

Full Length Research Paper

Nutritional survey, staple foods composition and the uses of savoury condiments in Douala, Cameroon

Marie M. Kana Sop¹, M. Fotso², I. Gouado^{1*}, E. Tetanye³ and P. H. Amvam Zollo⁴

¹University of Douala Faculty of Science, Department of Biochemistry, Douala, P. O. Box 24157, Cameroon.

²Centre for Research in Food and Nutrition, P. O. Box 6163, Cameroon.

³Faculty of Medicine and Biomedical Sciences, Cameroon.

⁴University of Ngaoundéré, Cameroon.

Accepted 23 January, 2008

Malnutrition and micronutrients deficiencies are serious public health problems in Cameroon as in other developing countries. Proteins, lipids, crude fibres and carbohydrates content of 15 recipes selected after a survey of 500 families were determined. Total contents ranged between 9.25 ± 0.53 and 16.86 ± 8.85 g/100 g DW for proteins, 10.64 ± 0.9 to 35.72 ± 8.56 g/100 g DW for lipids, 5.57 ± 2.14 to 38.8 ± 1.82 g/100 g for crude fibres and 24.11 ± 9.21 to 62.05 ± 3.02 g/100 g DW for carbohydrates. Glutamate contents of seven flavour enhancers ranged from 2.83% in Honig poulet to 13.87 % (W/W) in Maggi cube. More than 74% of the surveyed subjects regularly used cube-type savory condiments and 26% of the subjects used monosodium L-glutamate (MSG). MSG use was widespread in spite of a national ban on MSG use and importation, indicating high amounts of illegally imported MSG.

Key words: Cameroon, protein malnutrition, lysine, monosodium L-glutamate, staple foods.

INTRODUCTION

Low sensory quality of staple foods remains an overlooked nutritional problem in Cameroon, in spite of data showing that an increase in palatability stimulates appetite, potentially increasing the intake of macronutrients (that is, proteins), especially if staple foods are the only source of protein and energy. A FAO (2004) report indicated that protein malnutrition in Cameroon affects as many as 3.9 million people, especially children. In addition, the National Nutritional Survey conducted by the Cameroonian authorities in 1978, 1991 and 2000 revealed that protein-energy malnutrition has been progressively increasing. Nevertheless, the use of staple foods in Cameroon, as well as their protein contents and sensory qualities have not yet been evaluated (LOWE et al., 1993; SOCAPED, 2005).

Eating pattern and quality of staple foods can be improved through the enhancement of the sensory properties of foods. Monosodium L-glutamate (MSG) is

one of the most widely used flavour enhancers in savoury foods and free glutamate is the principal ingredient of almost all complex seasonings and condiments (Chi and Chen, 1992; Bellisle, 1999; FAO, 2004). The safety profile of MSG is well established and a recent study has documented a specific taste receptor system for umami, a basic taste transmitted by MSG and other sources of free glutamate [Brand, 2000]. General standards for food additives (CODEX Standard 192, Rev. 3-2001) integrated MSG into table of "Additives Permitted for Use in Food in General, Unless otherwise Specified, in Accordance with Good Manufacturing Practise", and thus permitted its use in foods in general, with no limitation other than the good manufacturing practise. However, the Cameroonian health authorities explicitly banned the consumption of MSG. This ban remains implemented, in spite of MSG entering the country's retail markets; causing concerns with the purity standards of the illegally imported MSG and the appropriateness of its use in the preparation of staple foods.

The first aim of the study was to determine the staple foods consumed in Douala, economic capital of Cameroon, in order to provide the initial database for the Food

*Corresponding author. E-mail: kanamod@yahoo.com, gouadoi@yahoo.fr.

