



A review of composition studies of Cameroon traditional dishes: Macronutrients and minerals

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ABSTRACT

This paper reviews published data that contributes to the knowledge of the ingredients and nutrients of Cameroon traditional dishes. Macronutrient (energy, carbohydrates, protein, total fat, fibre and ash) and mineral (iron, zinc, magnesium, calcium, phosphorus, copper, manganese, potassium, sodium and selenium) data are presented for 117 commonly consumed dishes from three eco-regions. Tables providing an overview of the main ingredients and nutrient values (range of means per 100 g edible portion) are presented. Considerable variability in nutrient values has been reported among dishes. Water contents range from 29.8 to 95.9 g/100 g edible portion while energy values range from 12 to 403 kcal/100 g. Energy yielding-constituents are the major nutrients recorded in published data, followed by iron, zinc and magnesium.

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1. Introduction

Nutrition plays an integral role in the optimal functioning of the body compared to malnutrition (including under nutrition and over nutrition) that is a health impairment resulting from a deficiency, excess or imbalance of nutrients. Most developing countries are faced with the double burden of persisting under nutrition as well as the growing epidemic of obesity, diabetes and non-communicable diseases, and Cameroon is no exception. Although consumption statistics are more and more available through national investigations (INS, 2002), studies determining associations between diet and nutrition are limited, in part because of the deficit of data on nutritional composition of commonly consumed foods and a lack of knowledge of the dietary habits. A recent study in Cameroon highlighted a lack of knowledge of the composition of healthy diets as a barrier to healthy dietary behaviours (Kiawi et al., 2006). Information to link nutrition and chronic diseases is necessary to inform consumers on healthier food choices, as consumers are becoming more health conscious and are increasingly focusing on food safety as well as their eating habits and

nutrient intake (Tanya & Bah, 2009, Section 1). The consumer's involvement influences agricultural production, food chain as well as research and development programs. It is established that food choices can have a positive or negative impact on the consumer's health status (Buttriss et al., 2003; Tanya, 2009). These studies emphasise the need for greater knowledge on the composition of foods that is essential to understanding the function of nutrients in the diet.

Food composition tables or databases (FCDBs) give information on the portion, composite sample, collection and analysis of the composition of foods (Greenfield & Southgate, 2003, chap. 1) and can be used to evaluate a person's food intake and compare it to the Dietary Reference Intake. FCDBs are resources providing detailed information on the nutritional composition of foods commonly eaten, usually from a particular country. Some of the data analysed in one country could also be used in the FCDBs of other countries. Incompatibilities arise where the different countries use different sampling and analytical methods as well as different measuring units and cooking treatments. Due to these differences in nomenclature and procedures, it is obvious that these FCDBs are not international and it is important that each country has their own FCDB (Deharveng, Charrondièrre, Slimani, Southgate, & Riboli, 1999). Currently there is no FCDB in Cameroon and Central Africa contrary to East, South and West Africa (CTA/ECSA, 1988; FAO/

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Table 1
Usual names, types and main ingredients of traditional dishes reported in Cameroon.

Code	Usual names	Type	Main ingredients	References
1	Banane-malaxée	m	Banana (<i>Musa sapientum.</i>), groundnut (<i>Arachis hypogea</i>), fish, garlic, green herbs, ginger, pepper, salt	Kana Sop, Fotso, et al. (2008), Kana Sop, Gouado, et al. (2008)
2	Bean-stew	s	Red bean (<i>Phaseolus vulgaris</i>), tomato, crayfish, onions, palm oil.	Sharma et al. (2007)
3	Bouillie-maïs	m, sn	Maize flour (<i>Zea mays</i>), roasted groundnut, sugar, tamarind pulp extract, rice (<i>Oriza sativa</i>)	Ndjouenkeu et al. (1989), Kouebou et al. (2008),
4	Bouillie infantile 1	m	Maize flour, sugar, milk, groundnut, egg yolk	Leroy (2000)
5	Bouillie infantile 2	m	Maize paste, sugar, milk, groundnut, egg yolk	Leroy (2000)
6	Cassava-fufu	c	Fermented cassava flour (<i>Manihot esculenta</i>)	Sharma et al. (2007)
7	Cassava-pudding	m, sn	Raw cassava, palm oil, salt	Sharma et al. (2007)
8	Chicken-stew	s	Chicken, tomato	Sharma et al. (2007)
9	Condres	m	Unripe banana (<i>Musa spp.</i>), palm oil, groundnut, salt, pepper, cow meat, smoked fish	Ponka, Fokou, Leke, et al. (2005), Ponka et al. (2006)
10	Corn chaff	m	Maize grains, red bean, palm oil, salt	Ponka, Fokou, Fotso, et al. (2005)
11	Corn/groundnut-pudding	sn	Maize flour, roasted groundnut, spices	Sharma et al. (2007)
12	Coucouma	s	Groundnut (<i>Arachis hypogea</i>), palm oil, onion, tomato, smoked fish, <i>Amaranthus</i> leave, salt	Ponka, Fokou, Leke, et al. (2005), Ponka et al. (2006)
13	Couscous/gombo	m	Maize, tomato, okra, green herbs, garlic, pepper, cow meat, spices	Kana Sop, Fotso, et al. (2008), Kana Sop, Gouado, et al. (2008)
14	Dried fish-groundnut soup	s	Fish, groundnut, salt, onion, spices, pepper	Sharma et al. (2007)
15	Ebobolo	c	Cassava tuber	Ponka, Fokou, Leke, et al. (2005), Ponka et al. (2006)
16	Egusi seed pudding	sn	Melon seed (egusi), dried fish, spices	Sharma et al. (2007)
17	Eru	s	<i>Gnetum africanum</i> leave, cow skin, cow meat, dried fish, crayfish, palm oil	Sharma et al. (2007)
18	Eru/fufu	m	Fermented cassava paste, <i>Gnetum africanum</i> leave	Sharma et al. (2007), Kana Sop, Fotso, et al. (2008), Kana Sop, Gouado, et al. (2008)
19	Etondo-non-Salé	s	Groundnut, palm nut pulp, onion, tomato, smoked fish, garden eggplant leave	Ponka, Fokou, Leke, et al. (2005), Ponka et al. (2006)
20	Etondo-Salé	s	Groundnut, palm oil, onion, tomato, smoked fish, garden eggplant leave, salt	Ponka, Fokou, Leke, et al. (2005), Ponka et al. (2006)
21	Fian-Ngon	s	Egusi seed, palm oil, onion, tomato, smoked fish, salt	Ponka, Fokou, Leke, et al. (2005), Ponka et al. (2006)
22	Fian-Ongoualik	s	Egusi seed (small), palm oil, onion, tomato, smoked fish, salt	Ponka, Fokou, Leke, et al. (2005), Ponka et al. (2006)
23	Fian-Owondo	s	Groundnut, palm oil, onion, tomato, smoked fish, salt	Ponka, Fokou, Leke, et al. (2005), Ponka et al. (2006)
24	Fian-tomate	s	Tomato, palm oil, salt	Ponka, Fokou, Leke, et al. (2005), Ponka et al. (2006)
25	Fish-stew	s	Raw fish, tomato	Sharma et al. (2007)
26	Fufu-corn	c	Maize flour	Sharma et al. (2007)
27	Gniri/Follere	m	Cereal flour, <i>Hibiscus sabdariffa</i> leaves, groundnut, cowpea, dried cow meat, fish, onion, potash (<i>kilbu</i>) cotton oil, groundnut oil	Teugwa et al. (1992), Teugwa et al. (1996), Yadang et al. (2009)
28	Gniri/Lalo	m	Cereal flour, <i>Corchorus olitorius</i> leave, dried groundnut, cowpea, dried cow meat, fish, onion, potash (<i>kilbu</i>) cotton oil, groundnut oil	Teugwa et al. (1992), Teugwa et al. (1996), Yadang et al. (2009)
29	Gniri/Tasba	m	Cereal flour, <i>Cassia tora</i> leave, dried groundnut, cowpea, dried cow meat, fish, onion, potash (<i>kilbu</i>) cotton oil or groundnut oil	Teugwa et al. (1992), Teugwa et al. (1996), Yadang et al. (2009)
30	Green vegetable sauce	s	Green vegetable, cow meat, tomato, onion, spices, melon seed	Sharma et al. (2007)
31	Groundnut-pudding	sn	Roasted groundnut, spices	Sharma et al. (2007)
32	Groundnut-soup	s	Roasted groundnut, tomato, onion, spices (fish, meat)	Sharma et al. (2007)
33	Huckleberry-pumpkin leaves soup	s	Leafy vegetable (huckleberry and pumpkin leaves), tomato, onion, spices, groundnut, fish, cow meat	Sharma et al. (2007)
34	Huckleberry-sauce	s	Huckleberry leave, tomato, onion, spices, groundnut, fish	Sharma et al. (2007)
35	Igname-malaxé	m	Yam tuber (<i>Discorea spp.</i>), tomato, paper, garlic, green herbs, dried fish	Kana Sop, Fotso, et al. (2008), Kana Sop, Gouado, et al. (2008)
36	Ikouan	c	Plantain (<i>Musa spp.</i>)	Ponka, Fokou, Leke, et al. (2005), Ponka et al. (2006)
37	Keleng-keleng	s	Green leafy vegetable, groundnut, dried cow meat, fish	Sharma et al. (2007)
38	Koki-beans	m, sn	Cowpea, palm oil, salt, onion	Sharma et al. (2007)
39	Koki-corn	m	Fresh maize, palm oil, salt, onions, green leafy vegetable	Sharma et al. (2007)
40	Koki/plantain	m	Cowpea, red palm oil, pepper, salt, banana	Kana Sop, Fotso, et al. (2008), Kana Sop, Gouado, et al. (2008)
41	Kon	s	Red bean, palm oil, tomato, salt, pepper	Ponka, Fokou, Leke, et al. (2005), Ponka et al. (2006)
42	Kpem	s	Cassava leave, palm nut pulp, groundnut, pumpkin seed	Sharma et al. (2007)
43	Kwem/manioc	m	Cassava leave, fresh palm nut, cassava tuber, salt	Kana Sop, Fotso, et al. (2008), Kana Sop, Gouado, et al. (2008)
44	Kwemp-non-salé	s	Palm nut pulp, onion, tomato, smoked fish, cassava leave	Ponka, Fokou, Leke, et al. (2005), Ponka et al. (2006)
45	Kwemp-salé	s	Cassava leave, groundnut, palm oil, onion, tomato, smoked fish, salt	Ponka, Fokou, Leke, et al. (2005), Ponka et al. (2006)
46	Legumes sauté/manioc	m	Dried fish, green herbs, garlic, onion, pepper, cassava tuber, tomato, vegetable (<i>Amaranthus sp.</i>)	Kana Sop, Fotso, et al. (2008), Kana Sop, Gouado, et al. (2008)

