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Development of enteral homemade diets for elderly persons receiving home care and analysis of macro and micronutrient composition

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Abstract

Objective: the development and analysis of the macro and micronutrient composition of homemade enteral diets. *Method:* A standard homemade enteral diet was developed at three caloric concentrations - 1500, 1800 and 2100 Kcal. After preparation and testing of viscosity, stability, odor and color, plus evaluation of cost, the chemical composition of the nutrients of the diets were analytically determined. Folic acid, vitamin D and vitamin B12 values were calculated using chemical composition tables. The results were compared with recommended nutritional standards for the elderly. *Result:* The diets exhibited normal macronutrient distribution. The 1500 caloric level presented some mineral and vitamin deficiencies. Suitable values were obtained at the other caloric levels for all minerals except magnesium. There were appropriate levels of all the vitamins in the 2100 Kcal diet, while vitamin E, D and B6 levels were below the recommended dietary allowances in the 1800 Kcal diet. *Conclusion:* The standard homemade enteral diets studied can contribute to the food and nutritional safety of elderly persons undergoing home care, if all are supplemented with magnesium and the 1800 Kcal diet is supplemented with vitamin E, D and B6. The 1500 Kcal diet was not nutritionally safe in terms of micronutrients.

Keywords: Home Care Services. Enteral Nutrition. Food Analysis. Elderly. Food and Nutrition Security.

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INTRODUCTION

The demographic transition caused by population aging in Brazil, which is now in its advanced stages[1] has consequences for the structuring of health care networks, resulting in the need for increased investment not only in basic and hospital care, but also in home care and in long-term care facilities[2].

Elderly persons have a high prevalence of chronic noncommunicable diseases such as hypertension, type II diabetes, cardiovascular diseases and neurological diseases, which impose the burden of surviving with disabilities on the individual and society[3]. These increase the frailty of the elderly, resulting in greater vulnerability and functional decline[4]. Such individuals are susceptible to malnutrition and sarcopenia, especially due to the permanent presence of dysphagia, with the inability to meet nutritional needs via the oral route[2,5]. In such cases, one treatment approach is home-based enteral nutritional therapy (ENT)[2,5,6].

Home-based ENT has a satisfactory cost-benefit ratio as it reduces the risk of infection by avoiding prolonged hospital stays, and is cheaper than hospital enteral therapy[6]. It also improves nutritional status[5,6] and allows coexistence with the family, favoring comfort and quality of life[7], contributing to an adequate and healthy diet.

The type of diet administered represents one of the most controversial aspects of home ENT. The majority of industrialized formulas provide a balanced nutritional composition, controlled osmolality, adequate stability and microbiological safety. They may be impracticable, however, due to high costs and the difficulty of making such products available free of charge within the public health system.

Homemade and semi-homemade enteral diets are those exclusively made from *in natura* foods, or those made from such foods combined with modules or supplements[8], respectively. These formulas require special care not only in the planning and calculation of their nutritional composition, but also in the technique of pre-preparation and cooking, standardization of measures, observation of physical-chemical characteristics and especially in the care of food hygiene and handling during the processes of preparation and administering[9-11].

They also have economic, cultural and social benefits. A US study found that the majority of patients receiving home-based ENT chose non-industrialized diets as they are composed of more natural foods, are made at home with foods usually also used by the family, and present greater gastrointestinal tolerance than industrialized enteral diets[12].

When using a homemade or semi-homemade diet, it is important to use formulas that provide the correct amounts of macro and micronutrients required to maintain or recover nutritional status, and which are low cost and easy to prepare. Considering the need for the development of these formulas, as well as the lack of studies that contain analytical measurements of minerals and vitamins, the present study aimed to elaborate and evaluate the macro and micronutrient composition of semi-homemade enteral diets created with the potential to become a prescription standard for elderly persons undergoing home-based ENT.

METHOD

This work was based on a previous study involving the bromatological analysis and evaluation of the composition of macronutrients and minerals of semi-homemade enteral diets prescribed at the moment of hospital discharge from five public institutions and recommended in home care provided by the Family Health Teams of a state capital in southeast Brazil. The results of this recently published analysis[11] indicated that the formulations were inadequate in terms of dietary fiber, potassium and magnesium composition. Calcium and sodium were high in 16.7% and 83.3% of the diets, respectively, while zinc, phosphorus, copper, manganese and selenium were low in up to 66.7% of the formulas. The study did not evaluate vitamins.

