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Thainá Loureiro Serafim[1]

Maria Cristina Jesus Freitas[1]

[1] Universidade Federal do Rio de Janeiro, Instituto de Nutrição Josué de Castro. Rio de Janeiro, RJ, Brasil.

Correspondence
Thainá Loureiro Serafim
thainaserafim1@gmail.com

Evaluation of market meters marketed as an instrument for study in the food and nutrition area

Avaliação de medidores caseiros comercializados como instrumento para estudo na área de alimentação e Nutrição

Abstract

Considering the great variety of brands with different materials and forms of measuring devices, the lack of studies, the importance and the reliability of data for dietary studies, was aimed to evaluate the mass and volume capacity of home meters. This was an experimental study carried out in the Laboratory of Dietetic Technique of UFRJ, where they purchased homemade meters marketed in Rio de Janeiro, with 11 brands of tea cups (XCH) and 12 brands of soup spoon (CS), in the which five measurements of gravimetric and volumetric capacities were carried out. The mass was determined with wheat flour and for the volume the water was used, density 1.0 kg/m3 at 4 °C, as reference. Data were submitted to descriptive statistics, ANOVA and Tukey's test. The average mass capacity for XCH and CS was 106.8 g and 6.8 g, respectively. The XCH and CS presented mean volumes of 213.1 mL and 15.4 mL, respectively, with inadequacy of 20-40% for XCH, while CS were 7.4 to 16%, notably lower variation for both capacities. The capacities of commercially available home meters were detected with the national recommendation proposed by RDC 359 of December 2003. It is concluded that there is a need for specific legislation for the standardization of marketed meters, and consequently control by of inspection organs in the manufacture and marketing of the same, in order to avoid imprecision in the practices in food and nutrition by the population and professionals of related areas.

Keywords: Food Utensils. Weights and Measures. Serving and Cooking

Resumo

Considerando à grande variedade de marcas com diferentes materiais e formas de utensílios medidores, a carência de estudos, a importância e a confiabilidade de dados para estudos dietéticos, objetivou-se avaliar a capacidade de massa e volume de medidores caseiros. Tratou-se de um estudo experimental, realizado no laboratório de Técnica Dietética da UFRJ, onde foram adquiridos medidores caseiros comercializados no Rio de Janeiro, sendo 11 marcas de xícaras de chá (XCH) e 12 marcas de colher de sopa (CS), nos quais se realizou cinco aferições das capacidades gravimétricas e volumétricas. A massa foi determinada com a farinha de trigo e para o volume utilizou-se a água, densidade de 1,0 Kg/m3 a 4 ºC, como referência. Os dados foram submetidos à estatística descritiva, a ANOVA e o teste de Tukey. A capacidade média de massa para as XCH e CS foi de 106,8 g e 6,8 g, respectivamente. As XCH e CS apresentaram volumes médios de 213,1 mL e 15,4 mL, respectivamente, com inadequação de 20 a 40% para as XCH, enquanto das CS foram de 7,4 a 16%, notoriamente de menor variação para ambas as capacidades. Detectou-se a não conformidade das capacidades dos medidores caseiros comercializados, com a recomendação nacional proposta pela RDC 359 de dezembro de 2003. Conclui-se há necessidade de uma legislação específica para padronização dos medidores comercializados, e por consequência controle por parte de órgãos fiscalizadores na fabricação e comercialização dos mesmos, a fim de evitar a imprecisão nas práticas em alimentação e nutrição pela população e profissionais das áreas afins.

Palavras-chave: Utensílios de alimentação. Pesos e medidas. Porção e culinária.

INTRODUCTION

From the earliest civilizations man has felt the need to measure things, and has found ways to accomplish them. For a long time, each people had their own system of measurements, based on arbitrary and inaccurate units such as those based on parts of their own body: the span, the foot, the inch, the fathom, the yard the cubit, and the pitch.[1] Some of these measures (the inch, the foot, and the yard) continue to be employed to this day.

In order to overcome the differences from individuals to individuals, it was decided to fix a reference such as the standard cube, strings spaced with knots, among others. This created many problems for trade because one region was unfamiliar with the measurement system of other regions. There was a difficulty buying or selling products whose quantities were expressed in different units of measurement and which did not correspond to each other.[2]

In the period of the French Revolution, in 1790, new proposals for a metrological legislation were sent to the National Assembly. With the conduction of the project, presented by the French Academy of Sciences, the Decimal Metric System emerged. Many other countries later adopted the system, including Brazil, by adhering to the Metro Convention of May 20, 1875.[3]

It was through Imperial Law nº. 1,157, June 26, 1862,[4] that Peter II placed Brazil as one of the first nations in the world to officially adopt the decimal metric system. Ten years later, by Decree nº. 5,089 of September 18, 1872, provisional instructions were issued for the execution of the Law, where, after this deadline, consumer goods would have to be expressed in meters, liters, and kilograms.

