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# A Comparative Study on the Proximate Composition and Protein Quality of Soya Bean Flour and Smoked Crayfish Sold in Dschang, Cameroon

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## Abstract

A study was carried outto compare the proximate composition and protein quality of soya beans flour and smoked crayfish. Proximate compositions of soya beans flour and smoked crayfish were determined and diets composed for rat growth and balance experimentation. Eighteen (18) weanling male wistar rats were distributed in three groups of sixelements.Test groups received respectively soya beans-based and smoked crayfish-based diets. Eachprotein product was fed as the sole source of 10% dietary protein. The evaluated biological parameters were protein efficiency ratio (PER) and net protein ratio (NPR). Smoked crayfish had significantly ($p <0.05$)higher values of crude protein (77.31±0.63% DM) and ash (5.89±0.08%) while soya beans flour containedhigher values ofcrude lipid (18.03±0.11%DM), carbohydrates (37.2±0.01% DM) and crude fibre (5.50±0.15% DM).Smoked crayfish showed significantly ($p < 0.05$) higher PER (3.83) and NPR (3.96) values compared to soya bean (3.20) and (3.39) respectively. Smoked crayfish could be a better source of dietary protein especially in weaning diet.

**Keywords:** Proximate composition; Soya bean flour; Smoked crayfish; Protein quality; PER; NPR.

## Introduction

Weaning isdescribed as the transitional period starting from 4 monthsonwards till the end of second or even third year in certainculture s so that the infant's diet progressively changes from milk alone to semi-solids and finally to the adult family food [1].WHO recommends the introduction of complementary foods (traditional or commercial weaning foods) around the sixth month of life, instead of between the fourthand sixth month, as previously recommended [2]. During this period, children need nutritionally balanced supplementary foods in addition to breast milk because of the increasing nutritional demands of the growing body [3, 4].

Several commercial weaning foods are marketed in developed and developing countries, but they are too expensive for people of low socio- economic status, especially those in the rural areas. In developing countries, Cameroon inclusive, the low- income mothers use traditional weaning foods formulated from local inexpensive and readily available raw materials such as cereals (maize and rice) and legumes (soya beans flour). 70% of the traditional weaning foods are supplied by cereals which are relatively poor source of protein [5]. Cereals are deficient in essential amino acids like lysine and tryptophan while, legumes are deficient in sulphur containing amino acids, that is methionine and cystine, but rich in tryptophan and lysine [6].The traditional weaning foods formulated by mothers in the rural areas contain high levels of carbohydrate with little or no protein due to the high cost of animal protein rich foods. This could be the cause of high prevalence of protein-energy malnutrition (PEM) during the weaning period [7, 8].

Many researchers have proposed traditional weaning foods formulated from maize, rice, soya bean, potatoes, vegetable, fishmeal, and crayfish in varying proportions [8, 9, 10]. Unfortunately, in Cameroon, the rural mothers do not use these food formulas because of time constraint. They formulate traditional weaning food predominantly made up of maize flour (source of carbohydrate) and small amount of soya bean flour (source of protein). Mothers exclude crayfish (Euastacusspp) in the traditional weaning food which is highly recommended by researchers [8]. Crayfish, classified as an animal polypeptide and a freshwater crustacean, is relatively cheap, affordable and readily available throughout the year.Crayfish is a good source of protein (36 -45%) with a superior biological value, true digestibility, net protein utilization,high content of essential amino acid, and protein efficiency compared to casein [11, 12]. It is very low in carbohydrate but rich in vitamin D, A and mineral elements such as calcium, potassium, copper,

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zinc and iodine, [13, 14].

In Dschang, locally processed soya bean flour and smoked crayfish are sold in the market. his work was therefore designed to compare the nutritional value of these foods which are consumed by the population without any quality control.

## Materials and Methods

### Source of food samples

Smoked crayfish and soya beans flour were brought from Dschang market, West Region of Cameroon. The smoked crayfish sample was sorted for stones, disposed of all kinds of waste and ground into powder using an electric blender (SinboMultifonction Blender Robots) to obtain a meal. The soya beans flour and the ground smoked crayfish were separately stored in identified tightly corked stainless containers awaiting proximate analysis and formulation of test diets.

