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Proximal Composition and Sensory Analysis of Food Broth Formulated from *Polypterus Congicus* and *Adansonia Digitata* Seeds

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ABSTRACT

Introduction: Food broths come in a variety of qualities, and each has a prominent place in the market. Starting with raw materials, these food broths come in different flavours: meat, fish, onions, vegetables, shrimps, etc.

Objective/Aim: The aim of this project is to formulate a flavour-enhancing food broth that meets nutritional quality requirements using local products, in particular *Polypterus congicus* flour and *Adansonia digitata* Kimbo, enriched with natural spices.

Methods: Four food broth formulations were produced, taking into account the two raw materials and the ingredients according to a mixing plan. The water, lipid and protein contents were determined using the AOAC method, and the ash content was determined in accordance with Codexstan standard NFT76.110. A penetrometer was used to determine the texture of the broths produced.

Results: The results showed that the water, lipid, protein and ash content of these broths varied from 9.01 to 34.08%, 5.01 to 5.26%, 9.12 to 17.26% and 0.18 to 14.56% respectively. These values are well within current standards. Sensory analyses using one-way ANOVA and Tukey's HSD test of the formulated food broths showed that the E2 food broth was more appreciated by the assessors.

Conclusion: The E2 formulation was chosen as a better food additive, opening up the possibility of using these two species in food.

Key Words: *Adansonia digitata*, Food broths, Formulations, Polypterus congicus, Proximal composition, Sensory analysis, assessors

INTRODUCTION

The formulation of food broths began in the 19th century with the preparation of meat broth in dehydrated form.[1] Since then, people have been increasingly improving their diet with supplements to guarantee their physiological and psychosensory health. Used as additives, these food supplements are now being used in kitchens all over the world, particularly in the Republic of Congo. These broths are formulated by adding certain salts, the best known of which is monosodium glutamate. This soluble, tasty salt has been the subject of several scientific studies showing toxic effects on several organs of the mouse.[2-5] Food broths come in a variety of qualities, each occupying a prominent place on the market. Starting with raw materials, these food broths come in a variety of flavours: meat, fish, onions, vegetables, prawns, and so on… Despite the commercial success of these food broths, most of them have been found to contain monosodium glutamate.[6] This soluble, flavour-enhancing salt is made by fermenting a starch and sugar, and has been shown to be hazardous to human health. According to the World Health Organisation (WHO) and the Food and Agriculture Organisation (FAO), chronic diseases are largely attributable to an unbalanced diet, including high sodium consumption, which has a negative effect on blood pressure.[7,8] Glutamate is a non-essential amino acid with numerous functions in the body. Its metabotropic and ionotropic receptors are expressed in various brain and peripheral tissues. Excessive ingestion of

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glutamate could activate these receptors and lead to a variety of symptoms. [9] The aim of this project is to formulate a flavour-enhancing food broth that meets nutritional quality requirements, using local products such as *Polypterus cangicus* flour and *Adansonia digitata* kimbo, enriched with natural spices.

MATERIALS AND METHODS

Materials used

The materials used consisted of Kimbo made from the seeds of the fruit of *Adansonia digitata* (baobab) in Figure 1 and 2, harvested in the Bouenza Department under the vernacular name moukondo, and *Polypterus congicus* fish, captured in the tributary of the Congo River at Mossaka in the cuvette department under the vernacular name monkoga. These localities are located in the south and north of the Republic of Congo respectively. The selected seeds and fish products were carefully washed with tap water. The weight of the fish and seeds was determined using a commercial scale.

Fabrication of kimbo and fish meal

The kimbo and fish meal used to formulate the broths studied are obtained by well-established manufacturing processes.[10,11,12] The manufacturing lines are shown in the technological diagrams illustrated in Figures 3 and 4.

Formulation of a food broth

Four food broth formulations were carried out, taking into account the two raw materials and the ingredients according to a mixing plan. The technological digram is shown in Figure 5.

