



The Open Nutrition Journal

Content list available at: <https://opennutritionjournal.com>



RESEARCH ARTICLE

Cereal-based Complementary Foods Marketed in the City of Yaounde: Assessment of the Compliance to Labeling and Nutritional Composition Standards

Mvogo N. Rolly^{1,*}, Djouhou F. Michelle¹, Saha F. Brice^{1,2}, Kuagny M. Blaise¹, Mafogang Borelle¹ and Fokou Elie¹

¹Laboratory for Food Science and Metabolism, Department of Biochemistry, University of Yaounde I, P.O. Box 812, Yaounde, Cameroon

²Department of Biochemistry, Faculty of Science, University of Bamenda, P.O. Box 39 Bambili, Cameroon

Abstract:

Background:

Complementary foods are foods intended for consumption by infants and young children to supplement then replace their milk diet. Compliance with labeling and nutritional composition standards conditions their nutritional quality.

Objective:

The aim of this study was to assess the compliance level of Cereal-based Complementary Foods (CCFs) marketed in the city of Yaounde to related standards.

Methods:

A descriptive cross-sectional study was conducted among 125 mothers in 2 hospitals of Yaounde using probabilistic cluster sampling. The labelings and nutritional compositions of the most consumed CCFs coded as “ASC O”, “ASC I”, “ASC E” and “ASC A”, were compared to *Codex Alimentarius* standards at an acceptability threshold of 80%.

Results:

The labeling standards were 95.24%, 93.48%, 89.68% and 59.34% compliant for “ASC O”, “ASC I”, “ASC E” and “ASC A” respectively, 52.5%, 73.75%, 83.75% and 35% for nutritional composition standards. 90% of these CCFs complied with labeling standards, while only 26% with nutritional composition standards.

Conclusion:

CCFs in Yaounde have as main defects: incomplete labels, labels with errors and falsities, protein and mineral deficiencies. Their producers, controllers, and buyers should respectively improve, control and seek their good quality for the well-being and good health of infants and young children.

Keywords: Complementary food, Cereals, Labeling, Nutritional quality, Standards, Yaounde.

Article History

Received: October 8, 2019

Revised: February 13, 2020

Accepted: February 20, 2020

1. INTRODUCTION

Malnutrition remains a major public health problem in the world in general, and in sub-Saharan Africa in particular. It mainly affects pregnant or breastfeeding women and children aged under 5 years old [1]. In 2016, WHO has estimated that 155 million children under 5 were stunted, 52 million were

underweight and 41 million suffered from overweight or obesity. Undernutrition has resulted in 45% morbidity for children under 5 years of age and 45% mortality for all children [2]. Repetitive infections, lack of drinking water, poor hygiene, poor eating habits, insufficient and poor quality nutrition are reported to be its main causes [2]. In sub-Saharan Africa, malnutrition is responsible for 35% of the deaths of children under 5 years of age [3] and its prevalence increases dramatically during the period of diet diversification or complementary feeding [4]. Most incriminated are bad practices of breastfeeding and poor nutritional value of the

* Address correspondence to this author at Laboratory for Food Science and Metabolism, Department of Biochemistry, University of Yaounde I, P.O. Box 812, Yaounde, Cameroon ; Tel:(+237)676192103; Email: rolly.mvogo83@gmail.com

complementary foods offered to children during this period [5]. In Cameroon, the situation is not less worrying, about 33% of children aged from 0 to 5 suffer from chronic malnutrition [6], and about 45 000 die each year [7]: malnutrition is the second leading cause of infant mortality in Cameroon [8]. The period of food diversification is the one with the highest prevalence and clinical complications. From 8% for children under 8 months of age, its rate increases to 42% for those between 18 to 35 months. About 60% of children aged from 12 to 24 months suffer from iron deficiency and 38.8% from vitamin A deficiency; 42% of children under 5 are stunted, and 19% underweight [9].

To overcome this problem, the WHO advocates early breastfeeding within an hour of birth, exclusive breastfeeding up to six months and, from six months the introduction of healthy Complementary Foods (CF) with good nutritional quality, while continuing breastfeeding up to 2 years and above [2]. The nutritional quality of complementary foods is, therefore, one of the assets of the overall strategy to combat child malnutrition which is more related to the quality of food offered to infants and young children than to its quantity or availability [4]. Knowing that there is a strong link between the quality of food consumed, the nutritional status and the general health status [10]; that almost all commercial products suffer from counterfeiting and commercial tricks [11]; the period of food diversification is the most favorable for child malnutrition [4] and that its consequences hardly disappear while growing up [4]. The assessment of the nutritional quality of CF offered to infants and young children become, therefore, a crucial necessity.

