POTENTIALS OF COCOYAM-SOYBEAN-CRAYFISH MIXTURES IN COMPLEMENTARY FEEDING

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ABSTRACT

Flours from cooked cocoyam cormels and soybeans were combined with flour from dried crayfish in the ratios 80:15:5, 70:25:5, 60:35:5 and 50:45:5, and the composite flours used as a base for preparing rat diets and complementary foods. Analyses of minerals, anti-nutritional factors, and organoleptic qualities of the complementary foods were carried out. The protein contents of the composite flours ranged from 11.90 to 20.70%, the fat contents from 4.20 to 11.13%, the fibre contents 2.20 to 2.23%, and the magnesium, calcium, phosphorus, zinc, and iron contents were high. There was no significant difference in protein efficiency ratio between the casein based rat diet (2.45) and the cocoyam-soybean-crayfish based diets (ranging from 2.25 to 2.51). The apparent protein digestibility values (ranging from 69.70 to 75.50%) of the cocoyam-soybean-crayfish based diets were high and comparable to that of the casein based diet (78.50%). The digestibility coefficients of these diets were very high (ranging from 87.30 to 89.60%) and also comparable to that of the casein based diet (90.00%). The weights of the liver, heart, spleen, and small intestines of rats on casein based diets tended to be higher than those on cocoyam-soybean-crayfish based diets. There was no significant difference among the complementary foods and between the complementary foods and NUTREND (a reference baby food) with respect to colour, flavour, mouthfeel and general acceptability. Cocoyam-soybean-crayfish composite flours produced in these ratios were found suitable for preparing organoleptically acceptable complementary foods with a potential to stimulate growth.

Key words: Cocoyam, soybean, crayfish, mixture, complementary feeding

INTRODUCTION

A complementary food is any food provided to a child at an age breast milk alone is not likely to meet the child's energy needs and requirements for nutrients such as iron, zinc, vitamin A and B vitamins (WHO, 1998). A complementary food should not only be accessible to the child but also should be adequate in protein, fat, carbohydrate, vitamins and minerals to obviate protein-energy malnutrition. Complementary feeding is an essential element in the care of young children especially in the developing countries where malnutrition is prevalent (WHO, 1998).

The raw materials that may be used to prepare complementary foods in developing countries are diverse but locally available materials have been recommended for economic and social reasons (Hofvander and Underwood, 1987). Cocoyams (*Colocasia and Xanthosoma* spp) have nutritional advantages over other root and tuber crops which may be used as sources of carbohydrates in complementary food formulations (Lyonga and Nzietcheung, 1986); cocoyams have more crude protein, highly digestible starch (because of the small size of the starch granules) and substantial levels of calcium, phosphorus, vitamin A and B vitamins, thus rendering the crop a good base for infant food preparation (Onwueme, 1987; Eleje, 1987). Soybean (*Glycine max)* has been suggested as a potential ingredient for upgrading the nutritional quality of starchy roots and tubers for use in baby food (Okaka, 1990). Baby foods fortified with soybeans have been shown to be nutritionally similar to milk based formulae (Uwaegbute, 1990). Statistics on the potentials of soybean as source of protein, fat and other nutrients strongly commend it for use in complementary food production (Emovon, 1987; Weingartner, 1987). It has been shown that the amino acid score of soybean protein is 100 for persons more than two years old implying that soybean protein has limiting amino acids for young children two years old and below (Fukushima, 1991).

A high quality weaning food has been produced from maize-cowpea-crayfish mixtures (Abbey and Nkanga, 1988). Crayfish (a crustacean of the order *Decapoda*) is a cheap source of animal protein capable of making up for soybean amino acid deficiencies (West *et al.*, 1988) and imparting a pleasant flavour to food preparations. Meeting micronutrient needs from complementary foods appears the greatest challenge (WHO, 1998); adequate amounts of certain key nutrients (iron, zinc, and calcium, in particular) can only be met if animal products such as liver, dried fish and milk powder are consumed as well.

The objectives of this study are (i) to evaluate the nutritional qualities of cocoyam-soybean-crayfish blends with a view to using the mixture as complementary food especially in developing countries, and (ii) to diversify the utilization of cocoyams of which Nigeria is the world's largest producer.

