}	4.4^{a}	0.31^{a}
MPPC	0.24^{a}	0.04^{a}	27.6^{c}	4.87^{a}	0.41^{a}
MPPD	0.22^{a}	0.02^{a}	40.1^{a}	4.6^{a}	0.31^{a}
MPPE	0.23^{a}	0.02^{a}	38.2^{b}	4.9^{a}	0.30^{a}
NUTREND	0.07^{b}	0.00^{b}	0.00^{d}	0.00^{b}	0.00^{b}
LSD	0.05	0.09	0.04	0.02	0.05

Means on the same row with the same superscript are not significantly different ($p<0.05$)

Table 3 shows anti nutritional content of the formulated flour blends and the control (nutrend) The phytate content ranges from 0.02 to 0.07. Abulude (2004) reported that the method of processing such as soaking, autoclaving and cooking has an effective result in reducing the phytate content of food. The values are generally lower than that reported by Ukachukwu and Obioha(1997) . Phytic acid forms insoluble salts with essential mineral like Calcium, iron, magnesium and Zinc in food, rendering them unavailable for absorption into the blood stream (Oboh *et al*., 2003) Values where comparable to that of nutrend.

The hydrogen cyanide ranges from 4.16 to 4.19 higher than that of the control. The control showed no hydrogen cyanide activity at ($p<0.05$) According to report from Miller (1990) cooking inactivates the hydrogen cyanide content of food. Hydrogen cyanide content of the samples were generally low and were within the standard recommendation of 10mg/kg of HCN maximum recommend by the codex Alimentarius Commission Of FAO/WHO (2004).

Bochuis (1954) reported that the lethal level for an adult man is 50-60mg/kg body weight. Trypsin inhibitors hamper the activities of certain proteolytic enzymes from performing their function of breaking down complex molecules into simple molecules . It leads to the formation of irreversible condition known as the enzyme-trypsin inhibitor complex. This causes a trypsin drop in the intestine and a decrease in the diet-protein digestibility leading to slower animal growth. Cooking, hot soaking cause significant reduction in trypsin inhibitor activity (Akinyele, 1989, Egbe and Akinyele 1990).

The values of trypsin inhibitors range from 27.6 to 43.8mg/g.Values where found to be lower than that reported by Ezeagu and Tarawaci *(*2003) and Udensi *et al., (*2008). The flour formulations had oxalate activity of 0.21-0.24% with nutrend showing a lower content of 0.07%. A high oxalate content in a diet can precipitate calcium and make it unavailable for nutritional purposes (Potter and Hotchkiss, 2004) Dietary oxalate has been known to complex with calcium, magnesium and iron leading to the formation of insoluble oxalate salts and resulting in

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oxalate stone (Oke, 1966). Values are very far below lethal level in man. Lethal level in man is 2-5g as reported by Munro and Bassir (1969)
Polyphenol is an amylase inhibitor, inhibiting the digestion of carborhydrate. Values are well below toxic level. The value ranges from 0.30-0.41 higher than that of the control. The processing method where enough to reduce the anti nutrients to acceptable limit.

The results revealed that the anti nutrient compositions of the flour blend were generally low such that none of the anti nutrient were above the lethal dosage approved by standard bodies like National Agency for food and drugs Administration and control (NAFDAC) in Nigeria. Results are well below values that are toxic. This means that the flour blends will not affect human nutrition if consumed in a large quantity.