The Decimal Metric System initially adopted three basic units of measurement: the meter, the kilogram and the second. However, scientific and technological development required increasingly precise and diversified measurements.[1,5] Several changes took place until, in 1960, it was consolidated by the 11th General Conference on Weights and Measures, the International System of Units (SI), which it is simple and easy to understand, making it mandatory throughout the national territory. Later, the National Institute of Metrology, Standardization and Industrial Quality[6] has became responsible for this control.[7]

In the International System of Units, there is a basic unit for each type of measure, being the most used in the area of food and nutrition: gram, liter, meter and degrees Celsius, are the units for weight / mass, volume, length and temperature, respectively. The use of SI positively affects the marketing and use of food products, facilitating and guaranteeing the consumer's right to check, monitor and question the weights defined in food packaging.

Accurate measurement is one of the most important factors in food and nutrition studies. The indication of quantity can be expressed in volume (liter or milliliter) or in weight (gram or kilogram) and, in order to obtain them, precise instruments such as scales, beaker, becker and graduated containers are needed to facilitate the measurement of the ingredients.[8,9]

There is also the expression of these quantities in home measurements. Home measures can be used from everyday household appliances and meal production units, such as coffee, tea, dessert, soup and serving spoons; cups of tea and coffee; cups and shells commonly used for preparing or serving meals.[10,11]

For the purposes of preparing menus, diets, nutrition labeling statements and other applications, RDC nº. 359 of 23 December 2003 established the home measure and its relationship to the corresponding portion in grams or milliliters and defined it as a commonly used tool used by consumers to measure food.[12]

In Brazil, currently, a major problem faced within this context is the lack of standardization of these household items[13] and commercialized home meters. At times, a utensil may have different capacities between brands sold by different manufacturers,[14] there being no control over the size and volume of these instruments (household utensil and home meter). They are only controlled according to the qualities of the material used - silver, stainless steel, aluminum, copper, plastic. The standards specify only the essential material characteristics, shear tests and material release in food.

The Pan American Association of Standards and the Home Economics Association advocate a 5% variation tolerance when using "home measures."[15] Both associations recommend that a cup of tea should average 236 mL, a tablespoon 15 mL and a 5 mL teaspoon

In Brazil, RDC nº. 359 of December 23, 2003 approves the Technical Regulation of portions of packaged food for nutritional labeling purposes, and is considered to measure homemade capacities and approximate dimensions of 200 cm³ or mL for teacup and cup and 10 cm³ or mL to a tablespoon.[12]

Given this reality of culinary utensils, especially the home marketed meters and considering the variety of brands with their different shapes and materials, the frequency of use, the importance of data reliability in Food and Nutrition research, and the lack of studies on these instruments, it is important to evaluate the mass and volume capacity of homemade meters sold in Rio de Janeiro.

MATERIALS AND METHODS

The research was carried out in the Dietetic Technique laboratory of the Josué de Castro Nutrition Institute of the Health Sciences Center of the Federal University of Rio de Janeiro from January to August 2017.

Two homemade meters of each model / brand from different commercially available manufacturers in the city of Rio de Janeiro were purchased during 2017, corresponding to a cup of tea (XCH) and a tablespoon (CS). There were 11 different models / brands for tea cups (XCH), namely 1-Inox; 2-Yangli; 3-Delta; 4-Paramont; 5-Injetemp; 6-Sanremo; 7-Cooking; 8- Casa do Chef; 9-Measung Cups; 10-Plasútil; 11-Wincy and 12 tablespoon (CS) models / brands: 1-Inox; 2-Yangli; 3-Paramont; 4-Injetemp; 5-Sendremo; 6-Cooking; 7-Wincy; 8-Art House; 9-without / ID; 10-Kitchen Tools; 11-Jolly; 12-without / ID. All numerically encoded from 1 to 12 on each type of appliance (XCH and CS).