From these results, and aimed at improving the nutritional adequacy of the analyzed diets, new recipes of the standard semi-homemade enteral diets were developed, with three caloric concentrations of 1500, 1800 and 2100 Kcal, all of which had lactose and lactose-free options. The normocaloric and normoproteic formula, without nutrient restrictions other than lactose in the lactose-free diets, was considered the standard diet. Each diet was composed of a formula and a juice and

was developed considering the stomatal position of the catheter.

The process of developing these recipes involved calculating and adjusting the nutrients of the original recipes evaluated in the previous study. The preparation of the diets and the viscosity, stability, odor and color tests were carried out in a technical-dietary laboratory, and cost was also analyzed. This process was continued until adequate diets were obtained. The ingredients of recipes for the semi-homemade enteral diet are shown in Chart 1.

Chart 1. Ingredients of standard and standard lactose-free semi-homemade enteral recipes. Belo Horizonte, Minas Gerais, 2016.

Ingredients	Formulas		
	1500 kcal	1800 kcal	2100 kcal
Whole milk (mL) *	-	500.00	500.00
Skim milk (mL) *	1000.00	500.00	500.00
Egg (g)	45.00 (2x /week)	45.00 (2x /week)	45.00 (2x /week)
Pure albumin powder (g)	17.40 (5x /week)	17.40 (7x /week)	29.00 (7x /week)
Oat flour (g)	45.00	45.00	50.00
Enriched Rice Cream (g)	50.00	55.00	55.00
Potato (g)	280.00	280.00	280.00
Brazil nut (g)	2.00	2.00	2.00
Canola oil (ml)	26.00	26.00	26.00
Soybean oil (ml)	13.00	13.00	26.00
Corn-based commercial cereal (g) **	5.00	15.00	25.00
Cinnamon powder (g)	12.00	12.00	12.00
Granulated sugar (g)	13.80	27.60	27.60
Iodized salt (g)	2.00	2.00	2.00
Ingredients	Juice		
Carrot, raw (g)	55.00	55.00	55.00
"Pera Rio" (Rio Pear) orange juice (g)	180.00	180.00	180.00
Granulated sugar (g)	-	13.80	13.80

*The lactose-free option used reduced lactose content milk; **Ingredients of enriched corn-based commercial cereal: Corn flour, sugar, enriched with iron, phosphorus, calcium zinc, folate, niacin, vitamins A, D, E, C, B1 and B6.

For the preparation of formulas, the solid ingredients were weighed in a BS3000A model semi-analytical scale (Bioprecisa® - São Paulo), with a maximum capacity of 3Kg and 0.1g divisions. After this process, the eggs and vegetables were washed in running water, and the latter were sanitized in a solution of 200 ppm of chlorine solution, suitable for food, for 20 minutes, according to the manufacturer's instructions. The milk and oil were fractionated in volumetric flasks. All ingredients were separated into identified containers for convenience during preparation.

The potatoes were cooked in their skins until soft. The eggs were brought to the boil and cooked for approximately 5 minutes after boiling began to ensure the firm consistency of the yolk. In order to avoid possible microbiological contamination of the diet, cinnamon was toasted at a medium heat for three minutes in a sufficient quantity for all preparations.

The ingredients that underwent the pre-preparation and cooking process were weighed again and, finally, mixed and beaten in a mixer with the

other ingredients until a homogeneous solution without residues was obtained.

For the preparation of the juice, the pulp of previously sanitized "Pêra Rio" oranges was extracted using an electric juicer, and then mixed with the other ingredients, blending the solution. Samples of 300 ml of each formula and the sucrose and sucrose were separated and frozen at below 20°C.

Finally, the macro and micronutrient chemical composition of the formulas and the juice was analyzed in the laboratory.

The results obtained in the analyzes were compared to the nutritional requirements recommended by the Dietary Reference Intake (DRI) for elderly males[13]. This gender was chosen as the recommendations of minerals for males are greater than those for females, thus covering the needs of both.

