Functional Nutritional and Sensory Properties of Seasoning Powders from Fermented African Locust Bean Chicken and Shiitake Mushrooms

Abstract

Seasoning powders can be defined as mixtures of different compounds whose main role is to enhance taste and flavor of ready to eat food to which they are added. The taste enhancement property of the seasoning powders is largely due to the presence of flavour enhancers in them which elicit the umami or savoury taste when added to food.Generally commercial powdered seasonings are made from monosodium glutamate (MSG), a potent flavour enhancer which has been accused of being responsible for many health problems such as brain damage. The aim of this study was to formulate of blends of seasoning powders from African locust bean seeds, chicken and mushroom and assessment of their functional, nutritional and taste properties..The development of functional seasonings is necessary as the commercial seasonings available in the market are full of the controversial MSGand deemed unfit for consumption . Four combinations were made containing different proportions of iru, chicken and mushroom (I/C/M) as follows 1 (16.6/16.6/66.7), 2(16.6/66.7/16.6), 3(66.7/16.6/16.6), 4(33.3/33.3/33.3).The functional, nutritional and sensory properties of the seasoning powders were evaluated using standard analytical procedures (AOAC 2020). There was no significant difference at P>0.05 in the bulk densities of all the four blends. The blend containing 66.7 % chicken powder had the highest protein content 50.32±1.18%.all the seasoning powder blends had less than 1% monosodium glutamate while free glutamic acid was found to most abundant 443.39± 1.44mg/100g in the blend containing more iru: 3(66.7/16.6/16.6)(I/C/M). This same blend was considered to be the most acceptable product as it had the highest general acceptability score 8.22 ± 0.17.the high protein content of this seasoning powder is advantageous as it makes it not only a flavourenhancer but also a nutrient-dense food product. The ingredients for this seasoning powders :African locust bean, chicken, mushrooms ,are all locally available in Africa and their use to produce a ready to use seasoning if implemented on an industrial level should go a long way towards food security in Africa.

Key words: *Seasoning powder, Iru, chicken, Shiitake Mushroom.*

Introduction

"Food spices, whether natural or artificial, are in high demand in daily meals because they enhance the flavor of common dishes and make them more attractive when added.Seasoning powders can be defined as mixtures of different compounds whose main role is to enhance taste and flavor of ready to eat food to which they are added. There are different types of food seasonings sold on the market, but what they have in common is that they are all produced in the laboratory using different ingredient ratios and techniques". (Nguyen Minh Thuy *et al*., 2024). "The main attraction of seasoning pwders is that they illicit the highly solicited umami taste when added to food.The term "umami" was coined from the Japanese adjective for delicious (umai). Beyond the four better known tastes of salty, sweet, bitter, and sour, umami finds its place as the fifth basic taste evoking savoury, full-bodied, and meaty flavor sensations. In general, human taste comprises five basic qualities: sourness produced by hydrogen ions such as HCl, acetic acid, and citric acid; saltiness produced mainly by NaCl; sweetness produced by sugars; bitterness produced by quinine, caffeine and MgCl2; umami (Japanese term for deliciousness) produced by monosodium glutamate contained in seaweeds, disodium inosinate (IMP) in meat and fish, and disodium guanylate (GMP) in mushroom" (Giovanni and Guinard, 2001, Toko, 2000, Zheng and Keeney, 2006).

The Research Problem

Before the advent of seasoning cubes and powders, local herbs and spices and fermented legumes were used to enhance flavour during the preparation of food. Nowadays seasoning cubes and powders such as *magi* cube and *Ajinomito are* popular due to the cheap cost and convenience as they are sold in ready-to use forms thus reducing preparation time and energy These products are mostly made from monosodium glutamate (MSG) a potent flavour enhancer industrially produced by bacterial fermentation of sugars. MSG elicits the umami or savoury taste at very low concentrations,. The consumption of MSG has however been associated with many health hazards such and brain damage, Chinese restaurant syndrome and organ failures. It is therefore of great importance that alternative seasonings be developed that limit the use of the controversial MSG.

Commercial spice blends or seasonings consist of spices, vegetables and other ingredients, includingflavorings,salt,sugar,dextrose,cornsyrupsolids,starches,maltodextrin,yeast extracts or hydrolysates, hydrolysed proteins, monosodium glutamate, or nucleotides. In the production of commercial seasoning blends, spices and other ingredients are first plated on some sort of carrier (e.g. salt, sugar, dextrose, or maltodextrin), before being mixed with other spices or ingredients. Anti-caking agents are usually added in required amounts below 2% [2]. According to FAO standards, powdered vegetable based food seasonings must satisfy following requirements: moisture $\leq$ 5%, NaCl $\leq$ 60%, monosodium glutamate $\leq$33% and dried vegetables$\geq$8% .