MATERIALS AND METHODS

Materials

The cocoyams (*Colocasia esculenta var. 'cocoindia'*) used for compounding the complementary food was produced by the Cocoyam Programme of National Root Crops Research Institute, Umudike. Soybean (TGX 3236) and yellow maize (FARTZ 7) were procured from National Cereals Research Institute, Amakama, Umuahia.

Crayfish (a crusfacean of the order *Decapoda*) was purchased dry from Umuahia Main Market. Vegetable oil (FILMA cooking oil produced by P.T. Smart Corporation, Indonesia) was also purchased from Umuahia Main Market. The albino rats used for the feeding trials were of the Wistar strain and were obtained from National Trypanomiasis Research Institute, Vom substation, Nigeria.

Methods

Processing of cocoyam flour

A mechanical slicer (Multi wonder UK Design No. S-309) was used to produce approximately 4mm thick slices from peeled and washed cormels of cocoyam (*Colocasia esculenta var. 'cocoindia'*). Three kilogrammes of the slices were boiled in 15L of potable water contained in aluminum pot for 15 min using a gas cooker. The cooked slices were oven-dried at 80°C for 9 hr, milled with a Premier Grinding Mill model 1A to obtain flour which was subsequently sieved through 0.35 mm sieve to yield a flour of fine texture.

Processing of soybean flour

The method of Faryana (1985) was used for processing the soybean into flour. The sorted and washed soybeans were boiled in water for 30 minutes using a gas cooker, the volume of water to soybean being 2:1. After boiling, the soybeans were soaked in water twice their volume for 12 hr and the water was changed every 6 hr. The seed coats were removed by rubbing between the palms. The kernels were rinsed with water and dried in forced air Gallenkamp oven at 80°C for 6 hr, the dried soybeans were milled with Premier Grinding Mill model 1A and the resulting flour sieved through 0.35 mm sieve to yield flour of fine texture.

Processing of crayfish flour

The crayfish (bought dry) was winnowed, washed and placed in a sieve for the water to drain after which it was oven-dried at 80^{0}C for 4 hr. It was then milled with the dry mill of National Quickie-Mini blender before screening with 0.35 mm sieve.

Preparation of cocoyam-soybean-crayfish flour

Composite flours were prepared from the cocoyam, soybean, and crayfish flours in the ratios 80:15:5, 70:25:5, 60:35:5, and 50:45:5. Complementary foods and rat diets were prepared using the composite flours as base.

Chemical analysis of samples

Moisture, crude protein, crude fibre, fat and ash contents of the raw/cooked cocoyam and soybean flours were determined according to AOAC (1990); only the protein content of the crayfish flour was determined. The total carbohydrates contents of the raw/cooked cocoyam flours were determined by difference. These parameters were also determined for the cocoyam-soybean-crayfish blends. The protein content of the rat faeces was determined by AOAC (1990) method. UNICAM 929 atomic absorption spectrophotometer was used for the estimation of the magnesium, calcium, phosphorus, iron, and zinc contents of the composite flours. The alkaline precipitation method of Harbone (1975) was employed in the estimation of alkaloid content. Haemagglutinin and trypsin inhibitor activities were determined by the method of Armtfield *et al.* (1985) whereas the tannin levels in the samples were estimated by the method described by Pearson (1976). Phytic acid and oxalate contents of the composite flours were respectively determined by the method of Hang and Lantzsch (1983) and, Eheart and Hurst (1962).

Animal response

Twenty-five 21-day old weanling male albino rats weighing between 51g and 65g were housed in metallic cages (one rat per cage). The room in which the rats were kept was well ventilated and the average room temperature and relative humidity during the 28 days of experimentation were 26.5 ± 0.3^{o}C and 70.8 ± 4.5%, respectively.

The experimental set-up was a completely randomized design of 5 experimental diets, each replicated 5 times. Four of the experimental diets were formulated to contain 10% protein contributed by the cocoyam-soybean-crayfish composite flour, and one (the control) to contain 10% casein. All the diets contained 2% vitamin/mineral mix as formulated by Fetuga *et al.* (1974), 5% corn oil, and 5% rice husk (fibre). The remaining portion of the diets was then made up to 100% with corn starch. The rats were provided both feed and water *ad libitum* and the feeding trial lasted 28 days after allowing 3 days of adjustment/acclimatization period.