The mass measurement was made using wheat flour as a reference and for the volume measurement of each home meter, water was used as a reference, since its density is 1.0 Kg/m^3 at 4°C. The measurements were performed quintuplicate with each duplicate model/brand studied. The purchased marketed home meters were previously washed and dried on paper towels, as well as the plastic and glass container used for the measurement. For the mass measurement, the wheat flour was accommodated without compression in the commercialized home meters and the wheat flour was leveled in 90º degrees using stainless steel spatula utensil. Then, for volumetric measurement, the commercialized meters were filled to full capacity by immersing them in a container with water until they reached their full capacity (the upper boda) and were dried at the end of each measurement.[13]

For the mass / weight measurement, the Mattri model electronic scale was used, with a digital display with a capacity of 1000 g and a variation of 0.01 mg. To measure the volume, glass beakers of 5, 10, 25, 50, 100, 250 and 500 mL were used.

Data analysis of descriptive nature was performed by the program Statistical for Windows version 6.0, where the mean, median, standard deviation and coefficient of variation were determined. Statistical analyzes were performed using the one-way ANOVA and Tukey tests to evaluate the differences in the means between the marketed home meters of each model / brand with a 95% confidence interval.

RESULTS AND DISCUSSION

Although cooking utensils are part of human history, especially in Brazil, scientific research in this area is scarce. Standardizing the quantities of ingredients and how to prepare a recipe enables reproducibility and repeatability.

The knowledge of the weight / volume ratio of some ingredients is notorious, so culinary measuring instruments (meters) usually carry this relation imprinted on their body. When not, imprinted this conversion is sometimes necessary to ensure the reproducibility of the preparation and consequently to convert its portions into corresponding home measures, a practice that has been universally adopted for decades.

Measuring utensils are known to be frequent, easy and fast to use, but of poor precision and accuracy. Thus, several authors declare the need for weighing after measurement by home methods.[8,9]

In the present study, by the results obtained, it was observed that all repetitions made with the commercialized home meters were performed with precision (table 1), since the CV (coefficient of variation) found were less than 5%.

In table 1, based on the results corresponding to measurements made in grams with wheat flour and milliliters with water, it was noticed that there are significant differences between the values for the home meters sold in Rio de Janeiro, both for mass and for volume. These exceed 5% and do not comply with the minimum level recommended by the American Association of Home Economics,[15] as well as the reference values found in RDC nº. 359 of December 2003, recalling that the volume quantity of XCH is 200 ml and CS is 10 ml.

It was observed that the highest values of inadequacy for the XCH presented percentages of 22.8% and 39.9% for larger and smaller volume capacity respectively. (table 1 and figure 1). For the tablespoon meters, the average found was 15.4 mL, but the reference volume is 10 mL,[12] which is higher than suggested. It is noteworthy that one of the brands studied exceeded 42.5% of the capacity considered standard (table 1).

When verifying that the capacities of the meters varied too much, it was decided to submit the data to ANOVA and Tukey test in order to verify the grouping by dimension through their gravimetric and volumetric similarity. It was a surprise to note the formation of subgroups ($p<0.05$) for home meters (standard meter), namely six subgroups (A to F) for mass XCH dimensions (figure 1A) and five subgroups (A to E) for the dimensions of the XCH volume meters (figure 1B). For the tablespoon meter (CS), three subgroups (A to C) were found significantly for both capacities (mass and volume) as shown in figure 2.

It can be noted that the commercialized home meters related to the teacups of the numerically coded brands 2 (subgroup E and D) and 11 (subgroup F and E) have higher mass and volume capacity respectively and differ from each other ($p<0.05$). However, when comparing brands 4 and 8 (subgroup A) that have lower mass and volume capacity, they did not differ from each other ($p>0.05$). They were, however, little more than a quarter of the expected volume for a cup of tea. The other brands coded in 1, 3, 5, 6, 7, 9 and 10 were divided into four subgroups (A, B, C and D) for mass (figure 1A) and three other subgroups (A, B and C) for volume (figure 1B). Vast majority were in the range of 116 to 119g for mass and 229 to 235 mL for volume and within the 5% limit recommended by the American and Pan American Standards Associations.

Table 1. Average weight and volume capacity of the various brands of home meters: teacup - XCH and soupspoon (CS), Rio de Janeiro, 2017.