Table 1 (continued)

Code	Usual names	Type	Main ingredients	References
47	Lombo	s	Cocoyam (<i>Colocassia</i> sp.) leave, groundnut, palm oil, onion, tomato, smoked fish, salt	Ponka, Fokou, Leke, et al. (2005), Ponka et al. (2006)
48	Macabo rape/arachide	m	Cocoyam tuber, groundnut, okra fruit (<i>Hibiscus esculenta</i>), green herbs, garlic, pepper, fresh fish, spices	Kana Sop, Fotso, et al. (2008), Kana Sop, Gouado, et al. (2008)
49	Macabo/Ndolè	m	Macabo tuber (<i>Xanthosoma</i> spp.), leafy vegetable (<i>Vernonia</i> sp.), groundnut, garlic, cow meat, pepper, spices	Kana Sop, Fotso, et al. (2008), Kana Sop, Gouado, et al. (2008)
50	Malaxé/pommes	m	Irish potato (<i>Solanum tuberosum</i>), tomato, green herbs, garlic, carrot, pepper, salt, red palm oil, spices	Kana Sop, Fotso, et al. (2008), Kana Sop, Gouado, et al. (2008)
51	Mbedi 1	m	Cassava leave, cassava tuber, groundnut, palm oil, fresh pepper, crayfish, salt	Ajuh (1985)
52	Mbedi2	m	Cassava leave, cassava tuber, groundnut (double dose), palm oil, pepper, crayfish (double dose), salt	Ajuh (1985)
53	Mbou	c	Cassava tuber	Ponka, Fokou, Leke, et al. (2005), Ponka et al. (2006)
54	Meat-Stew	s	Cow meat, tomato	Sharma et al. (2007)
55	Mebanga	c	Cocoyam tuber	Ponka, Fokou, Leke, et al. (2005), Ponka et al. (2006)
56	Mebouna	c	Sweet potatoe (<i>Ipomea batatas</i>)	Ponka, Fokou, Leke, et al. (2005), Ponka et al. (2006)
57	Medjana-Mebanga	m	Cocoyam tuber, palm oil, salt, pepper	Ponka, Fokou, Leke, et al. (2005), Ponka et al. (2006)
58	Midjem	s	Pumpkin leave (<i>Cucurbita pepo</i>), groundnut, palm oil, onion, tomato, smoked fish, palm nut pulp	Ponka, Fokou, Leke, et al. (2005), Ponka et al. (2006)
59	Na' kan se'	s	Palm oil, potash (aqueous extracts of ash), spices, smoked fish, salt, maggi cube, okra fruits	Fokou et al. (2009)
60	Na' mpfeu'	s	<i>Triumfetta pentandra</i> bark extracts, ground spices, salt, maggi cube	Fokou et al. (2009)
61	Na'nou'ne	s	Palm oil, potash, spices, smoked fish, salt, maggi cube	Fokou et al. (2009)
62	Na'sessouk	s	Smoked fish, spices, salt, maggi cube	Fokou et al. (2009)
63	Naching	m	Millet flour (<i>Eleusine coracana</i>), cowpea, salt, dalan (potash), okra, sorrel (<i>Rumex acetosa</i>)	Ajuh (1985)
64	Nang tare1	m	Cocoyam tuber, bitter leave (<i>Vernonia</i> sp.), palm oil, dry pepper (<i>Capsium annum</i>), salt	Ajuh (1985)
65	Nang tare2	m	Cocoyam tuber, bitter leave (double dose), palm oil (double dose), dry pepper (double dose), salt	Ajuh (1985)
66	Ndole	s	<i>Vernonia</i> leave, cow meat, dried shrimp, groundnut	Sharma et al. (2007)
67	Ndzap chou' mondzou	s	Groundnut, <i>Brassica deracea</i> leave, palm oil, onion, fresh tomato, smoked fish, salt, maggi cube	Fokou et al. (2009)
68	Ndzap-kanné	s	<i>Brassica deracea</i> leave, palm oil, onion, fresh tomatoe, smoked fish, salt, maggi cube	Fokou et al. (2009)
69	Ndzap-njheu'	s	Egusi seed, <i>Solanum nigrum</i> leave, palm oil, onion, fresh tomatoe, smoked fish, salt, maggi cube	Fokou et al. (2009)
70	Nkendi ndendieu'	s	Groundnut, banana, palm oil, onion, fresh tomatoe, smoked fish, salt, maggi cube	Fokou et al. (2009)
71	Nnam-Ngon	sn	Egusi seed, smoked fish, salt, pepper	Ponka, Fokou, Leke, et al. (2005), Ponka et al. (2006)
72	Nnam-Ngon/Ebobolo	m, sn	Egusi seed (<i>Cucumeropsis mannii</i>), salt, pepper, fermented cassava paste	Ponka, Fokou, Fotso, et al. (2005)
73	Nnam-Ongoualik	sn	Egusi seed, smoked fish, salt, pepper	Ponka, Fokou, Leke, et al. (2005), Ponka et al. (2006)
74	Nnam-Owondo	sn	Groundnut, smoked fish, salt, pepper	Ponka, Fokou, Leke, et al. (2005), Ponka et al. (2006)
75	Nnam-Owondo/Ebobolo	m, sn	Groundnut paste, salt, pepper, fermented cassava paste	Ponka, Fokou, Fotso, et al. (2005)
76	Nnem-non-salé	s	Okra leave, groundnut, palm nut pulp, onion, tomatoe, smoked fish	Ponka, Fokou, Leke, et al. (2005), Ponka et al. (2006)
77	Nnem-Salé	s	<i>Corchorus</i> leave, groundnut, palm oil, onion, tomatoe, smoked fish, salt	Ponka, Fokou, Leke, et al. (2005), Ponka et al. (2006)
78	Okok1	s	<i>Gnetum</i> leave, groundnut, palm oil, onion, tomatoe, smoked fish, salt	Sharma et al. (2007)
79	Okok2	s	<i>Gnetum</i> leave, groundnut, cow meat, smoked fish, palm oil, spices	Ponka, Fokou, Leke, et al. (2005), Ponka et al. (2006)
