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Methods of preparation and nutritional evaluation of dishes consumed in a malaria endemic zone in Cameroon (Ngali II)

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This study deals with the description of the methods of preparation and determination of the nutritional potential of dishes consumed by Cameroonians living in a rural area, which is a malaria endemic zone, called Ngali II. The dishes consumed are prepared from leguminous seeds, seeds of the Cucurbitaceae family (egusi seeds), green leafy vegetables, tubers, cereals unripe bananas and plantains. The contents in moisture, ash, proteins, lipids, crude fibres and carbohydrates were determined by standard AOAC methods. The results obtained are expressed in percentage f.w for moisture and percentage d.w for ash, proteins, lipids, crude fibres and carbohydrates. The moisture content ranges from 57.77-86.17; ash, 0.66-14.74; proteins, 1.49-37.25; lipids, 0.26-54.98; crude fibres, 1.43-17.82 and carbohydrates, 3.51-95.76. This study revealed that a higher consumption of dishes made from leguminous seeds, egusi seeds, green leafy vegetables, and low consumption of tubers, unripe bananas and plantains will lead to a good nutritional balance.

Keywords: Dishes, preparation, nutritional potential, malaria.

INTRODUCTION

Malnutrition is a very serious health problem to humans. From the International Conference on Nutrition held in Geneva from the 18-24 August 1992, about 780 million people in the World are chronically undernourished. Protein Calorie insufficiency affects 192 million children below 5 years old and micronutrient deficiency affects more than 2 billion people (FAO, 1992). These have led to many illnesses such as kwashiorkor, marasmus, goitre, obesity, diabetes, cancer and cardiovascular illnesses (Latham, 1997). Cameroon, despite its food diversity, is not exempted from nutritional problems.

Lowé et al. (1993) showed that the prevalence of nutritional pathology is high in Cameroon, especially in the vulnerable groups of the population where protein-calorie malnutrition and micronutrient deficiencies are high. These pathologies lead to high juvenile-infant morbidity. Well-nourished populations are better placed to resist tropical endemic diseases such as malaria (Dupin, 1984). Infact, previous studies like those of Tanner et al. (1987) in Tanzania, Pereira et al. (1995), Razanamparany et al. (1995) in Madagascar, Man et al. (1998) in Gambia, Tonglet et al. (1999) in Central Africa, showed that protein-calorie malnutrition favours the evolution of malaria.

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To fight against it, knowledge of the nutritional value of prepared dishes that are ready for consumption is necessary. Unpublished works by ICIDR (malaria project) showed a malaria prevalence of 57.2% and 52% in 1998 and 2002, respectively, in Ngali II. This work is therefore aimed at describing the methods of preparation and determination of the contents in moisture, ash, proteins, lipids, crude fibres and carbohydrates in 32 dishes consumed in the Ngali II malaria endemic zone.

MATERIALS AND METHODS

Collection and Treatment of Samples

Fifty (50) families were chosen at random in the area of study (Ngali II) which is a malaria endemic zone located at about 30 Km from the Yaounde city with a homogenous ethnic background. The food samples were collected from these families after a survey of the cooking methods and consumption of the dishes throughout the year 2002. The collected dishes were stored at -18°C until the time of analyses. The moisture content was determined using the unfrozen sample. Each type of dish except the complement was collected from six different families and analysed separately. The various dishes are found on Table 1 below which contain the list of dishes presently consumed in Ngali II. These dishes are numbered in alphabetical order from 1 to 32. The vernacular names, the forms of the dishes, the main ingredients and scientific names for each food are found on this table for easy recognition.

This table shows that the dishes consumed in Ngali II, are made up of light or thick sauces prepared from several green leafy vegetables, leguminous seeds, egusi seeds, pastes prepared from leguminous and cucurbit seeds, consumed with different tubers and plantains as complements.

Preparation of Dishes

Light sauces

Fian Ngon and Fian Ongoualik: This is prepared from egusi seeds that are ground into a paste with a grinding mill. A dried pot is placed on the cooker and palm oil is put inside and bleached. Onion is sliced and added into the oil. Once fried, ground or chopped fresh tomatoes are added. The mixture is stirred until the tomatoes get ready. Water is added from previously soaked smoked fish. When this boils, the egusi paste, which had also been soaked with salt and pepper is added. It is then allowed to boil on low heat for about 1 h 30 min. The sauce obtained is eaten with several complements such as tubers, rice and plantains.