Teacup (XCH)	**Mean ± SD (g)**	**CV%**	**Mean ± SD (mL)**	**CV%**
Brand 1	105.2^{a} ± 0.40	0.007	218.8^{b} ± 1.72	0.007
Brand 2	127.3^{e} ± 2.83	0.022	248.7^{f} ± 1.26	0.005
Brand 3	115.8^{d} ± 1.60	0.013	231.2^{a} ± 1.72	0.007
Brand4	59.6^{b} ± 0.66	0.011	120.0^{c} ± 1.67	0.013
Brand 5	117.5^{cd} ± 1.80	0.015	231.4^{a} ± 2.00	0.008
Brand 6	119.8^{c} ± 1.16	0.009	235.1^{d} ± 1.37	0.005
Brand 7	105.2^{a} ± 0.74	0.008	216.1^{b} ± 1.22	0.005
Brand 8	56.8^{b} ± 0.74	0.013	122.0^{c} ± 2.28	0.018
Brand 9	111.6^{f} ± 0.80	0.007	233.8^{ad} ± 1.83	0.007
Brand 10	119.4^{c} ± 0.80	0.006	228.2^{a} ± 1.16	0.005
Brand 11	138.8^{g} ± 1.32	0.009	258.8^{e} ± 2.71	0.01
MEAN	107.0 ± 24.70	0.231	213.1 ± 44.89	0.210
Soupspoon (CS)	**Mean ± SD (g)**	**CV%**	**Mean ± SD (mL)**	**CV%**
Brand 1	7.8^{b} ± 0.40	0.051	16.8^{ab} ± 0.40	0.023
Brand 2	6.9^{c} ± 0.53	0.078	13.9^{c} ± 0.35	0.025
Brand 3	6.5^{bc} ± 0.50	0.076	14.5^{c} ± 0.31	0.021
Brand 4	7.0^{a} ± 0.44	0.063	15.5^{a} ± 0.52	0.033
Brand 5	7.5^{a} ± 0.50	0.066	17.4^{b} ± 0.41	0.023
Brand 6	6.5^{bc} ± 0.50	0.076	14.4^{c} ± 0.41	0.028
Brand 7	6.8^{c} ± 0.60	0.088	15.6^{a} ± 0.58	0.037
Brand 8	6.1^{bc} ± 0.30	0.049	13.9^{c} ± 0.48	0.035
Brand 9	7.5^{a} ± 0.67	0.089	17.4^{ab} ± 0.41	0.023
Brand 10	7.3^{a} ± 0.45	0.062	15.2^{ac} ± 0.45	0.030
Brand 11	4.6^{d} ± 0.48	0.106	15.5^{a} ± 1.25	0.080
Brand 12	7.2^{a} ± 0.40	0.055	15.8^{d} ± 0.24	0.015
MEAN	6.8 ± 0.81	0.119	15.5 ± 1.17	0.075

DV: Standard Deviation and CV: Coefficient of Variation. Averages followed by equal letters in the column do not differ ($p>0.05$) by commercialized home meters (XCH and CS).

These associations set, as a reference standard, the volume value of 236 mL, but the values exceeded when compared to the national recommendation proposed by the RDC nº. 359,[12] which states the volume of 200 mL per cup of tea.

Analyzing the tablespoon commercialized homemade meter (CS), referring to the values of mass capacity (g), it was noticed that the variation is small, except for the brand coded by 11, whose value of quantity in grams of 4, 6 is much smaller (figure 2A). Regarding volumetric capacity, it was observed that the coded brands with digits 2 and 8 had lower volume capacity. However, they did not differ (p>0.05) from the brands coded with digits 3 and 6, all being from subgroup A, being within the 5% value recommended by the American and Pan American Association of Standards.[13] Most were found in the range of 15.2 mL to 16.8 mL (codes 4, 10, 11 and 12) as shown in figure 2B and of reduced coefficient of variation (table 1). However, none conforms to the reference given in RDC nº. 359, (standard 10 mL volume)