Table 4 **Biological Performance of Albino Rats on Flour Blends**

Parameter	***samples***						
	MPPA	***MPPB***	***MPPC***	***MPPD***	***MPPE***	***NUTREND***	***LSD***
Mean initial body weight	49.33^{a}	46.67^{a}	49.83^{a}	47.23^{a}	47.01^{a}	49.33^{a}	0.2
Mean final body weight	77.33^{b}	81.67^{a}	69.83^{b}	73.23^{b}	71.01^{b}	63.33^{b}	8.7
Mean body of weight gained	28.00^{a}	35.00^{a}	20.33^{c}	26.67^{b}	24.00^{b}	19.00^{c}	10.44
Mean daily weight gained	0.81^{b}	1.00^{a}	0.57^{c}	0.74^{c}	0.68^{c}	0.90^{b}	0.7
Mean total feed intake	332.03^{a}	330.30^{a}	331.02^{a}	330^{a}.05	338^{a}.22	332.01	1.5
Mean daily feed intake	9.48^{b}	9.42^{a}	9.45^{a}	9.68^{a}	9.65^{a}	9.48	0.03
Feed conversion ration	0. 08^{b}	0.11^{a}	0.06^{a}	0.07^{c}	0.77^{a}	0.57	0.10
Protein efficiency ratio	0.45^{b}	0.52^{a}	0.35^{a}	0.37^{a}	0.38^{a}	0.36	0.03

Means on the same row with the same superscript are not significantly different ($p<0.05$)

Biological Evaluation

The result of the nutritional evaluation is presented in Table 4. The flour blends compared favourably with the control (nutrend). The high feed intake was probably due to their palatability. The high weight seen was due to corresponding high feed intake and digestibility of the food as indicated by large values of protein efficiency ratio. There were significant differences at ($p<0.05$). in the feed efficiency ratio with rat fed with formulated diet having a higher feed conversion ratio and protein efficiency ratio. Sample MPPA and MPPB have higher protein efficiency ratio. This could be as a result of papain in pawpaw which helps in the digestion of protein. Increasing unripe pawpaw increases the feed conversion ratio and protein efficiency ratio.

The albino rats feed trial analyzed showed an overall progressive increase in the daily weight gained as the numbers of feeding days increased. Animal feed with MPPB had a higher weight gain and were more active, this could be as a result of higher protein content and more phytochemical in the blend. The flour blend thus will prevent mal-nutrition. The high weight gain also shows that the anti-nutrient were really reduced during processing. The nutritional quality of the flour blend observed in this study showed the adequacy of sample MPPB and MPPA of meeting the nutritional requirement of infants and diabetic patients under this study. This is evident as a result of no mortality and improved weight gain in all the entire experimental rat during the feeding trial.

Table 5 **Organ weight of rats on flour blends**

Parameter	***samples***						
	MPPA	***MPPB***	***MPPC***	***MPPD***	***MPPE***	***NUTREND***	***LSD***
Heart	1.17^{a}	1.19^{a}	0.99^{b}	1.13^{a}	1.14^{a}	0.91^{b}	0.60
Liver	2.59^{a}	2.78^{a}	2.24^{b}	2.47^{b}	2.50^{b}	2.53^{b}	0.08
Kidney	1.23^{a}	1.29^{a}	1.13^{b}	1.22^{a}	1.23^{a}	1.24^{a}	0.10
Spleen	0.26^{a}	0.29^{a}	0.21^{b}	0.27^{a}	0.28^{a}	0.21^{b}	0.04

Means on the same row with the same superscript are not significantly different ($p<0.05$)

The results of the organ weight of rats on experimental diets is shown in Table 5. The liver weight of the rat fed on the control diet (nutrend) was significantly different from those fed with the formulated diet at ($p<0.05$). The liver weight of the rat fed on the formulated diets (sample MPPA and MPPB) were higher . This could be due to a higher protein content of the formulated diet. Increasing lever weight is usually an index of increasing protein synthesis. The rats fed with sample MPPB has the highest spleen, heart and kidney due to high protein content indicating higher growth rate due to higher feed conversion and protein efficiency ratio.

CONCLUSION

The result obtained in the study showed that MPPB (50% *M. cochichinensis*, 20% unripe *Carica Papaya* and 30% Unripe *Musa Paradisiaca)* possessed the qualities that are required for the preparation of a weaning food. Diet MPPB compares favourably and economically to that of a standard baby food (nutrend). The weaning food is considered safe as the anti-nutrients were destroyed during processing and values are within recommendation by FAO and WHO 2004.This was seen through the performance of the rats. The procedure for its processing is easy and energy saving. It is recommended for commercial production and for use by households.

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