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Food and nutritional safety of hospitalized patients under treatment with enteral nutrition therapy in the Jequitinhonha Valley, Brazil

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Abstract

The Enteral Nutrition Therapy (ENT) has been widely used in hospital and home care assistance. However, research works are needed to make this technique more efficient and cheaper.

Objective: Evaluate the nutritional quality of handmade enteral diets used in a charity hospital in the Jequitinhonha Valley, Brazil, and propose qualitative and quantitative adjustments, when necessary, and compare the data available in tables of chemical composition of foods with the data achieved by laboratory analyses.

Materials and methods: The study was carried out in partnership with a charity organization of the region and the Universidade Federal dos Vales do Jequitinhonha e Mucuri, where the collection of the handmade enteral diets was performed. The analyses of the physical-chemical and centesimal composition of 36 samples of diets were carried out in the laboratories of the university.

Results: It was observed that the daily energy offer of the diets was below the recommended standards and presented a percentage distribution different from that estimated for patients receiving ENT. Besides, it can be seen that the nutrient values of the data achieved in laboratory do not agree with those available in tables of food chemical composition.

Conclusions: Significant losses of nutrients were verified during the processing and preparation of handmade enteral diets. It challenges nutritionists to standardize these diets and corroborates the relevance of new studies to determine the nutritional content of handmade enteral diets, since these diets have been widely used in poor regions of Brazil and in other countries.

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Key words: *Enteral nutrition. Handmade. Diets. Standard formulas.*

SEGURIDAD ALIMENTARIA Y NUTRICIONAL DE LOS PACIENTES HOSPITALIZADOS DE UN TRATAMIENTO CON NUTRICIÓN ENTERAL EN EL VALLE DEL JEQUITINHONHA, BRASIL

Resumen

La terapia de nutrición enteral (TNE) se ha utilizado ampliamente en la asistencia hospitalaria y domiciliar. Sin embargo, se necesitan trabajos de investigación para hacer que esta técnica sea más eficiente y barata.

Objetivo: Evaluar la calidad nutricional de dietas enterales elaboradas de forma casera en un hospital de caridad del valle de Jequitinhonha, Brasil, y proponer ajustes cualitativos y cuantitativos, cuando sean necesarios, y comparar los datos disponibles en las tablas de la composición química de los alimentos con los datos obtenidos en los análisis de laboratorio.

Materiales y métodos: El estudio se realizó en colaboración con la organización de caridad de la región y la Universidad Federal dos Vales do Jequitinhonha e Mucuri, donde se realizó la recogida de las dietas enterales caseras. Los análisis de la composición fisicoquímica y centesimal de las 36 muestras de las dietas se realizaron en los laboratorios de la universidad.

Resultados: Se observó que la oferta energética diaria de las dietas estaba por debajo de las recomendaciones estándar y presentaba un porcentaje de distribución diferente de la estimada para pacientes que reciben TNE. Además, se pudo ver que los valores nutricionales de los datos obtenidos en el laboratorio no concordaban con los disponibles en las tablas de composición química de los alimentos.

Conclusiones: Se comprobó una pérdida significativa de nutrientes durante el procesamiento y preparación de las dietas enterales realizadas casera. Supone un reto para los nutricionistas para estandarizar estas dietas y corroborar la relevancia de nuevos estudios para determinar el contenido nutricional de las dietas enterales de realización casera, puesto que estas dietas se han empleado ampliamente en regiones pobres de Brasil y otros países.

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Palabras clave: *Nutrición enteral. Elaboración casera. Dietas. Fórmulas estándar.*

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Abbreviations

EN: Enteral Nutrition.

ENT: Enteral Nutrition Therapy.

UFVJM: Universidade Federal dos Vales do Jequitinhonha e Mucuri.

AOAC: Association of Official Analytical Chemists.

TSS: Total Soluble Solids.

ANVISA: Agência Nacional de Vigilância Sanitária.

Kcal: Kilocalories.