Literature Review

According to European Spice Association (ESA), seasoning is a blend of permitted food ingredients added as necessary to achieve the purpose for which it is designed (e.g. to improve the taste, eating quality and/or functionality of a food).Seasoning powders can be defined as mixtures of different compounds whose main role is to enhance taste and flavor of ready to eat food to which they are added.Generally commercial powdered seasonings are added before or during cooking.Besides their taste, aroma and composition, seasoning powders also need to have certain physical and functional properties, which are very important during processing, packaging, handle, manipulation, storage, and application in the kitchen.The most important physical properties of food seasoning powders are bulk density, granulation, wettability, dispersibilty and flowability. Bulk density is a ratio of weight of powdered material and volume which that certain powder weight occupies. It depends on granulation, particle size and shape. Particles with irregular shape have lower bulk density. Bulk density is important for packaging and storage space. Dispersibilty is important for uniform mixing after addition to liquid food medium. Flowability is important for transport operations during processing and good flowability without caking is required.

"Foods and ingredients rich in amino acids such as monosodium glutamate or based on protein hydrolysates (soy or fish) have been used in culinary preparations for a long time in various cultures to enhance the sensory qualities in food. The umami taste also known as the savoury taste is mainly linked to the presence of glutamic acid and its salt, monosodium glutamate (MSG), but it can also be elicited by other substances, such as 5′-nucleotides and umami peptides" ((Dermiki *et al.*,2013); (Kong *et al.*,2019). The umami comes from glutamate and 5 ribonucleotides, including inosinate and guanylate, which appear naturally in many foods, such as meat, fish, vegetables and dairy products. It is for this reason that three three ingredients chosen in this study to produces seasoning powders are all rich in proteins.

African Locust Bean (*Parkia biglobosa*) is among the leguminous plants used by man particularly in some African countries for the production of local condiment. African locust bean seeds are rich in protein (about 35%). The proximate composition of African locust bean seeds according to Akabanda et al 2018 is shown in figure 1 below. “These seeds are fermented to a tasty food condiment called dawadawa which is used as a flavour intensifier for soups and stews and also adds protein to a protein- poor diet”(Yahaya Mode *et al.*,2018).“Dawadawa or iru is one of the most fully exploited traditional additives, used almost every day; in most food preparations, for its aroma and flavouring enhancing effects. Apart from serving as a food additive that enhances the organoleptic properties of the food, dawadawa may also serve as a source of proteins” (Murtala *et al.*, 2016).Fermented African locust beans seed (iru) contains high levels of free glutamic acid (a non-essential amino acid)which is also a potent flavour enhancer and which can be used to replace MSG in diet to elicit the highly solicited umami taste which makes bland food taste so much better.

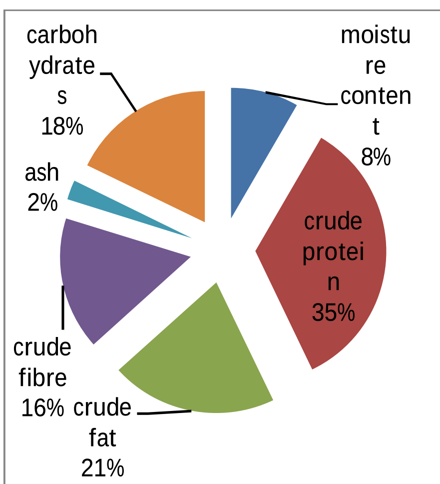

Figure 1: African locust Bean proximate composition Akabanda *et al.*, 2018

Chicken meat is a substantial food for consumers all over the world. It is rich in essential amino acids and involves large amount of proteins (Cui *et al.*, 2003). Chicken breast meat (a type of white meat) was selected because it has a lower fat content and is normally perceived as a healthier meat option by consumers.(Charlton et al., 2002). The proximate composition of dehydrated chicken meat is shown in figure .The chicken breast can be dehydrated and then is made into a famous natural seasoning (chicken powders) at home and abroad.

Chicken powders can be healthy, delicious, and rich in nutritional ingredient (*Ran et al*., 2003).

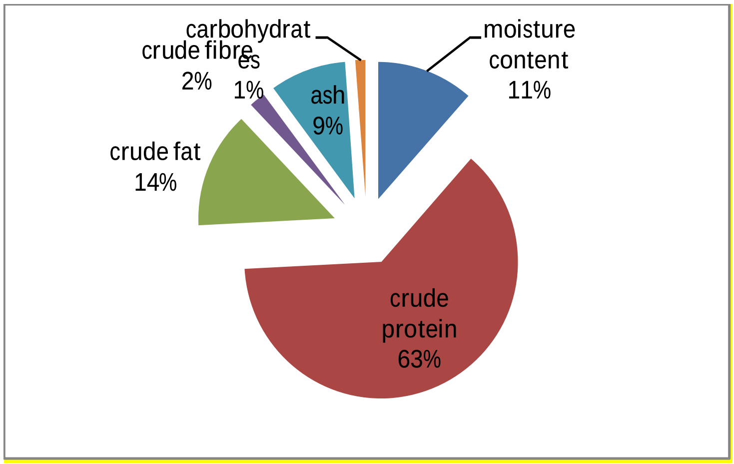

Figure 2: Chicken proximate composition Elkanah *et al*., 2022

"Mushrooms are excellent sources of proteins, minerals and vitamins which are important role for nutritional purpose. Shiitake mushroom is the medicinal and edible mushroom known for its potential health benefits. It is scientifically known as (*Lentinula edodes*). It is the main essential medicinal mushroom which second ranks in terms of total mushroom production in the world only next to *Agaricus* species. Shiitake is a high-quality delicious taste and texture with mushroom and many types of bioactive compounds are found in this mushroom which is as follows Lentinan β-(1glucan/polysaccharide), Lentinus edodes mycelium (LEM), Eritadenine, Ergothioneine (an amino acid that can act as an antioxidant. These compounds protect to various types of human diseases**.**These are important bioactive compounds that have lipid-lowering, antimicrobial, and antioxidant propertie**s.** Shiitake mushrooms have a rich, earthy flavour and a distinctive taste best described as meaty" (Prince *et al*.,2023).

