ISSN: 2318-8413 DOI: 10.18554/refacs.v6i0.2900

REFACS
Revista Família, Ciclos de Vida e Saúde no Contexto Social

Standardization of artisanal enteral diets for home care use in the Primary Attention

Padronização de dietas enterais artesanais para uso domiciliar na Atenção Primária

Estandarización de las dietas enterales hechos a mano para uso doméstico en la Atención Primaria

Received: 06/07/2017
Approved: 09/18/2017
Published: 07/05/2018

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This study aimed to standardize and compare artisanal enteral diets on energy value, energy density, macronutrients and cost. This is an experimental study, carried out in 2014. The bromatological analysis was carried out at the Laboratory of Bromatology and Food Microbiology of the Federal University of São Paulo, SP, Brazil. Three diets were standardized considering the daily volume and per meal administered, with or without polymeric enteral formula powder, total energy, energy density, macronutrient distribution and daily cost. Between DIET 1 and DIET 3 and between DIET 2 and DIET 3 there were statistically significant differences ($p < 0.05$) in the variables studied. The diets added with powdered enteral formula (DIET 1 and DIET 2) presented better energy density and macronutrient distribution. Three artisanal enteral diets were standardized and could be used by patients in enteral home therapy

Descriptors: Food formulated; Food analysis; Diet therapy.

Este estudo teve por objetivo padronizar e comparar dietas enterais artesanais quanto a valor energético, densidade energética, macronutrientes e custo. Trata-se de um estudo experimental, realizado em 2014. A análise bromatológica foi realizada no Laboratório de Bromatologia e Microbiologia de Alimentos da Universidade Federal de São Paulo. Foram padronizadas três dietas considerando-se o volume diário e por refeição administrada, acrescidas ou não de fórmula enteral polimérica em pó, total de energia, densidade energética, distribuição de macronutrientes e custo diário. Entre a DIETA 1 e a DIETA 3 e entre a DIETA 2 e a DIETA 3 houve diferenças estatisticamente significantes ($p<0.05$) nas variáveis estudadas. As duas dietas acrescidas de fórmula enteral polimérica em pó (DIETA 1 e DIETA 2) apresentaram melhor densidade energética e distribuição de macronutrientes. Foram padronizadas três dietas enterais artesanais possíveis de serem utilizadas por pacientes em terapia enteral domiciliar.

Descritores: Alimentos formulados; Análise de alimentos; Dietoterapia.

Este estudio tuvo por objetivo estandarizar y comparar dietas enterales artesanales en cuanto a valor energético, densidad energética, macronutrientes y costo. Se trata de un estudio experimental, realizado en 2014. El análisis bromatológico fue realizado en el Laboratorio de Bromatología y Microbiología de Alimentos de la Universidad Federal de São Paulo, SP, Brasil. Se han normalizado tres dietas que se consideran el volumen diario y por comida administrada, más o menos de fórmula enteral polimérica en polvo, total de energía, densidad energética, distribución de macronutrientes y costo diário. Entre la DIETA 1 y la DIETA 3 y entre la DIETA 2 y la DIETA 3 hubo diferencias estadísticamente significativas ($p < 0.05$) en las variables estudiadas. Las dos dietas añadidas de fórmula enteral polimérica en polvo (DIETA 1 y DIETA 2) presentaron mejor densidad energética y distribución de macronutrientes. Se han normalizado tres dietas enterales artesanales posibles de ser utilizadas por pacientes en terapia enteral domiciliar.

Descriptores: Alimentos formulados; Análisis de los alimentos; Dietoterapia.

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INTRODUCTION

Every individual depends on the food to maintain the proper functioning of their body, and to accomplish such a task, the introduction of food, in its endless presentations, is done through the oral cavity. In healthy individuals it occurs naturally, but in individuals affected by pathological processes, the diet depends on their physiological state, and a differentiated nutritional care plan may be required. When it is necessary, there are two other alternative feeding routes: enteral nutrition, which is the management of diet by a tube, and parenteral nutrition, which is through intravenous route[1].