Overall biochemical composition of fishmeal, baobab kimbo and formulations

The water, lipid and protein contents were determined using the AOAC method [13] and the ash content was determined in accordance with Codexstan standard NFT76.110.[14]

Texture of formulated food broths

A MECMESIM DT 110 penetrometer was used to determine the texture of the food broths manufactured.

Sensory analysis

To carry out the sensory analysis, a 4-scale hedonic test was carried out with a panel of 15 subjects in order to measure their appreciation of the products. For each sample, the tasters chose the category that corresponded to their assessment. Four dishes were prepared for the four food broths, and five-digit codes were established to distinguish the different preparations.

Data processing and analysis

The statistical processing of the various data from the overall biochemical characterisation of the raw materials and different formulations was carried out using conventional statistical methods. The calculation of averages, standard deviations and average ratings for the three sensory characteristics (Colour, Odour, Taste) attributed by the assessors, compared by analysis of variance (ANOVA) at the 5% significance level, were processed using Excel. Minitab17 software was also used to process the data obtained by creating the texture of the prepared dishes of the different food broth formulations. Tukey's HSD (Honest Significant Difference) test was chosen to perform the pairwise multiple comparison of rib means.

RESULTS

Proximal composition of fishmeal, baobab kimbo and formulations

The overall biochemical analysis of fishmeal, baobab kimbo and the various formulations gave the results shown in Table 1. The biochemical properties of the raw material and the formulations are very important parameters that determine the nutritional quality of a food broth. [15,16]

Table 1 gives the overall biochemical composition of fishmeal, baobab kimbo and the four formulations. Examination of the content values for the various parameters shows that the protein content ranges from 9 to 17.26%.

The lowest moisture content was 9.01% and the highest 34.08% (16).

It appears from this work that the ash content of the raw materials is well below 5%, 2.7%, and 0.24% respectively for fish meal and baobab kimbo. This content exceeds 10% for formulations E3 and E4.

The lipid contents are (4.98 ± 0.03) % and (6.61 ± 0.01) % respectively for Baobab seeds and fish meal. However, the four broth formulations had lipid contents ranging from (5.01 ± 0.03) % to (5.26 ± 0.06) %.

Evaluation of the texture of the food broths and sensory analysis

The texture of these broths was assessed using a penetrometer to measure the penetration force. The analysis of variance of the penetration force as a function of the samples is shown in Figure 6. Analysis of the mean preference ratings of the samples by the assessors using Anova and Tukey yielded the results shown in Figure 7.

DISCUSSION

This work consisted of formulating a food broth from *Polypterus congicus* fish meal and *Adansonia digitata* seeds. The first stage of this study was devoted to determining the proximal composition of the fish, the seeds and the various food broths formulated.

The protein content values found are within the range allowed by the standards in force, which indicate values of between 10% and 17% for a food broth.[17] They also coincide with the values of three commercial brands of stock cubes that have been analysed for their proximal and elemental composition.[18] These protein values are similar to those obtained in work evaluating mushroom-based bouillon cubes and comparing them with Maggi bouillon cubes produced in Saudi Arabia.[19] It should be noted that the increase in protein in the E3 formulation could be due to the protein percentages of some ingredients added during formulation. Proteins are important nutrients that supply the body with nitrogen radicals. They play a role as flavour enhancers in processed foods. [20,21]

The water content has a major influence on preservation. A lower water content means that the product can be kept for longer periods at room temperature, as it retards the growth of micro-organisms.

Ash content is related to the quantity of mineral salts present in a food. Its measurement enables the food to be classified according to the types defined by the regulations. Less than 5% for a natural food and more than 10% for a processed food. [22,23]

Lipids are also important biomolecules for the body.[24] Adansonia digitata seeds are less rich in lipids than Polypterus congicus fish meal.

With regard to the evaluation of the texture of the four formulated food broths, the P value is below the 5% significance level. The null hypothesis of equality of means is rejected. There is at least one significant difference between the mean penetration forces of the samples. With regard to the mean penetration forces, it can be seen that the mean for E2 broth is higher.