For macronutrients, values between 1.0 and 1.2 g/kg/weight/day of proteins, at least 50% of which were of high biological value[14], were considered normoproteic, diets with carbohydrate values of 45-65% were considered normoglycemic, and diets with 20-35% were considered normolipidic[13]. The calculation of protein adequacy per kilogram of body weight considered the median weight of a 65-74-year-old male, which according to the 2008/2009 Pesquisa de Orçamentos Familiares (Household Budgets Survey) (POF) is 70.3Kg[15]. A proportion of 14 grams for every 1000 calories of diet was considered adequate dietary fiber content[13].

Micronutrients were considered adequate when they had concentrations above the Recommended Dietary Allowance (RDA) and below the Tolerable Upper Intake Level (UL), with inadequate results below the Estimated Average Requirement (EAR) or above UL. For micronutrients that do not have a RDA, Adequate Intake (AI) was considered valid[13].

The viscosity test was conducted by administering the diets by French 12 (1 French =0.33mm) silicone catheters using the gravitational and *bolus* method. The administration of the diets by both methods was considered of adequate viscosity as there was no clogging of the catheter. The stability of the diets was tested by visual inspection of the phase separation process over a period of 12 hours of refrigerated storage. Olfactory and visual inspection evaluated odor and color. An acceptable cost was considered a monthly expense of up to R$312.00, which corresponds to one third of the minimum wage in force in 2017, based on daily totals of 1800 kilocalories.

The standard lactose-free diet, elaborated from the substitution of milk with milk with a reduced lactose content, was not analyzed, as the only modified ingredient was lactose, which did not impact the nutrients analyzed in this study.

Protein and lipid analysis was performed following standard procedures adopted by the Association of Analytical Chemists (AOAC)[16]. Fibers were analyzed by treatment with digestive enzymes (amylase, pepsin/pancreatin), alcoholic precipitation of the soluble fraction, incineration and gravimetric determination. Ash content was obtained by incineration in an oven at 550ºC and moisture determined in an oven at 105ºC. The summation of proteins, lipids, ash, moisture and fibers and the subtraction of 100 as an integer allowed total carbohydrates to be calculated[17].

The minerals zinc (Zn), iron (Fe), copper (Cu), calcium (Ca), phosphorus (P), potassium (K), magnesium (Mg), manganese (Mn) and selenium were quantified with Varian® brand ICP-OES equipment (720 ICP-OES, Varian Inc, California, USA) using the following spectral lines: 206.2 nm, 238.2 nm, 327.4 nm, 317.9 nm, 213.6 nm, 766.4 nm, 285.2 and 257.6. The choice of the analytical spectral lines was based on the sensitivity and interference levels of each mineral. Linear concentration ranges for each element varied between their detection limit and the maximum concentration values recommended by the manufacturer's manuals. The detection limits (3 x the standard deviation of 10 measurements of the analytical blank divided by the inclination of the calibration curve) were determined for all the elements read.

All aqueous solutions and sample dilutions were prepared with ultrapure water (18 MΩ cm^{-1}), Milli-Q (Millipore®, Bedford, MA). Certified reference material - NIST - Total Diet SRM 1548® (National Institute of Standards Technology - Gaithersburg, MD) was determined to validate the spectrophotometric measurements.

The vitamins A, C, E, Thiamine (B1), Riboflavin (B2) and B6 were analyzed by high performance liquid chromatography (HPLC) using a Shimadzu® apparatus, model LC-10AT VP. The methods described by the AOAC[15] were used for the chromatographic runs and standardization of the analytical conditions. The following columns and detection conditions were used 1) Vitamins B1 and B2: Spherical RP-18 reverse phase C18 column 5 µm/125 x 4.0 mm, with a Lichrospher 5 µm/4x4 mm pre-column; fluorescence detection: Ex 368 nm; Em 440 nm (B1) and Ex 450 nm; Em 530 nm (B2). 2) Vitamin B6: Superspher 100 RP-18 endcapped reverse phase C18 column 5 µm/250 x 4.0 mm, with a Lichrospher 100 RP-18 pre-column 5 µm/4x4 mm and fluorescence detection: Ex 296 nm; Em 390 nm. 3) Vitamin C: Microsorb-MV C18 column, 5mm, 250mm x 4mm, and detection at 238nm. 4) Vitamin E: C18 reverse phase, isocratic system, 5 µm, 250 mm x 4.6 mm, Bakerbond brand and ultraviolet (UV) detection at 292 nm. 5) Vitamin A: Shimpack CLC-ODS (M) 4.6 mm x 25 cm, using the 325 nm wavelength for detection.