Labeling is a set of general and nutritional information found on the label of commercial products and is intended to inform, reassure, direct the consumer in his/her choice, uses and conservation. The nutritional composition is a set of information on the quality and quantity of macro and micronutrients present in a food product [12]. General labeling and nutritional composition are respectively extrinsic and intrinsic quality factors of food products and are governed by *Codex Alimentarius* standards [13 - 18]. These standards describe how complementary foods need to be labeled for their commercialization and prescribe how they should be formulated to satisfy the physiological needs of infants and young children. Cereal-based Complementary Foods (CCFs) are those targeted in this study because they are the most consumed CF in Cameroon (by 51.3% of breastfed children and 74.4% for non-breastfed children) [9], commercial or marketed foods are the most used (by about 40% of mothers of the city of Yaounde), permanently available in all types of shops and easy to prepare or reconstitute for mothers [9, 19]. The evaluation of these two parameters on these food products would give a general idea about their presumed quality and the role they could play for the health or malnutrition of infants and young children, hence the aim of this study. In addition, this study aimed to diagnose potential deviations from the standards of formulation and characterization of these foods, in order to raise awareness among the various stakeholders for possible improvements and solutions.

2. MATERIALS AND METHODS

2.1. Survey

A descriptive cross-sectional study was conducted in two main hospitals in charge of children's health: The Yaounde Gyneco-Obstetric and Pediatric Hospital (YGOPH) and the Elig-Essono Medical Center, after receiving institutional ethical clearance and survey authorization, from September to October 2016, using a probabilistic cluster sampling. A total of 125 mothers with at least one child aged above 6 months and being used at least once a CCF purchased in the city of Yaounde (inclusion criteria) were surveyed.

2.2. Sample Collection

After statistical analysis of survey sheets, 03 samples of the four most consumed CCF (representing about 99% of the market share) were collected in January 2017 under their most used packaging (sachets or cartons) in different shops of neighbourhoods where they were mostly consumed.

2.3. Assessment of Compliance with Labeling and Nutritional Composition Standard

The labeling information on the different products were compared to the mandatory, prohibited and optional labeling standards prescribed by the *Codex Alimentarius*: CODEX STAN 146, CAC/GL 1, CAC/GL 2, CAC/GL 08 and CODEX STAN 1 [13, 18]. using a binary evaluation method (+ = 1pt and - = 0pt) according to which a general percentage of compliance was calculated.

Energy values, macronutrient and mineral contents (assuming that they are all true) were also assessed according to the WHO, FAO and UNICEF standards compiled by Mouquet *et al.* Table 1 [20], using a half-unit evaluation method (+ = 1pt, - = 0.5pt and Not Specify = 0pt) according to which a general percentage of compliance was calculated.

Vitamin levels have not been evaluated because their presence is mandatory on the label of a product only if their content is > 15% of Recommended Daily Allowance (RDA) for the indicated vitamin [21], and vitamins RDAs being highly variable between 6 to 36 months [22], vitamins have been excluded in this assessment.

2.4. Statistical Analysis

A descriptive analysis of results was carried out using SPSS 20.0 software. Results were presented in percentages (%) and EXCEL 2016 was used to draw the figures.

3. RESULTS AND DISCUSSION

3.1. Most Consumed Cereal-based Complementary Foods (CCFs) in Yaounde

The main CCFs consumed in the city of Yaounde were: *Phosphatine - Blédine - Cérelac - Tanty*. They represent nearly 99% of CCFs' market share in the city of Yaounde. Imported products represent 89.9% and only 10.1% are produced locally. This result is close to the proportions of 96% of imported complementary foods and 4% of local commercial products

obtained in the city of Dakar in Senegal [19]. This result highlights the weakness of local agri-food industries and the low use of locally produced fresh foods to formulate CCFs. Most CCFs consumed by infants in Yaounde, therefore, go through a long process before arriving in their dishes: loading, transport, shipment, handling, storage for customs clearance before the national distribution chain. The variable conditions within this long chain between the production and the

consumption can modify or reduce their nutritional composition: the longer the supply chain, the riskier the end products.

