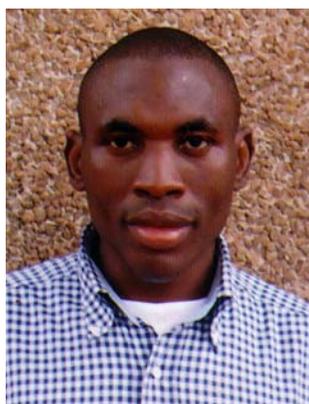


PEER REVIEWED ARTICLE No 8

METHODS OF PREPARATION AND THE ENERGY, PROTEIN AND MINERAL VALUES OF THREE CAMEROONIAN DISHES: "CORN CHAFF", "NNAM OWONDO/EBOBOLO" AND "NNAM NGON/EBOBOLO"

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ABSTRACT

This study analyses the different methods of preparation and the nutritional value of three Cameroonian dishes. These are: "Corn chaff", "Nnam Owondo/Ebobolo" and "Nnam Ngon/Ebobolo". "Corn chaff" is a mixture of corn (*Zea mays* L.), beans (*Phaseolus vulgaris*) and palm oil (*Elaeis guinensis*). "Nnam Owondo/Ebobolo" is made up of groundnut paste (*Arachis hypogaea*) and cassava paste (*Manihot utilisima*). "Nnam Ngon/Ebobolo" is made up of egusi paste (*Cucumeropsis mannii*) and cassava paste (*Manihot utilisima*). The moisture, ash, protein, lipid, fibre and carbohydrate contents were determined using standard methods. The mineral contents (magnesium, copper, iron and zinc) were determined by Atomic Absorption Spectrophotometry. A survey of these dishes in the market gave the quantity and the cost of each dish sold: A serving of "Corn chaff" which costs 200F CFA, weighs 641g; that of "Nnam Owondo/Ebobolo" which costs 150F CFA weighs 566g and that of "Nnam Ngon/Ebobolo" which costs 150F CFA weighs 507g. The proximate analysis gave the following nutritive content: moisture (67.9; 49.5 and 53.4 g/100g F.W), ash (4.30; 1.77 and 1.54 g/100g D.W), protein (11.7; 8.96 and 7.36 g/100g D.W), lipid (17.6; 13.5 and 7.79 g/100g D.W), fibre (3.18; 1.86 and 0.84 g/100g D.W), carbohydrate (63.3; 73.8 and 82.5 g/100g D.W), magnesium (95; 108.9 and 97.9 mg/100g D.W), copper (0.57; 0.27 and 0.23 mg/100g D.W), iron (6.08; 2.97 and 3.87 mg/100g D.W) and zinc (3.74; 3.29 and 3.14 mg/100g D.W) for "Corn chaff", "Nnam Owondo/Ebobolo" and "Nnam Ngon/Ebobolo" respectively. The content in nutrients shows that "Corn chaff" is balanced with respect to the proportions of protein, lipid and carbohydrate energy. On the other hand, "Nnam Owondo/Ebobolo" and "Nnam Ngon/Ebobolo" have low proportions of protein and lipid energy. The contents in minerals (Mg, Cu, Fe, and Zn) are low. The quantities actually ingested enable the coverage of 64; 69 and 45 % of the protein allowances and 31; 42 and 33% of the energy allowances for the three dishes respectively, for an averagely active adult. For a good nutritional balance, it is recommended to consume a greater quantity of "Nnam Owondo" and "Nnam Ngon with smaller quantities of "Ebobolo".

Key words: Cameroonian dishes, preparation, nutritional value.

FRENCH**RESUME**

*Dans le cadre général de la valorisation des aliments camerounais prêts à la consommation, trois plats alimentaires sont étudiés du point de vue de leurs protocoles de cuisson, de leurs valeurs nutritionnelles et des quantités de protéine, d'énergie et de minéraux qu'ils apportent aux consommateurs. Le "Corn chaff" est un mélange de maïs (*Zea mays* L.), de haricot (*Phaseolus vulgaris*) et d'huile de palme (*Elaeis guinensis*). Le "Nnam Owondo/Ebobolo" est un plat composé à base de pâte d'arachide (*Arachis hypogaea*) et de pâte de tubercule de manioc (*Manihot utilisima*). Le "Nnam Ngon/Ebobolo" est un plat composé à base de pâte de graines de courge (*Cucumeropsis mannii*) et de pâte de tubercule de manioc (*Manihot utilisima*). La teneur en eau, cendre, protéine, lipide, fibre et glucide est déterminée par les méthodes standards. Les minéraux (magnésium, cuivre, fer et zinc) par spectrophotométrie d'absorption atomique. L'enquête*