Vitamin B12, folate and vitamin D were not analyzed as concentrations were below the detection limits for liquid chromatography. The values presented in the results were estimated using chemical composition tables[18].

RESULTS

All formulas and juice were tested for viscosity, stability, odor, color and cost. The diets developed presented a normocaloric (0.9 to 1.2 Kcal / ml), normoproteic, normolipidic and normoglycidic nutritional composition. Carbohydrates represented 55, 53 and 52%, lipids, 28, 31 and 33% and proteins 69.6, 70.3 and 80.8 grams in the 1500, 1800 and 2100 Kcal diets, respectively, corresponding to 0.99 g/Kg of weight, 1.00 g/kg of weight and 1.15 g/kg of weight, based on a man weighing 70.3 kg. All diets contained more than 50% of proteins of high biological value (between 68% and 71%).

The total amount of dietary fiber was 17.22 g in the 1500 Kcal diet, 22.65 g in the 1800 Kcal diet and 24.10 g in the 2100 Kcal diet. It was observed that the inclusion of dietary ingredients that were sources of fiber elevated the adequacy of this nutrient to average levels of 85%. There was a predominance of insoluble fibers, except in juice (Table 1).

Table 1. Centesimal composition (g.100g-1, wet basis), chemical analysis results of semi-homemade enteral diets. Belo Horizonte, Minas Gerais, 2016.

Nutrients (g)	Formulas			
	1500 Kcal Mean (sd)	1800 Kcal Mean (sd)	2100 Kcal Mean (sd)	Juice with sucrose* Mean (sd)
Humidity[1]	79.77 (9.22)	76.80 (10.07)	76.78 (8.81)	81.91 (9.48)
Proteins[2]	4.48 (0.29)	4.18 (0.36)	4.15 (0.31)	1.82 (0.09)
Lipids[2]	3.33 (0.43)	3.84 (0.47)	4.27 (0.38)	0.23 (0.03)
Carbohydrates[3]	12.68 (2.09)	13.15 (2.21)	12.85 (2.11)	13.67 (1.98)
Fibers[2]				
Insoluble	0.95 (0.06)	1.07 (0.13)	0.99 (0.08)	0.67 (0.05)
Soluble	0.15 (0.01)	0.19 (0.01)	0.14 (0.01)	1.18 (0.08)
Ash[2]	0.64 (0.06)	0.77 (0.05)	0.82 (0.04)	0.52 (0.07)

[1]with raw food; [2]with cooked and lyophilized foods; [3]by difference: 100 g (moisture + protein + lipids + total dietary fiber + ash)[16]; *Juice without sucrose provided different results only in moisture and carbohydrates, which were 88.85 (9.05) and 7.23 (0.94) respectively.

Correction with source foods also improved the computations for minerals (Table 2). All the diets were adequate for calcium, phosphorus, iron, zinc, manganese and selenium, although not even the 2100 Kcal diet was able to reach more than 78% of recommended levels of potassium. Similar results were found for magnesium, the maximum adequacy of which was 63%. Only the 1500 Kcal diet failed to provide an adequate supply of copper. In terms of electrolytes, the sodium concentrations of all diets reached the recommended levels after the modifications.

Regarding the analysis of vitamins (Table 3), the diets achieved adequate concentrations of vitamin A, C and Riboflavin at all the caloric concentrations proposed. Vitamin E, thiamine and vitamin B6 met the EARs from the caloric concentration of 1800 Kcal and upwards. In the 2100 Kcal diet all these vitamins were provided in sufficient quantities. Vitamin B12 was adequate at all caloric levels and there were recommended levels of folate in the 1800 and 2100 Kcal diets, while vitamin D was not provided in adequate amounts at any of the caloric concentrations, although it should be noted that these three vitamins were estimated rather than analyzed.

