

# Nutritional Quality of Animal Polypeptide (Crayfish) Formulated Into Complementary Foods

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**Abstract** Crayfish is classified as animal polypeptide, has complete amino acid profile, highly digestible, considerable nutritive value with a superior biological value that is necessary for good health and normal growth. The objective of this study is to assess nutritionally the quality and quantity of animal polypeptide formulated into complementary foods. Maize (*Zea mays*) and crayfish (*euastacus spp*) were the sole energy and protein sources respectively. Dietary samples consisted of diet 1, carbohydrate100% (Basal) diet 2 (Powdered Crayfish: fermented maize 10:100), diet 3 (Powdered Crayfish: fermented maize15:100), diet 4, milk based commercial diet, the formulated complementary diets were fed to 50 albino rats. The experimental animals (50) were selected randomly, weighed, allocated to metabolic cages. The experimental animals were reweighed and grouped into five of ten each per group. Dietary samples and water were fed to experimental animals *ad libitum* for 28 days and the variations were noted. The results revealed that the growth rate, (non protein dietary) declined from 24.62- 23.79g, (protein dietary) increased from 23.36-45.74, 24.50-40.77, and 24.43-37.81g, for diets 1 2, 3, and 4 respectively. The average nitrogen content retained in the various organs of the experimental animals, such as liver, kidney and muscle of the diets 1 2, 3 and 4 were 33.52, 57.30, 55.70, 55.22; 43.60, 52.33, 53.20, 51.38; and 45.80, 57.80, 56.80, 56.08mg/100g respectively. The complementary food formulations at 10% animal polypeptide formulation was favourably comparable to control, was found superior in terms of growth rate, and ensure optimum nitrogen content in the animal organs. It is thus concluded that calories obtained at 10% formulation with an animal polypeptide (crayfish) inclusion result in optimal nutrient composition of complementary foods and may be suitable to provide caloric value for sustenance, met recommended dietary allowance (RDA) and sufficient to eradicate protein energy malnutrition (PEM), in the developing countries.

**Keywords:** *nutritional quality, animal polypeptide, caloric value*

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## 1. Introduction

Globally studies in Nigeria have shown that protein-energy malnutrition was the second cause of mortality and morbidity in children that were less than six years [1]. Crayfish are usually prepared for consumption by smoking, and occasionally preserved by sun-drying, and is a common delicacy in the diet, among the people of the Southern Western – Nigeria. Moreover, it may also be available at all the seasons, relatively cheap, affordable and suitable to supply adequate nutrients to cater for infants estimated daily nutrient requirements to eradicate protein energy malnutrition (PEM), in the developing countries. Crayfish is classified as an animal polypeptide, accounts for 36-45 per cent of crude protein, is a freshwater crustacean resembling small lobster, was reported to have high nutritive value with a superior biological value, true digestibility, net protein utilization, high content of essential amino acid, and protein

efficiency is favourable compared to casein [2,3]. Nutritional information of crayfish has been highlighted to contain total fat of 1g, saturated fat 0g, cholesterol 0g, 126mg, compared to one egg of 200mg, sodium 170mg, dietary fiber 0mg, sugar 0mg, calories of 80mg compared to beef 242mg calories, [4,5]. In addition, health benefit of crayfish including supply of vitamin D and A, also present were mineral elements such as calcium, potassium copper, zinc and iodine, [4,5]. It was reported to be highly pure, usually found in a clean lake that is free from industrial or water polluted environment, hence non-toxic for consumption, very low in carbohydrates, can be safely taken without gaining unnecessary weight. Apart medicinal value of crayfish (Lobster) is not only the delicate white meat, it taste delicious, nutrient-rich, can easily be absorb into the body and promote the healing of post-operative wound granulation, [4,5]. Hence the objective of the study is to assess the nutrition quality and quantity of animal polypeptide formulated into complementary foods that will meet recommended dietary allowance (RDA).

## 2. Materials and Methods

### 2.1. The Materials for the Formulations

Maize grains, Powdered crayfish (animal polypeptide), milk-based commercial diet product of Nestle, Nigeria Plc, were purchased from a local supermarket in Ile-Ife, South-West, Nigeria. The maize and crayfish were cleaned, sorted and all extraneous materials carefully removed, oven dried at 80°C for 24hour, grinded with hammer mill into fine powder and packed into air tight polyethylene bags and stored in the refrigerator prior to animal experiment.