auprès des vendeuses a donné les quantités d'aliments vendues actuellement sur le marché pour chacun des plats : 641,7g (200F CFA); 566,7 g (150F CFA) et 507,8 g (150F CFA) respectivement pour le "Corn chaff", le "Nnam Owondo /Ebobolo" et le "Nnam Ngon/Ebobolo". Les analyses ont donné les teneurs en principes nutritifs suivantes: eau (67,9; 49,5 et 53,4 g/100g M.F), cendre (4,30; 1,77 et 1,54 g/100g M.S), protéide (11,7; 8,96 et 7,36 g/100g M.S), lipide (17,6; 13,5 et 7,79 g/100g M.S), fibre brute (3,18; 1,86 et 0,84 g/100g M.S), glucide (63,3; 73,9 et 82,5 g/100g M.S), magnésium (95,0; 108,1; 97,9 mg/100g M.S), cuivre (0,58; 0,27; 0,24 mg/100g M.S), fer (6,08; 2,99; 3,87 mg/100g M.S), zinc (3,74; 3,29; 3,14 mg/100g M.S) respectivement pour le "Corn chaff", le "Nnam Owondo/Ebobolo" et "Nnam Ngon/Ebobolo". Les taux de couverture des apports journaliers pour les adultes modérément actifs sont les suivants: protéides (64,8; 69,3 et 45,7 %), énergie (31,4; 42,9 et 33,8%), magnésium (16,3; 25,9; 19,3%), cuivre (11,8; 7,70; 5,50), fer (6,9; 4,7; 5,1), zinc (12,8; 15,7; 12,4) respectivement pour le "Corn chaff", le "Nnam Owondo/Ebobolo" et le "Nnam Ngon/Ebobolo".

Mots clés : Plats camerounais, préparation, apports nutritionnels.

INTRODUCTION

In Africa in general and in Cameroon in particular, there are many dishes, which are very much appreciated by the consumers, whose methods of preparation are mastered by housewives. Unfortunately, some of these dishes disappear with the death of a certain generation of old women. Rural - urban exodus has not enabled the girls to learn from their mothers how to prepare these dishes. It is thus necessary to rationalise the methods of preparation of these dishes in order to know them better, to determine their nutritive value and enhance it. Four hundred (400) ways of preparing dishes from the main foodstuffs in Cameroon have been described [1]. However, their description was neither exhaustive nor quantitative, because the quantities of ingredients were not specified.

Some data is also available on the nutritional value of Cameroonian cooked foods. These include the vitamin C content of certain tubers and plantains before and after cooking [2]; the fatty acid composition of some dishes prepared in North Cameroon [3]; the composition of some dishes prepared traditionally in an urban area (Yaoundé) [4]; the chemical composition of some dishes prepared traditionally by the Bassa community [5]; the content of some important mineral salts in traditional sauces of the west province of Cameroon [6]; the nutritive value of some dishes consumed in some rural areas in the West province of Cameroon [7]; the protein and mineral contents of Cameroonian dishes [8] and a study of the nutritional potential of some traditional dishes consumed in a rural area in the far North province of Cameroon [9].

These studies, however, exhibit some gaps, because of the absence of specific data on the food determined, making a reproduction of this food for laboratory needs impossible. Other studies on Cameroonian foodstuffs have focussed on their nutritive value without considering the effects of cooking or technological treatments on the level of nutrients in cooked food [10, 11]. The results of these studies, although useful in optimising processes of technological transformation, have a limited scope in food and Human Nutrition.

This study is focused on quantifying the ingredients used by housewives in cooking, describes the cooking methods so as to make it possible to prepare the same food in the laboratory or within an industrial context for the dishes chosen. The determination of the

nutrients and the quantification of the actual protein, energy and mineral values of these dishes will facilitate their use in the management of malnutrition, which is still a public health problem in Cameroon. In fact, Protein-energy deficiencies affect 192 million children of less than 5 years old in Africa, and micronutrient deficiencies affect more than 2 billion persons [12]. "Corn chaff", "Nnam Owondo/Ebobolo" and "Nnam Ngon/Ebobolo" were chosen mainly because they comprise a mixture of cereals or tubers and leguminous seeds with known nutritional importance of these raw foodstuffs [13]. However, for a given community, foods complementary to these dishes in the food ratio should be studied in the same way so that the nutrition of the community can be mastered.

