Physicochemical characterization and comparison of labels of beef bouillon cubes

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Abstract

This study aimed at determining the centesimal composition, the energy value and the sodium content in beef bouillon cubes and compare them with the nutritional information by the manufacturer. Beef bouillon cube samples were collected in supermarkets in of the city of Limoeiro do Norte/CE, and the levels of nutrients were determined by official analysis methods. The physicochemical analyses carried out were moisture, lipids, proteins, fixed mineral residue, total carbohydrates and sodium content. The beef bouillon cubes analyzed showed a low moisture content (3.23 – 4.23 g/100 g) and high levels of lipids (19.72 – 20.05 g/100 g) and fixed mineral residue (53.24 – 57.61 g/100 g). When compared to the data reported on their labels, all the parameters were in smaller amounts than the ones declared in all analyzed brands. The average sodium content found in the samples ranged from 758.5 to 815.5 mg/serving of the product. Considering that the results were based on a portion of broth and that these amounts are related to half a cube of beef bouillon, it becomes quite alarming the amount of sodium available in this type of product, since the food prepared with this ingredient is usually eaten alongside other foods, which also contain sodium in their composition.

Keywords: dehydrated food; nutritional composition; labeling.

Practical Application: This study highlights the importance of investigating nutrients in foods and verifying whether this information is consistent with the one reported on labels, once the consumer is entitled to correct and truthful information. The products chosen for analysis were beef bouillon cubes. The results indicate that the nutritional composition described on the labels differs from the results found in the laboratory, suggesting the necessity of a greater control by the industry and regulatory agencies.

1 Introduction

Beef bouillon cubes, as other forms of spices, are widely used as ingredients in food preparation, providing them with flavor and a better sensory perception by the consumers (Kim et al., 2017). Gupta & Bongers (2011) classify beef bouillon cubes according to the ingredients present in their composition, varying mainly the flavor they are formulated with. They can have beef, poultry, vegetable flavors and others. On an industrial scale, the manufacturing process of the cubes consists in mixing ingredients (salt, monosodium glutamate, palm oil, caramel, spices such as soybean, locust bean gum, onion, tomato, natural proteins and starch), coloring and flavoring agents (Raw Materials Research and Development Council, 2003; Rodrigues et al., 2016).

The nutritional value of a food is related to the qualitative and quantitative composition of the nutrients present in it (Karšulínová et al., 2007). Among these, both lipid fraction and sodium content have an enormous relevance because they play important roles on the maintenance of human health (Visioli & Galli, 1998). This and other information can be seen on the labels of food packages. Food labeling is regulated by the National Health Surveillance Agency. It is mandatory and essential because, upon informing the consumer of the types of nutrients and their amounts, it allows a better selection of foods considering their nutritional information, contributing to dietary control and indirectly enabling disease prevention (Brasil, 2003a). However, for this purpose, it is essential that the information provided on the labels be reliable.

Labeling regulation in Brazil was an important achievement for consumers. However, studies have pointed out some imperfections, especially ones regarding to nutritional information (Câmara et al., 2008; Lobanco et al., 2009) or discrepancies between the results displayed on the label and those found in foods when they are analyzed. Therefore, this study aimed at determining the centesimal composition, the energy value and the sodium content of beef bouillon cubes sold in Limoeiro do Norte, Ceará (CE), Brazil, and compare them with the nutrition label informed by the manufacturer.

2 Material and methods

Beef bouillon cubes produced by the top three brands sold in supermarkets in Limoeiro do Norte district were evaluated. Three cubes of each brand were analyzed in duplicate, totaling 18 samples. The samples (A1, A2 and A3) were sent to the Food Biochemistry Laboratory of the Federal Institute of Education, Science and Technology of Ceará, campus Limoeiro do Norte, and stored in a cool and dry place until analysis.

The moisture and fixed mineral residue analyses were performed by the gravimetric method using direct drying at 105 °C in an oven until constant weight to determine the first and carbonization of the samples in plates followed by incineration in a muffle furnace at 550 °C to obtain the last; the crude protein content was determined by the Kjeldahl method and the result was multiplied by 6.25 to convert the total Nitrogen into protein; the lipid content was obtained by extraction using hexane in a Soxhlet apparatus according to the Association of Official Analytical Chemists (Association of Official Analytical Chemists, 2005). The content of total reducing sugars was obtained by the DNS (3, 5-dinitrosalicylic acid) method according to the methodology described by Miller (1959).