80	Okra-leaves-soup	s	Okra leaves, groundnut, dried cow meat, fish	Sharma et al. (2007)
81	Okra-pod-soup1	s	Raw okra fruit, dried fish, tomatoe, spices, groundnut	Sharma et al. (2007)
82	Okra-pod-soup2	s	Dried okra fruit, raw fish, tomatoe, spices, groundnut	Sharma et al. (2007)
83	Oles-bouilli	c	Rice, salt	Ponka, Fokou, Leke, et al. (2005), Ponka et al. (2006)
84	Oles-sauté	m	Rice, palm oil, salt	Ponka, Fokou, Leke, et al. (2005), Ponka et al. (2006)
85	Pap	sn	Fermented maize paste or flour, sugar, lemon	Sharma et al. (2007)
86	Pes	s	Groundnut, palm oil, onion, tomatoe, smoked fish, okra, salt	Ponka, Fokou, Leke, et al. (2005), Ponka et al. (2006)
87	Pilé/pommes	m	Irish potato, red bean, red palm oil, pepper, onion, salt	Kana Sop, Fotso, et al. (2008), Kana Sop, Gouado, et al. (2008)
88	Plantain-porridge	m	Green plantain, cow meat, tomatoe, onion, spice, palm oil, groundnut	Sharma et al. (2007)
89	Plantain/ sauce -tomate	m	Plantain, tomato, pepper, garlic, green herbs, green pepper, cow meat, spices	Kana Sop, Fotso, et al. (2008), Kana Sop, Gouado, et al. (2008)

(continued on next page)

Table 1 (continued)

Code	Usual names	Type	Main ingredients	References
90	Poumseing-djap	m	Red bean, vegetable, maize, banana, palm oil, salt, pepper	Fokou et al. (2009)
91	Poumseing-djap-mtom	m	Red bean, vegetable, maize, banana, Irish potato, palm oil, salt, pepper	Fokou et al. (2009)
92	Poumseing-kodok	m	Red bean, vegetable, maize, banana, palm oil, salt, pepper	Fokou et al. (2009)
93	Poumseing-kodok-mtom	m	Red bean, vegetable, maize, banana, Irish potato, palm oil, salt, pepper	Fokou et al. (2009)
94	Pumpkin leaves and huckleberry sauce	s	Pumpkin leave, huckleberry leave, tomatoe, onion, spices, fish	Sharma et al. (2007)
95	Riz-sauté	m	Rice, tomato, green herbs, fresh fish, garlic, carrot, oil, salt	Kana Sop, Fotso, et al. (2008), Kana Sop, Gouado, et al. (2008)
96	Riz-arachide	m	Rice, groundnut fresh fish, tomato, green herbs, pepper, oil, spices	Kana Sop, Fotso, et al. (2008), Kana Sop, Gouado, et al. (2008)
97	Riz-tomate	m	Rice, tomato, green herb, fresh fish, garlic, carrot, oil, salt	Kana Sop, Fotso, et al. (2008), Kana Sop, Gouado, et al. (2008)
98	Salad	s	Water leave (<i>Talinum fruticosum</i>), groundnut, palm oil	Ponka, Fokou, Leke, et al. (2005), Ponka et al. (2006)
99	Sanga1	m	Maize grain, cassava leave, palm nut pulp, sugar	Ponka, Fokou, Leke, et al. (2005), Ponka et al. (2006)
100	Sanga2	m	Fresh maize, green leave (cassava, huckleberry, pumpkin), palm nut pulp	Sharma et al. (2007)
101	Site-ngali	m	Gari, palm oil, onion, tomatoe, pepper, salt, maggi cube, crayfish or smoked fish	Fokou et al. (2009)
102	Site-sembùn	m	Cassava tubers, palm oil, onion, fresh tomatoe, salt, pepper	Fokou et al. (2009)
103	Site-sembùn-bo-kenà	m	Groundnut, Cassava tuber, palm oil, onion, fresh tomatoe, salt, pepper	Fokou et al. (2009)
104	Snail-stew	s	Snail, tomato, onion, salt, pepper, garlic, vegetable oil	Sharma et al. (2007)
105	Sog-sojà	s	Soybean, palm oil, onion, fresh tomatoe, smoked fish, salt, pepper	Fokou et al. (2009)
106	Steamed-fish	s	Fish, spices	Sharma et al. (2007)
107	Steamed-snails	s	Snail, spices	Sharma et al. (2007)
108	Tag-bankun	m	Boiled red bean, salt, steamed paste from maize flour, palm oil, salt, pepper	Fokou et al. (2009)
109	Tag-kenà	m	Maize grain, groundnut, pepper, salt, maggi cube, crayfish, smoked fish	Fokou et al. (2009)
110	Tchoû-goudom,	m	Red bean, vegetable, maize, banana, potato, palm oil, salt, pepper	Fokou et al. (2009)
111	Tchoû-khedé-mtom,	m	Red bean, vegetable, banana, potato, palm oil, salt, pepper	Fokou et al. (2009)
112	Tchoû-khedé,	m	Red bean, vegetable, banana, palm oil, salt, pepper	Fokou et al. (2009)
113	Tomato-stew	s	Fresh tomato, onion, fresh fish, garlic, oil, salt, pepper	Sharma et al. (2007)
114	Yellow-soup	s	Palm oil, meat stock, local spices	Sharma et al. (2007)
115	Zom-non-salé	s	Huckle berry leave, groundnut, palm nut, onion, tomatoe, smoked fish	Ponka, Fokou, Leke, et al. (2005), Ponka et al. (2006)
116	Zom-sale	s	Huckle berry leave, groundnut, palm oil, onion, tomatoe, smoked fish, salt	Ponka, Fokou, Leke, et al. (2005), Ponka et al. (2006)
117	Zou'tchou'nè	m	Red bean, yams tuber, palm oil, salt, pepper	Fokou et al. (2009)