MATERIALS AND METHODS

Food Samples

Among the women selling cooked food in the Melen Market in Yaounde, 30 were chosen to take part in this study. This market was chosen because it is one of the markets where these dishes are mostly sold and it is closer to the University of Yaounde I, where the analyses were carried out. The 30 women chosen were among the highest sellers of the dishes to be studied, who willingly accepted to take part in the study. After making contacts with some of these sellers, unplanned visits were made to their homes, in order to observe the different steps of cooking, note the duration of cooking, identify the ingredients and weigh the quantities used. These samples were bought in such a manner as to have 6 samples per dish. In order to limit our influence on the quantity of "Corn chaff" being measured for sale, we sent persons unknown to the vendors to buy our samples. The samples bought were kept in a freezer at -18°C up to the time of the analysis. However, the moisture content was determined on fresh samples.

The main ingredients of "Corn chaff" are corn (*Zea mays* L.), red beans (*Phaseolus vulgaris*) and palm oil (*Elaeis guinensis*). "Nnam Owondo/Ebobolo" is a dish made up of "Nnam Owondo" which is groundnut paste (*Arachis hypogaea*), and "Ebobolo" is a paste prepared from cassava (*Manihot utilissima*). The proportion of the components for a serving is 1 "Nnam Owondo" for 3 "Ebobolo". "Nnam Ngon/Ebobolo" is made up of "Nnam Ngon" which is a paste prepared from egusi seeds (*Cucumeropsis mannii*) and "Ebobolo" in the proportion 1 "Nnam Ngon" for 5 "Ebobolo".

The various methods of preparation of the different dishes are found in Fig. 1 and 2 below.

Fig 1-A: Preparation of "Corn chaff"

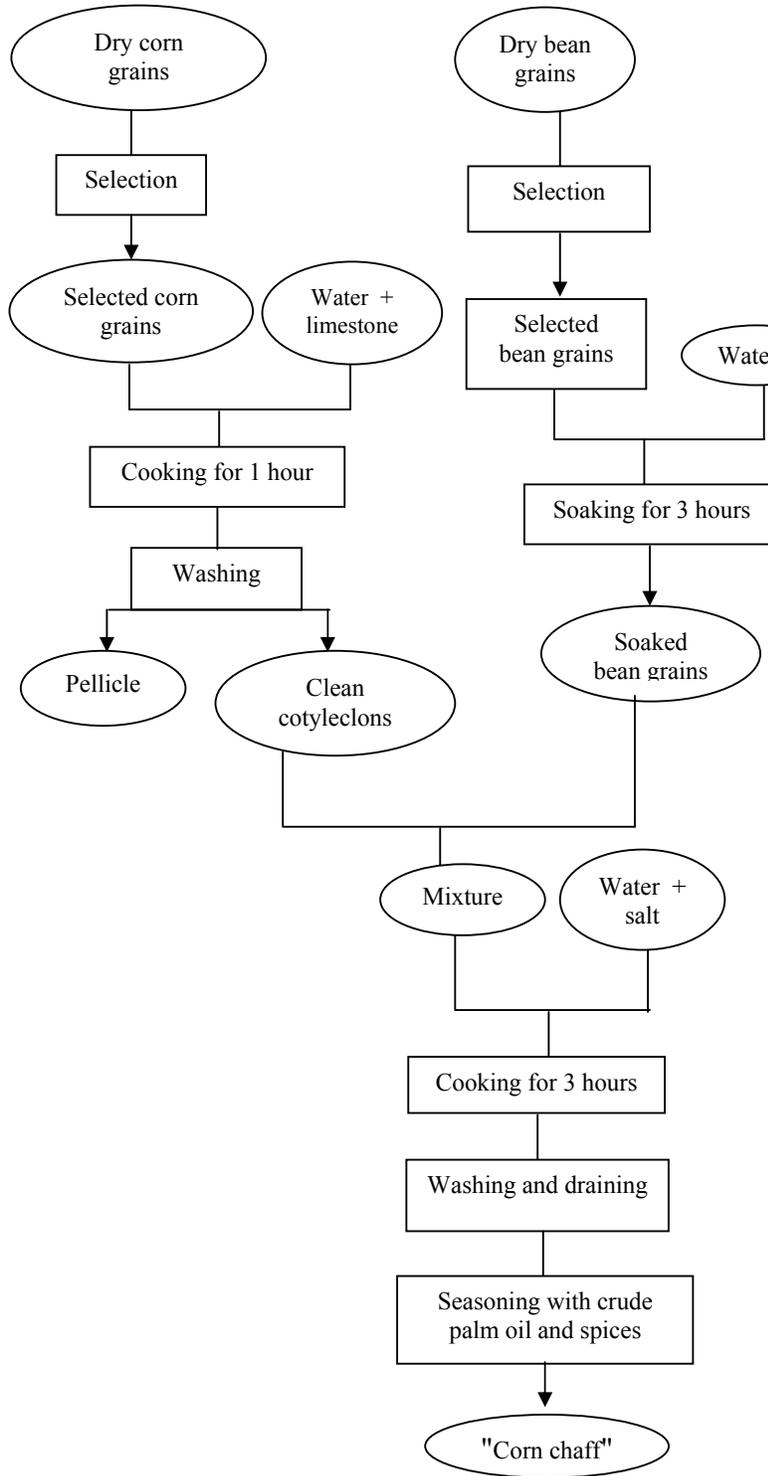


Fig 1-B: Preparation of "Ebobolo"