### 2.2. Animal Experiment

Fifty (50) weaning albino rats were obtained from Faculty of Pharmacy animal breeding centre, Obafemi Awolowo University, Ile-Ife, Nigeria. The rats were weighed and randomly allocated into metabolic cages previously labelled numbers 1-50. Their weights and ages were ranged from 26.62 to 42.06g and 3 to 4 weeks respectively. The animals were allocated into metabolic cages was pre-fixed with a cup and a small plastic bottle in order to supply food and water *ad libitum*. The animals were acclimatized to the laboratory environment by feeding them on normal diets for seven days. The animals were then reweighed and group into five of ten each per

group. Daily consumption of dietary samples was carefully recorded and the weights were noted for 28 days. Variations in weight of the experimental animals were taken every three days. At the end of the experiment, which is twenty-eight days, the experimental animals were sacrificed in similar way as control. Organs like kidney, liver and muscle of the hind leg were obtained, weighed and stored frozen at -10°C prior to nitrogen determination, [3,6,7].

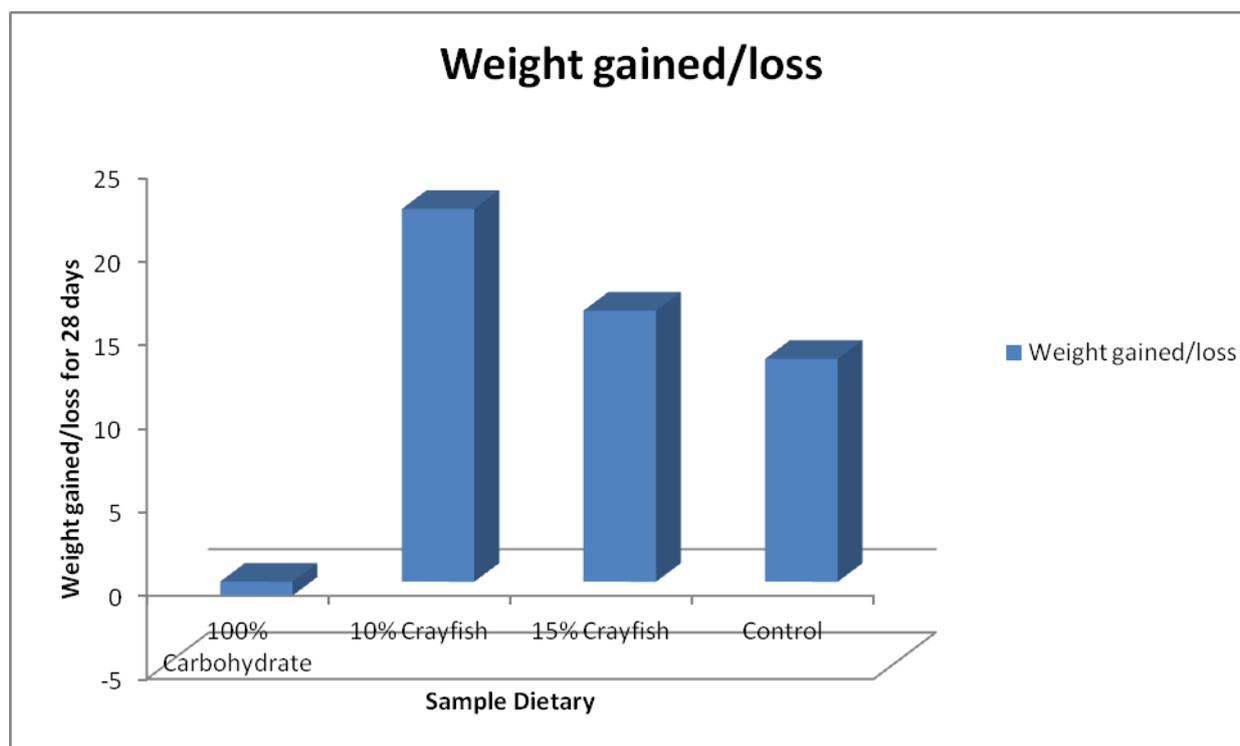
### 2.3. Chemical Analysis

Chemical Analysis determined included Protein (nitrogen x 6.25), moisture, fat, crude fibre carbohydrate, and vitamins of the ingredients and formulated diets were determined according to AOAC [6]. Energy value was determined using Combustion calorimeter, model e2K.