M, meal; s, sauce; sn, snack; c, starchy complement.

INFOODS/WAHO/Bioversity International, 2012; Sayed, Frans, & Schönfeldt, 1999).

In order to improve on the availability of reliable data on food composition and agro-biodiversity, food composition activities (FCA) were undertaken in Cameroon, as part of Central African Food Data Systems (CAFOODS). The major aim of these FCA was to compile the scientific literature available (in French and English) on food and nutrition research in Cameroon and present an overview of the food composition studies (Kouebou, Yadang, Acayanka, & Nzali, 2010; Kouebou et al., 2009). A compilation of the existing or available data may be a useful guide for nutritionists and nutrient data compilers as well as for further research. Ngo Som (2006) edited a directory of scientific references (3747 titles) published by 247 authors between 1978 and 2005 in Cameroon.

Quality food composition data is essential for nutrition researchers, health professionals, food labelling and education programs in choosing healthy diets. As the proportion of food eaten away from home is increasing, cafeterias, school canteens and restaurants are becoming attractive settings for interventions to encourage healthier food choices. Increasing the availability of healthier choices and making covert changes to dishes to improve their nutritional value has been shown to improve dietary behaviour (Ablan, 1993; Buttriss et al., 2003). Consumer demand for traditional dishes continues to rise nationally, especially as the prices of imported foods are higher and street businesses (home-based industries and small restaurants) are growing (unpublished, available from author). On the whole, the need for a representative and

reliable food composition data is underscore by the remarkable diversity and widespread consumption of traditional staples (unpublished data) in the various Cameroon eco-regions. A traditional food product is a product frequently consumed or associated to specific seasons, usually passed on from one generation to another, carefully prepared in a specific way according to the gastronomic heritage, with little or no processing/manipulation, that is distinguished and known because of its sensory properties and associated to a certain local area, region or country (Vanhonacker, Verbeke, Lengard, et al., 2008). To our knowledge, no review has been presented on composition studies of foods consumed in Cameroon. The objective of this review is to bring together published data on the food ingredients and nutrients of Cameroon traditional dishes and also to present a more reliable current nutrient data available for traditional dishes in Cameroon.

2. Data compilation and verification

FCA initiated in 2009 led to the development of a directory of about 500 references in Food Science and Nutrition in Cameroon (Achu, Kamda, Ponka, & Kouebou, 2009; Yadang, Kamda, Acayanka, Achu, & Kouebou, 2010). Nearly 60 scientific papers were collected containing approximately 350 foods distributed into 9 groups (traditional dishes, roots and tubers, cereals, fats and oils, leguminous plants, fruits, nuts and seeds, spices and vegetables) (Kouebou et al., 2009; Kouebou et al., 2010). The excel spreadsheets identification of single-item foods in the INFOODS Compilation tool and

Table 2
Nutritional values of traditional dishes consumed in Cameroon (results per 100 g of edible portion).