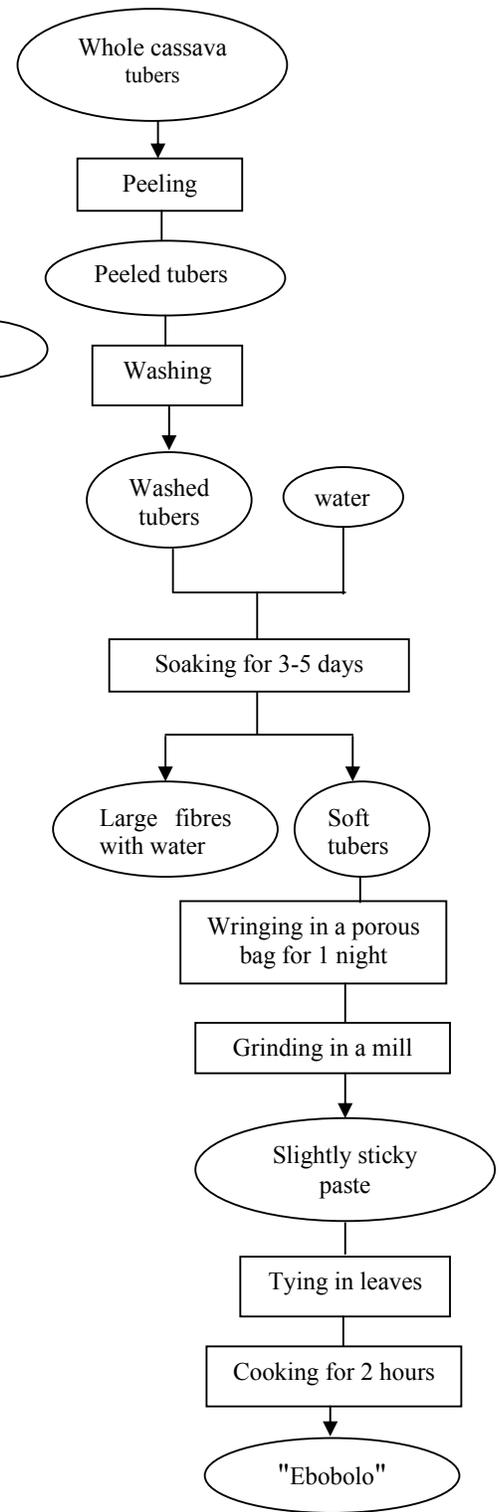


Fig 2-A: Preparation of “Nnam Owondo”