The enteral nutrition consists in the administration of nutrients through the gastrointestinal tract, with the help of a tube or Ostomy, when oral ingestion is not adequate. Enteral artisanal diets are prepared based on fresh foods (potato, cassava, Yam, rice, cornstarch - carbohydrate sources; milk, eggs, meats, legumes – source of protein; and vegetable oil-based fats), nutritional supplements, and/or nutrient modules (they provide a specific type of nutrient, alone), liquified and sieved in a domestic or hospital kitchen[2-4].

These diets are typically used in situations in which the gastrointestinal tract is with normal digestion and absorption capacity, since for its preparation nutrients in their intact form are used[3].

Enteral diet is frequently used as a routine therapy in patients with protein energy deficiency, because of severe dysphagia, major burns, bowel resection and fistulas, mostly categorized as severe cases, organically compromised who will probably stay hospitalized for long periods[5].

Industrialized enteral diets present advantages over artisanal formulas, especially about nutritional composition, the adequate supply of micronutrients[4] and microbiological control[6]. However, the cost of these diets is high and are not accessible to many families, especially those served by the public health network[7].

Home enteral nutrition is an economical and safe treatment, because it eliminates inpatient spending, avoid contamination and enables patients and family interaction[8].

This study objective is to provide three options of artisanal enteral diet to supply energy needs, using *in natura* foods and nutritional supplements, prepared in their own home without excessive costs, being a viable proposal[2].In this way, these artisanal enteral diets are a low-cost and nutritionally adequate option, given the concept of food and nutritional security[9] adopted in Brazil and reaffirmed by the Food Guide for Brazilian Population[10]. To achieve food and nutritional security it is necessary:

> *The realization of everyone's right to regular and permanent access to quality food, in sufficient quantity, without compromising access to other essential needs, based on food health-promoting practices, which respect cultural diversity and are social, economic and environmentally susteinable[9].*

On the above, the present study aimed to standardize and compare artisanal enteral diets as the energy value, energy density, macronutrients and cost.

METHOD

It is an experimental study conducted in the laboratory following strict planning[11],in 2014. There was a need to characterize the energy and macronutrients of content artisanal enteral diets from the preparation of stocks, which are not listed in food composition tables. The outcome of this research met the need for low-income patients in enteral home nutrition by means of a request from the management of the PSF-UNASP.

Fifteen recipes were initially developed, divided into juices, porridges and stocks. For thediets formulation we used recipes of the Manual of Diet Therapy and Nutritional Evaluation of the Heart Institute, since it is much used in clinical practice[12].

The final recipes were formulated by applying technical knowledge for food choice, according to its nutritional quality and solubilizing capacity to be administered by nasogastric tube.

A shopping list was carried out, with the food needed to elaborate the diets. The purchases were made in supermarkets of the

region studied, to find locally practiced prices. The prices of the products were transcribed, together with the dietary techniques and the nutritional information, in technical sheets, of each preparation. With this information it was possible to calculate the price spent for food and the total price of the preparation. We did not consider indirect expenditures such as electricity, water, cooking gas, syringes, and others.

In a dietary technic laboratory, foods were cleaned, chopped, measured/weighed and separated by preparation. After making the preparations, the diets were liquified and/or sieved.

To ensure the passage of diets by the tube, we carried out fluid tests, administering them through syringes, in bolus, checking possible occurrences of lumps that could obstruct the light of the tube. Specifically, for the porridge, we applied dextrinization method of the flour before baking, to reduce final viscosity reduction of the paste[2].

Meat, chicken and beans stocks prepared in the Dietary Technique Laboratory at UNASP, which formed the basis of some artisanal formulations, were sent for bromatological analysis to Food Microbiology and Bromatology Laboratory of Universidade Federal de São Paulo-UNIFESP.

Such analysis was performed in a specific laboratory with the use of chemical reagents that simulate the digestion that occurs in the body. Through this simulation is possible to quantify proteins and lipids contained in the food portion used for the test. Carbohydrate values were determined by difference calculating.

Bromatological Qualitative analyses assess other food components, such as the humidity and the ashes, that quantify the minerals present in the food portion, but these two variables were not evaluated in this study[13].

The recipes were arranged in technique sheets containing the information of the ingredients with the weight in grams and measures, cost, nutritional value and the preparation. To calculate the nutritional value, we used the Brazilian Table of Food Composition (BTFC)[14] and the nutritional information of processed foodlabels, that were not contained in BTFC.