Code	Energy (kcal)	Water (g)	Protein N × 6.25 (g)	Total fat (g)	Available carbohydrates (g)	Crude fibre ^a (g)	Ash (g)	Fe (mg)	Zn (mg)	Mg (mg)	Ca (mg)	P (mg)	Cu (mg)	Mn (mg)	K (mg)	Na (mg)	Se (mcg)
1	84	83.0	1.93	4.92	7.16	1.66	1.32	0.78	2.05	21	49	49	0.047	0.455	196	n.d.	n.d.
2	240	71.9	0.20	26.6	0.90	[0.20]	n.d.	0.10	0.10	2	5	5	n.d.	0.000	31	5	0.20
3	64	84.5	0.95	0.44	13.97	n.d.	0.13	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
4	51	86.9	0.77	0.38	11.86	n.d.	0.12	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
5	48	87.5	0.70	0.30	11.40	n.d.	0.09	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
6	158	55.5	4.90	0.50	32.70	[0.00]	n.d.	1.40	0.00	1	1	0	n.d.	0.000	45	2	0.00
7	115	79.4	5.70	n.d.	9.50	[1.90]	n.d.	1.60	0.80	52	77	90	n.d.	0.600	334	24	1.70
8	269	94.4	19.20	20.20	2.10	[0.90]	n.d.	1.10	2.10	22	16	140	n.d.	0.100	286	70	15.50
9	89	77.4	1.50	0.78	18.34	1.15	0.87	0.52	0.52	23	n.d.	n.d.	0.060	n.d.	n.d.	n.d.	n.d.
10	149	67.9	3.76	5.65	20.29	1.02	1.38	1.95	1.20	31	n.d.	n.d.	0.190	n.d.	n.d.	n.d.	n.d.
11	180	63.7	7.50	11.40	16.50	[3.40]	n.d.	1.40	1.10	55	23	131	n.d.	0.500	317	7	2.00
12	105	79.5	6.06	7.61	1.29	3.65	1.90	2.09	0.83	65	n.d.	n.d.	0.100	n.d.	n.d.	n.d.	n.d.
13	108	75.3	2.92	4.02	13.55	3.11	0.68	0.54	0.21	14	93	69	0.020	0.091	61	n.d.	n.d.
14	108	88.3	6.70	8.70	1.70	[0.90]	n.d.	0.40	0.30	23	17	98	n.d.	0.200	185	37	0.70
15	167	57.9	0.63	0.21	40.32	0.60	0.34	0.75	1.04	20	n.d.	n.d.	0.050	n.d.	n.d.	n.d.	n.d.
16	25	93.0	3.30	0.10	3.10	[0.30]	n.d.	0.40	0.20	11	12	48	n.d.	0.100	212	20	4.80
17	209	73.7	2.20	22.4	1.10	[0.40]	n.d.	0.60	0.30	21	67	35	n.d.	0.300	222	34	1.30
18	46	88.9	2.01	1.81	4.32	[2.26]	0.90	1.20	0.13	15	35	15	0.035	0.643	114	n.d.	n.d.
19	160	73.3	7.56	13.10	0.94	4.30	0.90	2.87	0.74	64	n.d.	n.d.	0.230	n.d.	n.d.	n.d.	n.d.
20	185	68.7	7.94	15.53	1.14	4.55	2.34	2.49	0.76	60	n.d.	n.d.	0.180	n.d.	n.d.	n.d.	n.d.
21	107	81.1	5.99	8.23	1.33	1.81	1.50	3.55	1.25	68	n.d.	n.d.	0.210	n.d.	n.d.	n.d.	n.d.
22	111	80.4	6.65	8.40	1.38	1.73	1.36	3.98	1.43	74	n.d.	n.d.	0.190	n.d.	n.d.	n.d.	n.d.
23	95	82.7	5.58	6.35	3.16	1.56	0.65	1.01	0.67	37	n.d.	n.d.	0.080	n.d.	n.d.	n.d.	n.d.
24	176	69.9	2.84	15.28	5.93	1.64	4.44	1.92	1.10	22	n.d.	n.d.	0.060	n.d.	n.d.	n.d.	n.d.
25	188	75.1	2.10	19.40	2.80	[1.20]	n.d.	0.40	0.30	17	14	36	n.d.	0.200	113	5	0.60
26	187	53.5	3.60	1.50	39.40	[1.70]	n.d.	0.60	0.20	25	4	52	n.d.	0.000	63	2	1.70
27	145	65.8	4.41	1.92	27.63	n.d.	1.03	5.20	1.23	n.d.	29	92	n.d.	1.334	n.d.	n.d.	n.d.
28	141	65.6	4.30	1.55	27.35	n.d.	1.14	5.74	1.75	n.d.	27	93	n.d.	1.170	n.d.	n.d.	n.d.
29	137	66.3	3.91	1.38	27.20	n.d.	1.15	4.92	1.55	n.d.	32	89	n.d.	1.281	n.d.	n.d.	n.d.
30	197	72.7	2.60	20.30	3.00	[0.90]	n.d.	1.30	0.70	48	n.d.	61	n.d.	0.400	341	31	0.60
31	403	33.5	18.3	35.00	11.50	[6.10]	n.d.	3.30	2.30	120	66	267	n.d.	1.400	502	14	5.10
32	250	61.8	8.10	23.70	3.90	[1.90]	n.d.	1.00	0.70	40	25	120	n.d.	0.400	236	27	1.50
33	199	79.2	5.30	19.20	2.90	[0.90]	n.d.	1.60	1.10	56	96	85	n.d.	0.500	399	42	3.40
34	134	83.0	0.90	14.50	1.10	[0.30]	n.d.	0.60	0.20	18	51	18	n.d.	0.200	171	18	0.30
35	110	73.7	3.37	3.93	13.59	3.53	1.92	0.73	0.31	20	150	123	0.062	0.175	300	n.d.	n.d.
36	90	76.6	0.81	0.14	20.64	1.39	0.41	0.51	0.52	22	n.d.	n.d.	0.050	n.d.	n.d.	n.d.	n.d.
37	152	78.7	5.70	13.90	3.20	[1.40]	n.d.	1.10	0.60	40	60	88	n.d.	0.500	298	33	1.20
38	169	73.1	3.20	14.00	8.60	[2.10]	n.d.	1.60	0.40	34	44	64	n.d.	0.600	287	14	0.90
39	75	78.8	2.40	0.90	17.40	[2.10]	n.d.	0.50	0.50	24	4	65	n.d.	0.100	218	5	0.60
40	107	75.6	2.48	4.11	13.13	3.58	1.08	1.60	0.32	29	10	49	0.069	0.381	259	n.d.	n.d.
41	161	64.7	7.38	7.05	15.15	3.52	2.20	2.24	1.52	38	n.d.	n.d.	0.120	n.d.	n.d.	n.d.	n.d.
42	153	84.9	3.00	15.5	2.30	[0.90]	n.d.	1.00	0.40	33	69	51	n.d.	0.400	269	26	0.80
43	118	74.9	2.32	4.88	15.55	1.42	0.80	0.91	0.37	22	40	42	0.047	0.260	193	n.d.	n.d.
44	97	82.8	2.99	7.04	4.15	2.67	0.35	2.86	0.68	36	n.d.	n.d.	0.140	n.d.	n.d.	n.d.	n.d.
45	118	77.5	6.53	8.09	3.13	3.22	1.56	2.34	0.91	50	n.d.	n.d.	0.110	n.d.	n.d.	n.d.	n.d.
46	87	79.3	2.71	3.38	9.83	3.09	1.56	1.22	0.25	29	182	52	0.069	0.204	164	n.d.	n.d.
47	94	81.6	5.31	6.44	2.45	2.36	1.80	1.71	0.66	35	n.d.	n.d.	0.120	n.d.	n.d.	n.d.	n.d.
48	138	70.1	4.78	6.69	12.45	4.34	1.63	1.52	2.06	26	31	74	0.087	0.286	324	n.d.	n.d.
49	102	78.0	2.74	4.49	12.04	1.47	1.25	0.63	0.27	25	63	69	0.054	0.101	255	n.d.	n.d.
50	121	77.5	1.76	8.02	8.90	3.00	1.16	0.88	0.29	20	20	66	0.061	0.171	251	n.d.	n.d.
51	178	63.8	2.47	8.03	24.01	n.d.	1.71	1.84	1.42	n.d.	16	43	n.d.	n.d.	n.d.	n.d.	n.d.
52	159	67.2	2.92	6.67	21.87	n.d.	1.31	1.90	n.d.	n.d.	14	63	n.d.	n.d.	n.d.	n.d.	n.d.
53	167	57.8	0.80	0.22	40.14	0.79	0.28	0.60	1.05	38	n.d.	n.d.	0.080	n.d.	n.d.	n.d.	n.d.
54	186	76.8	1.10	20.00	1.70	[0.70]	n.d.	0.20	0.20	8	7	18	n.d.	0.100	70	4	0.30

110	173	62.9	3.21	6.40	24.80	1.62	1.10	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
111	216	59.3	3.77	12.42	21.35	1.86	1.27	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
112	168	64.9	3.81	7.08	21.52	1.50	1.22	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
113	193	74.8	4.30	19.40	0.90	[0.50]	n.d.	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
114	144	83.4	0.10	16.00	0.40	[0.00]	n.d.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10
115	156	74.8	5.33	13.04	2.68	3.51	0.68	2.28	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.10
116	132	76.6	5.08	10.53	2.36	3.72	1.71	2.78	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.10
117	195	59.3	5.29	8.88	21.78	3.19	1.54	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.

n.d.: not determined by the reviewed studies.