Table 2: Mineral composition of semi-homemade enteral diets with three caloric levels (1500, 1800 and 2100 Kcal (formula and juice)) and comparison with Dietary Reference Intake (DRI) for elderly men[13]. Belo Horizonte, MG, 2016.

Minerals	EAR (mg/day)	RDA/AI* (mg/day)	UL (mg/day)	1500 kcal	1800 kcal	2100 kcal
Calcium (mg / day)	1000	1200	2000	1282.19	1570.06	1724.95
Phosphorus (mg / day)	580	700	4000	904.60	1258.57	1645.30
Iron (mg / day)	6	8	45	16.62	22.47	24.79
Sodium (mg / day)	ND	1200*	2300	1584.69	1759.71	2033.63
Magnesium (mg / day)	350	420	350	227.82	265.12	259.55
Copper (µg / day)	700	900	10000	790	930	960
Potassium (mg / day)	ND	4700*	ND	2615.17	3056.47	3648.10
Zinc (mg / day)	9.4	11	40	9.86	11.97	12.31
Manganese (mg / day)	ND	2,3*	11	2.63	3.01	3.26
Selenium (µg / day)	45	55	400	109.81	114.48	117.67

RDA = Recommended dietary allowance; * AI = Adequate intake; UL = Tolerable Upper Intake Level; EAR = Estimated Average Requirement; ND = Not Determined.

Table 3: Composition of vitamins of semi-homemade enteral diets with three caloric levels (1500, 1800 and 2100 Kcal (formula and juice)) and comparison with Dietary Reference Intake[13] for elderly men. Belo Horizonte, Minas Gerais, 2016.

Vitamins	EAR	RDA	UL	1500 kcal	1800 kcal	2100 kcal
A (µg RAE/day)	625	900	3000	1168.66	1.700.65	2628.61
C (mg/day)	75	90	2000	139.83	168.54	285.33
E (mg/day)	12	15	1000	8.28	12.00	21.33
Thiamine (mg/day)	1	1.2	ND	0.95	1.27	1.25
Riboflavin (mg/day)	1.1	1.3	ND	2.85	3.13	5.20
B6 (mg/day)	1.4	1.7	100	1.34	1.43	2.74
B12 (mg/day) *	2.0	2.4	ND	6.36	6.31	6.31
Folate (µg/day) *	320	400	1000	390.97	662.11	662.11
D (µg/day) *	10	15	100	5.87	13.12	14.88

RAE = Retinol Activity Equivalent; RDA = Recommended dietary allowance; UL = Tolerable Upper Intake Level; EAR = Estimated average requirement; ND = Not Determined; * Estimated values by means of food composition table[18]

DISCUSSION

The decision to use ENT with the elderly is complex due to controversies regarding its ability to recover or maintain nutritional status and impact on survival[2,19]. When ENT is used, the diet must have adequate physical and chemical characteristics, even if using homemade or semi-homemade diets[9,10].

The semi-homemade diets developed in this study had similar viscosity, stability, odor and color characteristics to other studies[9,20]. The infusion of enteral diets by thin caliber nasogastric catheters (French 10 to 12) is common in home care in Brazil, unlike other studies in which gastrostomy[6] or the oro-gastric position was more common[5]. Homemade diets usually have higher viscosity than industrialized ones. Therefore, adequate fluidity is required to avoid the clogging of the catheter or the need to exert excessive pressure on the syringe plunger when the infusion is in *bolus*, with risk of catheter displacement[21].

Regarding chemical characteristics, the diets developed had an adequate macronutrient profile[13,14] for the elderly, except for the dietary protein of 1500 Kcal, which provided 0.99 g/kg/day when considering an individual of 70.3Kg[15], however it is probable that an elderly person weighing 70.3Kg has a caloric requirement greater than 1500Kcal.

