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Elaboration and assessment of the nutritional suitability of multiple-mixture main porridge prepared with regional foods

Elaboração e avaliação da adequação nutricional de papas principais de misturas múltiplas preparadas com alimentos regionais

Abstract

Introduction: Food should be introduced starting from the 6th month of life as a complement to breast milk, prioritizing the choice of regional foods. In the traditional approach, it is recommended that foods be offered in varieties and consistency of purees and porridge, which should be gradually increased. **Objective:** The aim of this study was to develop multiple-mixture main porridges (MMMP) with regional foods being targeted at children for food introduction and to compare their suitability with healthy recommendations for the intake of food groups and nutrients. **Methods:** This is an experimental, quantitative and descriptive study in which three different formulations were developed: chicken-based, fish-based, and meat-based, with a focus on children aged 6-8 months of life. The MMMPs were packed in jars similar to commercial products. Nutritional value was calculated using the Food Guide for Children Under Two Years (*Guia Alimentar para Crianças Menores de Dois Anos*), and alternatively using the Brazilian Table of Food Composition (*Tabela Brasileira de Composição de Alimentos - TACO*), based on the nutrient intake recommendations of the National Academies of Sciences, Engineering, and Medicine. **Results:** The results obtained after analysis by the guide in kcal/portion were: 129.94 (beef), 148.85 (chicken), and 134.00 (fish). The energy density values found by TACO in kcal/g were: 1.72 (beef), 4.01 (chicken), and 2.06 (fish). Each jar (110 g) contained less than one portion of MMMP, with the exception of the preparation containing chicken. **Conclusion:** The preparations were found to be nutritionally adequate by both evaluated methods and contained all the recommended food groups.

Keywords: Complementary food, regional foods, energy density, food introduction.

Resumo

Introdução: A introdução alimentar deve ser iniciada a partir do sexto mês de vida, como complemento ao leite materno, priorizando a escolha de alimentos regionais. Na abordagem tradicional, recomenda-se que os alimentos sejam ofertados em variedades e em consistência de purês e papas, as quais devem ser aumentadas gradualmente. **Objetivo:** O objetivo deste estudo foi elaborar papas principais de misturas múltiplas (PPMM) com alimentos regionais direcionadas a crianças na introdução alimentar e comparar sua adequação com as recomendações saudáveis de ingestão de grupos alimentares e nutrientes. **Métodos:** Trata-se de uma pesquisa de natureza experimental, quantitativa e descritiva, na qual foram elaboradas três diferentes formulações - à base de frango, à base de peixe, e à base de carne - com

foco no público infantil na faixa etária de 6-8 meses de vida, que foram acondicionadas em recipientes, semelhantes aos produtos comerciais. Calculou-se o valor nutricional utilizando o Guia Alimentar para Crianças Menores de Dois Anos, e alternativamente, usando a Tabela Brasileira de Composição de Alimentos (TACO), com base nas recomendações de ingestão de nutrientes da *National Academies of Sciences, Engineering, and Medicine*. **Resultados:** Os resultados obtidos após análise pelo Guia, em kcal/porção, foram 129,94 (Carne), 148,85 (Frango) e 134,00 (Peixe); já os valores de densidade energética encontrados pela TACO, em kcal/g, foram 1,72 (carne); 4,01 (frango) e 2,06 (peixe). Cada recipiente (110 g) comportou menos de uma porção de PPMM, com exceção da preparação contendo frango. **Conclusão:** As preparações elaboradas encontraram-se nutricionalmente adequadas por ambos os métodos avaliados e contiveram todos os grupos alimentares recomendados.

Palavras-chave: Alimentação complementar. Alimentos regionais. Densidade energética. Introdução alimentar.

INTRODUCTION

The World Health Organization (WHO) recommends exclusive breastfeeding up to six months of life and maintaining it until the second year of life or more. However, food introduction begins from six months onwards, in which food must be offered in quantities, frequencies, consistencies and in varieties which together with breast milk meet the nutritional needs of children.¹ Food introduction must follow cultural and food characteristics of the different regions, recovering consumption and enhancing the foods such as fruits, vegetables and greens that are produced in the region,² enabling access by its population.