## 3. Ethical Consideration

This study was approved by the Ethical Review Committee of the Obafemi Awolowo University, Osun State, Ile-Ife, Nigeria.

## 4. Results and Discussion



**Figure 1.** weight gain/loss of experimental animal for 28 days

Diet 1, carbohydrate 100% (Basal) diet 2 (Crayfish: fermented maize 10:100), diet 3 (Crayfish: fermented maize 15:100), diet 4, milk based commercial diet (control).

Figure 1 showed the growth rate and response to dietary intake of the experimental animals for 28 days, the growth response gave the highest result at 10% crayfish (dry powder) inclusion (diet 2). This were followed by 15% crayfish (diet 3), milk-based diet (diet 4), and 100% Carbohydrate (diet 1) respectively. Diets 2 promoted growth more than the animals fed with control diet, diet 2 gained more weights than control diet. It may be that diet

2 has complete amino profile when compared to other formulated diets. Some workers had previously reported that 10% crayfish diets inclusion with animal polypeptide source may result in balance diet and meet the estimated daily nutrient requirements for complementary foods, [1,3,8,9]. Nitrogen retained and weight gained, was higher in 10% crayfish diet compared to 15% crayfish (animal inclusions), whereas 10% crayfish with less protein

promoted growth than 15% inclusion. Researchers have demonstrated adequate nutrients intake, this may be because nutrient intake has reached optimum at 10% inclusion, hence, more than 10% animal protein inclusion may not be utilized by body, hence could lead to excess nutrient that is not need by body and may result in diet-related diseases' [8,9,10,11,13]. However, diet 1, could not support growth, and found to decrease the weight of the animals in group 1. This may be due to the fact that the diet lacked adequate nutrient such as protein. It is however reported that cereals are deficient in essential amino acid,

such as lysine and tryptophan, hence was not nutritionally adequate to promote growth and conformed to previous studies [3,11,12].

Table 1 displays the chemical analysis (%) of the ingredients which including protein, moisture, fat, ash, crude fibre carbohydrates, Vitamin C mg/100g, Vitamin B1 mg/100g and caloric values. The ingredients were nutritional adequate to formulate a complementary food and meet the estimated daily nutrient requirements for complementary foods [1,13,14].

**Table 1. Chemical Composition (%) of the Ingredients**

Dietary	Protein %	Moisture %	Fat %	Ash %	Crude fibre %	CHO %	Caloric value (Kcal)	Vitamin Cmg/100g	VitaminB1 B1mg/100g
10% Crayfish	12.65±02	5.98±02	4.38±02	2.26±02	0.52±02	74.21±02	446±01	17.50±02	1.5±02
15 %Crayfish	15.50±01	3.56±03	5.30±02	2.20±01	0.75±01	72.69±02	467±02	15.30±03	1.2±04
Control	15.5±02	2.50±01	9.0±01	2.60±02	2.95±02	67.45±02	413±02	17±02	17±02

The data are mean ±SD values of three determinations with different superscript in a column are significantly different (P < 0.05). Foot note: Diet 1, carbohydrate100% (Basal) diet 2 (Crayfish: fermented maize 10:100), diet 3 (Crayfish: fermented maize15:100), diet 4, milk based commercial diet

**Table 2. Average food consumption over the 28 days of the experimental period**

Dietary	Time in Days					
	5	10	15	20	25	28
Basal	21.77 <sup>a</sup> ±01	46.24 <sup>a</sup> ±01	65.05 <sup>a</sup> ±01	84.26 <sup>a</sup> ±04	98.88 <sup>a</sup> ±01	113 <sup>a</sup> ±04
10% Crayfish	38.68 <sup>b</sup> ±02	80.82 <sup>d</sup> ±02	107 <sup>d</sup> ±04	154 <sup>d</sup> ±04	190 <sup>d</sup> ±03	208 <sup>d</sup> ±03
15% Crayfish	37.86 <sup>d</sup> ±01	76.92 <sup>b</sup> ±03	104 <sup>b</sup> ±03	150 <sup>b</sup> ±02	185 <sup>b</sup> ±02	206 <sup>c</sup> ±01
Control	38.52 <sup>b</sup> ±02	79.20 <sup>c</sup> ±01	105 <sup>c</sup> ±01	152 <sup>c</sup> ±01	186 <sup>c</sup> ±01	205 <sup>b</sup> ±02

The data are mean ±SD values of three determinations with different superscript in a column are significantly different (P < 0.05). Foot note: Diet 1, carbohydrate100% (Basal) diet 2 (Crayfish: fermented maize 10:100), diet 3 (Crayfish: fermented maize15:100), diet 4, milk based commercial diet (control diet).