In a recent publication, the PROT-AGE *Study Group* recommended protein ingestion greater than the RDA (0.8g/Kg/day) for healthy elderly persons, with the intake of 1.0-1.2g of protein/kg/day, at least 50% of which is of high biological value, aimed at maintaining the skeletal muscle structure and functional capacity[14]. Another important recommendation is related to the quality of proteins and their adequate distribution throughout the day, aimed at the prevention or control of sarcopenia. The greatest anabolic effect has been demonstrated in diets with at least 20g of protein per meal, containing 2.5g to 2.8g of leucine[14,22]. In the case of the proposed diets, which have a recommended distribution of five meals per day in addition to juice, the protein distribution at each meal does not reach this recommendation, despite the fact that the protein quality and leucine content are high[14]. This high protein quality was affected by the presence of milk, egg and albumin as the main sources of protein, while the division into five meals aims to reduce the volume infused at each meal, as a way of reducing gastrointestinal symptoms[23].

Lipids, which are present in the diets in up to 33% of the total calories, have a protective and therapeutic role in cardiovascular health[24], as their main sources are soybean and canola oil, vegetable fats with the presence poly and mono unsaturates. The choice of skim milk was aimed at reducing saturated fatty acids. The calculation of fatty acids by means of a food composition table[18] revealed that saturated fatty acid made up less than 10% of all the diets.

As for carbohydrates, when developing the new enteral diets, we chose to include complex carbohydrates such as potatoes, oat flour, rice cream and corn-based cereal. The acceptable sucrose component in a standard diet, present in sugar and corn-based cereal (20%), represented 4.0%, 9.9% and 8.8% of the total calories in the 1500, 1800 and 2100kcal diets, respectively, values which are considered acceptable[13]. Lactose can be removed by replacing milk with reduced lactose content milk, making the diet suitable for elderly persons with reduced lactase production.

The adequacy of fiber in non-industrialized enteral diets is a challenge, as most of the food sources of this nutrient contribute to an increase in dietary viscosity with consequent catheter occlusion. The developed diets contained an average of 85% of recommended fiber content. The use of powdered cinnamon and oat flour was fundamental in the supply of fiber without the excessive thickening of the formula. Araújo et al.[25] showed that powdered cinnamon contributed 50.11% of the total dietary fiber of an enteral diet, at a proportion of 25 g of powder to 2 liters of diet.

Few studies published in literature that analyze non-industrialized diets describe fiber content. Araújo and Menezes[26] did not achieve the recommended values, with the highest level reached 8.16g in two liters of diet, while Menegassi et al[20] recorded fiber values above the recommended level of 2 liters, which may alter the absorption of minerals, such as calcium, magnesium, iron or zinc, especially in the presence of phytates[13].

Fibers have an important role in intestinal functioning. A study showed that in partially institutionalized elderly people, the prevalence of constipation was 67%[27]. In addition, fibers are involved in improved postprandial glycemic response, cholesterol control and cardiovascular risk reduction[13]. The soluble fiber component, in turn, is linked to the processes of colonic fermentation in which short chain fatty acids, capable of promoting intestinal trophism and maintaining the symbiotic microbiota, are produced[13]. A study evaluating the association between fiber consumption and the presence of fecal short chain fatty acids in elderly persons aged between 76 and 95 years old found that potato consumption, present in the proposed diets, was associated with the presence of these fatty acids[28].

Although energy needs are lower in this life cycle compared to adults, micronutrient requirements are not. There is a high risk among this population of deficiency in vitamins A, C, D, E, B12, thiamine and folate, and minerals such as calcium, iron and zinc, all of which are related to deterioration of functionality, body composition and health[29]. Micronutrient content was found to be less adequate in the 1500 calorie formula due to the limited addition of *in natura* foods or industrialized products, which should be evaluated with caution in the prescription of this caloric profile.

Of the minerals, only magnesium was below the EAR in all diets. Von Atzingen et al.[30] also observed inadequacies for this mineral in homemade enteral diets. Magnesium acts as an important cofactor in several enzymatic reactions, contributing to protein synthesis and energy metabolism[13]. Initially, the adequacy of magnesium was sought through the addition of dehydrated parsley (400mg Mg in 100g of parsley), however, the cost of the diet and greater risk of contamination meant this possibility was rejected.

Potassium, although below AI, may not be inadequate. AI is recommended when there is insufficient and adequate scientific evidence to determine the RDA, and so is an approximation or estimate of consumption. In this case, although it is used for individual recommendations, its evaluation of the adequacy of food is limited, and estimates of the probability of nutrient inadequacy cannot be made[13].