After that, threediets were standardized taking into consideration the daily volumeand per meal administered, added or not enteral formula polymer powder, energy, energy density, macronutrients distribution and daily cost. For diets standardization, we used the reference values for macronutrients established by the Dietary Reference Intakes (DRI)[15]. That way only eight of the elaborate formulations were used as standard diets, since they presented appropriate nutritional composition.

From the dietary variables: energy, macronutrient and energy density; we applied variance analysis among the three diets. Bonferroni test was adopted when detected statistical significance. The tests were carried out by GraphPadPrism software, 6.0[16] with a significance level of 5%.

As an outcome of this study, a handbook for patients with enteral diet was developed to use in service. It includes the care required with the tube, with personal hygiene, environmental hygiene, food hygiene, suggestion of timetables, preparations to be administered, the recipes of artisanal diets, the preparation, and additional information about frequently asked questions.

RESULTS

Of the fifteen diets prepared, one was deleted (cassava starch porridge) because it cloggedthe tube after fluidity tests, totaling fourteen recipes used for the standardization of diets.

Table shows the three diets listed. We can observe that diet 1 (D1) was standardized in 2000 ml per day with two juices and two porridges of 250 ml, two stocks of 400 ml and two 100 ml juices with the main meals (lunch and dinner). The enteral formula polymer powder was added to juices and porridges, in a total of 120 g.

Diet 2 (D2) was standardized in 2200 ml a day with two juices and two porridges of 300 ml, two stocks of400 ml and two 100 ml juices with the main meals. The total amount of polymer enteral formula powder added was 140 g. Diet 3 (D3) was standardized with

the same specifications of D2, but without addition of enteral formula polymer powder.
Between D1 and D3 andbetween D2 and D3 there were statistically significant differences ($p<0.05$) in the variables: energy, energy density, protein and carbohydrates, as demonstrated in Table 2. Lipid and cost variables showed no significant differences between diets ($p>0.05$). There were no significant differences between D1 and D2 in the variables analyzed (Table 2).

DISCUSSION

This work shows positive results on artisanal enteral diets standardized for patients at home-care, both in relation to the energy density, as the cost of production.

The Institute of Medicine (IOM), proposes the adequacy of energy intake in macronutrients using the concept of acceptable macronutrient distribution range (AMDR Acceptable Macronutrient Distribution Range-).

AMDR is expressed as a percentage of total energy intake. In this way, it proposes that 10 to 35% of energy intake for adults is derived from protein; 20 to 35% from fats; and 45 to 65% fromcarbohydrates[15].

Even with the diversity of enteral formulas industrialized available in the market, long-term use and high-cost lead the patient to use artisanal formulas[17], because it is demonstrably a low-cost option[2]. The diet also need to satisfy the nutritional requirements of the patient, be well-tolerated, with easy preparation and advantageous cost/benefit[4].

Bromatological analysis, within the context of applied analytical chemistry plays an important evaluator role of nutritional quality and food safety. Through it is possible to obtain more accurate values than those found in nutritional tables. At certain times, its use becomes crucial to consider and solve public health problems and to define and complement actions of sanitary surveillance[13].

Artisanal enteral diets elaborated in this study (D1 and D2) featured energy density of 0.94 kcal/ml, with total daily cost of R$25.92 and R$30.25, respectively. Comparing industrialized enteral diets prices, available in online stores, containing the same volume of D1 and D2diets, with energy density of 1.0 kcal/ml, the average daily cost is R$218.04 (2000 ml) and R$245.51 (2200 ml).
From data exposed, elaborated diets cost is eight times less than the average cost of industrialized diets. D1 represents 11.88% of the total average cost for its industrial equivalent (R$218,04) and D2 represents 12.32% of the total average cost for its industrial equivalent (R$245,51).

Although D3 has not presented statistically significant difference in variable cost compared to the other two diets, we should emphasize that the economic situation of the population studied points to a real difference, which can be best observed with a monthly projection of the diets cost.
The sum of the monthly cost with D2 results in a waste of R$907,50 while the monthly cost with D3 results in a visibly smaller cost, R$490,50.

Comparing the results with the literature, it should be noted that the preparations of D1 and D2 have caloric balanced distribution, characterizing them as normoglycemic,normoprotein and normolipid, being therefore a macronutrient offer option to patient homenutritional therapy[8].