Introduction

Enteral Nutrition (EN) is the introduction of nutrients by means of a catheter or probe into the gastric or intestinal region of individuals unable to achieve their daily nutritional demands orally.¹ Thus, the Enteral Nutrition Therapy (ENT) is indicated for individuals whose oral ingestion does not supply at least two thirds of their daily energy needs,² and those under specific conditions, such as extensive burns, cancer, injuries to the central nervous system, food disturbances, impaired swallowing, among others.³

Enteral diets should be nutritionally balanced and present good hygienic conditions to assure or reestablish the supply of macronutrients, vitamins and minerals necessary to the metabolism of the patient.⁴ The chemical composition, osmolality and stability of industrialized formulas are well defined, while handmade diets are still unreliable in these aspects.⁵ These diets are made from foods “in natura”, which are subject to variations in their nutritional content due to environmental changes, modules of nutrients and food products. Besides, many hospitals do not have standardized manuals for the preparation of enteral diets.⁶

One of the main advantages of handmade formulas is the individual preparation, since the makers can mix several foods and prepare diets with different colors and tastes. Besides, they are cheaper than industrialized products.⁷ In a study carried out by Henriques and Rosado⁸ on the cost of handmade diets, considering the raw material suppliers, it was observed an average price variation of R\$ 6.12 per day, in three months. Such cost presented a value four times smaller than that observed for the industrialized diets available in the market.

However, the real nutrient composition and hygiene^{4,8} of handmade diets are questionable. Therefore, the adequate techniques involving all the preparation process, storage and administration of diets must be followed to avoid the contamination of the formulas and guarantee the quality of their enteral diets.⁹

Today, the Enteral Nutrition Therapy (ENT) has expanded to the home care assistance, which is a current trend, due to the benefits for the patients, such as the familiar environment, comfort and reduced risk of hospital-acquired infections.¹⁰ Thus, the use of these diets still prevails in Brazil, mainly in poorer regions,

such as the Jequitinhonha Valley,¹¹ with its several poor cities and high prevalence of malnutrition.^{11,12}

The significance of nutritional therapy is already known, but there is little knowledge about the true losses in foods due to processing. Consequently, the real nutritional value of the diet offered to patients in handmade ENT is still questionable. Besides, the calculations of the nutritional values of diets are performed based on tables of food composition, which many times limits the achievement of data.^{13,14}

Considering that the nutritive value of foods is essential for health and the improvement of patients' quality of life, the present study aimed at determining the nutritional quality, through chemical and centesimal determination, of the homemade enteral diets used in a charity hospital in the Jequitinhonha Valley, Brazil, and proposing qualitative and quantitative adjustments, when necessary. It also aims at comparing the data available in tables of food chemical composition with the data achieved through the laboratory analyses.

Materials and methods

This study was carried out from March to September 2009, in a charity hospital in the Jequitinhonha Valley-Brazil and in the Laboratories of Food and Nutritional Security and Technology and Cerrado Biomasses, at the Universidade Federal dos Vales do Jequitinhonha e Mucuri-UFVJM, Brazil.

Preparation and collection of samples of diets in the charity hospital

The homemade enteral diets used in the hospital are prepared as follows: first, the meat and vegetables are cooked separately. Next, they are blenderized together with the water used for cooking. The fruits are cleaned and blenderized with some water and the milk is heated to boiling. The foods were blenderized and passed through plastic sieves of various sizes. Finally, the modules of Nutren Active®, Albumax®, Nutri Soya® nutrients are added, when prescribed and/or available. If necessary, they are blenderized again. According to the characteristic of the foods used in the preparation of the diets, they can be separated into three different groups: vitamins, served in the breakfast and supper—containing milk and food supplement; juices and snack—containing water and fruits—; and soups, offered for lunch and dinner—containing meat and several vegetables. Table I describes the food and the quantities used to prepare these meals. After the preparation of each one of the six meals served during the day, the samples were collected in individual plastic pots with the capacity of 500 mL and stored in a freezer. The sample collection was performed for three consecutive days (n = 18).