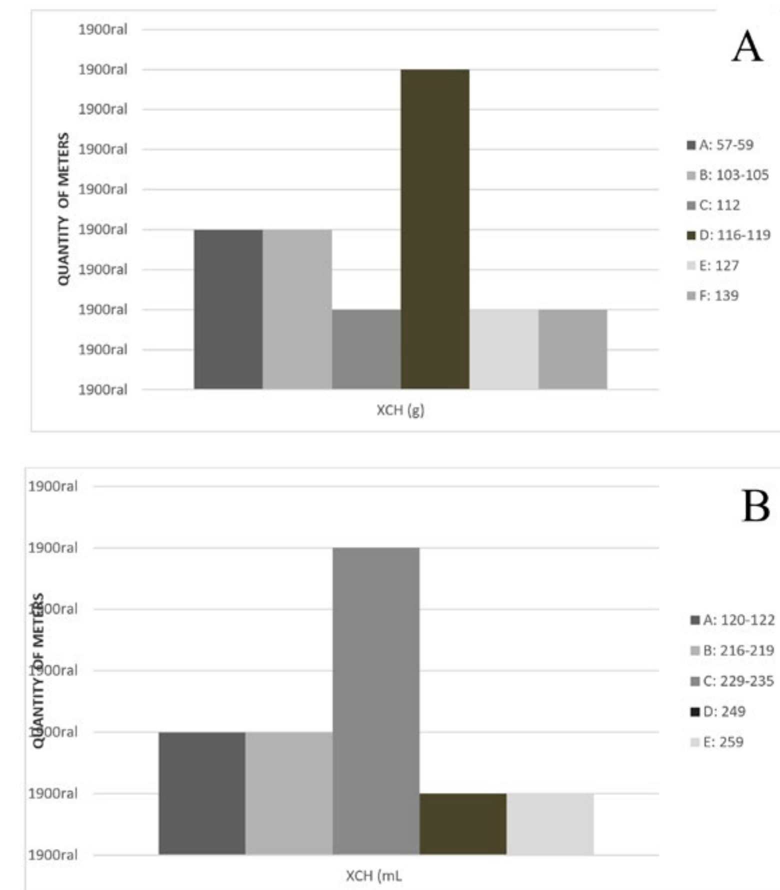
From the data, it was noted that the largest variation is in mass-capacity home XCH meters (g), because if they were to use volume-differentiated meters, four brands (3, 5, 6, and 10) would not differentiate (p>0.05). However, when evaluating the mass ratio (grams), there is an even greater division, totaling six different subgroups (p<0.05) as shown in figure 1A. Comparing, therefore, the marketed home meters XCH and CS, there is greater variation between brands for XCH, being very discreet for brands 4 and 8 (table 1).

An experiment conducted with the same methodology was carried out in Brasilia, by Botelho et al.[13] who evaluated food utensils in Brazil and their impact on the construction of home weight and measurement tables. The authors found a coefficient of variation of 11.62% for XCH and 26.64% for soup spoons with greater inaccuracies with the spoon measurements, especially soup spoons.

In 2008, in the city of São Paulo, Chemin & Martinez[16] studied the capacity of the household applianas XCH Duralex lisa and soup spoon (stainless steel), evidencing that the amount in grams of wheat flour in XCH was 150 g and, for CS, equal to 20 g. The home measurement ratios and their volumetric capacities were 250 mL and 13 mL, respectively, for XCH and CS.

An experiment conducted in Rio de Janeiro by Wandelli[17] on the Practical Guide to Menu Development (Home Measurement - Weight / Volume Conversion Chart) found that the cup of tea (XCH) contained 110 g of wheat flour, while the tablespoon (CS) contains 8 g; The volumetric capacities measured with drinking water were 63.5 mL and 8.1 mL, respectively for Schimidt porcelain cup utensils and the Hercules stainless steel CS. Araújo & Guerra,[18] in the city of Natal, RN, showed in their studies that the mass capacity for the leveling of the teaspoon and the household stainless-level tablespoon of the wheat flour were 129 g and 10 g, respectively.