Fian Owondo: It is prepared as above except that egusi seeds are replaced by roasted groundnut seeds (peanut seeds).

Fian tomate: Sliced or ground tomatoes are fried in bleached oil. A small quantity of water is added to it to obtain a light sauce.

Pes: It is prepared as "Fian Owondo" except that at the end of the cooking, ground or sliced okra fruits are added.

Thick sauces

The consistency of these sauces is due to the presence of several green leafy vegetables involved in their preparation.

Coucouma: Its preparation is similar to that of "Fian Owondo". Sliced and boiled leaves of *Amaranthus* are added into the sauce.

Etondo Salé: It is prepared as above. Here sliced and boiled leaves of the garden eggplant replace amaranthus leaves.

Etondo non Salé: It is similar to that of "Etondo salé" except that palm oil is replaced by palm nut juice and salt is not added into the food.

Kwemp non salé: Its preparation is similar to that of "Etondo non salé" except that it is prepared without groundnuts. The garden eggplant leaves are replaced by sliced and boiled cassava leaves.

Kwemp salé: It is prepared like "Fian Owondo" but sliced and boiled cassava leaves are added.

Lombo: It is prepared like "Kwemp salé" with the cassava leaves replaced by sliced and boiled cocoyam leaves.

Midjem: It is prepared as in "Lombo" except that cocoyam leaves are replaced by sliced and boiled melon leaves. The sauce is non-salted and palm nut juice is added.

Nnem Salé: It is prepared as "Kwemp salé" except that cassava leaves are replaced by sliced and boiled *Corchorus* leaves.

Nnem non salé: It is prepared as "Nnem salé", except that salt is not added. The leaves of *Corchorus* are replaced by sliced, boiled okra leaves. Palm nut juice is used.

Okok: It is prepared as in "Nnem salé", but *Corchorus* leaves are replaced by finely chopped, boiled leaves of "Okok".

Zom salé: It is prepared as in "Okok" but the "Okok" leaves are replaced by sliced, boiled huckle berry leaves.

Zom non salé: It is prepared as in "Zom salé" except that palm nut juice is used and sweet "Zom" leaves are replaced by bitter sliced, boiled "Zom" leaves.

Meals prepared from ungrounded grains and seeds

Oles bouilli: External particles are selected from rice and the rice is washed several times with water. The washed rice is placed into the boiled water in the pot and salted. It is carefully followed up to prevent the rice from burning in the pot. Small amounts of excess boiled water are added if the water dries off in the pot. The rice is ready as the grains become soft.

Oles sauté: It is prepared as in "Oles bouilli" except that bleached palm oil is added.

Sanga: It is prepared from fresh maize grains and cassava leaves. Fresh maize grains are mixed with sliced cassava leaves and palm nut juice is added, with no salt. Sugar is also added into the mixture.

Kon: Bean seeds are soaked, boiled and washed. They are fried in bleached palm oil containing tomatoes, salt and pepper.

Meals prepared from tubers

Mbou, Mebanga, Mebouna: Peeled tubers (cassava, cocoyam

Table 1. List of dishes consumed in Ngali II.