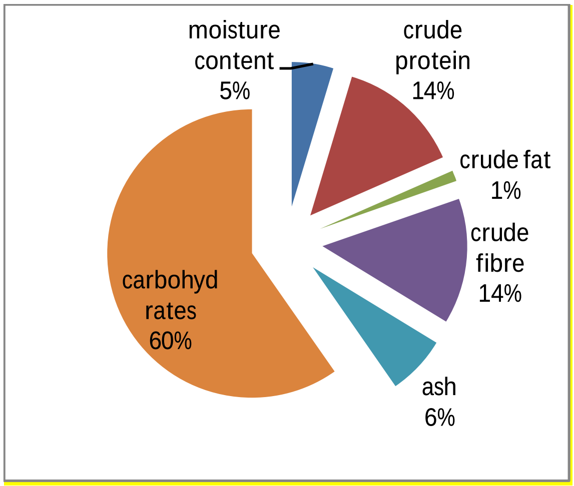

Figure 3: Shiitake Mushrooms Proximate composition Dimopoulou *et al.*, 2022

OBJECTIVE

The aim of this study therefore was to formulate of blends of seasoning powders from African locust bean seeds, chicken and mushroom and assessment of their functional, nutritional and taste properties. The results of this study would therefore be significant as it would provide an alternative product that can be used to enhance flavour in foods thus limiting the use of the controversial MSG.The intended significance of the study is to maximize the use of locally available raw materials in the production of seasoning powders for local consumption and exportation thereby ensuring food security in Africa.

Materials and Methods

African locust bean seeds were purchased from Wurukum market Makurdi Nigeria.Chicken and shiitake mushrooms were purchased from Agro-unbeatable farms Bambili Cameroon. The raw materials were transported to Chez Ayah Foods laboratory Bambili Cameroon were the seasoning powders were produced and analyses were carried out. Reagents of analytical grade used for the study were purchased from Emole Nigeria limited supply store Makurdi**.**

Production of Fermented African Locust Bean Powder

This was done according to the method described by (Adejumo *et al.,* 2013 and Zannou et al.2018) (Fig 1). Dried *P. biglobosa* seeds were washed and sorted in order to eliminate spoiled grains and foreigner particles. The seeds underwent the first cooking which is the first important operation that seeds undergo during condiments production and it consists of boiling seed in water for 6 to 24 hours. This operation allows not only a loss of astringency or bitterness of the seed but also the softening of the seminal integument. After this step, the cooked seeds were let to cool and washed in order to take off any remaining impurity and astringency. Seeds were then ready for dehulling. Dehulling is the second major operation involving in the production of the fermented condiments and consists of removing seed coats. Seed coats were taken off by pressing between palms of hands. The second cooking is a short 1 to 2 hours boiling of cotyledons in water. After the cooking, cotyledons will be well drained. The fermentation represents the last most important operation involved in the production of seeds condiments. Although above-cited operations prepare cotyledons to render the fermentation most successful, this step is the most sensitive amongst all operations. It gives to cotyledons all their nutritional capacities, microbiologic properties, and organoleptic characteristics. Cotyledons were spread in basket trays, calabash trays or containers, wrapped with heavy cloths, jutes backs and/ or polyethylene bags and then left for fermentation which lasts for 48 hr. After the fermentation, the condiment was oven- dried ground to a fine powder and packaged.

Production of Chicken Powder

Chicken flavouring powder was prepared as shown in Fig5. Muscle from slaughtered homebred chicken was used. It was washed, sliced into small pieces, salt herbs spices and water were added to it and it was boiled for one hour. It was then ground to a paste using a kitchen blender. The paste was spread in a laboratory drying oven and dried at 60°C for 12hr. It was then ground to a fine powder, sieved and packaged in polythene bags.

Production of Shiitake Mushroom Powder

Mushroom powder was prepared as shown in Figure 6 according to the method described byBalaji *et al*., 2009 (Fig 6). Dried shiitake mushrooms were soaked in water in a ratio 3:1(w/v) to rehydrate them.According to Wu and Wang (2000), the aroma of dried shiitake mushrooms is more flavourful and meaty than that of fresh mushrooms. They were washed with clean water to remove impurities and soil particles. They were then boiled in water for one hour together with herbs spices and salt after which they were blended into a paste using a kitchen blender. The pastes was oven dried at 90°C for 6 hr. after which it was ground to a fine powder, sieved and packaged polythene bags and stored at room temperature.