Table I
Food used in handmade enteral diets at a charity hospital in the Jequitinhonha Valley, Brazil

<i>Meal</i>	<i>Food</i>	<i>1° day of collection</i>	<i>2° day of collection</i>	<i>3° day of collection</i>
<i>Breakfast</i>	Whole milk	300 mL	300 mL	–
	Skimmed Milk	–	–	300 mL
	Nutren Active®	54 g	54 g	–
	Albumax®	–	–	54 g
	Nutri Soya®	–	–	–
<i>Collation</i>	Apple	65 g	70 g	75 g
	Orange	65 g	70 g	75 g
	Guava	20 g	20 g	–
	Papaya	35 g	–	–
	Albumax®	27 g	27 g	–
	Nutren Active®	–	–	–
	Nutri Soya®	–	–	27 g
	Sugar	50 g	50 g	–
Water	120 mL	140 mL	150 mL	
<i>Lunch/Dinner</i>	Potato	45 g	37 g	35 g
	Carrot	15 g	15 g	20 g
	Chayote	17 g	15 g	20 g
	Corn oil	1 mL	1 mL	1 mL
	Seasoning®	–	–	–
	Garlic®	–	–	–
	Urucum®	–	–	–
	Water	230 mL	230 mL	230 mL
<i>Collation</i>	Apple	75 g	70 g	75 g
	Orange	75 g	70 g	75 g
	Guava	–	20 g	–
	Papaya	–	–	–
	Albumax®	–	–	–
	Nutren Active®	27 g	27 g	–
	Nutri Soya®	–	–	27 g
	Sugar	–	–	50 g
Water	150 mL	140 mL	150 mL	
<i>Supper</i>	Whole milk	300 mL	300 mL	300 mL
	Skimmed milk	–	–	–
	Nutren Active®	54 g	54 g	–
	Albumax®	–	–	–
	Nutri Soya®	–	–	54 g

*Products used to attribute flavor and color to meals.

Centesimal and physico-chemical analysis

The centesimal composition was determined according to the Association of Official Analytical Chemists (AOAC):¹⁵ the humidity achieved by drying at 65° C in a greenhouse with forced air circulation up to constant weight. The content of ashes, or fixed mineral residue, was quantified after the incineration of the organic matter into muffle at 550° C and the content of crude protein, by the Semi-micro Kjeldahl method. The ether extract, or crude fat, was achieved through the continuous extraction in ethyl ether using the Soxhlet Extractor. The crude fiber was determined by acid hydrolysis and subsequent filtration in Gooch crucibles. The carbohydrates were achieved by difference. The pH was quantified by direct reading in a Peagatekph meter, according to the norms

of the Instituto Adolfo Lutz.¹⁶ And the total soluble solids (TSS) were determined in the diets by direct reading in a bench top refractometer and expressed in °Brix.¹⁶

The energy value of the homemade diets was achieved according to Angelis,¹⁷ using the Atwater conversion factors. All the analyses were carried out with three repetitions. The results were expressed by the averages and standard deviations. The Tukey test at 5% probability was applied for the statistical analysis.

Estimate of the chemical composition

The estimate of the chemical composition of the diets was calculated based on the tables of Pinheiro¹⁸

and Philippi,¹⁹ besides the nutritional information present in the packagings of the nutrient modules used.

Elaboration of new standardized homenade diets

After finding that the diets offered to patients were inadequate, the researchers proposed new formulas to the hospital, so that the specific demands of the hospitalized patients could be better met, as well as the needs of those patients under home care assistance.

The diets were prepared in the Laboratory of Food and Nutritional Security of the UFVJM, in accordance with the hygienic and sanitary standards established by the resolution 337 of the Agência Nacional de Vigilância Sanitária-ANVISA²⁰ (National Agency of Sanitary Surveillance).

The formulas were divided into: Standard 1,500 kilocalories (kcal) (A), Standard 2,000 kcal (B), Constipating 2,000 kcal (C), Laxative 2,000 kcal (D), Hyperprotein 2,500 kcal (E) and Hypoprotein 2,500 kcal (F). Three samples of each type of diet (n = 18) were collected into individual plastic pots with the capacity of 500 mL and stored in a freezer in the UFVJM Laboratory of Technology and Biomasses of the Cerrado for centesimal and physical-chemical determination, according to the item 4.2.

Nutritional adjustment of the formulas

For the analysis of the adjustment of the diets used in the institution and those proposed to the hospital, the references of Teixeira Neto²¹ and Baxter et al.²² were used for the caloric distribution: 40 to 60% of carbohydrates, 30 to 35% of lipids and 14 to 20% of proteins. The energy density was calculated according to the calorie supply per mL, considering the value from 0.9 to 1.2 kcal/mL for normocaloric diets.^{21,22}

Results

The results are shown in tables II, III, IV and V.