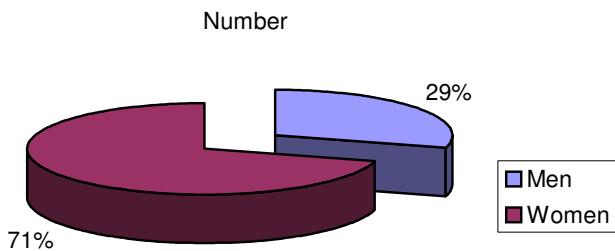


Figure 1. Distribution of subjects

Composition Tables of Cameroon. The secondary aims were to, (A) document the use and knowledge of MSG and other condiments in the cooking of staple foods, (B) highlight the motivation for MSG use and the quality standards of MSG available on retail markets. The initial hypothesis of the study was that the staple foods are based on cereals and vegetables and are thus protein deficient, and that MSG, in spite of the legal ban, is being used as the main savoury flavour enhancers in staple foods.

MATERIALS AND METHODS

The study was approved by the ethical committee of the University of Douala and the local authorities. Three hundred and fifty three adult females were recruited after a survey of 500 persons through local advertisements in the low-socio-economic areas of Douala. The subjects were of 22 to 44 years old and had an average BMI of 25. Inclusion criteria were a functional family with at least one child below 12 years of age, the ability to keep food records and no infectious diseases in the family. Females were chosen for the purposes of this study, due to their primary roles as family caretakers.

Food frequency and Twenty-four hour simplified recall surveys were used near the participants once weekly during January to March, 2006 using a questionnaire. Three hundred and fifty three subjects (females) responded correctly to the survey. The surveyed subjects recorded the staple foods consumed and the ingredients used in preparation. In addition, the subjects answered simple questions that were designed to document their knowledge of savoury condiments and flavour enhancers.

Sixteen most frequently used staple foods were then collected randomly in triplicates from randomly selected families and stored at -20°C until the time of analysis.

The food samples were thoroughly mixed and the moisture content was determined by drying in an ordinary oven at 103°C to a constant weight. Protein, lipid, and carbohydrate were also determined (AOAC, 1980).

Samples of MSG and the most frequently used seasonings and condiments were gathered in retail markets of Douala. The free glutamate content in MSG samples and selected flavourings was analyzed using high-performance liquid chromatography (HPLC). Results are shown as means \pm standard deviation.

RESULTS AND DISCUSSION

The 500 persons interviewed are comprised of 353 (71%) women and 147 (29%) men that usually participate or contribute in household feeding (Figure 1). However, only

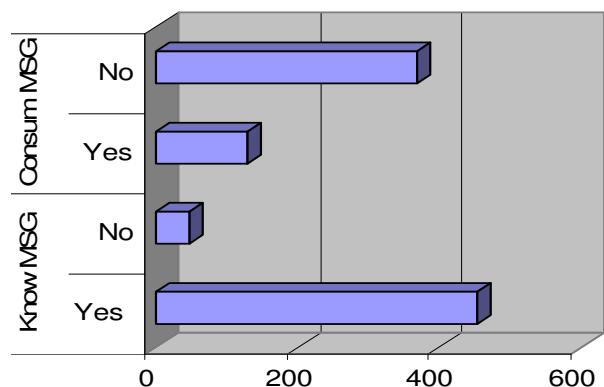


Figure 2. Knowledge and consumption of MSG in Douala

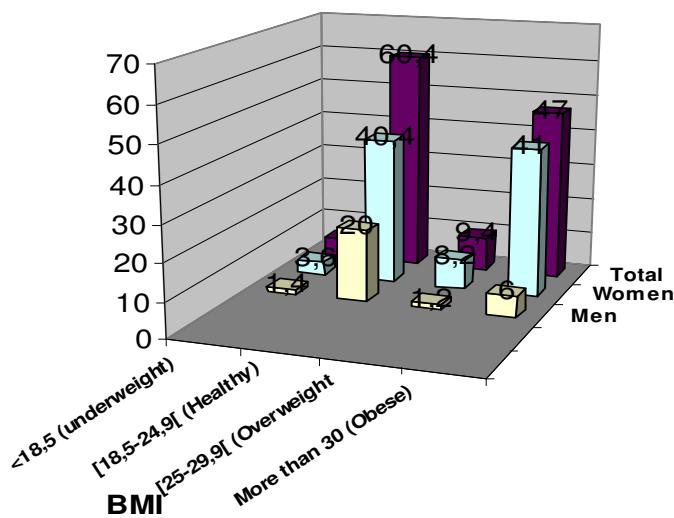
the women were able to describe cooking methods and recall the food consumption patterns (Table 1). It appears clearly from the study that, many persons know MSG (90.6%), but only 131 admitted they use it. No advertisement is made on the product in Cameroon. Instead, it has been rejected because of its ban and the large publicity against. Most of the interviewed persons stated that it is not good for human health which is similar to the message usually used by those advertising other flavour enhancer that are usually distributed freely in the families.