The concentration of sodium was determined by flame photometry after digestion of organic matter through wet pathway with nitric acid, according to the methodology described by Malavolta et al. (1997).

The total energy value (TEV) was obtained according to the system developed by Atwater (1910), which defines that 1 g protein provides on average 4 calories (4 kcal), 1 g fat provides on average 9 calories (9 kcal), and 1 g of carbohydrate provides on average 4 calories (4 kcal). However, for this study, protein concentrations were not considered for the calculation of energy value in order to facilitate a comparison with the labels, once they did not present results for that parameter.

The nutritional labels of products were recorded by photographing the packaging or using the information available on the company's website. Protein, lipid, carbohydrate and sodium contents were evaluated using both 100 g of product and one serving for comparison with the information provided in the Brazilian Table of Food Composition (Núcleo de Estudos e Pesquisas em Alimentação, 2011) and in the label of the products, respectively. According to the agreement made between the Brazilian Ministry of Health and food producers associations, the recommended serving product corresponds to the mass required to prepare 250 mL of bouillon (Brasil, 2003a).

The results were presented as means ± SD. Analysis of Variance (ANOVA) was used to assess this results and Tukey test to compare the averages ($p < 0.05$) using the Statistica 7 software (Statsoft, 2007).

3 Results and discussion

The chemical composition of the beef bouillon cube samples is shown in Table 1. The samples showed a low moisture content and high levels of lipids and fixed mineral residue, the latter being similar in all three samples. The high lipids content in these samples came from the addition of vegetable fat in its

composition, while the high mineral content can be justified because beef bouillon cubes contain a high concentration of flavor enhancers, salt and spices.

All analyzed parameters were higher than the values reported in the Brazilian Table of Food Composition (Núcleo de Estudos e Pesquisas em Alimentação, 2011), with the exception of crude protein and fixed mineral residue contents, whose variations were within the limits recommended in the Table above. Guimarães & Lanfer-Marquez (2002) studied the chemical composition of beef bouillon cubes and found 8.20 and 8.57% of protein, values higher than those found in this study. The low protein content found in the samples, especially A1 (1.68 g/100 g) and A3 (2.39 g/100 g), may be a result of the amount of protein source used in the broth formulation, which is it possible to observe even in the labels, since in this all the ingredients must appear in descending order, of the respective proportion; in the analyzed samples, the beef appeared only from the seventh ingredient, with the salt appearing as the highest concentration component in all the samples.

It is important to observe that the information provided on the labels of beef bouillon cubes refer to the recommended serving to prepare 250 mL of bouillon. Therefore, the next results will be presented in function of this serving to facilitate a comparison with the data provided on the labels.

The protein concentrations found in the servings of beef bouillon cube samples (Table 2) were less than 0.5%. Therefore, they are not considered significant by the legislation, allowing the nutritional information to be expressed as "zero", "0" or "does not contain" (Brasil, 2003b). The lipid and carbohydrate contents found analytically in bouillons were very close to those reported in the labels of the samples A1 and A3. However, the carbohydrate content found in the sample A2 was almost four times higher. We believe that there may have been a failure in preparing the label of this product since the results are very close to those found in other analyzed brands.

The average sodium content found in the samples ranged from 758.5 to 815.5 mg/serving of the product, corresponding, respectively, to 38 and 41% of the recommended daily intake. This is worrisome, as food prepared with this ingredient is usually eaten together with other foods containing salt in their composition. Ingestion of sodium is essential to health, but excess intake this mineral is a risk factor for hypertension and

Table 1. Centesimal composition of beef bouillon cubes of three brands and Brazilian Table of Food Composition (BTFC) reference values.

Components* (g/100 g)	Samples**			BTFC
	A1	A2	A3	
Moisture	4.23a	3.78ab	3.23b	2.90
Lipids	19.84a	20.05a	19.72a	16.60
Proteins	1.68a	6.71b	2.39a	7.80
Fixed mineral residue	57.61a	54.34b	53.24c	57.60
Total carbohydrates	16.60b	14.96c	19.12a	15.10
Sodium	16.87a	17.17a	15.45a	-

*Results expressed on a wet basis; **Same letters in the same row do not differ by Tukey test at 5%; (-) Data not available; Values are mean ± SD (n = 6).