Discussion

Since these diets need to pass through fine probes, they were supposed to present high humidity levels. However, the average humidity found in diets composition (table II) was higher than normocaloric diets recommended by Mitne.⁶ The same author considers that the volume of water in the prepared diets may decrease their nutritional quality, and there may be a hyperdilution to facilitate the passage through fine probes, directly affecting the caloric density, which becomes lower than expected.

The fiber content of the preparations (table II) had mean values consistent with the recommendations for home enteral feeding from 4 to 20 g/L.²²

The average content of mineral (table II) was lower than the total observed by Araújo and Menezes,¹³ Atzingen et al.²³ and Menegassi et al.,²⁴ 1.62, 0.84 and 0.98 g/100 g, respectively.

The pH of the diets varied from slightly acid to neutral (table II), which is close to the values found by Araújo and Menezes (6.00)¹³ and Montejo et al. (6.71)²⁵. It may favor the growth and dissemination of microorganisms in the preparations. Thus, enteral diets must be prepared in locations with ideal conditions, in accordance with the standards for the production and adequate cleaning of utensils, surfaces and handlers. A study carried out by Maurício et al.⁸ evaluated enteral diets in three private hospitals in Paraná, Brazil. This study led to the conclusion that the samples of the three hospitals were contaminated and that the diets had not been prepared according to the norms. Besides, the physical structure itself represented a risk factor for the contamination of the diets produced.

In their research work, Medina, Nascimento and Oliveira²⁶ demonstrated that 91% of the enteral diets used in a public service for home care assistance were contaminated by mesophilic aerobic microorganisms, total and faecal coliforms, *Salmonella sp*, *Staphylococcus aureus* and *Listeria monocytogenes*, compromising the nutritional quality of these formulas. Besides, Oliveira and Waitzberg²⁷ highlighted another potential factor of microbiological contamination, the non-sterile nutrient modules added to the enteral preparations, in which pathogenic microorganisms, such as *Bacillus ssp*, *Pseudomonas ssp*, *Bacillus Cereus* and *Enterobacter ssp* have been isolated.

As for the content of Total Soluble Solids (TSS), the recommended value found in Literature is about 20%.²⁸ In this case, the diets presented more fluidity of the preparations (table II).

No statistical difference was observed in the nutritional content of the diets on the days of the collection, according to the Tukey test.

In the comparison between the data of the centesimal/physical-chemical analysis and the estimate of the chemical composition, it is possible to observe that the total caloric value (TCV) was overestimated by both food composition tables, adjusting in 40.76%, according to Pinheiro¹⁸ and in 45.87%, according to Philippi¹⁹ (table III).

However, as for the protein content (table III), the average values found presented adjustment of 107.52%, according to the table of Pinheiro¹⁸ and 91.98%, according to Philippi.¹⁹ It may be associated to the presence of food supplements with a determined amount of proteins. Consequently, their composition in the formulas is more accurate.

The carbohydrate values achieved by the centesimal composition (table III), achieved adjustment of 108.42% and 102.5%, according to Pinheiro¹⁸ and Philippi¹⁹,

Table II
Centesimal and physical-chemical characteristics (mean = standard deviation) of handmade enteral diets (current and proposed diets), according to the day of collection, in a hospital in Jequitinhonha Valley-Brazil

Current diets	1 st day of collection		2 nd day of collection		3 rd day of collection	
Protein	6.54 ± 1.86		6.63 ± 4.65		4.20 ± 5.58	
Carbohydrate	19.35 ± 12.48		14.01 ± 14.22		16.89 ± 10.47	
Lipid	2.01 ± 1.86		2.40 ± 3.54		2.73 ± 4.56	
Fiber	1.86 ± 2.52		3.24 ± 5.10		2.70 ± 3.99	
Ash	1.71 ± 1.38		2.70 ± 1.77		2.19 ± 1.02	
Humidity	268.50 ± 18.45		270.96 ± 31.17		271.29 ± 23.55	
pH	6.63 ± 0.71		5.88 ± 1.16		5.61 ± 0.64	
TSS	18.36 ± 15.57		21.36 ± 25.11		18.54 ± 12.57	
Energy	121.83 ± 68.88		104.34 ± 122.07		109.02 ± 98.46	