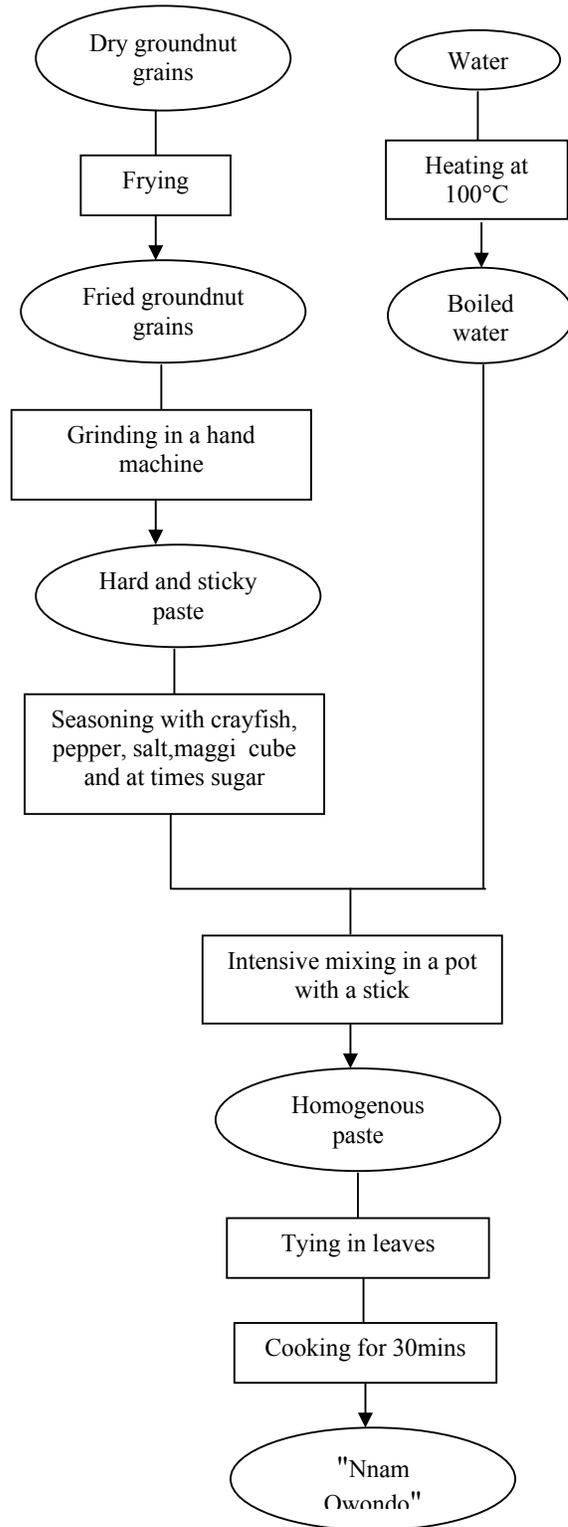
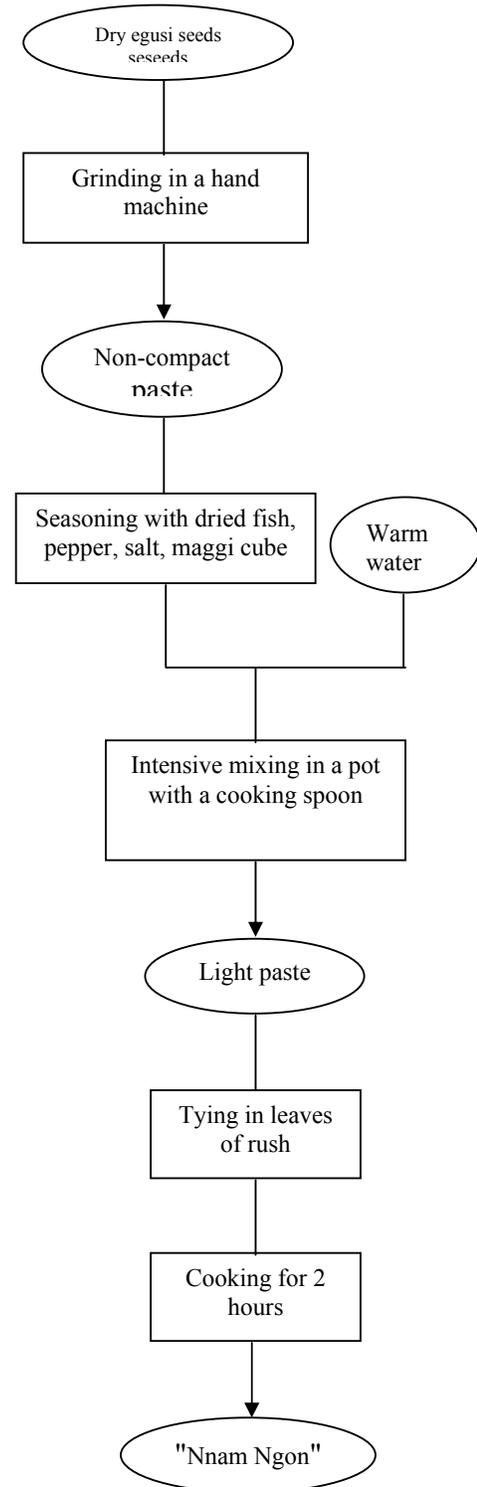


Fig 2-B: Preparation of “Nnam Ngon”



Proximate and Statistical Analysis

The moisture content was determined by drying in an ordinary Oven at 103°C to a constant weight, ash determination was by simple incineration in a Furnace, «PROLABO" at 550°C for 48 hours. The following were also determined: protein by determination of nitrogen using the micro method of Kjeldahl, using 6.25 as the conversion factor of nitrogen to protein, lipid by extraction with petroleum ether at 40-60°C in a Soxhlet apparatus for 6 hours, crude fibre by successive digestion of the defatted sample with H₂SO₄, 0.26N and KOH, 0.23N and carbohydrate by difference [14]. The mineral content (magnesium, copper, iron and zinc) was determined by Atomic Absorption Spectrophotometry [15]. The level of coverage of minerals was calculated from Standard values for adults [16]. The energy value was calculated using the Atwater coefficients (4 Kilocalories of energy per gram of protein and carbohydrate, and 9 kilocalories of energy per gram of lipid). The level of coverage of protein and energy was calculated from Standard values for adults [17].