Table 2. Nutritional composition determined analytically in servings* of beef bouillon cubes and the values displayed on product labels.

Brand/Lot	Proteins (g/serving*)	Lipids (g/serving*)	Carbohydrates (g/serving*)	Sodium (mg/serving*)	TEV (kcal)
Brand A1					
1	0.09	0.93	0.76	697.30	11.46
2	0.07	0.95	0.78	885.88	11.69
3	0.07	0.94	0.83	821.16	11.81
Mean	0.08b	0.94b	0.79a	801.44a	11.64b
SD	0.01	0.01	0.04	95.82	0.19
Label**	-	1.00	0.90	1,025.00	12.00
Brand A2					
1	0.31	0.96	0.73	767.36	11.55
2	0.36	0.95	0.69	838.85	11.28
3	0.30	0.95	0.71	840.39	11.41
Mean	0.32a	0.95b	0.71c	815.54a	11.41b
SD	0.03	0.01	0.02	41.73	0.13
Label**	0.00	1.00	0.20	971.00	12.00
Brand A3					
1	0.08	1.04	1.03	794.06	13.44
2	0.14	1.04	1.01	743.66	13.44
3	0.16	1.03	0.97	737.76	13.11
Mean	0.13b	1.04a	1.00a	758.49a	13.33a
SD	0.04	0.01	0.03	30.94	0.19
Label**	0.00	1.20	1.00	993.00	15.00
Deviation (X)***	0.13	0.05	0.31	29.71	1.69

*The serving of the samples A1 and A2 correspond to 4.75 g of product, the serving of the brand A3 corresponds to 5.25 g; **Values declared in the nutrition facts on the product packaging; ***Standard deviation of the mean of all brands. Means followed by the same letter in the column do not differ significantly by Tukey test ($p \geq 0.05$); (-) Data not reported; TEV = total energy value.

cardiovascular disease in some individuals (Garfinkle, 2017; Mancia et al., 2017). The World Health Organization (2013) recommends a 30% reduction in sodium intake worldwide until 2025 and a mean sodium intake target of less than 2 g/day, enough to meet human needs both for both sodium and iodine. This nutrient is added by industries to foods to improve taste, ensure food safety and maintain the texture and structure of products (Brasil, 2006; 2011). In 2011, in Brazil, several agencies have signed a Statement of Commitment in order to monitor and reduce the sodium content in processed foods, specifying the term for compliance at the end of 2013. This statement included breakfast cereals, bouillon cubes, bouillon powder, margarine, pasta seasoning and spices for rice (Brasil, 2011). In general, all cube bouillon samples, regardless of the lot, reached the limit of no more than 1,100 mg of sodium per serving as stipulated in the Statement of Commitment signed between the Brazilian Ministry of Health and food producer associations.

The results for protein, fat, total carbohydrates, sodium and total energy in beef bouillon cubes diverged from the contents reported on the labels, but only sodium exceeded the margin of error of 20% allowed by the RDC Resolution no. 360/2003 of the National Health Surveillance Agency (Brasil, 2003b). Incorrect information regarding the sodium content in the label hurts the consumer's right regarding the precise information of the food contents. However, the mistake can be mitigated when the variation is less than 20%. In this case, this is desirable.

4 CONCLUSIONS

The beef bouillon cubes analyzed showed a low moisture content and high levels of lipids and fixed mineral residue. When compared to the data reported on their labels, all the parameters were in smaller amounts than the ones declared in all analyzed brands. However, in one of the samples, there was a high discrepancy between the levels of carbohydrates: nearly four times higher. We believe that there may be a problem in the labeling of this product, since the results are very close to those found in other analyzed brands.

Although the manufacturers of these products have reached the limit of no more than 1,100 mg of sodium per serving as stipulated in the Statement of Commitment signed between the Brazilian Ministry of Health and the food producer associations, the average sodium content found in the samples is still high, corresponding on an average to 40% of the recommended daily intake. This is worrisome because food prepared with this ingredient is usually eaten alongside other foods containing salt in their composition. The results also reinforce the importance of the consumer to verify the nutritional composition informed in the product labels so that they are able to identify foods with a lower sodium content within a same product category or between different categories.

Acknowledgements

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