Potassium stimulates natriuresis and participates in the regulation of the renin angiotensin system, contributing to the reduction of blood pressure, counteracting the action of sodium. However, the definition of the recommendations of potassium take into account a higher sodium consumption than that found in the analyzed diets. The sodium/potassium ratio (Na^+/K^+) should be one at most[31]. The proposed diets exhibited a ratio (Na^+/K^+) of 0.61; 0.58 and 0.56 at the caloric levels of 1500, 1800 and 2100 kcal respectively, and were therefore within recommended levels.

The iron content of the elaborated diets reached the recommended amounts at all caloric levels. According to Patel[32], approximately one third of the anemias developed in the elderly are caused by nutritional deficiencies attributed to iron, folate and vitamin B12, and of these, iron accounts for almost half of the cases. The addition of enriched rice cream made an important contribution to the values found.

Only the 2100 Kcal diet contained all vitamins in adequate quantities. Vitamins A, C, B12 and riboflavin were sufficient in the 1500 kcal diet. Although vitamin E, B6 and D were below the RDA but between the EAR and RDA in the 1800 Kcal diet, which is considered probably inadequate[13].

Vitamin E has an important natural antioxidant function through its reaction with free radicals that are soluble in lipid membranes[13,29]. Deficiency of this vitamin, along with vitamin C and carotenoids, is associated with cognitive decline in the elderly[33]. Vitamin D, which is important not only in the bone health of the elderly[13], but also associated with muscle strength, functional capacity[34] and prevention of chronic degenerative diseases[13], was low in 2/3 of the diets. As the solar exposure of individuals in home ENT is normally impaired due to the bedridden status of most of these elderly people, it is necessary to supplement this vitamin in the 1500 and 1800 Kcal diets.

Among the B complex vitamins analyzed, Riboflavin and vitamin B12 were adequate in all diets. Vitamin B12 deficiency is common in the elderly due to atrophic gastritis or low consumption[29]. Thiamine acts as a coenzyme in the metabolism of

carbohydrates and branched-chain amino acids[13]. Folate and vitamin B12, when deficient, are associated with megaloblastic anemia and elevated levels of homocysteine[29]. In addition to its relationship with cardiovascular diseases, a recent study showed that high concentrations are associated with lower bone mineral density among the elderly[35].

The findings of the present study demonstrate the importance of the use of dietary techniques based on the bromatological data of the centesimal composition of macro and micronutrients. In addition, no studies were found in literature that evaluated the composition of vitamins from non-industrialized enteral diets for home use.

Seasonality in the nutrient content of the *in natura* foods used in the diet is a limiting factor that should be considered in this study. However, its concentration is approximately 30% of the content of solids, which maintains composition at generally acceptable levels of variability. In the case of industrialized products enriched in vitamins and minerals, such grades are generally standardized. The analytical limitation imposed by the low levels of detection of vitamins B12 and D and folate justifies the use of food composition tables, with the assumption that the values may be greater or smaller within an acceptable variability. The need for the supplementation of some micronutrients, while it represents an additional unitary operation in the formulation, has a low impact on the final price of the diet, as the dosages of the supplements are very low, increasing the cost of the 1800 Kcal formulation, for example, by one *real* per day.

It should be pointed out that, due to the need for exhaustive manipulation in the pre-preparation and preparation of the diets, their microbiological safety becomes fragile. The training of food handlers and caregivers, as well as the establishment of simple routines such as the washing and disinfection of hands and *in natura* food, in addition to cooking, can minimize the possibility of contamination. The pre-mixing of the ingredients in powder form to prepare the diet for an entire day is also recommended, as this facilitates incorporation with the other ingredients at the time of preparation, and reduces handling and manipulation.

CONCLUSIONS

The analysis of the macro and micronutrients of the enteral diets developed showed that these can contribute to guaranteeing the right of the elderly in home enteral therapy to food. Magnesium should be supplemented in all diets and vitamin D, E and B6 supplementation is required in the 1800 Kcal diet. The 1500 Kcal diet did not demonstrate nutritional safety for the elderly with respect to micronutrients.

Bromatological analysis is of great importance for the evaluation of homemade and semi-homemade enteral formulas, considering the possible losses during the preparation of food, which is not always observed in analysis by food composition tables.

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