As for the sensory analysis, the results show that the P value is below the 5% threshold. This means that the null hypothesis of equality of means can be rejected. In particular, there was a significant difference between the mean scores of samples E2 and E4. The results of pairwise comparisons of means using Tukey's HSD test show that E2 was the most popular sample. The assessors' preferences for the ranking of the broth samples showed that they preferred sample E2, which had a high average and was ranked first for all criteria (colour, taste, smell). It was selected as the best formulation.

CONCLUSION

The main aim of this work was to formulate nutritious food broths, capable of improving the taste of cooked dishes and subsidiarily of being nutritious from *Polypterus congicus* and Kimbo baobab seeds. It has been shown that the formulated broths contain substantial qualities of protein, fat and ash. These broths are acceptable, safe and supposedly harmless. They are a good source of nutrients. Other physicochemical parameters to be determined include pH, friability and dispersibility. The sodium content will also need to be checked, given the reported negative effects of high levels on consumption.

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Authors' Contribution:

Eliane Thérèse Biassala : study idea, collection and processing of samples, formal analysis and drafting of the original article, review and submission

Christian Feueltgaldah Bopoundza : Data Collection and analysis, wrinting and reviewing

Bob Wilfrid Loumouamou validation of the methodology, analysis, writing and revision

Stéphanie Gabine Samba Bandzouzi : Collection and processing of samples, formal analysis

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Table 1: The overall biochemical composition of fishmeal, baobab kimbo and the four formulations.

Samples	Parameters			
	Water content (%)	Fat content (%)	Protein content (%)	Ash content (%)
E1	11.61± 0.03	5.26 ± 0.06	11.50 ± 0.30	0.18 ± 0.02
E2	34.08 ± 0.06	5. 08 ± 0.05	9.12 ± 4.03	4.98 ± 0.03
E3	12.58 ± 0.20	5.01 ± 0.03	11.50 ± 0.30	14.56 ± 0.16
E4	9.01 ± 0.02	5.25 ± 0.21	17.26 ± 0.09	10.77 ± 0.10
Fish meal	5.36 ± 0.08	6.61 ± 0.01	12.90 ± 0.11	2.70 ± 0.28
baobob Kimbo	2.69 ± 0.08	4.98 ± 0.03	16.80 ± 0.71	0.24 ± 0.02

Figure 1: Baobab seeds (*Adansonia digitata*)