Number of the food	Vernacular name in "éton"	Forms of the foods	Main ingredients	Scientific names of main ingredients
1	"Condrès"	Pieces	Banana + groundnut + palm oil	<i>Musa sp.</i>
2	"Coucouma"	Thick sauce	Leaves of Amaranthus + groundnut + palm oil	<i>Amaranthus hybridus</i>
3	"Ebobolo"	Bundle	Cassava tuber	<i>Manihot esculenta</i>
4	"Etondo salé"	Thick sauce	Leaves of garden egg plant + groundnut+ palm oil	<i>Solanum macrocarpum</i>
5	"Etondo non salé"	Thick sauce	Leaves of garden egg plant + groundnut + palm oil juice without salt	<i>Solanum macrocarpum</i>
6	"gonFian N"	Light sauce	Large egusi seeds + palm oil	<i>Curcumeropsis mannii</i>
7	"Fian Ongoualik"	Light sauce	Small egusi seeds + palm oil	<i>Curcumeropsis mannii</i>
8	"Fian Owondo"	Light sauce	Groundnut + palm oil	<i>Arachis hypogea</i>
9	"Fian tomate"	Light sauce	Tomato + palm oil	<i>Lycopersicum esculentum</i>
10	"Ikouan"	Piece	Plantain	<i>Musa sp.</i>
11	"Kon"	Seed	Beans + palm oil	<i>Phaeolus vulgaris</i>
12	"Kwemp non salé"	Thick sauce	Cassava leaves + palm nut juice without salt	<i>Manihot utilisima</i>
13	"Kwemp salé" "	Thick sauce	Cassava leaves + groundnut + palm oil	<i>Manihot utilisima</i>
14	"Lombo"	Thick sauce	Leaves of cocoyam + groundnut + palm oil	<i>Xanthosoma sp.</i>
15	"Mbou"	Piece	Cassava tubers	<i>Manihot esculenta</i>
16	"Mebanga"	Piece	Cocoyam tubers	<i>Xanthosoma sp.</i>
17	"Mebouna"	Piece	Sweet potato tubers	<i>Ipomea batatas</i>
18	"Mendjana Mebanga"	Piece	Cocoyam tubers + palm oil	<i>Xanthosoma sp.</i>
19	"Midjem"	Thick sauce	Melon leaves + groundnut + palm nut juice without salt	<i>Cucumis sp.</i>
20	"Nnam Ngon"	Paste	Paste with large egusi seeds	<i>Curcumeropsis mannii</i>
21	"Nnam Ongoualik"	Paste	Paste with small egusi seeds	<i>Curcumeropsis mannii</i>
22	"Nnam Owondo"	Paste	Paste with groundnut	<i>Arachis hypogea</i>
23	"Nnem salé"	Thick sauce	Corchorus Leaves + groundnut + palm oil.	<i>Corchorus olitorius</i>
24	"Nnem non salé"	Thick sauce	Okra leaves+ palm nut juice without salt	<i>Hibiscus esculentus</i>
25	"Okok"	Thick sauce	<i>Gnetum</i> leaves + groundnut + palm nut juice without salt	<i>Gnetum africanum</i>
26	"Oles bouilli"	Grain	Rice	<i>Oryza sativa</i>
27	"Oles sauté"	Grain	Rice + palm oil	<i>Oryza sativa</i>
28	"Pes"	Light sauce	Groundnut + palm oil + okra	<i>Arachis hypogea</i> <i>Hibiscus esculentus</i>
29	"Salad"	Thick sauce	Waterleaves + groundnut + palm oil.	<i>Talinum fruticosum</i>
30	"Sanga"	Grain	Cassava leaves + fresh maize grains + palm oil juice without salt	<i>Zea mays</i>
31	"Zom salé "	Thick sauce	Sweet huckle berry leaves + groundnut + palm oil	<i>Solanum nigrum</i>
32	"Zom non salé "	Thick sauce	Bitter huckle berry leaves + groundnut + palm nut juice	<i>Solanum aethiopicum</i>

and sweet potatoes) are cut into pieces and boiled with water.

Medjana Mebanga: Preparation of cocoyam tubers with addition of palm oil, salt and pepper.

Ebobolo: Peeled cassava tubers are washed and soaked in water for 3 to 5 days. These tubers become soft. They are removed from the water and drained in a porous bag for about 24 h. They are then pounded or ground and tied in "jonc" leaves and cooked for 3 to 4 h.

Preparation of various pastes

Nnam Owondo: Dried groundnut seeds are roasted and ground. They are mixed with hot water. Smoked fish, salt and pepper are added, tied in "jonc" leaves and cooked.

Nnam Ngon and Nnam Ongoualik: Dried egusi seeds are ground and mixed with cold water. Smoked fish, salt and pepper are added and tied in "jonc" or bananas leaves and cooked.

Meals prepared from bananas and plantains

Ikouan: Peeled plantains are cut into pieces and boiled.

Condres: Peeled unripe bananas are cut into pieces, mixed with palm oil, groundnuts, salt, pepper and cooked.

Kjeldahl micromethod and conversion of nitrogen to proteins by the factor 6.25, total lipids by extraction in a Soxhlet apparatus for 6 h using petroleum ether as solvent, crude fibres by successive digestion of the defatted sample with 0.26 N sulphuric acid and 0.23 N potassium hydroxide solutions and carbohydrates by the difference method (AOAC, 1980).

Moisture Determination and Chemical Analysis

The moisture content was determined by drying in an oven at 103°C until constant weight, ash by incineration in a muffle furnace at 550°C for 48 h, proteins by nitrogen determination using the

RESULTS

The results of analysis are shown on Table 2. This gives the contents in moisture, ash, proteins, lipids, crude

Table 2. Nutrient Contents of Dishes.