For the following results, the selected products were codified in order to avoid any advertising or counter-advertising effect. The codes chosen were: “ASC A”, “ASC E”, “ASC I” and “ASC O” to represent the 4 CCFs.

Table 1. Desirable nutritional composition of infant flour according to a compilation of WHO, FAO and UNICEF standards.

MINIMUM OR MAXIMUM CONTENT (FOR 100 KCAL)	
• Proteins and amino acids :	
Raw proteins.	< 5.5 g Digestible protein. > 3.0 g
Histidine.	> 28 mg Phenylalanine + tyrosine. . . > 138 mg
Isoleucine.	> 67 mg Threonine. > 103 mg
Leucine.	> 181 mg Tryptophan. > 18 mg
Lysine.	> 120 mg Valine. > 101 mg
Methionine + cystine. . .	> 66 mg
• Lipids and essential fatty acids :	
Lipids.	> 2.1 g Linoleic acid. > 480 mg
	Linolenic acid. > 56 mg
• Minerals :	
Sodium	> 74 mg Iron. > 4 mg
Potassium	> 129 mg Iodine. > 5 µg
Chlorine	> 81 mg Copper. > 40 µg
Calcium	> 125 mg Zinc. > 0.8 mg
Phosphorus	> 114 mg Manganese > 4 µg
Magnesium	> 19 mg selenium > 1.1 µg
• Vitamins :	
Vitamin A.	> 35 µg ER Folic acid > 3 µg
Vitamin D	> 2.5 µg Pantothenic acid. . . . > 200 µg
Vitamin C	> 2.3 mg Vitamin B12. > 0.03 µg
Thiamine.	> 50 µg Vitamin K1. > 3.3 µg
Riboflavin.	> 70 µg Nicotinamide. > 1.1 mg

3.2. Assessment of Compliance with Labeling Standards

3.2.1. Assessment of compliance with mandatory labeling

The presence of these components is mandatory on the labels of CCF products. The result of their assessment is summarized in Table 2 below, (+) means the product meets the standards and (–) means the product does not.

From this assessment, the following defects were found:

- “ASC I” products were labelled in French and in Arabic, but not in English (one of the country’s official languages). The labeling language promotes proper use, understanding and respect of the instructions on product labels (instructions for use, shelf life and storage conditions, composition, presence of ingredients or allergenic additives) [16, 21]. These information are nearly inaccessible for English-speaking users of the city of Yaounde, representing about 30% of the population [23].

- “ASC A” products did not indicate carbohydrate, lipid and mineral contents, thus making their nutritional values less appreciable and their energy value questionable. The buyer is not sufficiently informed about the nutritional virtues, deficiencies or excesses to which consumers are exposed. These products also contained deletable information such as the expiry date, the batch identification number and the net weight; those modifiable information could raise doubts about their reliability because they are modifiable at the convenience of crooked producers or producers. Moreover, the identification of the products, according to their batches and their recall in

case of a problem detected in a production batch, then becomes difficult or impossible. The “ASC A” products do not specify the storage conditions. When this information is unknown, it cannot be respected by the end-users, thus leading to contamination or rapid deterioration of the products and their nutritional principles, exposing consumers to serious growth and health problems depending on the quantities consumed [24].

The analysis of the nutritional labeling of these foods revealed that “ASC I”, “ASC E”, “ASC O” presented a group 2 labeling, while “ASC A” products belonged to group 1. This latter group does not comply with the standards of complementary foods, as they are dietetic products [25].

Regarding compliance with mandatory labeling standards, the following classification has been established: “ASC E” > “ASC O” > “ASC I” > “ASC A”.

3.2.2. Assessment of compliance with prohibited labeling information

These are the mentions which presence is strongly prohibited on the labels of CCF products. The result of their evaluation is summarized in Table 3 below.

From these results, many defects on “ASC I”, “ASC E” and “ASC A” products were noted:

“ASC A” products clearly showed the photograph of a young child on their main face, which is firmly prohibited by the standards.

Table 2. Assessment of compliance with the mandatory labeling requirements for CCF foods marketed in the city of Yaounde, according to CODEX STAN 146.