^a In studies where total dietary fibre was available, the value is marked in [].

guidelines were used to compile food data, starting with traditional dishes (INFOODS, 2010). Only studies that clearly identify the eco-region of origin as well as the main ingredients of the cooked dishes analysed were included. Also, sampling (process and sample number) and data generation (calculation or analytical methods) used had to be clearly described. The data provided as dry weight were transformed into fresh weight (as per 100 g edible portion) resulting in loss of information regarding the standard deviation or variation. This led to 117 traditional dishes from the major agro-ecological zones of Cameroon, which are the Sudano-Sahelian zone (Ajuh, 1985; Kouebou, Essia Ngang, & Etoa, 2008; Leroy, 2000; Ndjouenkeu, Mboufung, & Etoa, 1989; Teugwa, Mbiapo, Fokou, & Fotso, 1992; Teugwa, Mbiapo, Fokou, & Fotso, 1996; Tourneux, 2002; Yadang, Tchatchueng, & Tchiégang, 2009), the Coastal/High Land zone (Ajuh, 1985; Ponka, Fokou, Leke, et al., 2005; Kana Sop, Fotso, Gouado, Tetanye, & Amvam Zollo, 2008; Sharma et al., 2007; Kana Sop, Gouado, et al., 2008; Fokou et al., 2009) and the Humid Forest zone (Ajuh, 1985; Leroy, 2000; Ponka, Fokou, Fotso, Achu, & Tchouanguép, 2005; Ponka et al., 2005; Ponka et al., 2006; Fokou et al., 2009; Sharma et al., 2007). For these composite dishes, the food usual names given by the authors in local or Cameroon official languages (French and English) were maintained and coded (1–117) in alphabetic order. The food ingredients were provided in the description of the dish from the publications. The nutrient values were produced by analytical means with the exception of Sharma et al. (2007) who calculated the food composition using the US Department of Agriculture National Nutrient Database.

3. Food characteristics and ingredients

The dishes and their principal ingredients are listed on Table 1. The names are given in about 15 local dialects and the two official languages (French and English) in Cameroon. These dishes represent a selection of staple foods frequently consumed in households and restaurants of urban and rural areas. They play an important role in nutrition and belong to four inter-complementary categories including two majors (sauces 41.8% and complete meals 40.9%) and two minors (snacks 10% and starchy complements accompanying the sauces 7.3%). The starch-based complements are derived from cereals (2.7%), roots and tubers (2.2%), fruits (1.4%). Within cereals, the most reported are maize (1.4%) and rice (0.9%). This trend confirms the importance of locally produced cereals as opposed to rice, which is mainly imported as far as Cameroon dishes are concerned. Within the roots and tubers, there are cassava (1.1%), cocoyam (0.4%), sweet potato (0.4%), yam (0.1%) and Irish potato (0.1%) whereas fruits are the other sources of complements, particularly bananas (0.7%) and plantains (0.7%). The 92 vegetable ingredients used for sauces were divided into 5 groups largely dominated by green leafy vegetables (40%) followed by tomatoes (15.5%), red beans (11.8%), groundnuts (10%) and pistachios (6.4%). The 135 ingredients supplying chiefly proteins belong to different animals (including fish, 42.7% and meats, 13.6%) and plant sources (dominated by groundnuts, 39.1% followed by beans, 18.2%). The contributions in terms of fat content are ensured by 102 vegetables divided into various categories with palm oil (47.3%) and groundnuts (17.3%) ranking first. This review reveals the use of a number of leafy vegetables in the preparation of sauces largely lesser than the 24 species identified in a village in Adamoua Region (Tchiegang & Kitikil, 2004).

4. Macronutrient values

Table 2 details the nutrient values for each food item. Table 3 presents an overview of nutrient values of Cameroon traditional dishes distributed into four categories recognised in food habits

(sauces, complete meals, snacks and starchy complements). Table 4 presents some components, divided into several intervals into which the homogenous food groups were distributed based on the nutrient values. In majority, these staple foods contain water between 60 and 80 g, energy between 100 and 200 kcal, proteins between 2 and 4 g, fats between 0 and 9 g, less than 6 g of available carbohydrates and less than 4 g of crude fibre. However the study revealed dishes showing protein values between 8 and 20 g, fats higher than 20 g and energy above 300 kcal. This appears very interesting as regards to the prevalence of (infant) malnutrition in Central Africa, which is twice higher than in West Africa (FAO, 2008). These results reveal as a whole, an important variability in the macronutrient profile which could be related to agricultural biodiversity (materialised by nearly 92 ingredients for sauces, 135 protein-rich ingredients and 102 fat-rich substrates), technological diversity (washing, fermentation, sieving, boiling, steaming, frying etc.), as well as the nature and variable amount of ingredients required for each traditional recipe. The food items (3 meals and 2 snacks) less concentrated in water are the best sources of energy, protein and fat.

5. Mineral values

Tables 2 and 3 contain the mineral values of the dishes distributed into meals, sauces, snacks and complements. The complements contribute the least amount of minerals, including potassium, the major element with values between 5 and 502 mg per 100 g edible portion. Potassium is followed by phosphorous with a better contribution from snacks. Calcium and magnesium have higher average values in the meals, followed by sauces. Magnesium is averagely present between 1 and 158 g, snacks containing more followed by sauces and meals. Manganese is not present in starchy complements while snacks contain a maximum of 1.4 mg. Iron varies between 0 and 7.29 mg whereas zinc is found between 0 and 2.96 mg. Copper and selenium are represented at average contents of 0.1% and 2.6%. Snacks are averagely the most furnished with these four trace elements.

Table 4 presents trace element values, divided into several ranges into which the dishes were grouped. Iron values between 0.5 and 1 mg are found in the highest number of food items ($n = 26$) especially in meals ($n = 15$). Snacks and complements con-

tain the least amounts of iron. Two thirds of the dishes ($n = 61$) present zinc values similarly distributed between the intervals of 0–0.5 mg and 0.51–1 mg with most sauces in the second portion. Almost half of the dishes were not analysed for copper. Two snacks and a meal have the highest copper value (0.35 mg). Most dishes ($n = 65$) were not examined for manganese. The majority of sauces and meals have between 0.1 and 0.8 mg of manganese; that is a considerable variation (800%). Selenium was the least assayed mineral (70.94% dishes not analysed). Sauces are the highest number of items described, with selenium values between 0 and 5 mcg.

Minerals were also distributed into several regular intervals (data not presented). The category of 15–30 mg for magnesium was mostly found in 31 dishes. Meals and sauces were represented in all categories of values between 1 and 182 mg of calcium although about half contain the lower range (less than 30 mg). The dishes are distributed mainly in 2 of the 4 intervals for phosphorous values. These are the lowest intervals (0–50 mg and 51–100 mg). However, a sauce and a snack present a phosphorous mean of 227 mg which is quite considerable as compared to other staples. Meals and sauces have between 50 and 331 mg of potassium, which is a variation of more than 600%. The highest value in potassium (502 mg) is provided by a snack (Groundnut-pudding). Sodium is more in the sauces than in the starchy complements.

6. Discussion and conclusions

No food composition database is yet available in Cameroon and Central Africa. This compiled data has provided the nutrient composition of 117 commonly consumed staple foods in the various agro-ecological regions of Cameroon, a country made up of many tribes with different food habits (Mennen et al., 2000; Requier-Desjardins, 1993). These traditional dishes were structured into four categories (snacks, sauces, complete meals and starchy complements). The three daily meals are based on these categories, depending on the economic situation of the household (Dapi, Nouedoui, Janlert, & Haglin, 2005; Requier-Desjardins, 1993). Most reported dishes come from Forest and Coastal/High-Land zones contrary to the Arid Sudano-Sahelian zone where food insecurity and deficiency diseases constitute a more pressing problem. In the Sudano-Sahelian and Forest zones, green leafy vegetables,

Table 3
Overview of nutrient values* of Cameroon traditional dishes distributed into categories.