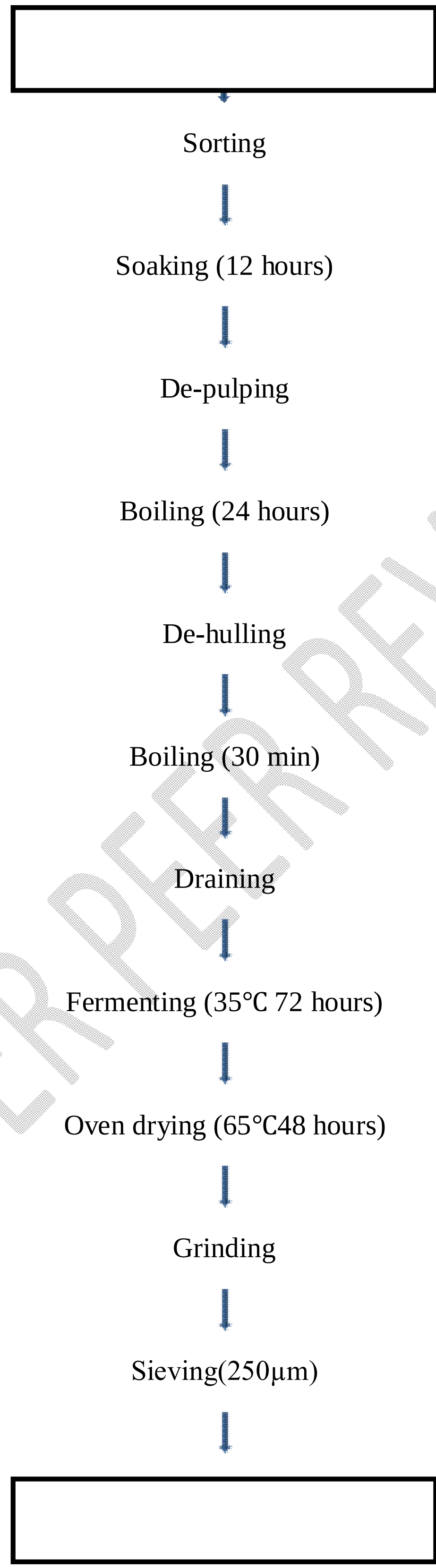

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Figure 4: Flow Chart for the Production of *Iru* Powder. Source**:**(Adejumo *et al.,* 2013, Zannou *et al.*,2018,)

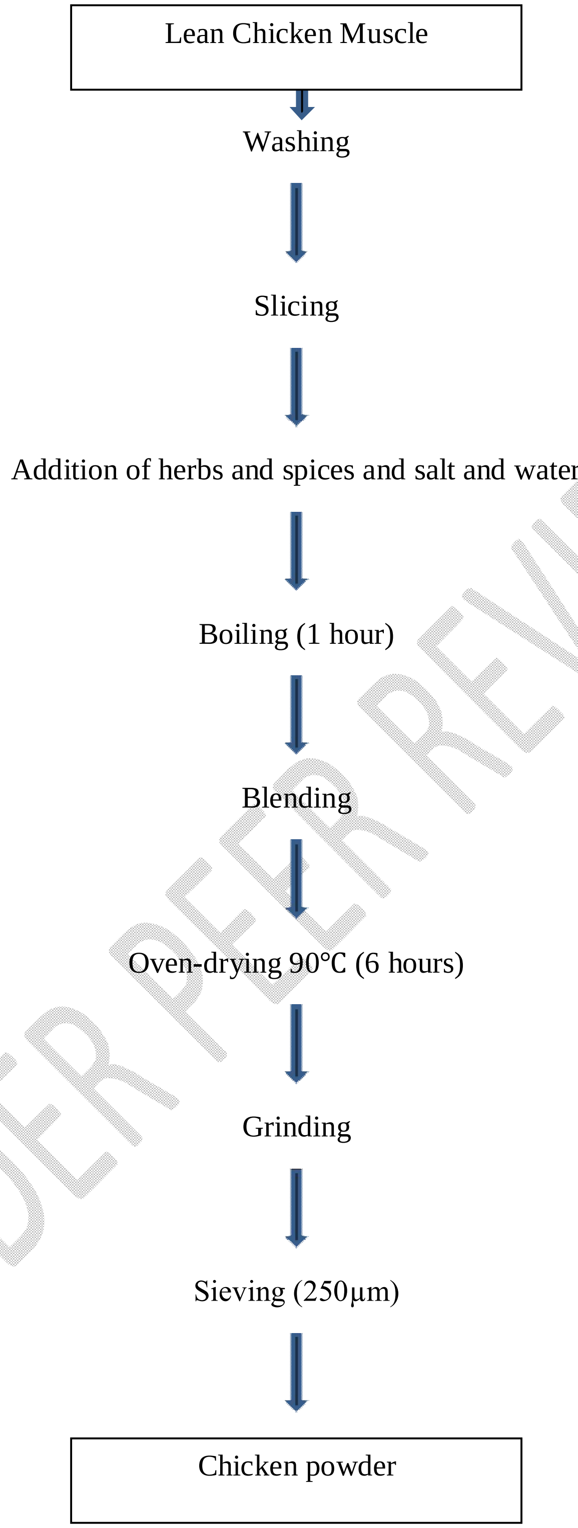

Figure 5: Flow Chart for the Production of Chicken Powder

Dehydrated Shiitake Mushrooms

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Soaking (1hour)

↓

Addition of salt, herbs spices and water

↓

Boiling (1 hour)

↓

Blending

↓

Oven-drying (90°C for 6 hours)

↓

Grinding

↓

Sieving (250µm)

↓

Mushroom Powder

Figure 6: Flow Chart for the Production of Mushroom Powder

Source:Balaji *et al*., 2009

Fig 7: Iru (I), Chicken (C) and Shiitake Mushroom (M) Seasoning Powders

Blend Formulation

Four different blends were prepared of combinations of iru, chicken and mushroom powders as shown in Table 1.