The rats were weighed every 7 days. The unconsumed feed was weighed and the faeces were collected and dried in a forced air oven at 80^{0}C for 4 hr. The dried faeces were ground and screened with 0.35mm sieve to obtain a fine flour. The digestibility of the feeds and feeds' proteins were estimated by the method of McDonald *et al.* (1981). At the end of the feeding trial the rats were sacrificed and the livers, hearts, spleen, and small intestines were collected and weighed for determination of the effects of the diets on these organs.

Preparation, and sensory evaluation, of cocoyam-soybean-crayfish based complementary foods.

Cocoyam-soybean-crayfish composite flours prepared in the ratios 80:15:5, 70:25:5, 60:35:5 and 50:45:5, were used as base to prepare complementary foods. The quantity of each composite flour containing 10g protein was mixed with a 10g sucrose, 5g deodorized vegetable oil, and 0.2g vanilla, and the mixture was made up to 100g with cooked corn starch.

The method of Watts *et al.* (1989) was used for sensory evaluation of the complementary foods. Twenty-five panelists were drawn from staff of National Root Crops Research Institute, and students of Michael Okpara

University of Agriculture, Umudike to assess the colour, flavour, mouthfeel and general acceptability of the foods using a 9-point hedonic scale ranging from like extremely, through neither like nor dislike, to dislike extremely. The samples were presented in identical sample containers coded with 3-digit random numbers, each sample having a different number. The sample order was randomized for each panelist. The samples were presented all at once to enable the panelists re-evaluate the samples if desired and make comparisons between samples. NUTREND (a maize-soybean based baby food manufactured by NESTLE' Foods Nigeria) was used as a reference sample. The complementary foods and the NUTREND presented to panelists for evaluation were prepared by constituting 20g of each food with 100ml clean water which had been boiled and allowed to cool to 40°C.

Statistical analysis

Analysis of variance (ANOVA) was carried out on all data collected using Generalized Linear Model procedure of SAS (Statistical Analysis System) (1989) and mean separation done using Fischer LSD to determine significant differences.

RESULTS AND DISCUSSION

Table 1 shows the proximate composition of raw and cooked soybean and cocoyam flours and the protein content of crayfish flour. The levels of protein and fat in the cooked soybean flour used for preparing cocoyam-soybean-crayfish blends were high and the level of total carbohydrates in the cooked cocoyam was very high. The crayfish flour contained a high level of protein and the crude fibre content of cocoyam flour was very low.

Table 1. Proximate composition of raw/cooked and soybean flours and protein content of crayfish flour

Sample	Moisture (%)	Crude protein (%)	Fat (%)	Crude fibre (%)	Ash (%)	Total carbohydrates (%)
Raw cocoyam	9.42 (0.18)*	7.30 (0.43)	0.42 (0.21)	1.55 (0.27)	4.41 (0.55)	76.90 (0.60)
Cooked cocoyam	10.82 (0.87)	7.00 (0.67)	0.40 (0.07)	1.51 (0.46)	4.36 (0.41)	75.91 (0.61)
Raw soybean	7.32 (0.54)	43.40 (0.51)	18.53 (0.03)	5.31 (0.16)	4.93 (0.26)	20.51 (0.69)
Cooked soybean	7.90 (0.31)	42.90 (0.27)	18.42 (0.02)	5.23 (0.10)	4.55 (0.37)	21.10 (0.92)
Crayfish	-	47.70 (0.63)	-	-	-	-

*Data in parenthesis are standard deviations (of 3 replicates)Significant differences ($P<0.05$) occurred among the composite flours CSC 1, CSC 2, CSC 3 and CSC 4 with respect to moisture, protein, fat, ash, total carbohydrates, calcium, phosphorus, zinc and iron contents (Table 2). There were no significant differences ($P>0.05$) in the levels of fibre and magnesium in the mixtures. CSC 4 had the highest level of protein and fat whereas CSC 1 had the lowest levels of these nutrients, but the highest level of carbohydrates.

The ratio of crayfish flour to cocoyam and soybean flours was the same in the four cocoyam-soybean-crayfish blends. Consequently the observed increase in levels of protein and fat as the ratio of soybean flour in the blends increased may be attributed to soybean (cocoyam being a poor source of protein) and is in agreement with the report that soybean is a rich source of protein and fat (Emovon, 1987). Similarly, the observed increase in total carbohydrates is principally due to cocoyam, this crop having been shown to be a rich source of carbohydrates (Coursey, 1967).