	Meals	Sauces	Complements	Snacks	Total
<i>Macronutrients</i>					
Water (g)	69.6 (29.8–88.9)	77.39 (55.7–95.9)	63.6 (53.5–76.6)	62.61 (33.5–93)	72.17 (29.8–95.9)
Energy (kcal)	142.2 (46–394)	146.9 (12–269)	140.5 (90–187)	51.6 (11–85)	147.5 (12–403)
Proteins (g)	3.2 (0.11–14.83)	5.24 (0.1–19.2)	1.94 (0.63–4.9)	9.61 (0.8–20.9)	4.39 (0.1–20.9)
Total fat (g)	6.01 (0.3–24.95)	12.56 (0.05–26.6)	0.39 (0.06–3.14)	12.58 (0.1–35)	8.87 (0.05–35)
Available carbohydrates (g)	18.22 (1.3–39.7)	3.2 (0.4–15.15)	31.79 (20.64–40.32)	12.79 (3.1–38.45)	12.27 (0.4–40.32)
Fibre (g)	2.36 (0.79–8.5)	1.97 (0–5.57)	0.99 (0–1.7)	2.65 (0.3–6.1)	2.09 (0–8.5)
Ash (g)	1.25 (0.09–2.78)	1.53 (0.35–4.44)	0.61 (0.28–1.18)	1.88 (0.72–2.59)	1.33 (0.09–4.44)
<i>Macrominerals</i>					
Magnesium (mg)	28 (6–147)	43 (1–158)	19 (1–38)	73 (5–141)	39 (1–158)
Calcium (mg)	48 (4–182)	40 (4–103)	3 (1–4)	26 (2–66)	41 (1–182)
Phosphorus (mg)	62 (7–123)	79 (2–187)	26 (0–56)	113 (8–267)	71 (0–267)
Potassium (mg)	206 (51–334)	221 (5–399)	54 (45–63)	261 (15–502)	212 (5–502)
Sodium (mg)	40 (5–150)	29 (2–78)	2 (2–2)	11 (3–20)	27 (2–150)
<i>Trace elements</i>					
Iron (mg)	1.58 (0.38–7.29)	1.68 (0–5.57)	0.68 (0.34–1.40)	2.26 (0.1–5.52)	1.60 (0–7.29)
Zinc (mg)	0.82 (0.1–2.74)	0.77 (0–2.10)	0.71 (0–1.05)	1.52 (0.1–2.96)	0.84 (0–2.96)
Copper (mg)	0.079 (0.02–0.39)	0.142 (0.06–0.23)	0.068 (0.04–0.10)	0.253 (0.11–0.340)	0.112 (0.02–0.39)
Manganese (mg)	0.382 (0–1.334)	0.304 (0–0.7)	0	0.5 (0–1.4)	0.342 (0–1.40)
Selenium (mcg)	0.92 (0.20–1.70)	3.03 (0.1–19.50)	0.85 (0–1.70)	3.15 (0.70–5.10)	2.60 (0–19.50)

* Mean (min–max) for 100 g edible portion.

Table 4
Distribution of traditional dishes according to component range.

Range	% (n)	Mean	Food codes			
			Meals	Sauces	Compl.	Snacks
<i>Energy (kcal)</i>						
<50	5.1 (6)	35.8	4, 5, 18	60		16, 85
51–100	18.8 (22)	87	1, 3, 9, 39, 46, 63, 84, 87, 89, 96, 97, 100	23, 44, 47, 59, 62, 70, 98, 106	36, 83	
101–150	32.5 (38)	126.2	7, 10, 13, 27–29, 35, 40, 43, 48–50, 57, 65, 88, 95, 103	12, 14, 21, 22, 34, 45, 58, 67, 69, 76, 77, 80, 82, 86, 94, 104, 105, 114, 116	55, 56	
151–200	27.4 (32)	173.4	38, 51, 52, 64, 90–93, 110, 112, 117	19, 20, 24, 25, 30, 33, 37, 41, 42, 54, 61, 68, 78, 81, 113, 115	6, 15, 26, 53	11
201–250	12.0 (14)	223.4	72, 75, 99, 101, 109, 111	2, 17, 32, 66, 79, 107,		71, 74
251–400	4.3 (5)	331.2	102, 108	8		31, 73
<i>Water (g)</i>						
30–50	4.3 (5)	39.54	75, 102, 108			31, 73
51–60	9.4 (11)	56.83	92, 101, 109, 111, 117	66	6, 15, 26, 53	74
61–70	23.1 (27)	65.14	10, 27–29, 51, 52, 57, 64, 65, 72, 90, 91, 93, 100, 103, 110, 112	20, 24, 32, 41, 79, 107	55, 56	11, 71
71–80	42.7 (50)	76.18	7, 9, 13, 35, 38, 39, 40, 43, 46, 48–50, 63, 84, 87–89, 95–97, 99	2, 12, 17, 19, 25, 30, 33, 37, 45, 54, 61, 62, 67, 68, 70, 76–78, 81, 82, 86, 94, 104, 105, 113, 115, 116	36, 83	
81–90	17.1 (20)	83.89	1, 3 – 5, 18	14, 21–23, 34, 42, 44, 47, 58, 59, 69, 80, 98, 106, 114		
91–96	3.4 (4)	93.82		8, 60		16, 85
<i>Protein (g)</i>						
<2	23.1 (27)	1.01	1, 3–5, 9, 50, 57, 64, 65, 84, 88, 101	2, 34, 54, 59 – 62, 114	15, 36, 53, 55, 56, 83	85
2.1–4	35.0 (41)	2.92	10, 13, 18, 29, 35, 38–40, 43, 46, 49, 51, 52, 63, 87, 89–91, 95 – 97, 99, 100, 102, 103, 110–112	17, 24, 25, 30, 42, 44, 68, 70, 80, 98	26	16, 74
4.1–6	22.2 (26)	5.11	7, 27, 28, 48, 75, 92, 93, 117	21, 23, 33, 37, 47, 58, 67, 69, 76 – 78, 81, 86, 94, 113, 115, 116	6	
6.1–8	9.4 (11)	7.15	108, 109	12, 14, 19, 20, 22, 41, 45, 79		11
8.1–10	4.3 (5)	8.94		32, 66, 82, 105, 107		
10.1–20	6.0 (7)	15.75	72	8, 104, 106		31, 71, 73
<i>Total fat (g)</i>						
0–3	22.2 (26)	0.89	3–5, 9, 18, 27–29, 39, 63, 84, 95, 96	60, 62, 106	6, 15, 26, 36, 53, 55, 56, 83	16, 85
3.1–6	15.4 (18)	4.48	1, 10, 13, 35, 40, 43, 46, 49, 57, 65, 87, 89, 91, 93, 97	70, 98		74
6.1–9	21.4 (25)	7.54	48, 50–52, 64, 75, 88, 90, 92, 99, 103, 110, 112, 117	12, 14, 21–23, 41, 44, 45, 47, 59, 105		
9.1–12	12.8 (15)	10.18	7, 101, 108, 109	58, 67, 69, 76, 77, 82, 86, 94, 104, 116		11
12.1–15	8.5 (10)	13.36	38, 72, 100, 111	19, 34, 37, 80, 81, 115		
15.1–18	6.8 (8)	15.86		20, 24, 42, 61, 68, 79, 114		71
18.1–21	6.8 (8)	19.59		8, 25, 30, 33, 54, 78, 107, 113		
21.1–35	6.0 (7)	25.21	102	2, 17, 32, 66		31, 73
<i>Iron (mg)</i>						
0–0.5	9.40 (11)	0.25	95	2, 14, 25, 54, 106, 113, 114	83	16, 85
0.51–1	22.22 (26)	0.67	1, 9, 13, 35, 39, 43, 49, 50, 57, 65, 84, 88, 89, 96, 97	17, 34, 80–82	15, 26, 36, 53, 55, 56	
1.1–1.5	13.67 (16)	1.17		8, 23, 30, 32, 37, 42, 78, 94	6, 18, 46, 64, 87, 99, 100	11
1.51–2	13.67 (16)	1.7	7, 10, 38, 40, 48, 51, 52, 63, 75	24, 33, 47, 66, 86, 107		74
2.1–3	10.26 (12)	2.43		12, 19, 20, 41, 44, 45, 76, 77, 98, 104, 115, 116		
3.1–7.5	9.40 (11)	4.75	27–29, 72	21, 22, 58, 79		31, 71, 73
n.d.	21.37 (25)					
<i>Zinc (mg)</i>						
0–0.5	25.64 (30)	0.24	13, 18, 35, 38, 40, 43, 46, 49, 50, 87–89, 95, 96, 100	2, 14, 17, 25, 34, 42, 54, 80, 106, 113, 114	6, 26	16, 85
0.51–1	26.50 (31)	0.71	7, 9, 39, 57, 63, 64, 84, 99,	12, 19, 20, 23, 30, 32, 37, 44, 45, 47, 76–79, 81, 86, 94, 98, 104, 115, 116	36, 56	
1.1–1.5	11.97 (14)	1.2	10, 27, 51	21, 22, 24, 33, 107	15, 53, 55, 83	11, 74
1.51–2	6.84 (8)	1.61	28, 29, 75, 97	41, 58, 66, 82		
2.1–3	5.98 (7)	2.39	1, 48, 72	8		31, 71, 73
n.d.	23.08(27)					