Dishes	Moisture (g/100g f.w)	Ash (g/100g d.w)	Proteins (g/100g d.w)	Lipids (g/100g d.w)	Fibers (g/100 g d.w)	Carbohydrates (g/100g d.w)
1	77.36 ± 0.02	3.85 ± 0.22	6.61 ± 0.64	3.44 ± 0.01	5.10 ± 0.38	80.99
2	79.49± 9.04	9.24 ± 1.48	29.56± 1.08	37.09 ± 2.23	17.82± 0.40	6.29 ± 0.07
3	57.89± 0.48	0.80 ± 0.07	1.49 ± 0.31	0.51 ± 0.00	1.43 ± 0.09	95.76
4	68.70± 5.31	7.47 ± 0.28	25.37 ± 1.45	49.62± 1.02	14.55± 1.11	3.63± 1.25
5	73.29 ± 5.42	3.38 ± 1.51	28.31± 0.89	49.03± 0.57	16.10 ± 0.69	3.51± 0.47
6	81.13 ± 4.28	7.96 ± 1.15	31.77± 0.89	43.62± 2.034	9.58± 0.04	7.06± 0.05
7	80.39 ± 3.24	6.93± 0.98	33.91± 3.80	42.81± 4.57	8.82± 0.69	7.06± 0.05
8	82.703 ± 3.64	3.73± 0.83	32.27 ± 3.01	36.72 ± 2.81	8.99± 0.42	18.28± 5.54
9	69.87± 0.13	14.74 ± 0.88	9.43± 0.59	50.71 ± 0.78	5.45± 0.13	19.67± 0.00
10	76.60± 0.56	1.77± 0.72	3.48± 0.15	0.61 ± 0.12	5.93± 0.19	88.21
11	64.70 ± 0.49	6.22± 0.30	20.90± 0.70	19.98± 0.84	9.97± 0.40	42.93
12	82.79 ± 1.06	2.04± 0.25	17.36 ± 2.11	40.93 ± 2.39	15.54 ± 2.08	24.12± 4.04
13	77.46± 4.00	6.94 ± 1.25	28.97± 3.22	35.90 ± 3.26	14.29 ± 0.63	13.90± 2.72
14	81.63± 6.60	9.81 ± 0.13	28.93 ± 1.13	35.08± 2.21	12.84 ± 1.32	13.33 ± 1.01
15	57.77 ± 6.60	0.66± 0.01	1.90± 0.01	0.52± 0.00	1.86± 0.091	95.06
16	66.16 ± 0.17	3.49± 0.14	4.95± 0.16	0.26± 0.00	2.79± 0.19	88.50
17	66.73 ± 0.97	2.84 ± 0.66	3.86 ± 0.019	1.25 ± 0.12	3.12± 0.20	88.91
18	66.16± 0.17	6.32± 0.51	5.39 ± 0.63	12.72 ± 0.54	2.33± 0.01	73.24
19	80.47 ± 3.65	5.58 ± 1.49	22.04 ± 2.72	50.71± 4.86	13.08 ± 1.29	8.59 ± 2.97
20	61.13± 5.37	6.03 ± 1.00	33.59 ± 2.33	40.80± 0.32	8.18 ± 0.03	11.39± 1.92
21	60.18± 5.84	6.97 ± 1.04	37.25 ± 3.59	37.30± 0.86	8.13 ± 0.08	10.24± 1.60
22	41.55 ± 12.22	4.43± 0.19	35.76± 1.57	37.45± 0.51	7.67± 0.70	14.68± 1.57
23	77.91± 3.65	7.34 ± 0.78	27.03± 3.10	41.01 ± 4.93	17.73± 0.81	6.81 ± 2.19
24	79.53± 1.71	2.79 ± 1.19	19.92 ± 1.48	54.98 ± 4.94	16.26± 2.48	6.07± 1.51
25	63.44 ± 4.76	4.72± 0.30	20.74 ± 3.01	46.72± 5.48	15.23± 1.91	12.49 ± 4.31
26	74.60± 0.33	1.91± 0.36	7.25± 0.52	0.24 ± 0.06	5.62± 0.25	84.97
27	76.08 ± 0.14	2.74± 0.36	7.70 ± 0.30	5.16 ± 0.01	7.78± 0.01	76.59
28	77.15± 12.92	5.45± 0.99	26.08± 1.94	41.42 ± 7.62	6.88± 1.15	17.66 ± 4.06
29	86.17± 4.60	11.60 ± 0.15	27.2 ± 1.48	40.57 ± 1.36	15.94 ± 0.27	4.65 ± 2.41
30	72.13 ± 7.18	1.55 ± 0.12	10.54± 2.01	28.61± 2.38	11.85± 0.56	4.65 ± 1.45
31	76.60± 0.61	7.32 ± 0.73	21.69± 1.19	45.01 ± 0.54	15.90 ± 2.84	10.07 ± 1.189
32	74.75 ± 3.12	2.70 ± 0.18	21.12 ± 4.60	51.66 ± 5.55	13.89 ± 2.74	10.60 ± 5.13