Food introduction from the traditional approach must respect the variety of foods and initially have a consistency of purees and porridge.³ In addition to this, there are participatory approaches, including baby-led weaning (BLW) and baby-led introduction to solids (BLISS).^{4,5}

The nomenclature to refer to salted porridge in the traditional approach was changed to multiple-mixture main porridge (MMMP) (*Papas Principais de Misturas Múltiplas*), which should be offered to the child as lunch and dinner. The first MMMP must be introduced starting in the infant's sixth month of life, and the second starting in the seventh month. The following food groups must compose the mixtures: cereals or tubers; legumes; animal protein; and vegetables.^{6,7} It is recommended to knead the foods with a fork and present them individually for its preparation, allowing the infant to get to know the foods better and thus build a diversified palate and develop their preferences.⁷ This is extremely important, as it is in the first years of life that eating habits are formed.⁸

Current lifestyles marked by changes in family nuclei, where those responsible for preparing meals spend a good part of their time working, means that industrialized foods are offered to children, mainly due to their practicality. However, these foods usually have additives in their composition, such as preservatives, acidulants, thickeners, stabilizers, flavorings and colorings, which in the future may contribute to trigger a series of comorbidities in those who consume them.^{9,10} In addition, high consumption of ultra-processed foods is associated with higher caloric intake, favoring weight gain, lower fiber intake, lower protein intake, higher sodium intake and increased cholesterol and fat levels, which support developing cardiovascular diseases.¹¹ However, processed products have the following advantages: diversity, food safety, quality in their conservation methods and durability.¹²

In aiming at a healthy and practical food introduction to infants, the availability of MMMPs with regional foods which provide quality, quantity, harmony and adequacy of nutrients, free from additives, having all recommended food groups, presented separately and which meet children's nutritional needs and at the same time enhance the flavor and texture of each food is relevant as an option in the market (among several other aspects). The importance of choosing to use regional foods is rooted in the historical, cultural, socioeconomic and affective relationships of regional foods with the community.¹³

It is worth noting that the Food Guide for Children Under Two Years of Age (*Guia Alimentar para Crianças Menores de Dois Anos*)⁸ classifies foods according to the processing degree into: *in natura*, which do not undergo any type of processing; minimally processed, which undergo some processing such as removal of unwanted parts, cleaning, grinding, drying, pasteurization, refrigeration, freezing or similar processes in which there is no addition of any substance to the initial food such as the use of salt, fat, sugar, or oils; processed foods, which are developed from fresh foods and undergo an addition of ingredients into their composition, such as salt or sugar, to enable greater durability; ultra-processed foods, which are developed by the food industry through applying various techniques and processing steps to provide greater processing to foods, as well as the addition of ingredients in its composition such as salt, sugar, food additives, oils, and fats.

In this context, MMMPs are classified as minimally processed foods. It is noteworthy that fresh foods, as well as minimally processed foods, should be the pillar of infant feeding and of the entire family structure with a view to promoting health. Therefore, this aspect must be considered in food planning for infants.

Adequate food and nutrition are necessary conditions to enable children's health, growth and development. The previously referenced Food Guide for Children Under Two Years of Age addresses guidelines and recommendations to enable a healthy and adequate diet for them.⁸ One way to investigate dietary adequacy is using the Brazilian Table of Food Composition (TACO), which analyzes the composition of foods in calories and nutrients, supporting the food industry in product development.¹⁴ Thus, the information obtained follows the nutrient intake recommendations of the National Academies of Sciences, Engineering, and Medicine.¹⁵

Based on the above, this study aimed to prepare multiple-mixture main porridges with regional foods aimed at children in food introduction as a proposal for an alternative product to industrialized ones, and to compare the adequacy of the formulations prepared based on the recommendations of the Food Guide for Children Under Two Years of Age and Nutrient Intake Recommendations from the National Academies of Sciences, Engineering, and Medicine.