Table 1: Blend Formulation

Experimental Blend	Iru	Chicken Powder	Shiitake Mushroom Powder %
1	16.6	16.6	66.7
2	16.6	66.7	16.6
3	33.3	33.3	33.4
4	66.7	16.6	16.6

Analytical Procedures

Determination of Bulk Density

The bulk density of the flour samples were determined by the method described by Onwuka (2005).The sample (50g)was weighed into 100 mL graduated cylinder, then, this was gently tapped at the bottom several times on a laboratory bench, until no further diminution of the sample level. The bulk density was calculated as:

$$\text{Bulk density } \left({}^{g}/_{mL}\right) = \frac{\text{Weight of sample (g)}}{\text{Volume of sample (mL)}} \quad (1)$$

3.8.2 Determination of Swelling Index

The swelling index was determined as described by AOAC (2016). The sample was transferred into clean, graduated (50 mL) cylinder up to the 10 mL mark and the volume noted. Distilled water was added to the flour sample up to the 50 mL mark. The cylinder was swirled and allowed to stand for 2 min after which it was swirled again. It was allowed to stand for another 8min after which the volume of the swollen sample was taken. The swelling index or power of the sample was calculated as:

$$\text{Swelling Index } = \frac{\text{Sample volume after swelling(mL)}}{\text{Sample volume before swelling (mL)}} \quad (2)$$

3.8.3 Determination of Water Absorption Capacity

The AOAC (2016) method was used. One gram of flour was weighed into a graduated conical flask and 10 mL of water was added to the weighed sample and mixed well. The sample was allowed to stand at room temperature for 30 min and then centrifuged at 5000 rpm for 30 min. The supernatant was carefully decanted and measured to know the volume of the free water or oil. The absorption capacity was expressed as grams of water absorbed per gram of sample or in percentage. Calculation: Water absorption capacity of the sample was calculated as:

$$WAC\ \left(\frac{g}{g}\right) = (V_1 - V_2) \times \text{density of water (g/mL)} \quad (3)$$

Where V_1 is initial volume of distilled water added

V_2 is volume of supernatant decanted

3.8.4 Determination of Oil Absorption Capacity

The AOAC (2016) method was used. One gram of flour was weighed into a graduated conical flask and 10 mL of oil was added to the weighed sample and mixed well. The sample was allowed to stand at room temperature for 30 min and then centrifuged at 5000 rpm for 30 min. The supernatant was carefully decanted and measured to know the volume of the free oil. The absorption capacity was expressed as grams of oil absorbed per gram of sample or in percentage. Calculation: Water absorption capacity of the sample was calculated as:

$$OAC\ \left(\frac{g}{g}\right) = (V_1 - V_2) \times \text{density of oil (g/mL)} \qquad (4)$$

Where V_1 is initial volume of oil added

V_2 is volume of supernatant decanted

Determination of Proximate Composition of Seasoning Powders

Moisture, ash, crude fat and crude fibre were determined in accordance with the official methods of the Association of Official Analytical Chemists [5]. Moisture content was determined by oven drying of a weighed sample to a constant weight at 105°C. Crude protein content was determined by Kjeldahl method using 6.25 as the conversion constant after the determination of each sample's nitrogen. Crude fat content was determined by Soxhlet method using n-hexane as solvent. The ash content was determined gravimetrically after ignition at 550°C. Carbohydrate content was calculated by difference. All analyses were carried out in triplicates.

Determination of Taste Compounds

MSG content in the seasoning powders was determined by HPLC using the method described by Verni *et al*., 2010. Free glutamic acid content was determined using an amino acid analyser. IMP and GMP contents were determined by HPLC using the method described by Qiu *et al*., 2016.

Sensory Evaluation

Sensory evaluation was carried out on aqueous solutions (10g in 100ml distilled water) of the seasoning powders prepared using a 20 member panel of semi trained panellists composed of both male and female students from the university of Bamenda Cameroon. A nine point hedonic scale was used to grade the seasoning powders with 1 being extremely dislike and 9 being extreme like. The parameters evaluated were appearance, taste and general acceptability.

Statistical Analysis

All analysis was done in triplicates. Results were expressed as the mean ± standard deviation. The data obtained was subjected to statistical analysis by ANOVA at 5% level of significance. Separation of means was carried out using Duncan's Multiple Range test.