Body mass indexes were used to evaluate nutritional indicators of beneficiaries. In both groups, 5% were underweighted with BMI less than 18.5 comprising 1.4% men and 3.6% women. Those with normal or healthy weight (BMI between 18.5 and 25.9) were 60.4 % (20% of men and 40.4% of women). The percentage of slightly overweight was 25.2% (5.8% men and 18% women) with BMI ranging between 25 and 29.5. Finally, 9.4% of all the interviewed persons were overweight (1.2% of men and 8.2% women) (Figure 2). Inside the men group and from BMI values, 4.77% were underweighted, 68.03% had normal or healthy weight, 23.13% were overweighed and 4.08% obese. In the women group, the trend was similar; with 5.10% underweighted, 57.22% with normal or healthy weight, 26.06% over weighted and 11.62% obese (Figure 3). The number of men with normal weight was greater than that of women. The overweighed and obese were greater in the group of women.

The most frequently used staple foods are shown in Table 2, alongside with the content of total proteins, lipids, crude fibres and carbohydrates. All staples foods were based on cereal proteins, predominantly cassava, yam, wheat rice and banana, and thus were characterized by high carbohydrate content. The moisture contents were slightly higher than those reported by Ponka et al. (2005a) ranging from 57.77 to 86.17 g/100 g and from 49.5 to 67.9 g/100 g (Ponka et al., 2005b). Crude fibres values varying between 5.57 ± 2.14 g/100 g DW in cassava-based foods to 38.8 ± 1.82 g/100 g DW in rice meals were higher than those reported by Ponka et

Table 1. Ingredient content of the main stales foods in Douala, Cameroon.

Food	Main ingredients	Forms of consumption
Rice with tomato sauce	Rice, tomato, herbs, fish, garlic, carrot, oil, salt	Grain with sauce
Rice with peanut sauce	Rice, peanut, tomato, herbs, fish, garlic, oil, pepper	Grain with sauce
"Jallof" rice	Rice, tomato, green herbs, fish, garlic, oil, carrot	Grain
Banana stew	Banana, groundnuts, fry fish, pepper, ail, herbs, salt	Pieces
Plaintain-banana stew	Plaintain-banana, tomato, pepper, thin beef slices	Pieces
Vegetable meal	Cowpea, red palm oil, pepper, salt, banana	Pieces
Leaf vegetable stew	Leaf vegetables (<i>Vernonia sp.</i>), peanut, beef slices	Pieces in sauce
Yam stew	Yam, tomato, pepper, garlic, dried fish, green herbs	Pieces
Cocoyam stew	Cocoyam (<i>Colocassia sp.</i>), groundnut, okra, fish	Pieces
Cassava stew	Cassava, manioc, onion, dried fish, herbs, garlic	Pieces
Cassava tuber	Cassava leaves, fresh palm nut, cassava tubers	Pieces
Cassava paste with sauce	Cassava paste meal, leaves of <i>Gnetum Africanus</i>	Soft pieces
Corn meal with okra	Corn, okra, tomato, green herbs, garlic, pepper, fish	Paste
Pounded potato mea	Potato, beans, red palm oil, pepper, onions, oil	Pieces
Potato puree	Potato, tomato, green herbs, ail, carrot, pepper, salt	Soft pieces