Mandatory Labelling Information		Commercial CCF			
		ASC I	ASC E	ASC O	ASC A
Food name	Trade name	+	+	+	+
	Brand name	+	+	+	+
List of ingredients		+	+	+	+
Nutritional Labelling	Energy	+	+	+	+
	Proteins	+	+	+	+
	Carbohydrates	+	+	+	–
	Lipids	+	+	+	–
	Minerals	+	+	+	–
	Vitamins	+	+	+	–
Net content	–	+	+	+	+
Manufacturer’s name and address	–	+	+	+	+
Country of origin	–	+	+	+	+
Batch identification	–	+	+	+	+
Expiry date	–	+	+	+	+
Instructions for use	–	+	+	+	+
Storage conditions	–	+	+	+	–
All mentions indelible	–	+	+	+	–
Information in local languages	English	–	+	+	+
	French	+	+	+	+
Total		18 + 01 –	19 +	19 +	13 + 06 –

+ = Respects standards – = Does not respect standards.

Table 3. Assessment of Compliance with Prohibited Labeling standards on CCF Marketed in the City of Yaounde according to CAC/GL 1, CAC/GL 2 and CAC/GL 08.

Prohibited labelling information/statement	Commercial CCF			
	ASC I	ASC E	ASC O	ASC A
Complete food / Breast milk substitute	+	+	+	+
Infant image	+	+	+	-
Exclusive food	+	+	+	+
Nutraceutical	+	+	+	+
Negative claims on similar products	+	+	+	+
Unjustified, false or contrary allegations	+	-	+	-
Total	6 +	5 + 1 -	6 +	4 + 2 -

+ = Respects standards - = Does not respect standards.

“ASC E” had a false claim: the zinc content was expressed in grams and not in milligrams, which is excessive for an oligo-mineral. There would have been a confusion of units during labeling, for the comparison with the label of the same product in another package showed a zinc content expressed in milligrams, which confirmed our hypothesis. These products also presented two contradictory claims: the age of introduction of the product was different from the front and the backside of the label, 8 months and 6 months, respectively. This contradiction may lead some parents to introduce it before the required age of 8 months (as confirmed by the other packages of the same product). It may also cause digestive difficulties related to the immaturity of the infant's digestive tract [26].

- “ASC A” products also presented one unjustified claim and one false claim. The displayed energy values were unjustified because not underpinned by the content of all the energy molecules contained in the product (absence of carbohydrate and lipid contents). The mode of preparation also presented a false allegation, because it alluded to a perfume (Peanut perfume) other than that named (Multi-cereals perfume), This description is copied-pasted from another perfume or type of product, leading to a fake labeling.

According to the evaluation of compliance with the prohibited labelling standards, these products comply in the following order: “ASC O”> “ASC I”> “ASC E”> “ASC A”.

3.2.3. Assessment of optional labeling information

Although optional, these labeling statements are very important for the selection, use and mastery of the beneficial and sides effects of CCF. Their assessment is summarized in Table 4 below.

These results showed that the products “ASC I”, “ASC O”

and “ASC E” were those with the most complementary labelling information to facilitate their selection and use by consumers. From these results, the following classification was obtained: “ASC O”> “ASC I”> “ASC E”> “ASC A”. This order is the same as the order of consumption: optional labeling information may also be a determinant for the selection of CCFs.

3.2.4. General assessment of compliance with labeling standards

Table 5 below summarizes the results of the 32 labeling items (mandatory, optional and prohibited) using a binary evaluation system: (+) value as a unit value (1) and (-) value as a zero value (0).

From this Table, 3 of the 4 products analysed globally respect the labelling standards (with percentages higher than the 80% threshold). They represent about 90% of the market share. The compliance order with the general labeling standards is as follows: “ASC O”> “ASC I”> “ASC E”> “ASC A”. This order is the same as consumer preference: labeling is a selection and appreciation criterion for CCFs.

3.3. - Assessment of Compliance with the Nutritional Composition Standards of CCFs Marketed in the City of Yaounde

This evaluation focused on the energy values, the macronutrient and mineral contents displayed on the various products, considering all the displayed claims as true.

3.3.1. Assessment of compliance with energetic and macronutrient composition standards

The results obtained from this assessment are summarized in Table 6 below.

Table 4. Evaluation of optional labeling standards of CCF marketed in the city of Yaounde according to CODEX STAN 1.