Results and Discussion

Functional Properties of Seasoning Powder Blends

Functional properties are intrinsic physicochemical characteristics which affect the behaviour of properties in food system during processing, manufacturing, storage and preparations. These properties include emulsion capacity and stability. Functional properties are the fundamental physico- chemical properties that reflect the complex interaction between the composition, structure, molecular conformation and physico-chemical properties of food components together with the nature of environment in which these are associated and measured (Kaur and Singh , 2006). Functional characteristics are required to evaluate and possibly help to predict how new proteins, fat, fibre and carbohydrates may behave in specific systems as well as demonstrate whether or not such protein can be used to stimulate or replace conventional protein (Siddiq *et al.*, 2009). The food property is characterized of the structure, quality, nutritional value and /or acceptability of a food product. A functional property of food is determined by physical, chemical, and/or organoleptic properties of a food. Prominent properties are water absorption capacity and oil absorption capacity, bulk density, viscosity and swelling index (Aremu *et al.*, 2007). Table 2 shows the functional properties of the blends of seasoning powders made from ALB, chicken and mushroom.

There was no significant difference in the bulk densities of the seasoning powders at 5% significance level observed in this study.This could be because of the fact that all the raw materials were sieved using the same size (250µm) after production .The blend with equal quantities of the three powders (I, C, M) had a bulk density of 0.59±0.04g/ml. Bulk density is a vital parameter that determines the suitability of flours for the ease of packaging and transportation of particulate foods as well as for infant formulations(Shittu *et al*.,2005).Bulk density depends on the particle size and initial moisture content of flours. The compressibility of the powder determines the appearance of a container's contents upon reaching the consumer, and may serve as an index of cohesion (see below). Bulk density control, therefore, is a prime objective of many food processes, especially spray drying and grinding. Bulk density is one of its most important characteristics. It determines the choice of the container size and strength of the reconstituted food, if prepared from a given volume (e.g., tablespoon, cup, etc.).(Micha, 2003) Differences in the bulk density is generally affected by the particle size and the density of the flour and it is very important in determining the packaging requirement, material handling and application in wet processing in the food industry.(Adebowale *et al*., 2008). The fat that that all the seasoning powders had statistically the same bulk densities means that their packaging requirements should be the same and their Hausner ratios and Carr's indices would also be similar.Hausner ratio and Carr index of compressibility are indicators of flowability and cohesiveness. Lower values of these two properties indicate better flowability and lower cohesiveness. (Geldart *et al*., 2006)

Swelling index values ranged from 1.60± 0.04in sample 1(16.6/16.6/66.7) (I/C/M)1.90± 0.01n in sample 3(66.7/16.6/16.6)(I/C/M)The blend with equal parts of the three ingredients had a swelling index of 1.73± 0.21. It was observed that the blend with more mushroom (16.7/16.7/66.6 I/C/M) had a swelling index of 1.60 ± 0.04, while the blend with more iru (66.7/16.6/16.8 I/C/M) had a swelling index of 1.90± 0.01.Finally the blend with more chicken powder (16,6/66.7/16.6 I,C,M) had a swelling index of 1.72 ±0,02 which was not significantly different from the blend with equal quantities of the three ingredient and 95 % confidence level.

Water absorption capacity or characteristics represent the ability of a product to associate with water under conditions where water is limited (Singh, 2001). Water absorption capacity is a critical function of protein in various food products like soups, dough and baked products. The absorption capacity of water by flour is a useful functionality for protein utility in aqueous food formulations, especially those involving high handling(Osungbaro *et al.*,2010).

Water absorption capacity of the powders in this study was observed to increase with increasing quantities of shiitake mushroom powder. Therefore the blend containing more mushroom powder1(16.6/16.6/66.7) (I/C/M) had a water absorption capacity of 40.16± 0.04 %.The matrix of protein with water is advantageous to properties, such as hydration, swelling power, solubility and gelation (Etudaiye *et al.*,2009).

The OAC also makes flour suitable in facilitating enhancement in flavor and mouth feel when used in food preparation. Due to these properties, the protein probably could be used as functional ingredient in foods such as whipped toppings, sausages, chiffon dessert, angel and sponge cakes etc.The ability of the proteins of these flours to bind with oil makes it useful in food system where optimum oil absorption is desired. This makes flour to have potential functional uses in foods such as sausage production and seasoning cube production. Oil absorption capacity values ranged from 15.48^{a}± 0.37% in the blend with (16.6/16.6/66.7)(I/C/M) to 18.31^{c}± 0.02% in the seasoning powder with more chicken powder (16.6/66.7/16.6)(I/C/M). The blend with equal quantities of the three ingredients had an oil absorption capacity of 17.82 ±0.10%. The high oil absorption capacity observed in the flour samples suggests the presence of good lipophilic constituents and therefore may be suitable as recipes for sausage, soups, and cakes (Aremu *et al*., 2006).High oil absorption capacity observed in these blends suggests the presence of good lipophilic constituents and therefore may be suitable as recipes for sausage, soups, and cakes (Aremu *et al*., 2006).

Peak viscosity is often correlated with the final product quality. It also provides an indication of the viscous load likely to be encountered during mixing. Higher swelling index is indicative of higher peak viscosity(Maziya-Dixon *et al*., 2004).The highest viscosity 375.86±0.55 RVU was registered in the sample containing 16.6% Iru, 66.7% chicken powder and 16.6% mushroom powder. The lowest viscosity 311.06± 0.02 RVU was observed in the sample (66.7/16.6/16.6)(I/C/M).