Proposed diets	A	B	C	D	E	F
Protein	9.36 ± 3.6	7.62 ± 2.31	10.47 ± 0.66	9.42 ± 1.98	17.28 ± 2.1	6.87 ± 0.45
Carbohydrate	38.44 ± 10.11	44.28 ± 14.17	49.60 ± 17.65	41.74 ± 18.90	63.94 ± 2.11	43.81 ± 9.89
Lipid	3.92 ± 1.49	3.99 ± 1.54	2.17 ± 1.52	5.58 ± 1.67	1.15 ± 1.11	5.73 ± 1.92
Fiber	4.11 ± 1.08	2.91 ± 1.74	1.53 ± 0.37	3.94 ± 1.68	1.37 ± 0.22	3.74 ± 1.45
Ash	2.29 ± 0.73	1.90 ± 0.48	2.40 ± 0.37	1.89 ± 0.70	3.23 ± 1.76	1.58 ± 0.15
Humidity	241.88 ± 15.28	239.28 ± 15.32	233.97 ± 18.98	237.42 ± 18.98	213.05 ± 4.54	238.27 ± 8.71
pH	5.95 ± 0.17	6.36 ± 0.27	6.68 ± 0.73	5.94 ± 0.53	6.35 ± 0.41	5.19 ± 0.42
TSS	55.50 ± 6.85	47.40 ± 5.1	47.70 ± 6.81	51.30 ± 7.84	70.95 ± 6.12	56.40 ± 6.24
Energy	226.50 ± 21.23	243.53 ± 64.60	259.20 ± 78.10	254.87 ± 71.63	335.34 ± 14.08	254.26 ± 36.61

Macro and micronutrients expressed in grams; humidity in milliliters; TSS: (Total soluble solids) in °Brix; energy in kcal; A: Standard 1,500 kilocalories (kcal); B: Standard 2,000 kcal; C: Constipating 2,000 kcal; D: Laxative 2,000 kcal; E: Hyperprotein 2,500 kcal; F and hypoprotein: 2,500 kcal. Values are expressed as a portion of 300 ml of diet.

Table III
Comparison of the daily (kcal) total caloric value (TCV), macronutrients (%) and energy density (kcal/mL), according to centesimal composition and the estimated chemical composition of the diets offered in a hospital in the Jequitinhonha Valley-Brazil

	Centesimal composition	Chemical composition	
		Pinheiro (2005)	Philippi (2002)
Daily TCV	670.5	1,461.93	1,645.01
Proteins	23.29	25.53	21.66
Carbohydrates	66.99	65.35	61.79
Lipids	9.72	9.12	14.46
Density	0.37	0.81	0.91

respectively. Thus, both of them underestimated the values of carbohydrate present in the foods. On the other hand, the average found for lipids (table III) was adequate in 67.21% by the table of Pinheiro¹⁸ and in 107.23%, by the table of Philippi.¹⁹ Comparing the values achieved by the centesimal composition and by the table of Pinheiro,¹⁸ it was suggested a nutritional loss of 32.79% of lipids during food processing.

Composition tables are an important source of data. However, studies reveal that the data available in these tables in Brazil are not reliable, since they have not been updated and are not very clear, which make them unsafe for clinical use.^{13,29}

The energy density (table III) was adjusted in 40.66%, according to Pinheiro¹⁸ and in 45.68%, according to Philippi.¹⁸ This low energy density requires higher volume of the meals offered to the patients to compensate the low caloric supply. According to Mitne⁶, the offer of diets with low energy density presents a negative impact on osmolality, load of solutes and viscosity of the diets.