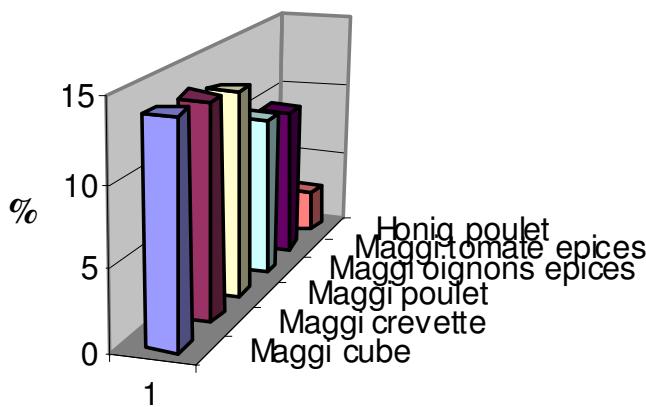
**Figure 3.** Body mass indexes of respondents.

al. (2005a) (1.43 to 17.82 g/100 g DW) and Ponka et al. (2005b) (0.84 to 3.18g/100g D.W). Rice eaten with tomatoes sauce that has high content of crude fibres can be used to improve crude fibres intakes. Other recipes with the average of 20 g/100 g of crude fibres like potatoes purée and cassava paste with sauce are also encouraging. Carbohydrates ranging from 24.11 ± 9.21 to 62.05 ± 3.02 g/100 g DW were lower compared to those reported in 2005a (3.51 to 95.76 g/100g D.W) and in 2005 b (63.3 to 82.5 g/100g D.W) by Ponka et al. Proteins contents in this study ranged between 9.25 ± 0.53 and 16.86 ± 8.85 g/100g DW and were lower than those reported by Ponka et al. (2005a), but higher in those they reported Ponka et al. (2005b) and closer to those reported by Teugwa (1991) and Kana Sop (2000).

Dishes made from leguminous seeds, fish, peanut and green leafy vegetables have high protein contents and could be used to improve proteins intake in high risk of protein energetic malnutrition in young children during complementary feeding period. Lipid contents ranging from 10.64 ± 0.9 to 35.72 ± 8.56 g/100 g DW were higher to those reported by Ponka et al. (2005a) (0.26 to 54.98 g/100 g DW) and Ponka et al. (2005b) (7.79 to 17.6 g/100 g D.W). These high contents of lipid are due to poor knowledge of the recommendations regarding good feeding. They contribute to increasing prevalence of over nutrition which causes many chronic diseases in developing and developed countries (FAO, 2005). Total lipid content varied significantly from 10.64 ± 0.9 to 35.72 ± 8.56 depending on the mode of food preparation, rather than on ingredients *per se*. Crude fibres varied between 5.57 g/100 g dry weight in cassava-based foods to 38.8 g/100 g dry weight in rice meals. The protein contents in all analyzed samples were below 18.2 g/100 g dry weight, supporting the notion of widespread protein malnutrition in the weak socio-economic groups in Douala. Crude fibres values varying between 5.57 ± 2.14 in cassava-based foods to 38.8 ± 1.82 g/100 g DW in rice meals were higher than those reported by Ponka et al. (2005a) (1.43 to 17.82 g/100 g DW) and Ponka et al. (2005b) (0.84 to 3.18 g/100 g DW). Carbohydrates ranging from 24.11 ± 9.21 to 62.05 ± 3.02 g/100 g DW were lower compared to those reported by Ponka et al. (2005a) (3.51 to 95.76 g/100 g DW) and by Ponka et al. (2005b) (63.3 to 82.5 g/100 g DW). Carbohydrates vary from 24.11 ± 9.21 to 62.05 ± 3.02 g/100 g DW (Table 2). MSG samples of various producers were purchased on the retail markets. All samples were in unopened sachets of 3 to 100 g, indicating that food-grade MSG produced overseas are being illegally smuggled into Cameroon. The HPLC analysis confirmed that MSG was of food

Table 2. Macronutrient composition of the main stales foods in Douala, Cameroon.