### Proximate composition

Soya beans flour and the ground smoked crayfishsamples were separatelyanalyzed for proximate composition. The method of AOAC (15) was adopted for the estimation of crudeproteins, crude fiber, ash and crude lipid.All analyses were carried out in triplicate. These analyses were necessary for theformulation of test diets.Total carbohydrate content was determined by subtracting the sum of crude fat, crude proteins, ash and crude fibre contents from 100g of the food [16].

### Formulation of experimental diets

A total of 3 diets were prepared as per ICN (17) protocol. Table 1 gives thecomposition of the experimental diets. The 2 test diets were formulated on the basis oftheir proximate compositions with all the dietscontaining 10% protein. The protein free diet provided an estimate of weight loss (protein used) due to metabolic processes while the soya beans flour-based, and smoked crayfish-based served as the two test diets.

***Table 1:*** *Composition of the experimental diets used in biological assay (g/100 g complete diet).*

| Ingredients (g/100g complete diet) | Protein free diet | Soya bean diet | Smoked-crayfishdiet |
|---|---|---|---|
| Corn starch | 15 | 15 | 15 |
| Pure soybeanoil | 5 | 5 | 5 |
| Minera l Complex | 4 | 4 | 4 |
| Vitamin Complex | 1 | 1 | 1 |
| Cellulose | 7,9 | 7,9 | 7,9 |
| Sucrose | 67,1 | 38,1 | 52,1 |
| Protein | 0 | 0 | 0 |
| Soya beans flour | 0 | 29 | 0 |
| Smokedcrayfish | 0 | 0 | 15 |
| Total | 100 | 100 | 100 |

### Experimental design

A rat feeding study was carried out to determine the protein quality of the test diets based on rat growth. Twenty four weanling male wistar rats (Ratusnovergicers) aged 21-23 days with an average weight of 28.5 ± 2.7g, bred in the Biochemistry Departmental Animal House, University of Dschang, Cameroon, were used. The animals (rats) were divided into 3 groups (n = 8), with differences in average group weight not more than 3 as recommended by AOAC (18). Protein-free group was placed on protein-free diet and the 2 test groups received respectively soy bean-based and smoked crayfish-based diets.

The animal cages used were designed as described by Sarwar and Estatira [19]. The animal were housed individually in labeled stainless steel screening bottom plasticcages,to permit free dropping of feces and stainless steel mesh tops to ease ventilation. Highly absorbent paperwas placed under the cages to catch spilled food and to minimize contamination of feces with urine. All the cages were placed away from direct sunlight in a cage rack, thoroughly cleaned daily and maintained at room temperature with 12 hours light/dark cycle.The rats were given the corresponding diets and water ad libitum for 14 days and records of daily food consumption and body weights were kept from the fifth day. The first 4 days were considered acclimatization period.

### Protein quality determination

Records of dailyfood consumption and body weights ofindividual ratswere kept during the collection period.Protein efficiency ratio(PER) and Net protein ratio (NPR) values (10days), were calculated using the followingequations [20].

$$PER = \frac{\text{Weightgainoftestrat (g)}}{\text{Total protein consumed by test rat (g)}}$$

$$NPR\ (g/g) = \frac{\text{Weightgain of test rat} + \text{Weight loss of protein free rat}}{\text{Total protein consumed by test rat}}$$

### Data analysis

Statistical analyses were performedwith the aid of SPSS for windows softwareprogramme (Release 11.0). Data weresubmitted to analysis of variance (ANOVA), and the test of Duncan was used to comparetreatment means at a 5% significance level.

## Results and discussion

### Proximate composition

**Table 2** presents the proximate composition of the smoked crayfish and soya bean flour. Chemical composition (lipids, proteins, carbohydrates and ashes) varied with source of protein. The crayfish showed significantly ($p < 0.05$) higher values crude protein content (77.305±0.63%DM). The soja bean has more fat (18.025±0.11%DM), crude fibre (5.495±0.15%DM) and carbohydrate (37.2%DM).