MATERIALS AND METHODS

Study design

This is an experimental, quantitative and descriptive study developed at the Laboratory of Technique and Dietetics of the *Instituto Federal de Educação, Ciência e Tecnologia do Ceará (IFCE)*, Limoeiro do Norte campus, CE, Brazil, conducted from August 2019 to February 2020. It is part of a larger project entitled "Development and evaluation of the stability of multiple-mixture main porridge prepared with regional foods", which aimed to develop multiple-mixture main porridges with regional foods aimed at children in food introduction, which can be produced industrially without the addition of preservatives in compliance with current legislation, and made available as a healthy alternative to those already on the market.

Development of the multiple-mixture main porridge formulations with regional foods

The recommendations of the Food Guide for Children Under Two Years of Age^{2,8,16} and of the Orientation Manual of the Brazilian Society of Pediatrics (*Sociedade Brasileira de Pediatria*) were followed^{6,7} for choosing the ingredients to develop the preparations.

The Food Guide for Children Under Two Years of Age¹⁶ presents the recommended energy intake approach for the first two years of life based on the WHO tables.¹⁷ Thus, the data from these tables were used to determine the minimum energy content value of a portion of each formulation. It is noteworthy that although there is the most current version of the Food Guide for Children Under Two Years of Age⁸ of 2019, it does not address the recommended energy intake for the first two years of life, and therefore the 2005 version was used.

The energy requirements of the 6-8 month age group were initially used as a reference based on the calories needed for total energy expenditure and for promoting the growth of breastfed children. Next, the estimated amount of energy from a moderate consumption of breast milk¹⁷ for children in this age group was subtracted from the value found, thus determining the mean energy value needed from complementary foods. This value was divided by the maximum number of MMMP recommended for the age group (up to

two),⁸ thereby reaching the value of 90 kcal, which represents the minimum energy value necessary for a MMMP in a complete portion.

The Food Guide for Children Under Two Years of Age was used as a reference¹⁶ to determine the amount of food to compose each formulation, in which foods are presented both in grams and in household measures, by food group, in caloric equivalents referring to one portion, and based on the precepts of the children's food pyramid. Then, the foods to compose the formulations were selected in accordance with the recommendations of the Brazilian Society of Pediatrics,^{7,8} which advises that the MMMP preparation to be offered from the sixth month of life onwards must be composed of the following food groups: cereals or tuber, protein food of animal origin, legumes and vegetables. Next, it was considered that each porridge made should have at least half of the daily portions recommended for each food group because two MMMPs are offered from the seventh month onwards.

Aquisition of raw materials

The following ingredients were used for the MMMP preparation with regional foods: beef knuckle, carioca beans, carrots, sweet potatoes, chicken breast, black-eyed beans, pumpkin, parboiled rice, soy oil, tilapia fish fillet, beets and cassava. The ingredients were purchased from local markets in the city of Limoeiro do Norte, CE, Brazil.

MMMP preparation with regional foods

Three different main mixtures were elaborated in order to present an alternative product to commercially available industrialized products: beef knuckle, carioca beans, carrots, sweet potatoes (BBCP); shredded chicken breast, black-eyed beans, pumpkin, parboiled rice (CBPR); and tilapia fish fillet, black-eyed beans, beets, cassava (FBBC). The formulations were prepared in the *IFCE* Technical and Dietetic Laboratory of the Limoeiro do Norte campus, CE, Brazil, following all the recommendations in the Technical Regulation of Good Practices for Food Services (*Regulamento Técnico de Boas Práticas para Serviços de Alimentação*), RDC No. 216 of 2004 by *ANVISA*.¹⁸

All foods were prepared separately and without the addition of salt. Carrots, sliced beetroot, sliced pumpkin, cassava and sweet potato were cooked immersed in boiling water. The chicken fillet and the beef knuckle were initially marinated with soy oil and minced garlic, with subsequent addition of minced coriander, and then boiled in water. Tilapia fish fillet was marinated with soy oil, grated garlic, chopped cilantro and chives and cooked in water. The beans (black-eyed or carioca beans) were left to soak for eight hours and were cooked in a pressure cooker with clean water after discarding the soaking water.

After cooking, the food was kneaded with a fork in accordance with the recommendations of the Brazilian Society of Pediatrics.⁷ Next, 110 g of food for each formulation were added in glass jars suitable for food purposes with a capacity of 100 mL, previously sterilized in a water bath at 100 °C for 15 minutes. The amount of each ingredient to be added in each jar for 110 g of formulation was calculated by rule of three to maintain the proportionality of the ingredients calculated from the Guide recommendations for one portion.