Food	Water content (g/100 g fresh weight)	Protein	Lipids (g/100g dry weight)	Crude fibre	Carbohydrate
Rice with tomato sauce	78.01 ± 4.12	12.75 ± 1.22	16.50 ± 1.83	38.80 ± 1.82	24.11 ± 9.21
Rice with peanut sauce	78.82 ± 0.38	16.86 ± 2.10	7.00 ± 0.89	12.92 ± 4.54	47.32 ± 7.12
"Jallof" rice	74.09 ± 2.41	7.82 ± 0.16	10.64 ± 0.93	15.05 ± 3.49	61.42 ± 4.94
Banana stew	83.02 ± 2.44	11.34 ± 0.71	28.97 ± 3.23	9.79 ± 1.75	42.18 ± 1.08
Plaintain-banana stew	77.75 ± 1.33	10.23 ± 1.38	17.52 ± 0.08	14.97 ± 1.90	51.67 ± 0.74
Vegetable meal	75.63 ± 1.05	10.17 ± 0.03	16.86 ± 1.36	14.68 ± 1.77	53.88 ± 2.28
Leaf vegetable stew	78.01 ± 0.33	12.44 ± 0.25	20.43 ± 1.60	6.70 ± 3.60	54.77 ± 5.01
Yam stew	73.67 ± 1.64	12.81 ± 1.47	14.94 ± 2.76	13.40 ± 1.24	51.61 ± 5.31
Cocoyam stew	79.28 ± 2.59	13.10 ± 1.15	16.33 ± 4.82	14.93 ± 1.19	47.43 ± 5.95
Cassava stew	74.94 ± 0.85	9.25 ± 0.53	19.48 ± 2.14	5.67 ± 2.14	62.05 ± 3.02
Cassava tuber	70.13 ± 4.30	16.01 ± 1.05	22.39 ± 2.69	14.54 ± 1.70	41.67 ± 4.4
Cassava paste with sauce	88.93 ± 2.54	18.16 ± 3.20	16.35 ± 0.47	20.41 ± 0.56	38.98 ± 2.87
Corn meal with okra	75.25 ± 0.47	11.80 ± 0.67	16.23 ± 0.57	12.56 ± 0.65	54.75 ± 0.78
Pounded potato mea	77.54 ± 2.29	7.84 ± 1.00	35.72 ± 8.56	13.34 ± 1.33	39.63 ± 8.35
Potato puree	79.93 ± 0.29	12.93 ± 1.14	20.48 ± 0.38	20.25 ± 3.27	38.78 ± 1.62

**Figure 4.** Free glutamate content in some additives.

grade, opposing the initial assumption that MSG used in poor communities might be adulterated due to a ban on its legal imports. Of the 500 subjects, 453 (90.6 %) knew of MSG as against 47 (09.4) that ignore it and 131 (26.2 %) use it as against 369 (73.8 %) that did not. We could attribute poor knowledge and uses of MSG to its ban and high publicity on other forms of additives (maggi and honig) with the same role. MSG was used mainly for its effect in enhancing flavour and food intake in children. Twelve random samples of cube-type condiments were gathered from the same local markets analyzed for free glutamate content (Figure 4). The average was $10.70 \pm 1.70\% \text{ (w/w)}$ ranging from 2.83% in Honig poulet to 13.87% (w/w) in Maggi cube (Figure 4). This suggested

that free glutamate with umami test is the main base of its test as in numerous manufactured and traditional condiments (Yamagushi, 1998). The use of cube-type savoury condiments in household preparation of staple foods was as high as 80%. The protein content in all samples was below 18.2 g per 100 g dry weight, supporting the notion of widespread protein malnutrition in the weak socio-economic groups in Douala. Although free amino acids were not analyzed, we presume that the protein inadequacy was accompanied by a deficiency of at least the first limiting amino acid, L-lysine (Pellett and Ghosh, 2004). The analyses show that the condiments available on the Cameroon retail markets do contain high amounts of free glutamates, indicating that the ban on MSG was not based on safety concerns related to glutamate consumption. Taken together, our data show that the main staple foods in poor communities of Douala are based on cereals and vegetables, mainly banana, yam, wheat, rice and cassava and that, in the absence of appropriate intake of animal-derived proteins, flavour enhancers, such as MSG or condiments are being used to enhance flavour and intake of protein-inadequate foods. However, the palatability enhancement cannot be the sole solution, and community-based fortification programs of the limiting amino acids, mainly L-lysine, are recommended, especially in weak socio-economic groups (Hussain et al., 2004; Smriga et al., 2004).