(continued on next page)

Table 4 (continued)

Range	% (n)	Mean	Food codes			
			Meals	Sauces	Compl.	Snacks
<i>Copper (mg)</i>						
0.02–0.05	9.40 (11)	0.039	1, 13, 18, 43, 84, 87, 89, 95–97		83	
0.06–0.1	13.68 (16)	0.068	9, 35, 40, 46, 48–50, 57	23, 24, 86, 98	15, 36, 53, 56	
0.11–0.15	10.26 (12)	0.118	55, 75, 99	12, 41, 44, 45, 47, 76, 77	55	74
0.16–0.2	4.27 (5)	0.174	10	20, 22, 58, 116		
0.21–0.25	3.42 (4)	0.22		19, 21, 79, 115		
0.26–0.4	2.56 (3)	0.347	72			71, 73
n.d.	56.41 (66)					
<i>Manganese (mg)</i>						
0–0.1	6.84 (8)	0.011	13, 88	2, 113, 114	6, 26	85
0.11–0.2	11.11 (13)	0.13	35, 39, 49, 50, 87, 89, 96, 97, 100	8, 54, 106		16
0.21–0.4	10.26 (12)	0.254	40, 43, 46, 48, 95	14, 17, 25, 34, 80, 82, 104		
0.41–0.8	12.82 (15)	0.52	1, 18, 7, 38	30, 32, 33, 37, 42, 66, 78, 81, 94, 107		11
0.81–1.6	3.42 (4)	1.3	27–29			31
n.d.	55.55 (65)					
<i>Selenium (mcg)</i>						
0–1	12.82 (15)	0.5	38, 39, 100	2, 14, 25, 30, 34, 42, 54, 80, 104, 114	6	85
1.1–2.5	9.40 (11)	1.5	7, 26, 88	17, 32, 37, 78, 81, 94	26	11
2.6–5	4.27 (5)	3.8		33, 66, 82, 107		16
5.1–10	1.71 (2)	6		113		31
10.1–20	1.71 (2)	17.5		8, 106		
n.d.	70.09 (82)					

n.d.: Not determined by the reviewed studies.

groundnuts or melon seeds are usually added to almost all sauces whereas this practice is not common among the Coastal/High-Land zones (Sharma et al., 2007; Tchiegang & Kitikil, 2004). Snacks in most cases have 30–70 g of water contrary to other categories of dishes. This, at least partly, explains why snacks have more minerals. This data confirms the high variation previously mentioned in nutrients. This could be due to the agricultural biodiversity, multiple pretreatments, culinary operations applied and/or recipe variations. Similar observations were reported in West and Central Africa (Amani & Kamenan, 2004; Mosso, Kouadio, & Nemlin, 1996; Smith, Clegg, Keen, & Grivetti, 1996; Tchiegang & Kitikil, 2004; Tchiegang & Mbougeng, 2005). Determining the nutritional composition of common foodstuffs is of critical importance for defining average daily nutrient intakes, a step to enable studies of diet-related diseases, among others. Protein-rich dishes are reported and could serve for healthy dietary behaviours since in Cameroon, over 50% of boys and girls have protein intake below the recommended values (Dapi, Hörnell, Janlert, Stenlund, & Larsson, 2011). Also, low iron intake has been related to iron deficiency among women and children. This is linked to the fact that iron-rich foods (such as meat and fish) are expensive and there is general a lack of awareness that girls need to eat more iron-rich foods because of menstruation (Dapi et al., 2011). This review identifies iron-rich meals, sauces and snacks that are affordable and could improve iron intake by these vulnerable groups in Cameroon.

Direct chemical analysis is the most precise method for producing nutrient data. This requires adequate sampling, analytical protocols and equipments, which are lacking in many food laboratories in many countries, and Cameroon is no exception. This paper compiled Cameroon food composition studies conducted with both chemical analyses of whole cooked mixtures and calculation of the composition of dishes based on the recipes. The reported data are essential since some dishes may be useful in the prevention or treatment of nutrition related disorders (protein-energy malnutrition, diabetes or obesity) or in any nutritional study or research in Cameroon.

The literature review of nutrient data on Cameroon traditional dishes is dominated by macronutrients. Considerable gaps between nutrient values and more research prospects were revealed such as additional analyses required for macronutrients (starch, sugars) and minerals (copper, manganese and selenium). In the various eco-regions where chronic diseases such as cardiovascular disease, diabetes, hypertension and obesity are growing, these ranges of constituents could serve as guidelines for preventive dietary practices. The availability of this compiled nutrient data will also facilitate further nutrition-related studies in Cameroon.

The nutrient composition of Cameroon traditional dishes is influenced by ethnic belongings and dietary habits which define the nature and doses of ingredients. In addition, variability in the nutrient composition of recipes, even within a dish, can be expected because of environmental factors such as climatic conditions, processing techniques and biodiversity, or interaction of these factors. Further review on composition studies of common ingredients and their diversity may contribute to improving the nutritional value of traditional foods. This review on traditional dishes has contributed to improve our knowledge on the macronutrient and mineral composition of Cameroon cooked staples. The majority of these traditional dishes are good for insertion in a food composition database for use in Cameroon. This compilation is an important contribution to the knowledge and valorization of traditional foods from Central Africa.

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