Optional labelling statements	Commercial CCF			
	ASC I	ASC E	ASC O	ASC A
Age of introduction	+	+	+	+
Recommended quantity by age and day	+	+	+	-
Quantitative labelling of ingredients	-	-	-	-
Precision of the presence of Gluten	+	+	+	-
Precaution of use	+	+	+	+

(Table 4) contd.....

Importance of breastfeeding	+	+	+	+
Absence / Presence of certain additives	+	+	+	-
Total	6 + 1 -	6 + 1 -	6 + 1 -	3 + 4 -

+ = Respects standards - = Does not respect standards.

Table 5. General assessment of compliance with labeling standards for CCF.

Percentages of compliance with labelling standards	ASC I	ASC E	ASC O	ASC A
Mandatory information (%)	94.74	100	100	68.42
Prohibited information (%)	100	83.33	100	66.67
Optional information (%)	85.71	85.71	85.71	42.86
General Labelling (%)	93.48	89.68	95.24	59.34

From this table, it appeared that:

- The protein contents of the products “ASC I”, “ASC E” and “ASC O” although higher than those obtained by Sanou *et al.* [27] in a study in Ouagadougou and Koudougou (in Burkina Faso), had low values compared to international standards. The protein content of “ASC A” products was conformed to standards. This protein content is justified by its high Soybean content. Soybean is a major source of vegetable proteins (30 to 40%) and is rich in essential amino acids [5, 27, 28], while in other products, Soybean is either absent or present in traces.

- For lipid contents, “ASC A” products did not specify the lipid content, which is a factor of non-quality [25]. The lipid content of “ASC I” products was within the compliance range of the standards and “ASC E” products were the only ones to have a lipid content in accordance with international standards, as well as the reference value ($> 8.5 \text{ g} / 100\text{g}$) used by Sanou *et al.* [27]. This accordance is the fact of the olein added only in “ASC E”.

- For carbohydrate contents (not specified by *Codex Alimentarius* standards), no value was specified for “ASC A” products, which is another factor of non-quality. Only “ASC E” products had value within the reference range ($64 \pm 4 \text{ g}/100\text{g}$) used to compare the infant flours analysed by Sanou *et al.* [27].

- The energy values of all these products complied with the standard (between 320 - 480 kcal/100 g) but were all below the reference value ($\geq 420 \text{ kcal} / 100 \text{ g}$) used by Sanou *et al.* [27].

This comparison suggests that the energy values of CCFs marketed in the city of Yaounde are not optimal, they can be upgraded. Although displayed, the Energy Value (EV) of “ASC A” products could not be verified because the carbohydrate and lipid contents are not specified. Using the conversion factors according to the formula $\text{EV (kcal} / 100 \text{ g)} = (\% \text{ Proteins} \times 4 \text{ kcal}) + (\% \text{ Carbohydrates} \times 4 \text{ kcal}) + (\% \text{ Lipids} \times 9 \text{ kcal})$, the result for “ASC E” was 418, 8 kcal, which rounded by default gave the value displayed on the product (418 kcal). Meanwhile, the results of the products “ASC O” and “ASC I” were respectively 391.6 kcal and 408.5 kcal, these values did not correspond to the displayed values (respectively 396 kcal and 419 kcal). These mismatches suggested that the energy values of the dietary fibres (respectively 2.4 g and 5.2 g) were added in order to obtain the total energetic values ($391.6 + 4.8 = 396.4 \text{ kcal}$ for “ASC O”; $408.5 + 10.4 = 418.9 \text{ kcal}$ for “ASC I”) rounded by default. This latter calculation method is not suitable for determining the energy value of foods formulated for infants and young children, due to the immaturity of their digestive system which does not allow them to properly metabolize dietary fibres [26]. The non-compliance of protein content in “ASC I”, “ASC E” and “ASC O” and in lipid content for “ASC O” suggest an energy imbalance in these products [28]. This can lead to imbalanced diets and nutrients deficiencies in infants in case of long-term and exclusive consumption.

From the macronutrient compositions of these products the following classification was obtained: “ASC E” > “ASC I” > “ASC O” > “ASC A”.

Table 6. Assessment of compliance with energy values and macronutrient composition standards according to the standards of WHO, FAO and UNICEF.