Table 1. Standardization of diets 1, 2 and 3 in volume, energy, energy density, macronutrients andprice by preparation.UNASP - São Paulo, 2014.

	Volume	Energy	EnergyDens.	PTN	LIP	CHO	Price
DIET 1 (D1)	**(ml)**	**(kcal)**	**(kcal/ml)**	**(g)**	**(g)**	**(g)**	**(R$)**

Fortified apple juice	250	226.89	0.90	6.30	0.93	48.33	2.94
Fortified orange juice	250	231.80	0.92	7.67	1.16	47.67	2.89
Fortified cashew and apple juice	100	77.38	0.77	2.52	0.38	15.97	1.18
Laxative fortified juice	100	65.67	0.65	2.79	0.43	12.66	2.24
Cornstarch porridge	250	302.46	1.20	18.20	9.05	37.06	3.87
Corn meal porridge	250	391.74	1.56	19.14	17.14	40.23	2.01
Chicken foot stock	400	416.80	1.04	26.00	32.80	4.40	4.68
Muscle beef stock	400	173.60	0.43	20.80	7.20	6.40	6.11
TOTAL	**2000**	**1886.34**	**0.94**	**103.42**	**69.09**	**212.72**	**25.92**
PROPORTION (%)				**21.94**	**32.96**	**45.10**	

DIET 2 (D2)	**Volume (ml)**	**Energy (kcal)**	**Energy Dens. (kcal/ml)**	**PTN (g)**	**LIP (g)**	**CHO (g)**	**Price (R$)**
Fortified apple juice	300	272.24	0.90	7.55	1.12	57.99	3.53
Fortified orange juice	300	278.59	0.92	9.19	1.39	57.33	3.48
Fortified cashew and apple juice	100	77.38	0.77	2,52	0.38	15.97	1.18
Laxative fortified juice	100	65.67	0.65	2.79	0.43	12.66	2.24
Cornstarch porridge	300	361.37	1.20	21.12	10.89	44.72	4.56
Corn meal porridge	300	430.47	1.43	21.04	17.95	46.19	4.47
Chicken foot stock	400	416.80	1.04	26.00	32.80	4.40	4.68
Muscle beef stock	400	173.60	0.43	20.80	7.20	6.40	6.11
TOTAL	**2200**	**2076.12**	**0.94**	**111.01**	**72.16**	**245.66**	**30.25**
PROPORTION (%)				**21.39**	**31.28**	**47.33**	

DIETA 3 (D3)	**Volume (ml)**	**Energy (kcal)**	**Energy Dens. (kcal/ml)**	**PTN (g)**	**LIP (g)**	**CHO (g)**	**Price (R$)**
Apple juice	300	155.08	0.51	0.28	0.00	38.49	0.54
Orange juice	300	166.61	0.55	2.03	0.29	38.97	0.51
Cashew and apple juice	100	38.37	0.38	0.10	0.01	9.47	0.19
Laxative juice	100	26.66	0.26	0.37	0.06	6.16	1.25
Corn starch porridge	300	250.17	0.83	3.85	9.77	26.71	1.57
Corn meal porridge	300	328.89	1.09	13.84	16.85	30.47	1.50
Chicken foot stock	400	416.80	1.04	26.00	32.80	4.40	4.68
Muscle beef stock	400	173.60	0.43	20.80	7.20	6.40	6.11
TOTAL	**2200**	**1556.18**	**0.70**	**67.27**	**66.98**	**161.07**	**16.35**
PROPORTION (%)				**17.75**	**39.76**	**42.49**	

Table 2. Comparison of diets 1, 2 and 3 as to dietary and cost variables.UNASP – São Paulo, 2014.

	DIET 1	DIET 2	DIET 3	P
VARIABLES				
Energy (kcal)	[1]1886.34*	[2]2076.12***	1556.18	0.0007
Energy density (kcal/ml)	[1]0.94***	[2]0.94***	0.70	< 0.0001
Protein (g)	[1]103.42*	[2]111.01**	67.27	0.0063
Lipid (g)	69.09	72.16	66.98	0.0401
Carbohydrate (g)	[1]212.72*	[2]245.66***	161.07	0.0007
Cost (R$)	[1]25.92	[2]30.25	16.35	> 0.05

[1] DIET 1 vs DIET 3. [2] DIET 2 vs DIET 3* p<0.05** p<0.01*** p<0.001

D3 energy density, as well as its macronutrient distribution, ranks it as a low-calorie diet. This classification is justified because this diet contains only *in natura* food without adding enteral formula polymer powder.