fibres and carbohydrates of dishes expressed in grams per 100 g of dry weight (% d.w) except the moisture content which is expressed in grams per 100 g of fresh

weight (% f.w). The results presented here are average values for each sample collected from six different families and analysed separately except complements,

which are made up of a single ingredient. Three replications were done per sample. The results are given in the form: mean \pm standard deviation.

DISCUSSION

From Table 2, the moisture content ranges from 57.77% ("Mbou", 15) to 86.17% f.w ("Salad", 29). The high moisture content in these dishes is due to water added into the dishes during cooking.

The ash level ranges from 0.66% ("Mbou", 15) to 14.74% dw ("Fian tomate", 9). Theoretically, these values are proportional to the mineral salt values of food. The protein values range from 1.49% ("Ebobolo", 3) to 37.25% d.w ("Nnam Ongoualik", 21). From these analyses, it is seen that dishes made from leguminous seeds, egusi seeds and green leafy vegetables have high protein contents. In fact, Fokou et al. (2004) showed that egusi seeds are rich in protein (24.3 - 41.6% d.w), Fokou and Domngang (1987) showed that protein levels of green leafy vegetables range from 20.48 - 41.66% d.w. On the other hand, the complements that accompany them, such as tubers and plantains are poor in proteins. For a good protein balance, these inhabitants will benefit more by consuming greater quantities of dishes prepared from egusi seeds, leguminous seeds and green leafy vegetables, and lower quantities of their complements. This will enable each dish to attain a reference level of 15% of protein for a plate (Herberg et al., 1985). The protein levels of the sauces and pastes are higher than those of dishes consumed in a rural area of the Far North province of Cameroon with values ranging from 11.6-12.2% d.w (Teugwa et al., 1992, 1996). A higher consumption of "Nnam Ongoualik", "Nnam Ngon", "Fian Ongoualik" and "Fian Ngon" is to be encouraged in the inhabitants of Ngali II, which will greatly help in combating malnutrition and parasitic illnesses such as malaria.

The lipid levels of the dishes vary from 0.26% ("Mebanga", 16) to 54.98% d.w ("Nnem non salé", 24). The high, lipid levels observed in these sauces are due to the fact that the palm oil added increases the lipid levels in the leguminous and egusi seeds. These values are higher than those found by Domngang et al. (1989) in dishes consumed in some rural areas of the West Province of Cameroon, with values ranging from 15.08 - 35.3% d.w. Palm nut juice added in the preparation of some of these non salted thick sauces provides β - carotene which is a precursor of vitamin A, which among several roles, protects from cancer, contributes in the fight against infection, favours growth and plays an important role in vision. (Le Gruisse and Watier, 1993).

The crude fibre contents range from 1.43% ("Ebobolo", 3) to 17.82% d.w ("coucouma", 2). Crude fibres are important in these dishes because they protect the body from intestinal cancer, diabetics and cardiovascular

illnesses (Mottran, 1979). The carbohydrate contents range from 3.51% ("Etondo non sale", 5) to 95.76% d.w ("Ebobolo", 3 and Mbou, 15").

The results of these analyses show that dishes prepared from leguminous seeds, cucurbit or egusi seeds, and green leafy vegetables contain high protein and lipid levels while their complements (tubers, bananas and plantains) contain high carbohydrate levels. For a better nutritional balance, it is advisable for inhabitants of Ngali II to consume greater quantities of sauces or paste and smaller quantities of the different complements.

Further research is to be conducted to determine the micronutrient content and antinutritional factors present in these dishes and to determine the quantity of nutrients in a plate of food consumed each time by an individual in Ngali II, in order to better educate them nutritionally. This will prevent these people from contracting malaria and other illnesses.

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