Proximate Composition of Blends of Seasoning Powders

Table 3 shows the proximate composition of the seasoning powder blends produced from iru, chicken and shiitake mushrooms. There was no significant difference in the moisture contents of the seasoning powder blends. Moreover all the seasoning powders had moisture contents lowers than 6%.. Generally, foods high in moisture are susceptible to microbial attack. Therefore, the low moisture exhibited in the flavouring powders may make them stable to microbial growth and thus confer on them extended shelf life. Lower moisture content too will prevent caking of the powder during storage and avoid the use of chemical anticaking agents.

It was observed that protein content generally increased with increasing concentrations of iru and chicken. The highest protein content 50.32±1.18% was observed in the blend with high concentration of chicken powder (16.6/66.7/16.6) (I/C/M).The blend with equal quantities of all three ingredients had a protein content of 35.28± 0.41%.Proteins are essential for body building.

Lipid or crude fat content in the seasoning powders ranged from 6.11± 0.01% in the powder that contained more mushroom (16.6/16.6/66.7)(I/C/M) to 15.41± 0.37% in the blend that contained more chicken (16.6/66.7/16.6) (I/C/M). Lipid content generally increased with increasing concentration of chicken and ALB. Lipids contribute to flavour in food products.

Crude fibre on the other hand increased with increasing concentration of mushroom powder. Thus the highest crude fibre content 9.47 ±0.28 % was observed in 1(16.6/16.6/66.7) (I/C/M) the sample with more mushroom (16.6/16.6/66.7)(I/C/M) .Fibre in foods generally offers a variety of health benefits and it is essential in reducing the risk of chronic diseases (Food Science Avenue, 2008)..

Ash content ranged from 6.25^{a}± 0.12 % in the powder blend with equal quantities of all three ingredients (33.3/33.3/33.3)(I/C/M) to 7.12± 0.01% in the blend with more chicken powder(16.6/66.7/16.6) (I/C/M). High ash content implies high mineral contents which helps retard the growth of certain micro-organisms and some minerals are necessary in diets for health benefits (McClements, 2003).

The blend with equal quantities of the three ingredients had a carbohydrate content of 41.72± 0.55%.This same blend had a total energy content of 407.01 ±0.96Kcal/100g.the lowest carbohydrate content 24.04^{c} ±1.47 %was observed in the blend with more chicken powder (16.6/66.7/16.6) (I/C/M) and the highest carbohydrate content 60.41^{g}±0.29%was seen in the blend with more mushroom (16.6/16.6/66.7).(I/C/M).

Total energy contents in the seasoning powders ranged from 365.59± 0.41Kcal/100g in the blend with more mushroom powder (16.6/16.6/66.7).(I/C/M) to 437.05 ± 1.51Kcal/100g in the blend with more iru (66.7/16.6/16.6).

Table 2: Functional Properties of Blends of Seasoning Powders

Sample I/C/M %	Bulk Density (g/ml)	Swelling Index	WAO (%)	OAC (%)	VISCOSITY(RVU)
1(16.6/16.6/66.7)	0.62[a]±0.01	1.60[a]± 0.04	40.16[d]± 0.04	15.48[a]± 0.37	342.95[c] ± 1.47
2(16.6/66.7/16.6)	0.63[a] ±0.00	1.72[b] ±0,02	34.63[b]± 0.04	18.31[c]± 0.02	375.86[d]± 0.55
3(66.7/16.6/16.6)	0.63[a]±0.04	1.90c± 0.01	32.67[a]± 0.40	18.24[c]± 0.18	311.06[a]± 0.02
4(33.3/33.3/33.3)	0.59[a]±0.04	1.73[b]± 0.21	36.23[c]± 0,05	17.82[b]±0.10	328.84[b]± 2.50

Results are reported as mean ± standard deviation of triplicate determinations. Means with the same superscript are not significantly different at $p<0.05$
Key: I is Iru, C is chicken and M is shiitake Mushroom

Table 3: Proximate Composition of Seasoning Powders Blends

Sample I/C/M %	Moisture %	Crude Protein %	Crude Fats %	Crude Fibre %	Ash %	Carbohydrates %	Total Energy Kcal/100g
1(16.6/16.6/66.7)	5.66[a] ±0.04	17.24[a]± 0.18	6.11[a]± 0.01	9.47[d] ±0.28	6.77[b]± 0.17	60.41[c]±0.29	365.59[a]± 0.41
2(16.6/66.7/16.6)	5.12[a]± 0.01	50.32[c]±1.18	15.41[d]± 0.37	3.11[b]± 0.02	7.12[b]± 0.01	24.04[a] ±1.47	436.13[c]±1.90
3(66.7/16.6/16.6)	5.21[a]± 0.01	35.11[b] ±10.11	13.57[c]±0.25	1.34[a]± 0.08	6.36[a] ±0.22	43.62[b]± 0.13	437.05[c]± 1.51
4(33.3/33.3/33.3)	5.01[a] ±0.01	35.28[b]± 0.41	11.01[b]±0.03	5.77[c]± 0.07	6.25[a]± 0.12	41.72[e]± 0.55	407.01[b]±0.96