The statistical analysis of data was by Analysis of Variance (ANOVA) using 5% level of significance with the package being SPSS 7.5. This enabled us to see the significant differences between the ingredients used for preparing the various dishes and the nutrients of the dishes studied. The Duncan multiple range statistical test was used to compare between means.

RESULTS

The results are presented on the tables below.

Results of Survey

Table 1 shows the weights of the ingredients used by the different women to prepare 1000g of each dish as it is consumed. From this table, the main ingredients for these dishes are corn, beans, palm oil, groundnut and egusi seeds. Table 2 shows the cost and weight of a serving of each dish as it is sold.

Results of Analysis

Table 3 shows the nutritional value of the different dishes and table 4 shows the nutritional value and levels of coverage of the dietary allowances per adult. The moisture content is given in grams per 100grams fresh weight (g/100g F.W) and the contents in ash, protein, lipid, crude fibre and carbohydrate are given in grams per 100grams dry weight (g/100g D.W). The magnesium, copper, iron and zinc contents are given in milligrams per 100 grams dry weight (mg/100g D.W). The values are given in the form: mean ± standard deviation.

DISCUSSION

From table 1, the main ingredients of "Corn chaff" are corn, beans and palm oil, which represent about 25%, 13% and 8% respectively of the weight of the food as it is consumed. The rest of the constituents represent only 3.5%, while the water added during cooking represents 57% of the cooked food. It was noticed that the weight of the food after cooking was different from the sum of the ingredients due to the water absorbed during the preparatory phase and the water that evaporated during cooking.

"Nnam Owondo" and "Nnam Ngon" are dishes with one main ingredient: dry groundnut and egusi seeds respectively. These seeds are very rich in oil and so kitchen oil is not used again to cook them. The water used in cooking represents about 19% and 45% of the weight of "Nnam Owondo" and "Nnam Ngon" respectively. The Analysis of Variance showed a significant difference between the quantities of maggi cube, salt, pepper, crayfish and water used for preparing these dishes ($P < 0.05$). The Duncan multiple range test showed no significant difference between the quantities of maggi cube and salt used for preparing "Nnam Owondo" and "Nnam Ngon" ($P > 0.05$).

From table 2, for a serving of "Nnam Owondo/Ebobolo" of 150F CFA, the weight of "Ebobolo" is 3 times greater than that of "Nnam Owondo" (proportion in weight is 1/3) while for a serving of "Nnam Ngon/Ebobolo" of 150F CFA, the weight of "Ebobolo" is 5 times greater than that of "Nnam Ngon" (proportion in weight is 1/5).

From table 3, the moisture contents of the dishes analysed range from 49.5 ("Nnam Owondo/Ebobolo") to 67.9 /100g F.W ("Corn chaff") with significant differences between all the dishes ($P < 0.05$). The high water content of "Corn chaff" is due to the fact that much water is used for its preparation. The ash contents of the dishes range from 1.54 ("Nnam Ngon/Ebobolo") to 4.30g/100g D.W ("Corn chaff") with significant differences between all the dishes ($P < 0.05$). The Duncan multiple range tests showed no significant difference between the ash contents of "Nnam Owondo/Ebobolo" and "Nnam Ngon/Ebobolo" ($P > 0.05$). The protein contents of the dishes range from 7.36 ("Nnam Ngon/Ebobolo") to 11.7 g/100g D.W ("Corn chaff") with significant differences between all the dishes ($P < 0.05$). These values are lower than those for a reference dish, which is estimated to be 15% [18]. The mixture of corn (which is poor in lysine but rich in methionine) with beans, (which is poor in methionine but rich in lysine), is a good nutritional practice [19]. The lipid contents of the dishes range from 7.79 ("Nnam Ngon/Ebobolo") to 17.6 g/100g D.W ("Corn chaff") with significant differences between all the dishes ($P < 0.05$). Only "Corn chaff" has a lipid content compared to the 18% for a reference dish [18]. Crude palm oil used for preparing this dish is very important because it provides Beta – carotene, which is a precursor of Vitamin A, which plays several roles such as promotion of growth, plays an important role in vision and protects the body against infection and cancer [20]. The fibre contents of the dishes range from 0.84 ("Nnam Ngon/Ebobolo") to 3.18 g/100g D.W ("Corn chaff") with significant differences between all the dishes ($P < 0.05$). These fibres protect the body against colon cancer, diabetes and cardiovascular illnesses [21]. The carbohydrate contents of the dishes range from 63.3 ("Corn chaff") to 82.5 g/100g D.W ("Nnam Ngon/Ebobolo") with significant differences between all the dishes ($P < 0.05$). The carbohydrate content of "Corn chaff" is not very different from that of a reference dish, which is estimated to be 67% [18]. The magnesium contents of the dishes range from 95 ("Corn chaff") to 108.9 mg/100g D.W ("Nnam Owondo/Ebobolo") with significant differences between all the dishes ($P < 0.05$). The Duncan multiple range test showed no significant difference between the magnesium contents of "Corn chaff" and "Nnam Ngon/Ebobolo" ($P > 0.05$). The copper contents of the dishes range from 0.24 ("Nnam Ngon/Ebobolo") to 0.58 mg/100g D.W ("Corn chaff") with significant differences between all the dishes ($P < 0.05$). The iron contents of the dishes range from 2.99 ("Nnam Owondo/Ebobolo") to 6.08 mg/100g D.W ("Corn chaff") with significant differences between all the dishes ($P < 0.05$). The Duncan multiple range test showed no significant difference between the copper and iron contents of "Nnam Owondo/Ebobolo" and "Nnam Ngon/Ebobolo" ($P > 0.05$). The zinc contents of the dishes range from 3.14 ("Nnam