In thinking about the best presentation of food for children, the formulations were added in layers in the following order: cereals or tubers, vegetables, legumes and animal protein. They were subsequently pasteurized in a water bath at 95 °C for 25 minutes in jars covered with a metal lid. Once this time was reached, the jars were removed from heating and turned over so that the lid was down. The jars were gradually immersed in cold water baths for faster cooling, and later stored under refrigeration.

Assessment of nutritional adequacy of MMMP with regional foods

The nutritional adequacy of the MMMP prepared with regional foods was evaluated according to the healthy recommendations for the ingestion of food groups and nutrients through two different methodologies in order to estimate the percentage of nutritional needs recommended for children among the age group of 6-8 months of life that each elaborated formulation satisfied.

The caloric value per portion and energy density were initially calculated using the Food Guide for Children Under Two Years of Age according to the food groups of each formulation.¹⁶ Then, the nutritional composition and energy density of each formulation were analyzed through the *TACO*¹⁴ using the recommendations of the National Academies of Sciences, Engineering, and Medicine¹⁵ as a reference to assess the adequacy.

It was decided to use the estimated average requirement (EAR) as the minimum adequate intake value to assess dietary intake through *TACO*,¹⁴ or the adequate intake (AI) in its absence, and the Tolerable Upper Intake Level (UL) as the maximum healthy intake. An exception was made for protein for which the Recommended Dietary Allowance (RDA) was considered, replacing the EAR, because it is only available in g/kg, which makes it impossible to use it at a population recommendation level. Thus, the analyzed nutrients and their considered reference values (in mg) were: calcium (260 AI; 1500 UL); phosphorus (275 AI); iron (6.9 EAR; 40 UL); vitamin A (500 AI; 600 UL); thiamine (0.3 AI); riboflavin (0.4 AI); niacin (4 AI) and vitamin C (50 AI). The reference values for macronutrients (in g) were: carbohydrates 95 (AI); protein 11 (RDA) and lipids 30 (AI). The energy density data obtained by the two methodologies were then compared.

RESULTS

The formulations are characterized in Table 1 according to the constituent food groups, the ingredients and the amounts of portions used, determined in accordance with the Food Guide for Children Under Two Years of Age.

Table 1. Characterization of the MMMPs regarding the constituent food groups, number of portions used and ingredients. Limoeiro do Norte, CE, Brazil, 2020

Food group	Number of minimum portions used *	Ingredients		
		BBCP	CBPR	FBBC
Meat	One	Beef knuckle	Shredded chicken	Tilapia fish
Legumes	Half	Carioca beans	Black-eye beans	Black-eye beans
Vegetables	One and a half	Carrot	Pumpkin	Beets
Cereals/tubers	One and a half	Sweet potato	Parboiled rice	Cassava
Oils and fats	One	Soy oil	Soy oil	Soy oil

* According to the Food Guide for Children Under Two Years of Age (16)
Source: Elaborated by the authors.

The MMMPs prepared with regional foods are presented in Figure 1, and were put in jars with 110 g of food, in a similar way to industrialized ones. It is possible to observe the layers of the different constituent food groups, noting that the foods were previously kneaded with a fork.

Figure 1. Multiple-mixture main porridges made with regional foods. From left to right: CBPR, FBBC, BBCP



Source: Elaborated by the authors.

Table 2 presents a comparative analysis between the energy value of a calculated portion of each formulation and the energy value corresponding to the amount of food contained in each prepared MMMP jar (110 g).

Table 2. Analysis of the MMMPs using the portions method of the Food Guide for Children under Two Years of Age. Limoeiro do Norte, CE, Brazil, 2020.