Results are reported as mean ± standard deviation of triplicate determinations. Means with the same superscript are not significantly different at $p<0.05$
Key: I is Iru, C is chicken and M is shiitake Mushroom

Umami Compounds in Seasoning Powders

The compounds that elicit umami taste present in the different blend formulations are presented in table 4. All the seasoning powder blends had negligible quantities of MSG with values ranging from 0.18 ± 0.04% in the blend 16.6/66.7/16.6 (I/C/M) 0.24^{c} ± 0.02% in the powder with equal quantities of the three ingredients F(33.3/33.3/33.3). There was no significant difference in the MSG content of this sample with that of the sample with more chicken (66.7/16.6/16.6).. Glutamic acid content was highest 443.39^{i}± 1.44mg/100g in the powder with more iru (66.7/16.6/16.6)and 290.61^{a} ± 0.33in the powder with equal quantities of the three ingredients. This same blend with equal quantities of the three ingredients also had the lowest IMP content 56.18 ± 0.16 while the highest IMP content 70.96 ± 0.17 was observed in the blend that contained more of iru (66.7/16.6/16.6 I/C/M).Guanosine monophosphate (GMP) however was found to be most prominent 209.10 ± 0.24 in the blend with more chicken 16.6/66.7/16.6 (I/C/M). The lowest value 99.30 ± 0.16 of GMP was found in the blend that contained equal quantities of the three ingredients.

Table 4: Umami Taste Compounds in Seasoning Powders

Sample I/C/M %	MSG %	Glutamic acid (mg/100g)	IMP (mg/100g)	GMP (mg/100g)
1(16.6/16.6/66.7)	0.22^{b} ± 0.08	363.44^{c}± 1.17	62.79^{b} ± 0.46	192.95^{c}± 0.65
2(16.6/66.7/16.6)	0.18^{a} ± 0.04	352.40^{b}± 0.32	63.34^{b} ± 0.18	209.10^{c}± 0.24
3(66.7/16.6/16.6)	0.24^{c} ± 0.01	443.39^{d}± 1.44	70.96^{c} ± 0.17	110.62^{b} ± 0.33
4(33.3/33.3/33.3)	0.24^{c} ± 0.02	290.61^{a} ± 0.33	56.18^{a} ± 0.16	99.30^{a} ± 0.16

Results are reported as mean ± standard deviation of triplicate determinations. Means with the same superscript are not significantly different at $p<0.05$

Sensory Properties of the Seasoning Powders

Table 5 shows the sensory properties of the seasoning powders prepared by blending Iru, chicken and shiitake mushroom powders. The highest score for appearance was observed in the blend containing 16.6% iru, 66.7% chicken and 16.6% mushroom. On the other hand the blend containing 66.7% iru 16.6% chicken and 16.6% mushroom had the highest score for taste and appearance. This could be as a result of its high glutamic acid content. This particular blend was therefore considered to be the most acceptable product.

Table 5: Sensory Properties of the Seasoning Powders

Sample I/C/M %	Appearance	Taste	General Acceptability
1(16.6/16.6/66.7)	$7.11^{a} \pm 0.08$	$6.31^{a} \pm 1.17$	$6.27^{a} \pm 0.46$
2(16.6/66.7/16.6)	$8.18^{c} \pm 0.24$	$7.22^{b} \pm 0.32$	$6.95^{b} \pm 0.18$
3(66.7/16.6/16.6)	$7.52^{a} \pm 0.21$	$8.76^{d} \pm 1.44$	$8.22^{d} \pm 0.17$
4(33.3/33.3/33.3)	$7.98^{b} \pm 0.02$	$7.67^{c} \pm 0.43$	$7.55^{c} \pm 0.16$

Conclusion

Knowledge contribution

Food seasoning powder can be produced from a combination of fermented African locust bean, chicken and mushroom powders. The most acceptable product was that which contained 66.7% iru, 16.6% chicken and 16, 6% mushroom powders**.** This seasoning powder blend has a high protein content, and when used as a spice, it can provide good nutrition for human health, been selected as the best formula with a good combination of other ingredients. This product has higher protein content than seasoning powder made from other sources, so it is very suitable for people with protein needs and can be used to replace part of seasoning powder from meat/fish/shrimp. This seasoning powder also contains very little monosodium glutamate unlike other seasoning powders commonly sold in the markets. This provides a healthier solution for people sceptical about consuming the controversial MSG which is said to be the cause of many health issues. The work is significant because it investigates a more nutrient-dense and possibly healthier substitute for commercial seasonings, which sometimes contain high levels of monosodium glutamate (MSG). By emphasizing the nutritional, functional, and sensory qualities of theseseasoning powders, it advances the fields of food science and nutrition. The study also encourages the use ofregionally accessible and culturally relevant foods, which can help ensure food security and sustainable production methods.

Recommendation

However, it is recommended that technological improvements applied and tested on a larger production scale to develop this new product for the food technology industry with the goal of utilizing locally available products for food seasoning..

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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