Ngon/Ebobolo") to 3.74 mg/100g D.W ("Corn chaff") with no significant difference between all the dishes ($P > 0.05$).

According to the energy profile for a balanced diet, which is 10 to 15% for protein calories, 30 to 32% for lipid calories and 55% for carbohydrate calories [22], only "Corn chaff" shows a good balance (10; 34 and 55%). The two other dishes are unbalanced due to less proteins and lipids and an excess of carbohydrates (8; 26 and 65%) for "Nnam Owondo/Ebobolo" (6; 16 and 77%) and "Nnam Ngon/Ebobolo" (tables 3 and 4). In order to reduce the protein deficiency of these two dishes, the quantity of "Nnam Owondo" and "Nnam Ngon" should be increased while that of "Ebobolo" remains the same (ratio of 1:1).

From table 4, a serving of "Corn chaff" covers close to 65% of the protein allowance for an averagely active adult, while only 31% of the energy value is covered. This low energy density with respect to protein, 39.3 Kcal/g of protein is due to the high fibre content. This dish can be recommended for hypocaloric and normoproteic diets. The energy density of "Nnam Owondo/Ebobolo" is 50.2 Kcal /g of protein and that of "Nnam Ngon/Ebobolo" is 59.90 Kcal /g of protein. Eating two servings of "Nnam Owondo/Ebobolo" per day covers 91% of the energy value but puts the body on a protein overload. On the other hand, eating two servings of "Nnam Ngon/Ebobolo" covers 91% of the protein value and about 67% of the energy value.

From the contents in minerals, these dishes cannot be considered as important sources of minerals, especially iron whose level of coverage is about 5% in an adult. Magnesium, whose role in energy metabolism is well known, only covers 16 to 25 % of the recommended values. The iron levels in the dishes being low, they can be recommended for people suffering from malaria fever. In fact, foods with a high content of iron exacerbate malaria fever in times of crises [23, 24].

CONCLUSIONS AND RECOMMENDATIONS.

"Corn Chaff" as it is prepared is a balanced diet. Its low energy density per gram of proteins makes it a dish that can be recommended for use in hypocaloric and normoprotein diets. "Nnam Owondo/Ebobolo" and "Nnam Ngon/Ebobolo" are two unbalanced diets, due to the low levels of proteins and lipids, but excess carbohydrates. This imbalance can be improved by reducing the quantity of "Ebobolo" in these dishes or by increasing the quantities of "Nnam Owondo" and "Nnam Ngon" in a serving of dish, while that of "Ebobolo" remains the same (ratio of 1:1).

The mineral levels of these dishes are low, such that the quantities of food consumed per meal cover less than 20% of the required values. Since most of the consumers are low-income earners, these dishes are usually eaten without any other sources of nutrients such as fruits and vegetables. It will be interesting to study how the mineral levels of these dishes can be improved with acceptable organoleptic characteristics and costs.