The fibre contents of the blends are considered low but their magnesium, calcium, phosphorus, zinc and iron contents appear adequate for complementary food formulation (WHO, 1998). Soybean has been shown to be an excellent source of calcium and iron (Weingartner, 1987) and cocoyam has been proposed as a good base for infant foods because of its reasonable contents of calcium and phosphorus for bone building (Onwueme, 1987). It has been estimated that the concentration of zinc in mature human milk is 1.2 ± 0.2mg per litre and this level has been found adequate for stimulating growth in young children (WHO, 1998). The levels of zinc in the cocoyam-soybean-crayfish blends ranged from 4.5mg per 100g to 7.0mg per 100g and such levels in complementary foods are considered high enough to obviate growth retardation in infants (Sanstead, 1991). The performance of rats fed cocoyam-soybean-crayfish based diets did not reveal any metabolic malfunction attributable to deficiency of minerals; the animals were very active and looked healthy throughout the 28 days of experimentation.

Table 2. Proximate and mineral composition of mixtures of cocoyam, soybean, and crayfish flours

Sample	Moisture (%)	Crude protein (%)	Fat (%)	Ash (%)	Crude fibre (%)	Total carbohydrates (%)	Mg (mg $100g^{-1}$)	Ca (mg $100g^{-1}$)	P (mg $100g^{-1}$)	Zn (mg $100g^{-1}$)	Fe (mg $100g^{-1}$)
CSC1	10.40	11.90	4.20	4.60	2.20	67.60	246.00	690.00	295.00	7.00	6.25
CSC 2	9.40	14.50	6.30	5.50	2.30	60.00	244.00	662.00	350.00	7.50	8.33
CSC 3	9.20	15.70	8.50	5.10	2.33	59.23	244.00	621.00	400.00	4.50	8.65
CSC 4	8.43	20.70	11.13	5.60	2.20	52.03	247.00	618.00	363.00	4.75	8.84
$LSD_{0.05}$	1.52	0.77	0.76	0.77	0.21	4.31	12.67	67.24	27.62	0.89	1.15

CSC 1: Mixture of cocoyam, soya, crayfish flours in the ratios 80:15:5 respectively
CSC 2: Mixture of cocoyam, soya, crayfish flours in the ratios 70:25:5 respectively
CSC 3: Mixture of cocoyam, soya, crayfish flours in the ratios 60:35:5 respectively
CSC 4: Mixture of cocoyam, soya, crayfish flours in the ratios 50:45:5 respectivelyThere were no significant differences (P>0.05) among the composite flours in oxalate and trypsin inhibitor contents, but significant differences (P<0.05) were found in alkaloid, phenol, tannin, haemagglutinin and phytate contents (Table 3).

The cocoyam (*Colocasia* spp.) fed to the rats was properly cooked to remove the itching effect of the oxalate it contained (Sakai *et al.* 1972). Cooking the soybean for 30 min destroyed other heat-labile anti-nutritional factors it contained (Sathe and Desphande, 1989). None of the adverse nutritional effects of the heat labile anit-nutritional factors (trypsin inhibitor and haemagglutinin) namely poor protein digestibility, poor growth and loss of weight was observed in rats fed cocoyam-soybean-crayfish based diets.

Table 3. Anti-nutritional factors in mixtures of cocoyam, soybean and crayfish flours

Oxalate (mg $100g^{-1}$ flour)	Alkaloids (mg $100g^{-1}$ flour)	Phenols (mg $100g^{-1}$ flour)	Phytate (mg $100g^{-1}$ flour)	Tannin (µg $100g^{-1}$ flour)	Haemagglutinin (Hu* g^{-1} flour)	Trypsin Inhibitor (TIA** g^{-1} flour)
250.00^{a}	340.00^{c}	100.00^{a}	640.00^{b}	139.00^{c}	26.40^{c}	126.40^{b}
220.00^{a}	406.00^{b}	80.00^{bc}	360.00^{c}	208.00^{b}	29.60^{c}	124.80^{b}
220.00^{a}	362.00^{bc}	105.00^{a}	620.00^{b}	264.00^{a}	40.80^{b}	124.80^{b}
210.00^{a}	380.00^{bc}	95.00^{bc}	580.00^{c}	194.00^{b}	44.13^{b}	116.20^{b}
41.47	57.10	15.49	30.26	16.10	11.47	10.84

*Hu = Haemgglutinnin unit, **TIA = Trypsin inhibitor unit
a,b,c, Means with the same letter down the column are not significantly difference (P>0.05)