Another important aspect to be considered is the energy content of the diets offered to hospitalized patients (table III), which is below the recommended amount for adults, considering the reference of 2,000 kcal³⁰ for the Brazilian population. It is a paradox, since

Table IV
Food used in the preparation of new enteral feedings proposed to a charity hospital in Jequitinhonha Valley-Brazil

<i>Diet</i>	<i>Breakfast/ supper</i>	<i>Portion - 300 mL</i>	<i>Collation</i>	<i>Portion - 300 mL</i>	<i>Lunch/ dinner</i>	<i>Portion - 300 mL</i>
A	Whole milk	200 mL	Whole milk	165 mL	Wheatflour	20 g
	Comflour	20 g	Oat	18 g	Beef	25 g
	Banana	56 g	Sustagen®	18 g	Comflour	20 g
	Water	45 mL	Banana	30 g	Carrot	25 g
	–	–	Water	50 mL	Pumpkin	72 g
	–	–	–	–	Water	210 mL
B	Whole milk	200 mL	Whole milk	165 mL	Comflour	40 g
	Banana	30 g	Apple	90 g	Bolied egg	45 g
	Comflour	40 g	Sustagen®	18 G	Potato	60 g
	Oat	18 g	Comflour	40 g	Carrot	25 g
	Water	50 mL	–	–	Sustagen®	18 g
C	Whole milk	200 mL	Nutren Active®	31.5 g	Rice	50 g
	Oatmeal cookie	20 g	Comflour	20 g	Potato	60 g
	Mucilon Arroz®	18 g	Biscuit	20 g	Carrot	25 g
	Sustagen®	18 g	Oat	18 g	Chicken breast	30 g
	Water	50 mL	Fiber Mais®	5 g	Comflour	40 g
	Fiber Mais®	15 g	Water	200 mL	Water	150 mL
D	–	–	–	–	Fiber Mais®	10 g
	Whole milk	200 mL	Whole milk	200 mL	Pumpkin	40 g
	Papaya	50 g	Apple	45 g	Tomato	30 g
	Oat	30 g	Oat	36 g	Comflour	30 g
	Fiber Mais®	15 g	Nutren Active®	15.7 g	Beef	25 g
	Banana	30 g	Papaya	50 g	Cornmeal	30 g
E	Nutren Active®	15.17 g	–	–	Corn oil	8 g
	Whole milk	200 mL	Whole milk	200 mL	Wheatflour	40 g
	Sustagen®	36 g	Apple	65 g	Chicken breast	30 g
	Nutren Active®	31.5 g	Oat	36 g	Rice	50 g
	Oatmeal cookie	10 g	Nutren Active®	63 g	Beetroot	40 g
	Banana	30 g	–	–	Comflour	40 g
F	Water	50 mL	–	–	–	–
	Whole milk	200 mL	Orange	100 g	Rice	68 g
	Mucilon Arroz®	18 g	Apple	45 g	Pumpkin	36 g
	Apple	65 g	Nutren Active®	15 g	Beetroot	20 g
	Cream	30 g	Oat	15 g	Boiled egg	45 g
	Comflour	40 g	Comflour	30 g	Milk cream	15 g
F	–	–	Biscuit	30 g	Comflour	30 g
	–	–	–	–	Apple	45 g
	–	–	–	–	–	–

A: Standard 1,500 (kcal); B: Standard 2,000 (kcal); C: Constipating 2,000 (kcal); D: Laxative 2,000 (kcal); E: Hyperprotein 2,500 (kcal); F: Hypo-protein 2,500 (kcal).

the nutritional therapy recommends the maintenance or recovery of the nutritional status, which is inconsistent with the nutritional characteristics of the diets provided to patients. Besides, in a broader sense, it may represent a risk factor for the occurrence of new pathologies, such as malnutrition and other specific problems, thus increasing mortality rate.

Several studies demonstrate that the enteral diets offered in hospitals present caloric value lower than the prescribed amount, besides an infused volume deficit. These factors decrease the amount of energy available to the patients and may aggravate their health condition.^{31,32,33}

After the inadequacy of the diets available at the hospital was observed, new homemade enteral formulas

Table V
Proposed and achieved daily total caloric value (TCV) (kcal), distribution of macronutrients (%), and energy density (kcal/mL) of the diets proposed to a hospital in the Jequitinhonha Valley-Brazil

	Standard 1,500 kcal	Standard 2,000 kcal	Constipant	Laxative	Hyperprotein	Hypoprotein
Proposed TCV	1,500	2,000	2,000	2,000	2,500	2,500
Real TCV	1,358.97	1,461.17	1,555.18	1,529.2	2,012.02	1,525.56
Proteins	18.11	13.64	16.62	16.6	21	12.16
Carbohydrates	73.31	79.22	79.88	73.57	77.61	77.68
Lipids	7.57	7.14	3.5	3.5	1.4	10.16
Density	0.75	0.81	0.86	0.85	1.12	0.84

were proposed. In the elaboration of new diets, priority was given to regional foods, foods of the season and those usually available in the hospital, besides some calorie supplements (Nutren Active®, Sustagem®) and fiber modules (Fiber Mais®). The food used to prepare these meals and quantities are described in table IV.