TABLES

Table 1:

Weights (g) of ingredients for 1000g of Dish

Dish					
"Corn chaff"		"Nnam Owondo"		"Nnam Ngon"	
Ingredients	Weight of Ingredient (g)	Ingredients	Weight of Ingredient (g)	Ingredients	Weight of Ingredient (g)
Dry corn grains (<i>Zea mays</i> L.)	248.3 ± 17.9	Dry groundnut grains (<i>Arachis hypogaea</i>)	829.1 ± 26.3	Dry egusi seeds (<i>Cucumeropsis mannii</i>)	467.5 ± 22.4
Dry grains of red beans (<i>Phaseolus vulgaris</i>)	132.0 ± 24.2	Maggi cube	1.32 ± 0.29	Dried fish	85.8 ± 8.09
Raw palm oil (<i>Elaeis guinensis</i>)	80.7 ± 18.5	Kitchen salt	7.26 ± 0.90	Maggi cube	1.16 ± 0.18
Limestone	3.60 ± 0.86	Pepper (<i>Capsicum frutescens</i>)	6.21 ± 1.18	Kitchen salt	8.11 ± 0.97
Maggi cube	2.30 ± 0.59	Crayfish	7.93 ± 1.78	Pepper (<i>Capsicum frutescens</i>)	11.3 ± 2.06
Kitchen salt	3.70 ± 0.97	Sugar*	2.03 ± 0.75*	Water	453 ± 31.9
Pepper (<i>Capsicum frutescens</i>)	2.68 ± 0.85	Water	187.4 ± 20.2	/	/
Crayfish*	5.16 ± 1.11*	/	/	/	/
Onion (<i>Allium cepa</i>) *	8.40 ± 0.56*	/	/	/	/
Ginger (<i>Zingiber officinale</i>) *	6.66 ± 0.90*	/	/	/	/
Garlic (<i>Allium sativum</i>)	3.56 ± 0.55	/	/	/	/
Water	569 ± 7.99	/	/	/	/
Total weight of food after cooking	1000	Total weight of food after cooking	1000	Total weight of food after cooking	1000

*: Optional ingredient

Table 2

Weight (g) of a Serving of Dish

"Corn chaff" for 200 FCFA (1 plate)	641.7 ± 57.1
"Nnam Owondo" for 100 FCFA (1 bundle)	148.3 ± 17.2
"Nnam Ngon" for 100 FCFA (1 bundle)	89.5 ± 6.12
"Ebobolo" for 50 FCFA (1)	418.3 ± 26.4
"Nnam Owondo/Ebobolo" for 150 FCFA (1/3 w/w)	566.7 ± 32.6
"Nnam Ngon/Ebobolo" for 150 FCFA (1/5 w/w)	507.8 ± 30.3

Table 3

Nutritional Value of Dishes

Samples Parameters	"Corn chaff"	"Nnam Owondo/Ebobolo"	"Nnam Ngon/Ebobolo"
Moisture g/100g F.W	67.9± 2.24 ^a	49.5 ± 1.11 ^c	53.4± 0.81 ^b
Ash g/100g D.W	4.30± 0.88 ^a	1.77± 0.08 ^b	1.54± 0.01 ^b
Protein g/100g D.W	11.7± 1.42 ^a	8.96± 0.36 ^b	7.36± 0.03 ^c
Lipid g/100g D.W	17.6± 2.93 ^a	13.5± 0.48 ^b	7.79± 0.34 ^c
Fibre g/100g D.W	3.18± 0.48 ^a	1.86± 0.27 ^b	0.84± 0.02 ^c
Carbohydrate g/100g D.W	63.2± 2.56 ^c	73.9± 0.00 ^b	82.5± 0.00 ^a
Magnesium mg/100g D.W	95.0± 5.35 ^b	108.9 ± 0.00 ^a	97.9± 7.76 ^b
Copper mg /100g D.W	0.58± 0.08 ^a	0.27± 0.01 ^b	0.24± 0.02 ^b
Iron mg /100g D.W	6.08 ±2.19 ^a	2.99± 0.08 ^b	3.87 ± 0.45 ^b
Zinc mg /100g D.W	3.74 ± 1.65 ^a	3.29 ± 0.04 ^a	3.14 ± 0.09 ^a

F.W: Fresh Weight, D.W: Dry Weight

Means with different letter superscript within each row are significantly different (P < 0.05).

Table 4

Nutritional Value and levels of Coverage of the Dietary Allowances per adult for a serving of Dish

Dishes		"Corn chaff"	"Nnam Owondo/Ebobolo"	"Nnam Ngon/Ebobolo"
Protein values	g/ serving	24 ±3.01	25.6 ± 3.23	16.9 ± 2.25
	Level of coverage (%)	64.8	69.3	45.7
Energy values	Kcal/ serving	943.4	1288.7	1013.3
	Level of coverage (%)	31.4	43	33.8
Magnesium	g/serving	68.5	108.9	80.9
	Level of coverage (%)	16.3	25.9	19.3
Copper	g/serving	0.23	0.15	0.11
	Level of coverage (%)	11.8	7.70	5.50
Iron	g/ serving	0.63	0.42	0.46
	Level of coverage (%)	6.95	4.71	5.08
Zinc	g/ serving	1.54	1.88	1.49
	Level of coverage (%)	12.8	15.7	12.4

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