In a study by Felício *et al*., which assessed the nutritional quality of artisanal enteral diets used by a charity hospital in Jequitinhonha Valley, it is observed that there is a significant loss of nutrients during processing and preparation of these diets, but the concomitant use of *in natura* and industrialized enteral diets (modules and/or powder polymeric enteral formulas) provides a more effective nutritional adequacy[18].

Other limiting factors for ensuring adequate supply of macronutrients by artisanalenteral diets are: the use of food composition tables, which show great variability and usually overestimate the distribution of macronutrients, impairing the reliability of the offer[19] and; the challenge to guide and train the caregivers in the process of diets handling, preparing, storing and administrating, so that losses are avoided and microbiological quality is acceptable[6].

Artisanal enteral nutrition, in most cases, is a transition diet[20]. The patient has the right to receive, via the State Health Secretariat, industrialized enteral diet. São Paulo State Government provides the form to the population that requires the use of industrialized enteral diet, trough evaluation and request by the doctor and nutritionist[21], although the knowledge regarding the benefit is limited, and the way to acquire it is complex and time-consuming.

The response to the request of industrialized diet occurs after 30 working days of the complete form delivery[22]. During this period, the nutritionist in charge must provide a means for the patient to be fed properly. Artisanal diets are used as a resource for families within this reality, preventing in this way the patient's malnutrition, which has consequences for the patient and the society, increases hospitalizations, as well as high morbidity and mortality[20].

Ministerial policies emphasize care of patients after their discharge, ensuring maintenance and/or full recovery of their health. Therefore, the importance of home care as a more humane treatment where the individual is attended in their own family environment[23].

This way of treatment, tends to retrieve psychosocial values of the supply process, once the patient's diet is prepared with conventional foods used by their family[24].

CONCLUSION

Three artisanal enteral diets were standardized. The two diets added withenteral polymer powder formula (D1 and D2) presented better energy density and distribution of macronutrients, while the diet without addition of enteral polymer powder formula (D3) presented weak distribution in macronutrients.

With respect to the cost, the analysis shows that the diets added withenteral polymer powder formula (D1 and D2) did not show greater cost than the diet prepared only with food (D3).

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CONTRIBUTIONS

Nyvian Alexandre Kutz contributed in the methodological design, carried out data collection and analysis, writing and final revision of the article. **Vanilda Amaral de Souza Bonfim** carried out data collection and analysis andtext writing. Data collection and analysis were carried out by **Ariane Lopes Assis**. **Marcia Cristina Barbosa** conducted the final analysis and writing. **Natalia Miranda da Silva** conducted the final analysis and text writing. **Márcia Maria Hernandes de Abreu de Oliveira Salgueiro** participated in the methodological outlining, writing and final revision.

How to cite this article (Vancouver)

Kutz NA, Bonfim VAS, Assis AL, Barbosa MC, Silva NM, Salgueiro MMHAO. Standardization of artisanal enteral diets for home care use in Primary Attention. REFACS [Internet]. 2018 [cited in *enter day, monthand year access*]; 6 (Suppl. 1): 298-305. Available in: *Insertaccess link.* DOI: *Insert link.*

How to cite this article (ABNT)

KUTZ, N. A.; BONFIM, V. A. S.; ASSIS, A.L.; BARBOSA, M.C.; SILVA, N.M.; SALGUEIRO, M.M.H.A.O. Standardization of artisanal enteral diets for home care use in Primary Attention. **REFACS**, Uberaba, v. 6, p. 298-305, 2018. Suppl. 1. Available at: < access link >. Access in: *enter day, month and year.* DOI: *Insert DOI link.*

How to cite this article (APA)

Kutz, N. A., Bonfim, V. A. S., Assis, A. L., Barbosa, M. C., Silva, N. M. & Salgueiro, M. M. H. A. O.(2017). Standardization of artisanal enteral diets for home care use in Primary Attention. *REFACS*, 6 (Suppl 1), 298-305. Retrieved on: *enter day, month and year access* to *insert link*.