Table 2 highlights the average food consumption for over the 28 days of the experimental period in ascending order of 10% crayfish, 15% crayfish; milk based commercial diets and 100% carbohydrate (basal diets). This may be because of adequate nutrition, appropriate formulation of diets that affect amount of nutrient intake in quality and quantity, [15,16].

**Table 3. The average nitrogen retained in various tissues of experimental animals**

Dietary	Liver(mg/g)	Kidney(mg/g)	Muscle(mg/g)
Basal	33.52 <sup>a</sup> ±01	43.60 <sup>a</sup> ±01	45.80 <sup>a</sup> ±03
10% Crayfish	57.30 <sup>d</sup> ±02	52.33 <sup>c</sup> ±04	57.80 <sup>d</sup> ±04
15% Crayfish	55.70 <sup>c</sup> ±03	53.20 <sup>d</sup> ±01	56.80 <sup>c</sup> ±02
Control	55.22 <sup>b</sup> ±01	51.38 <sup>b</sup> ±03	56.08 <sup>b</sup> ±01

The data are mean ±SD values of three determinations with different superscript in a column are significantly different (P < 0.05). Foot note: Diet 1, carbohydrate100% (Basal) diet 2 (Crayfish: fermented maize 10:100), diet 3 (Crayfish: fermented maize15:100), diet 4, milk based commercial diet,

Table 3 outlines the average nitrogen content retained in various organs of the animal experimental animals including the liver, kidney and tissue nitrogen are general reflection of dietary nitrogen content level. The average nitrogen retained in diets 2, 3, and 4 organs of experimental animals were similar but highest retention of nitrogen was found in experimental animals fed on diet 2 compared with the control, while the average nitrogen retained in diet 1 (non protein dietary) organs of animal experimental animals was lowest compared with diets 4 (milk based diet). It could be inferred that diets 2, 3, 4, have enough nutrients which could be retained by

experimental animals muscle. This may be due to the fact that amino acid profile of all infant formulae diet are complete and that the diets can liberate more nitrogen that is sufficient to supply to the body organ, this is in agreement with previous findings [3,17,18].

**Table 4. Average weight in grams of various organs of the experimental animal**

Dietary	Liver(g)	Kidney(g)	Muscle(g)
Basal	3.206 <sup>a</sup> ±01	3.204 <sup>a</sup> ±01	3.423 <sup>a</sup> ±02
10% crayfish	4.106 <sup>d</sup> ±03	4.999 <sup>d</sup> ±02	3.440 <sup>b</sup> ±03
15% crayfish	4.102 <sup>c</sup> ±02	4.890 <sup>c</sup> ±01	3.450 <sup>c</sup> ±02
(control)	4.086 <sup>b</sup> ±01	4.653 <sup>b</sup> ±04	3.530 <sup>d</sup> ±01

The data are mean ±SD values of three determinations with different superscript in a column are significantly different (P < 0.05). Foot note: Diet 1, carbohydrate100% (Basal) diet 2 (Crayfish: fermented maize 10:100), diet 3 (Crayfish: fermented maize15:100), diet 4, milk based commercial diet,

Table 4 presents the various internal organs of the experimental animal such as livers, kidneys and selected muscles ranged from to 3.206 to 4.106, 3.204 to 4.999 and 3.440 to 3.530 respectively. On the other hand, it was observed, that the weight of the animals dictate the size of the organs obtained from the experimental animals, that is the higher the animal the higher the organ, other workers confirmed this, [3,7].

## 5. Conclusion and Implication

It is thus concluded that formulation at 10% animal polypeptide (Diet 2) has complete amino acid profile that

could be supplied to maintain body nitrogen when compared to other formulated diets. Animal polypeptide (crayfish powder) supplement to maize (energy source) at 10% formulation with an animal polypeptide could result in optimum nutrient composition of complementary foods. The implication of the study is that if complementary food exceeds or deficient in adequate or essential nutrient, could lead to diet-related diseases such as marasmus, kwashiorkor and obesity. Hence, the formulations has produce adequate caloric value that are necessary for optimal deposition, maintenance, body building, good health, good appearance, proper functioning, activeness of the body, nitrogen retention and normal growth in infants and young children.

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