***Table 2:*** *Proximate composition of the crayfish and soya bean.*

| Sample | Dry matters | Lipids (%DM) | Proteins (%DM) | Ash (%DM) | Carbohydrates Crude fiber (%DM) (%DM) |
|---|---|---|---|---|---|
| Crayfish | 87.55 ± 0.10b | 4.23 ± 0.16b | 77.30 ± 0,63a | 5.89 ± 0,08a | 8.93 ± 0.10b 3.66 ± 0.16b |
| Soya bean | 96.52 ± 0.11a | 18.02 ± 0.11a | 35.67 ± 0,06b | 3.61 ± 0,27b | 37.2 ± 0.12a 5.50 ± 0.15a |

*Values are means (n =3). Within a column, values with different superscripts are significantly different (p < 0.05). DM: Dry Matter.*

***Table 3:*** *Growth of rats and protein quality of experimental diets.*

| Diets | Growth of rats | | Protein quality | |
|---|---|---|---|---|
| | Weight gain(g/10 days) | Food consumed (g/10 days) | PER | NPR |
| Crayfish | 28.75±0.02a | 8.36 ± 0.01a | 3.83 ± 0.02 a | 3.96 ± 0.02 a |
| Soya bean | 16.43 ± 0.05b | 5.73 ± 0.03b | 3.20 ± 0.03 b | 3.39 ± 0.03 b |

*[*]values are means (n =8). Within a column, values with different superscripts are significantly different (p <0.05). PER: Protein Efficiency Ratios, NPR: Net protein ratio.*

Proximate composition was carried out tohave an idea of the nutrient contents of soya beans flour and smoked crayfish. The results of this studyrevealed different values of nutrients in soya beans flour and smoked crayfish with smoked crayfish =having higher value of crude protein and lower value of crude lipid. This agrees with the findings of other researchers [13, 12, 14]. However, the values gotten in this study were higher than those presented by other studies. The reason being that our results were presented as percentage dry matter.

**Protein quality**

The protein efficiency ratio (PER) and net protein ratio (NPR) of test diets are showed in table 3. Crayfish showed significantly (p < 0.05) the higher PER value (3.83) compared to soya bean (3.20). The results showed that crayfish had significantly (p < 0.05) the higher NPR (3.96) and soya bean had the lower (3.39). The rat growth and food intake data needed to determine PER and NPR of the diets are also showed in **Table 3**. The rats fed crayfish (8.36g/day) registered the higher food consumption, and soya bean diet (5.73g/day) had the lower. The weight gain followed approximately the same trend as the food consumption. The crayfish diet showed the higher weight gain (28.75g/10days), and soya bean diet (16.43g/10days) had the lower.

The smoked crayfish-based diet had a better protein quality than the soya bean flour-based diet. This followed a trend similar to the findings of Ibironke, et al. [12] and Ibironke, et al. [14] though higher. The lower protein quality observed with the soya bean flour-based diet agrees with the report of Hertzler et al. [21] which indicates thatthe nutritional quality of plant proteins may be inferior in some respects relative to animal proteins.NPR values of all the protein sources (soya bean flour and smoked crayfish) were higher than the PER values. The reason being that NPR method unlike the PER method credits protein used for both growth and maintenance [22]. The protein required to prevent weight loss of rats fed the protein-free diet is assumedto be equivalent to the protein needed formaintenance. PER measures only growth and not maintenance, hence NPR is more reliable than PER to determine theprotein quality of a food [23, 24].

## Conclusion

This study has demonstrated that rats fed smoked crayfish-based diet had significantly higher NPR value than those fed soya bean-based diet. This suggests that the proteins in smoked crayfish were more biologically available than those in soya bean flour. Hence, smoked crayfish could be a better source of dietary protein especially in weaning diet. Dietary protein sources intraditional weaning foods could be either the smoked crayfish alone or a mixture of smoked crayfish and soya bean flour.

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## Author Contributions

All the authors collaborated during the execution of this research work. Author EEA designed study, wrote the protocol and the first draft. Authors GTY and BT participated in sample collection, proximate analysis and animal experimentation.All authors read and approved the final manuscript.

## Conflicts of Interest

The authors declare no conflict of interest.

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