CSC 1: Mixture of cocoyam, soya, crayfish flours in the ratios 80:15:5 respectively
CSC 2: Mixture of cocoyam, soya, crayfish flours in the ratios 70:25:5 respectively
CSC 3: Mixture of cocoyam, soya, crayfish flours in the ratios 60:35:5 respectively
CSC 4: Mixture of cocoyam, soya, crayfish flours in the ratios 50:45:5 respectively

There were no significant differences (P>0.05) in protein efficiency ratio (PER) between the casein based diet and the cocoyam-soybean-crayfish based rat diets (Table 4). Significant differences (P<0.05) occurred among the cocoyam-soybean-crayfish based rat diets in feed digestibility and apparent protein digestibility (Table 4). There was no significant difference between the casein based diets, CSC 1, and CSC 4 with respect to feed digestibility, but significant differences were observed between casein based diets and the cocoyam-soybean-crayfish based diets. There were no significant differences (P>0.05) in spleen weights among the rats fed cocoyam-soybean-crayfish based diets and between these diets and the casein based diets (Table 5).

Although the cocoyam-soybean-crayfish based rat diets did not differ in PER from the casein based diet, the cocoyam-soybean-crayfish based rat diets with the lowest proportion of soybean protein and that with the highest proportion of soybean protein differed in PER. Swaminathan, (1976) reported that amino acid imbalance occurs when protein intake is low. Since the diet with the lower PER contains 10% protein which, according to Eggum, (1973) is not considered a low level in animal feeds, it does not appear tenable to implicate amino acid imbalance in the lower PER value of this diet. The observed less impressive performance of rats on this diet when compared to those of the rats where the PERs were higher probably arose from amino acid antagonism, a phenomenon elicited by excess of one amino acid depressing the utilization of a structurally similar one (Swaminathan, 1967). This observation may be further elucidated by obtaining the amino acid profiles of the rat diets.

The recommended minimum PER for complementary foods is 2.10 (FAO/WHO, 1970) and the cocoyam-soybean-crayfish based diets have PER values above the recommended minimum since the PERs ranged from 2.25 to 2.51 with casein based diet at 2.45. Any of the blends is therefore considered suitable for complementary food formulation on the basis of growth promotion.

The digestibilities of the rat diets were very high and comparable to that of casein based diet. McDonald *et al.* (1981) observed that the crude fibre ratio of the feed has the highest influence on its digestibility and both the amount and chemical composition of the crude fibre are important. The crude fibre contents of the blends which were used as base for the rats diets did not differ significantly from one another, and in compounding the rat diets 5g rice husk (fibre) were included in each of the formulations.

The observed PERs, feed digestiblities and apparent protein digestibilities of the cocoyam-soybean-crayfish based diets agree to a large extent with the findings that (i) the extremely small size of *Colocasia* starch makes it very easily digestible (Onwueme, 1987) and proper cooking improves cocoyam digestibility (Eleje, 1987), (ii) heat improves the digestibility of most legumes and the sulphur-containing amino acids (Bender, 1970) and, (iii) heat treatment denatures protein and facilities enzymic decomposition of the molecule and hence improved digestibility (Gitler, 1994).
The tendency of the weights of the livers, hearts, spleens and small intestines of rats on casein based diets to be higher than those of organs on cocoyam-soybean-crayfish based diets suggests that the later diets did not have the property of producing excessive growth of the organs studied.

CSC 1 based diet = diet with of cocoyam, soybean, crayfish mixture in the ratios 80:15:5 respectively
CSC 2 based diet = diet with of cocoyam, soybean, crayfish mixture in the ratios 70:25:5 respectively
CSC 3 based diet = diet with of cocoyam, soybean, crayfish mixture in the ratios 60:35:5 respectively
CSC 4 based diet = diet with of cocoyam, soybean, crayfish mixture in the ratios 50:45:5 respectively

Table 4. Biological response of albino rats to cocoyam-soybean-crayfish based diets

Rat diets	Food intake (g)	Weight gain (g)	PER	Digestibility coefficient (%)	Apparent protein digestibility (%)
CSC 1 based diet	307.64(13.72)*	77.22 (6.94)	2.51^{a}	88.90^{ab}	74.20^{b}
CSC 2 based diet	257.82 (17.42)	65.08 (7.00)	2.43^{ab}	88.00^{bc}	70.50^{c}
CSC 3 based diet	278.29 (17.68)	68.46 (6.42)	2.46^{ab}	87.30^{c}	69.70^{c}
CSC 4 based diet	208.36 (11.00)	46.88 (1.98)	2.55^{b}	89.60^{a}	75.50^{b}
Reference diet (casein based)	196.06 (7.40)	48.03 (1.75)	2.45^{ab}	90.00^{a}	78.50^{a}
$LSD_{0.05}$			0.22	1.18	2.53