ACKNOWLEDGMENTS

We are very grateful to ECU association that financed this study. We will also like to thank the authorities and the population that participated with lots of interest in the nutritional survey.

REFERENCES

- AOAC (1980). Official Methods of Analysis. 13th ed. Willian Horwitz edr, Washington DC.
- Bellisle F (1999). Glutamate and the UMAMI taste: sensory, metabolic, nutritional and behavioural considerations. A review of the literature published in the last 10 years. *Neurosci. Biobehav. Rev.* 23: 423-438.
- Brand JG (2000). Basic characteristic of glutamates and umami sensing in the oral cavity and the gut. Receptor and transduction processes for umami taste. *J. Nutr.* 130(4S): 942S-945S.
- Chi SP, Chen TC (1992). Predicting optimum monosodium glutamate and sodium chloride concentration in chicken broth as affected by spice addition. *J. Food Proc. Preserv.* 16: 313-326.
- Food and Agriculture Organization/Faostat (2004). Food Balance Sheets 1961 – 2001. Rome: FAO. <http://www.fao.org>.
- Hussain T, Abbas S, Khan MA, Scrimshaw NS (2004). Lysine fortification of wheat flour improves selected indices of the nutritional status of predominantly cereal-eating families in Pakistan. *Food Nutr. Bull.* 25: 114-122.
- Kana Sop MM (2000). Etude de la biodisponibilité du fer et des apports en quelques minéraux des principaux aliment de sevrage de trois zones du Cameroun. Thèse de Doctorat de troisième Cycle, p. 203.
- Lowe JC, Nestel P, Rustein PO (1993). In: Nutrition et Santé des Jeunes Enfants au Cameroun. Résultats de l'Enquête Démographique et de Santé au Cameroun en 1991. Macro Inter. Inc. Collumbia, Maryland USA, pp. 13-25.
- Pellett P, Ghosh S (2004). Lysine fortification: past, present, and future. *Food Nutr. Bull.* 25: 107-113.
- Ponka R, Fokou E, Leke R, Fotso M, Souopgui J, Achu Bih M Tchouanguep. FM (2005a). Methods of preparation and nutritional evaluation of dishes consumed in a malaria endemic zone in Cameroon (Ngali II). *Afr. J. Biotechnol.* 4(3): 273-278.
- Ponka R, Fokou E, Fotso M, Achu MB, Tchouanguep FM (2005b). Methods of preparation and the energy, Proteins and Mineral Values of three Cameroonian Dishes "Corn Chaff", "Nnam Owondo/Ebobolo" and "Nnam Ngon/Ebobolo. *AJFAND* 5(1): 1-14.
- Smriga M, Ghosh S, Mounemne Y, Pellett PL Scrimshaw NS (2004). Lysine fortification reduces anxiety and lessens stress in family members in economically weak communities in Northwest Syria. *Proc. Natl. Acad. USA* 101: 8285-8288.
- SOCAPED (2005). (Société Camerounaise de Pédiatrie), IX ème Conférence, :Nutrition de l'enfant Africain, livre des abstracts, p. 90.
- Teugwa C (1991). Etude Nutritive des Plats Traditionnels Consommés dans une Zone Rurale de l'Extrême- Nord Cameroun. Leur Influence sur Quelques Paramètres Biochimiques Sériques.Thèse de Doctorat de 3 ème cycle de Biochimie, Université de Yaoundé Fac Sci. pp. 106-114.
- Yamagushi S (1998). Basic properties of umami and its effects on food flavour. *Food Rev. Int.* 14: 139-176.