It was observed that the new diets presented average humidity 78% (table II) which is below the value found by Araújo and Menezes,¹³ 79%, and by Menegassi et al.,²⁴ 83%. The literature mentions the value of about 80 to 85% of humidity for normocaloric diets.⁶ Comparing the diet offered in the hospital with the new standard proposal of 2,000 kcal (B), it can be seen that it is closer to the values found by other authors.

The pH average is similar to the pH values of the diets used in the hospital (table II). This is something expected, considering that most foods used to make the preparations presented pH close to neutral. Therefore, all the processing and preparation of foods need careful handling, observing the critical points of control to guarantee the microbiological quality of the diets³⁴, since they are subject to more manipulation than the industrialized formulas²⁴ and, consequently, are more susceptible to contamination. Besides, these diets are intended to weak patients, who present lower immunity.²⁷

The TSS present values more satisfactory than those of the diets offered in the hospital (table II). In the study carried out by Araújo and Menezes,¹⁴ the values of soluble solids ranged between 18 and 22%, for home-made enteral diets.

The new formulas proposed to the hospital showed an average fiber content similar to the diets offered in the hospital (table II). In this context, some authors claim that fibers are essential to stimulate the local immune system, balance the pH, maintain the colonic microflora and avoid the bacterial translocation, helping in the treatment of patients.^{22,35}

The average value of total minerals is similar to the value presented by the diets offered in the hospital (table II). Mitne⁶ suggests that mineral and/or vitamin supplements may be necessary for patients with deficiencies or those under a long-term nutritional therapy, since the deficit of these nutrients usually occurs in handmade diets.

It was observed that the profile of macronutrient distribution was different from the recommendation proposed for non-industrialized enteral diets^{21,22}, and the diets were classified as hyperglycemic and hypolipidic (table V), presenting variable protein content. Araújo and Menezes¹³ mentioned that the adequate distribution of macronutrients in the diets plays a fundamental role in their nutritional quality and confers more credibility to the ENT.

However, when the diet offered to hospitalized patients is compared to the proposed standard diet 2,000 kcal, a significant improvement is verified in the energy offer (table V). In the first case, TCV achieved about 34% of the daily energy needs (table III). But in the second, it achieved about 73%, although it did not adjust to the macronutrient expected distribution, either^{21,22} (table V).

The energy density of the new diets allowed them to be classified into slightly hypocaloric (table V), which is similar to the results found by other authors.^{23,24} The hyperprotein formula was an exception. It was classified as normocaloric. By comparing the density value of the standard diet 2,000 kcal proposed (table V) and the diets currently available in the hospital (table III), it is possible to verify a significant improvement in the kcal/mL diet relation.

Considering that these diets were prepared and adjusted nutritionally through previous calculations using chemical composition tables, it was observed in the present work that not only the percentage distribution, but also the caloric value achieved were not compatible with those found in the laboratory analyses (table V), corroborating the results of Menegassi et al.²⁴. Therefore, there are some factors that may have contributed to the variability of the data, such as the time for cooking food, fruit maturation and the losses occurred during the processes of diet production.

Conclusions

The diets offered in the hospital presented insufficient caloric values for the supply of the energy needs of the hospitalized patients, which makes them vulner-

able to food insecurity and to the aggravation of their nutritional status. Besides, the data of the chemical composition suggest that there are significant losses of nutrients during the processing and preparation of homemade enteral formulas, which is a challenge for nutritionists regarding the standardization and adjustment of these formulas.

To implement the use of the new formulas proposed to the hospital, quantitative adjustments must be carried out aiming at improving their nutritional value and ensure the quantitative and qualitative offer provided to patients under nutritional therapy. It is also highlighted the importance of the development of other studies to determine the nutritional content of homemade enteral diets, since they are widely used in clinical practice in poor regions of Brazil and other countries.

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