Commercial CCFs	MACRONUTRIENT STANDARDS (Per 100 Kcal)				Total
	Energy values* [320 - 480] kcal/100g	Total proteins ($< 5,5 \text{ g}$)	Lipids ($> 2,1 \text{ g}$)	Carbohydrates (NS)	
ASC I	419* +	14* < 23 -	8.5* < 8,8 +	69 +	3 + 1 -
ASC E	418* +	15* < 23 -	10* > 8,8 +	67.2 +	3 + 1 -
ASC O	396* +	14.7* < 21,78 -	3.6* < 8,3 -	75.1 +	2 + 2 -
ASC A	390* +	19* < 21,45 +	NS	NS	2 + 2 NS

+ = Meets standards - = Does not meet standards NS = Not specified * in bold = Value displayed on the label The value not in bold is the reference value calculated according to standards and energy values.

3.3.2. Assessment of compliance with mineral compositional standards

The results of this analysis are summarized in Table 7 below.

From this table, it appeared that:

- For the sodium and iron contents, there was a non-conformity for all the products. The low content of these minerals in CF can promote physiological disorders such as: anaemia, asthenia, weak development and muscular weakness, enzymatic disorders, a weak ratio Mass/age, stunting [22, 29].

- For the calcium content, the products “ASC I” and “ASC E” respectively complied with the standards and its tolerance margin, while the products “ASC O” and “ASC A” did not comply. The exclusive consumption of these latter products may lead to the following diseases and symptoms: rickets, osteoporosis, delayed dental flare, tooth fragility and nervous irritability [29, 30].

- For the potassium and zinc contents, only the products that specify them (“ASC E” for potassium and “ASC O” and “ASC A” for zinc) had values that complied with standards. Knowing that zinc deficiency can lead to retarded growth (low muscle and bone mass), weakened immune system, vision problems, respiratory infections [32, 33], and that potassium deficiency can cause digestive disorders (constipation or diarrhoea) and limit the development of nervous and motor skills [29] the exclusive consumption of these products may favour in children who consume them the occurrence of one or

more of these symptoms.

From the analysis of the mineral composition, all the products showed a deficiency in one or more minerals. Their prolonged or almost exclusive consumption could lead to chronic nutritional deficiencies, the main cause of stunting. The order of mineral composition conforming to the standards is as follows: “ASC E” > “ASC I” > “ASC O” > “ASC A”.

3.3.3. General assessment of compliance with nutritional composition standards

Based on the values of the nine (09) nutritional elements listed on the different products, a half-unit evaluation system was defined. Each positive value (+) as a unit value (1 point), each negative value (-) as its half (0.5 point) and each non specified value (NS) as a zero value (0 point), considering that a non-displayed or unreported nutritional information was either absent or far below standards [12, 31]. The results obtained are summarized in Table 8 below.

Based on this table and on the minimum acceptability threshold (80%) of the standards, only “ASC E” products (representing about 26% of CCFs marketed in the city of Yaounde) met the standards. The order of compliance with the nutritional composition standards is “ASC E” > “ASC I” > “ASC O” > “ASC A” and is different from that obtained for compliance with general labeling standards: the quality of labeling of CCFs do not guarantee the respect of their nutritional composition; the extrinsic quality of a food product is not a guarantee, nor a determinant of its intrinsic quality.

Table 7. Assessment of compliance with mineral compositional standards for CCF marketed in the city of Yaounde according to the standards of WHO, FAO and UNICEF.

MINERAL STANDARDS (Per 100 Kcal)						
Commercial CCFs	Na (> 74 mg)	Fe (> 4 mg)	Ca (> 125 mg)	K (>129 mg)	Zn (> 0,8 mg)	TOTAL
ASC I	100* < 310.1 -	9* < 16.8 -	697* > 523.7 +	NS	4.5* > 3.4 +	2+ 2- 1 NS
ASC E	145* < 309.3 -	7.6* < 16.7 -	440* < 522.5 +	550.8* > 539.2 +	5* > 3.3 +	3+ 2-
ASC O	130* < 293 -	10.5* < 15.8 -	330* < 495 -	NS	NS	3- 2 NS
ASC A	NS	5* < 15.6 -	70* < 487.5 -	NS	NS	2- 3 NS

+ = Meets standards - = Does not meet standards NS = Not specified * in bold = Value displayed on the label. The value not in bold is the reference value calculated according to standards and energy values.

Table 8. General level of compliance with the nutritional composition standards of CCFs marketed in the city of Yaounde.