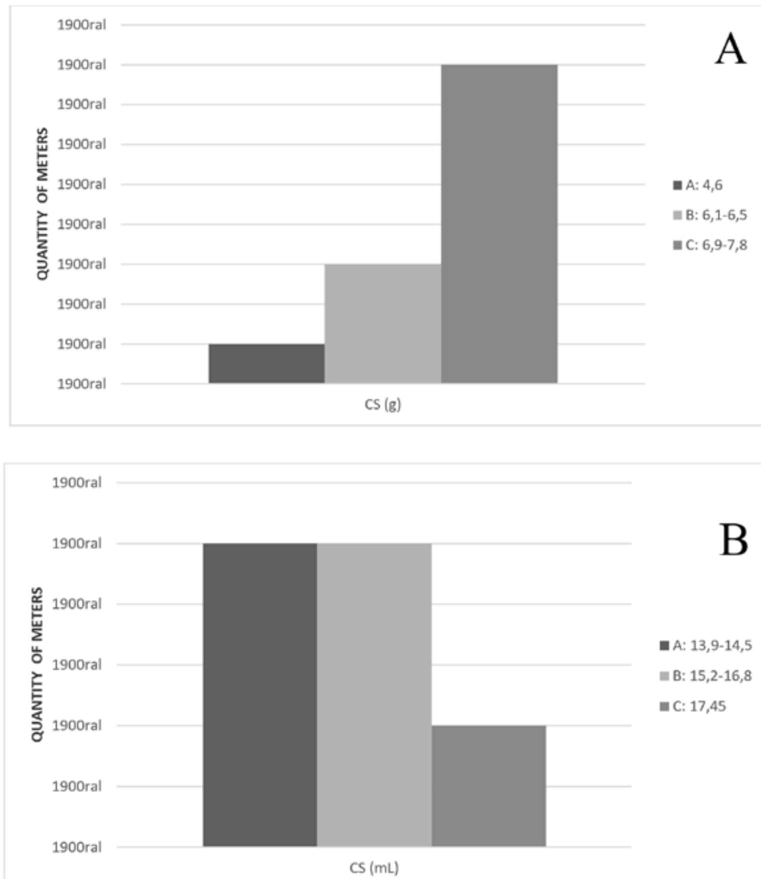
Figure 1. Commercialized home meters (XCH- Tencup) grouped by equality (p>0.05) of capacity: A- mass (g) and B-volumetric (mL), Rio de Janeiro, 2017.



It was evident from the above studies the wide variation of domestic utensils used in national level. Corroborating this situation, the weight and measurement tables found in literature do not state the brands of the utensils, which were used to obtain the data.[19-22] Nevertheless, they are considered essential guides and facilitate the practice of professionals in the field of Food and Nutrition.

Botelho et al.[13] in 2007 described that in order to establish acceptable values Inmetro had stated that the minimum variation limit should not exceed 5%. However, there is no oversight in manufacturing and marketing to ensure that the divergences between household items and household meters sold are not greater than the index presented by the institute.

Figure 2. Commercialized home meters (CS- souspoon) grouped according to capacity equality (p>0.05): A- mass (g) and B- volumetric (mL), Rio de Janeiro, 2017.



It can be seen that, in this situation, the consumer has difficulty in knowing the exact portion for the preparation of any product. Similarly, professional nutritionists, for example, have a hard time prescribing a meal plan without the help of meters and or household utensils to provide the consumer with adequate information. These variations also have an impact on the reproduction and standardization of recipes, directly affecting the work of the food and nutrition professional.

The authors of the present study reinforce the need and importance of standardization of homemade meters marketed in Brazil, as these irregularities compromise the stages of production of menus, recipes, diets, in the nutritionist's work environment. These large differences in quantities directly affect the morphological characteristics and, above all, texture, color and flavor and, consequently, alter the indicators of quality and quantity in preparation.

Indeed, the authors found so-called standard home meters with capacity of ¼ of XCH to 11/5 XCH, adding that their materials can sometimes undergo noticeable deformation, resulting in sharp inaccuracies.

Botelho et al[13] pointed out that the way to solve these biases would be to weigh the ingredients after being measured by home methods with reasonable accuracy for domestic use. It is necessary to clarify that, for each type of ingredient/food, it is necessary to perform the correct measurement techniques, which are related to the physical state (solid, pasty, liquid and viscous) and the moisture content (powder, flour, solid and liquid) of the food matrix.

The differences found in the mass / weight and volume capacity of standard meters and household items directly reflect the quantitative and qualitative control of the final product,[23] in the preparation of diets and menus,[24-26] in dietary studies,[27-29] especially in the inadequacy of the established portion - therefore, with direct implications for the recommended nutrient intake. Considering that the technical regulation of nutritional labeling emphasizes that the quantity of the portion of the packaged foods must be displayed in both weight and homemade measures, a further conflict was established, as the standard meters sold in Brazil varied according to their manufacturers and may have different capacities and quantities of food.

CONCLUSION

There is a need for specific legislation to standardize the standard meters sold and, consequently, control by the inspection agencies in their manufacture and marketing. This would ensure greater certainty in the results of dietary prescriptions, reproduction of recipes / formulations, studies of food labeling and food consumption, and portioning evaluation. There would be better quality and quantity control of food intake, supply management and costs in collective feeding, which would be positively reflected in the practice of professionals working in the area of Food and Nutrition, especially the nutritionist.

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Contributors

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