*Figures in parenthesis are standard deviations based on 5 rats
a,b,c, Means with the same letter down the column are not significantly different (P>0.05)

Table 5. Effect of food composition on organ weight of albino rats fed cocoyam-soybean-crayfish based diets

	Organ weight (% wet body wt.)			
Organ	Liver	Heart	Spleen	Intestine
CSC 1 based diet	4.75^{ab}	0.40^{c}	0.52^{a}	3.65^{c}
CSC 2 based diet	3.72^{c}	0.41^{bc}	0.50^{a}	3.88^{bc}
CSC 3 based diet	4.68^{ab}	0.46^{ab}	0.43^{a}	4.25^{abc}
CSC 4 based diet	5.46^{a}	0.49^{a}	0.57^{a}	4.76^{a}
Reference diet (casein based)	4.82^{ab}	0.50^{a}	0.47^{a}	4.22^{abc}
$LSD_{0.05}$	0.89	0.06	0.20	0.93

a,b,c, Means with the same letter down the column are not significantly different (P>0.05)

CSC 1 based diet = diet with of cocoyam, soybean, crayfish mixture in the ratios 80:15:5 as base
CSC 2 based diet = diet with of cocoyam, soybean, crayfish mixture in the ratios 70:25:5 as base
CSC 3 based diet = diet with of cocoyam, soybean, crayfish mixture in the ratios 60:35:5 as base
CSC 4 based diet = diet with of cocoyam, soybean, crayfish mixture in the ratios 50:45:5 as base Sensory evaluation of the cocoyam-soybean-crayfish based complementary foods did not show significant differences (P>0.05) among the complementary foods and between the complementary foods and NUTREND (a reference baby food) with respect to colour, flavour, mouthfeel and general acceptability (Table 6).

When the colour, flavour, mouthfeel and general acceptability of the complementary foods prepared with the cocoyam-soybean-crayfish blends were considered, it appeared each blend was organoleptically suitable for complementary food production. The crayfish incorporated in the blends contributed to the flavour of the complementary foods, and, as a source of animal protein, had the potential of providing essential amino acids in which cocoyam and soybean were deficient (Oyenuga, 1968; Emovon, 1987).

Table 6: Sensory qualities* of freshly prepared cocoyam-soybean-crayfish based complementary foods

Complementary foods	Colour	Flavour	Mouthfeel	General acceptability
F1	8.05^a	8.15^a	8.00^a	7.90^a
F2	8.10^a	8.10^a	8.10^a	8.00^a
F3	8.05^a	8.00^a	8.00^a	8.10^a
F4	8.10^a	7.90^a	8.05^a	8.05^a
NUTREND (Reference formula)	8.30^a	8.20^a	8.15^a	8.15^a
$LSD_{0.05}$	0.20	0.33	0.16	0.28

*9-Point Hedonic scale

[a,b,c,] Means with the same letters down the column are not significantly different ($P>0.05$)

F1: Formula with cocoyam-soybean-crayfish mixture in the ratio 80:15:5 as base

F2: Formula with cocoyam-soybean-crayfish mixture in the ratio 70:25:5 as base

F3: Formula with cocoyam-soybean-crayfish mixture in the ratio 60:35:5 as base

F4: Formula with cocoyam-soybean-crayfish mixture in the ratio 50:45:5 as base

CONCLUSION

Flours from cooked cocoyam ad soybean when combined with dried crayfish in the ratios 80:15:5, 70:15:5, 60:35:5 and 50:45:5 produce a suitable base for the manufacture of complementary food. Complementary foods prepared using cocoyam, soybean and crayfish combined in these ratios were organoleptically acceptable and had the potential of stimulating growth in infants. Cocoyam has been shown to be a rich source of carbohydrates with a high potential of providing adequate energy in human diets and should be aggressively exploited for production of complementary foods. Utilization of cocoyam in this manner will stimulate its production in Nigeria (the leading world producer of the crop) thus contributing to national food security and good nutrition.

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