Nutritional composition standards	ASC O	ASC I	ASC E	ASC A
Energetic values and Macronutrients (%)	75	87.5	87.5	50
Micronutrients (%)	30	60	80	20
Percentages of standards met (%)	52.5	73.75	83.75	35

CONCLUSION

It has been observed that 90% of CCF in the city of Yaoundé complied with labeling standards, while only 26% had a nutritional composition compliant with the relevant standards. According to their labels, these CCFs present some labeling defects, lacks and falsified information as well as proteins and minerals deficiencies. These results highlight the need for their producers to improve their nutritional labelling, proteins and minerals supplementation, the urgency to activate or strengthen the internal and external systems of quality assurance by the various stakeholders, and the need to educate the buyers of these foods on the objective criteria of discrimination or selection which are good nutritional composition and comprehensive general labelling.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethical approval was obtained from the Research of the Institutional Ethics Committee for Research for Human Health (CIERSH) (Approval No. E1395), Yaounde, Cameroon.

HUMAN AND ANIMAL RIGHTS

Not applicable.

CONSENT FOR PUBLICATION

Informed consent was obtained from each participant.

AVAILABILITY OF DATA AND MATERIALS

The data that support the findings of this study are available from the corresponding author, [Mvogo N. Rolly], upon reasonable request.

FUNDING

None.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

ACKNOWLEDGEMENTS

Authors are grateful to the Elig-Essono District Medical Center and the Yaounde Gyneco-Obstetrics and Pediatric Hospital for authorizing the conduct of the surveys in their hospital facilities.