Figure 2: *Polyterus congicus* fish

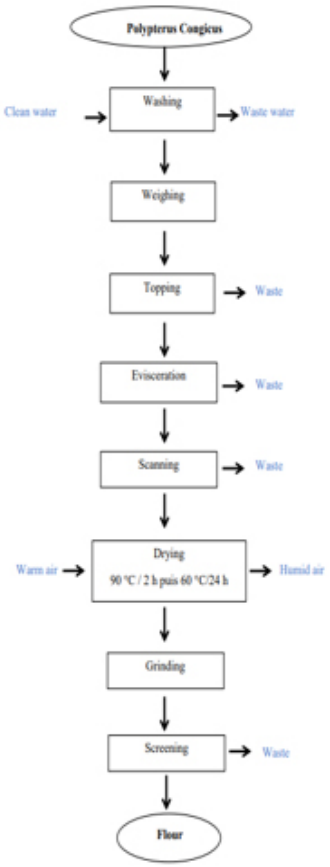

Figure 3: Production Diagram of the *Polypterus Congicus's* Flour

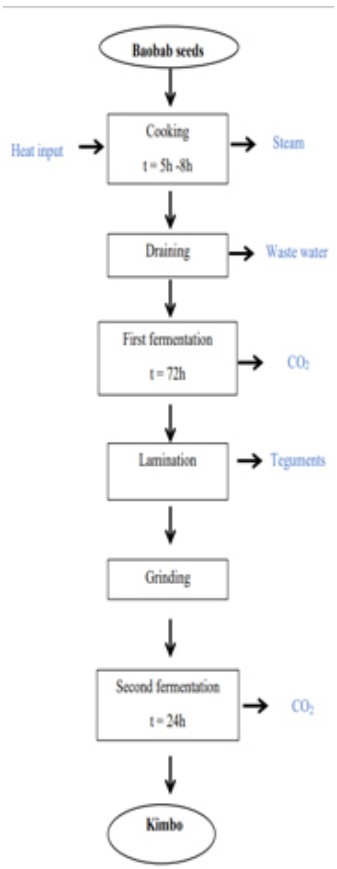

Figure 4: Production Diagram of Kimbo

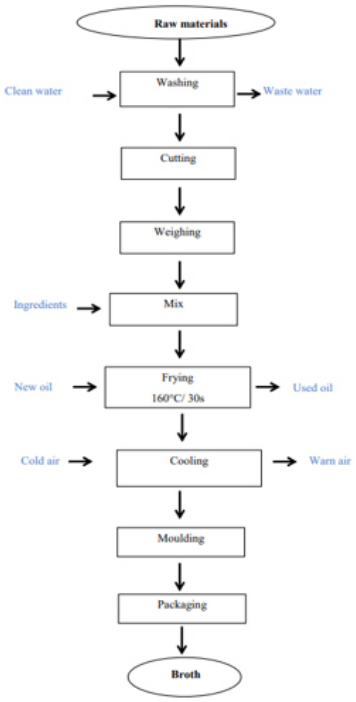

Figure 5: Food broth making diagram

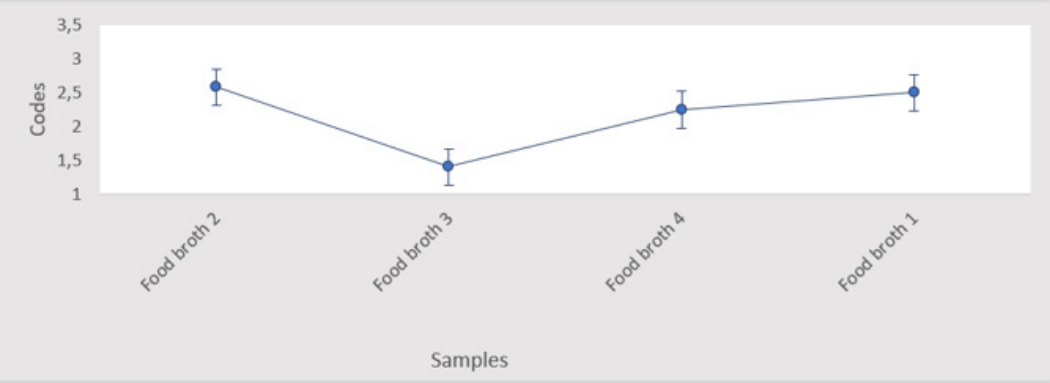

Figure 6: Graph of 95% confidence intervals for the mean.

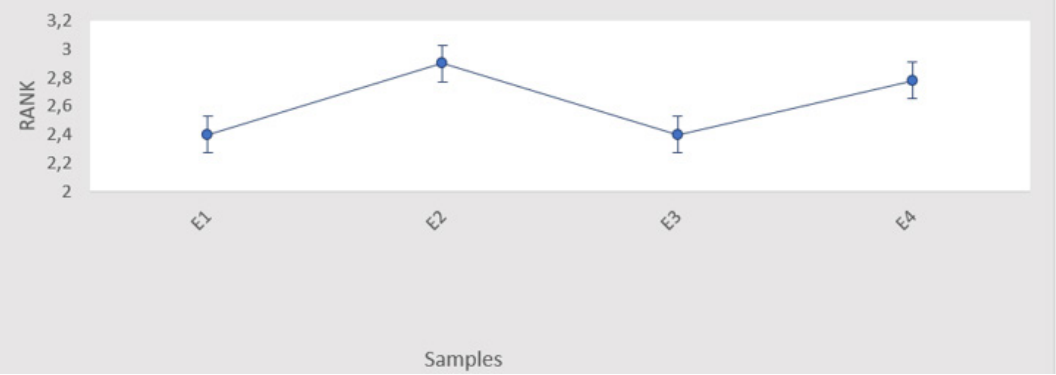

Figure 7: Grouping information using Tukey's method and a 95% confidence level