REFERENCES

- [1] FAO/OMS. Garantir la sécurité sanitaire et la qualité des aliments: directives pour le renforcement des systèmes nationaux de contrôle alimentaire. Rome: FAO/OMS 2016.
- [2] WHO. Infant and young child feeding, 2018 <http://www.who.int/fr/news-room/fact-sheets/detail/infant-and-young-child-feeding> 2018. May 22nd, 2018)
- [3] Afrique OMS. Activités de l'OMS dans la région africaine 2014-2015: rapport biennal de la Directrice régionale. OMS, Bureau Régional de l'Afrique 2015.
- [4] UNICEF. Guide de Programmation Alimentation du Nourrisson et du Jeune Enfant Section de Nutrition, Programmes. New York: UNICEF 2012.
- [5] Zannou-tchoko JV, Kouamé GM, Bouaffou KGK. Bull Soc R Sci Liege 2011; 80: 748-58.
- [6] INS. EDS-MICS 2011, note de présentation des résultats préliminaires Institut National de la Statistique. Yaoundé: Cameroun 2012.
- [7] Cameroon UNICEF. Humanitarian action update, silent emergency affecting children in Cameroon. Yaounde, Cameroon: Unicef 2009.
- [8] INS. Enquête par grappes à indicateurs multiples (MICS 5) 2014, Rapport de résultats clés Yaoundé, Cameroun, Institut National de la Statistique 25.2015;
- [9] INS et ICF International. Enquête Démographique et de Santé et à Indicateurs Multiples du Cameroun 2011. Calverton, Maryland, USA: INS et ICF International 2012.
- [10] FAO. La situation mondiale de l'alimentation et de l'agriculture: le commerce agricole et la pauvreté, le commerce peut-il être au service des pauvres. Rome: FAO 2005.
- [11] WTO. World Trade Organization: who we are, what we do, 2017 https://www.wto.org/english/thewto_e/whatis_e/who_we_are_e.htm https://www.wto.org/english/thewto_e/whatis_e/what_we_do_e.htm 2017 May 17th;
- [12] ACIA. Guide d'étiquetage et de publicité sur les aliments, 2011 <http://www.inspection.gc.ca/francais/for/mpppf.shtml> 2018 May 18th;
- [13] FAO/OMS. Directives générales concernant les allégations. CAC/GL 1, révisées en 1991 3.1979;
- [14] FAO/OMS. Norme pour les aliments transformés à base de céréales destinés aux nourrissons et enfants en bas âge. CODEX STAN 074, révisée 2006 1981; 10.
- [15] FAO/OMS. Norme générale pour l'étiquetage des denrées alimentaires pré-emballés CODEX-STAN 1, amendée en 2009 3.1985;
- [16] FAO/OMS. Norme générale pour les mentions d'étiquetage et les allégations concernant les aliments diététiques ou de régime préemballés. CODEX-STAN 146, révisée en 1985 et 1991, amendée en 1999, 2001, 2003 et 2005 10.1985;
- [17] FAO/OMS. Directives concernant l'étiquetage nutritionnel. CAC/GL 2, révisées en 1993 et 2006, amendées en 2003 8.1985;
- [18] FAO/OMS. Lignes directrices pour la mise au point des préparations alimentaires complémentaires destinées aux nourrissons du deuxième âge et aux enfants en bas âge. CAC/GL 08, révisées en 2013 11.1991;
- [19] Ndiaye QV. Enquêtes sur l'utilisation des aliments de sevrage commercialisés à Dakar. Thèse de doctorat en médecine, Université CHEIKH ANTA DIOP de Dakar. 108. 1999;
- [20] Mouquet C, Treche S, Gret, Bruyeron O. "Caractéristiques d'une bonne farine infantile. Bulletin Du Réseau Technologie et Partenariat en Agoalimentaire 1998; 15: 8-11.
- [21] ANIA. Recommandations pratiques sur l'étiquetage nutritionnel. France 2009.
- [22] FAO/OMS. Human vitamin and mineral requirements: Report of a joint FAO/OMS expert consultation. Bangkok: FAO/OMS 2001.
- [23] INS. Annuaire statistique du Cameroun Institut National de la Statistique. Yaoundé: Cameroun 2011.
- [24] Motarjemi Y, Käferstein F, Moy G, Quevedo F. Contaminated weaning food: a major risk factor for diarrhoea and associated malnutrition. Bull World Health Organ 1993; 71(1): 79-92. [PMID: 8440042]
- [25] ANIA/ACTIA. . Guide étiquetage nutritionnel en application du règlement (ue) n° 1169/2011 concernant l'information des consommateurs sur les denrées alimentaires France 2016; 98.
- [26] Northstone K, Emmett P, Nethersole F. ALSPAC study team. avon longitudinal study of pregnancy and childhood. The effect of age of introduction to lumpy solids on foods eaten and reported feeding difficulties at 6 and 15 months. J Hum Nutr Diet 2001; 14(1): 43-54. [<http://dx.doi.org/10.1046/j.1365-277X.2001.00264.x>] [PMID: 11301932]
- [27] Sanou A, Tapsoba F, Zongo C, Savadogo A, Traore Y. "Etude de la qualité nutritionnelle et microbiologique des farines infantiles de quatre unités de production: CMA saint Camille de Nanoro, CSPS Saint Louis de Temnaore, CM saint Camille d'Ouagadougou et CHR de Koudougou", *Nature & Technology Journal, Vol. B. Agronomic & Biological Sciences* 2017; 17: 25-39.
- [28] Ponka R, Lina E, Nankap T, Tambe S T, Fokou E. Composition nutritionnelle de quelques farines infantiles artisanales du Cameroun International Journal of Innovation and Applied Studied 16(2): 280-92.
- [29] Ekweagwu E, Agwu AE, Madukwe E. The role of micronutrients in child health: A review of the literature. Afr J Biotechnol 2008; 7: 3804-10.
- [30] Pointillart A, Gueguen L. Calcium, Phosphore, minéralisation osseuse et prévention de l'ostéoporose Support de Cours. France: LNSA-INRA 2003.
- [31] ACIA. Test de conformité de l'étiquetage nutritionnel, <http://www.inspection.gc.ca/aliments/etiquetage/l-etiquetage-des-alim>

- ents-pour-l-industrie/etiquetage nutritionnel/reenseignements-additionnels/test-de-conformite/fra/2014; 75. May 18th, 2018
- [32] Prasad AS. Discovery of human zinc deficiency and studies in an experimental human model. *Am J Clin Nutr* 1991; 53(2): 403-12.
- [33] Aggarwal R, Sentz J, Miller MA. Role of zinc administration in prevention of childhood diarrhea and respiratory illnesses: A meta-analysis. *Pediatrics* 2007; 119(6): 1120-30. [<http://dx.doi.org/10.1093/ajcn/53.2.403>] [PMID: 1989405]
- [<http://dx.doi.org/10.1542/peds.2006-3481>] [PMID: 17545379]

© 2020 Rolly *et al.*

This is an open access article distributed under the terms of the Creative Commons Attribution 4.0 International Public License (CC-BY 4.0), a copy of which is available at: <https://creativecommons.org/licenses/by/4.0/legalcode>. This license permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.