Comparison between the calculated portion and a jar of MMMP prepared with regional foods		Preparations		
		BBCP	CBPR	FBBC
One portion	Food weight (g)	182	158.95	176.39
	Energy value (kcal)	129.94	148.85	134.00
	Energy density (kcal/g)	0.71	0.94	0.76
One jar of elaborated MMMP	Food weight (g)	110	110	110
	Energy value (kcal)	78.54	103.01	83.55
	Energy density (kcal/g)	0.71	0.94	0.76

Source: Elaborated by the authors

It is possible to observe that there is energy adequacy in a calculated portion, as at least 90 kcal per day is necessary to consume a complete portion according to the Food Guide for Children under Two Years of Age. As the amount of food in each formulation in a jar corresponds to less than one calculated portion, it is necessary to consume a jar plus 16.05 g of the BBCP formulation, and a jar plus 8.49 g in the case of the FBBC formulation to achieve the energy recommendations. In addition, a single 110 g jar in the case of the CBPR preparation meets the recommendations of the Food Guide for Children under Two Years of Age,¹⁶ having its value influenced by parboiled rice which solely provides 53.74 kcal.

It is found that all formulations are adequate in terms of energy density, and that a jar of 110 g of each formulation satisfies the equivalent of 60.43% (BBCP), 69.20% (CBPR) and 62.36% (FFBC) of the recommended energy requirements for one portion, according to the analysis carried out through the Food Guide for Children Under Two Years of Age.

Table 3 shows the results of the analysis of the nutritional composition of the MMMP according to the TACO table and the recommendations of the National Academies of Sciences, Engineering, and Medicine.¹⁵

Table 3. Analysis of the nutritional composition of MMMP per 100 g and verification of dietary recommendations (AI/EAR/UL) for infants aged 7-12 months by TACO. Limoeiro do Norte, CE, Brazil, 2020.

Nutrients	Recommended EAR/AI* or UL	Preparations								
		BBCP			CBPR			FBBC		
		Found			Found			Found		
		G	kcal	%	g	kcal	%	g	kcal	%
Macronutrients										
Carbohydrates	95* g	23.93	95.72	55.58	73.80	295.20	73.55	24.37	97.48	47.43
Protein	11g RDA	7.02	28.08	16.30	14.70	58.80	14.65	13.76	55.04	26.79
Lipids	30*g	5.38	48.42	28.12	5.26	47.34	11.80	5.89	53.01	25.79
Micronutrients										
Ascorbic acid (mg)	50* mg	Found			Found			Found		
			26.76			2.91			8.25	
Calcium (mg)	260* /1500 mg (UL)	30.36			10.78			25.23		
Phosphorus (mg)	275* mg	76.99			97.18			148.50		
Iron (mg)	6.9/40 mg (UL)	0.80			0.62			0.57		
Niacin (mg)	4* mg	4.69			1.90			2.73		
Retinol (mcg)	500*/600 mcg (UL)	0.39			-			-		
Riboflavin (mg)	0.4* mg	0.02			-			0.04		
Thiamine (mg)	0.3* mg	0.14			0.06			0.10		
Energy density (kcal/g)		1.72			4.01			2.06		

AI = Adequate Intake (*); EAR = Estimated Average Requirement; RDA = Recommended Dietary Allowance; Tolerable Upper Intake Level = UL; mcg = microgram; mg = milligram; g = gram; kcal = calories.

Source: Elaborated by the authors

In terms of macronutrients, the MMMP prepared with regional foods reached the following percentages in relation to that recommended for the age group studied per 100 g of foods: BBCP – carbohydrates (55.58%), protein (16.30%), and lipids (28.12%); CBPR – carbohydrates (73.55%), protein (14.65%), and lipids (11.10%); FFBC – carbohydrates (47.43%), protein (26.79%), and lipids (25.79%), as indicated in Table 3.

Furthermore, the following values were reached for micronutrients: BBCP - calcium (11.67%), phosphorus (27.99%), iron (11.59%), vitamin A (0.07%), thiamine (46.66%), riboflavin (5%), niacin (117.25%), and vitamin C (53.52%); CBPR - calcium (4.14%), phosphorus (35.33%), iron (8.98%), thiamine (20%), niacin (47.5%), and vitamin C (5.82%); FFBC - calcium (9.70%), phosphorus (54%), iron (8.26%), thiamine (33.33%), riboflavin (10%), niacin (68.25%), and vitamin C (16.5%).

The results obtained show differences in energy density analyzed using the two methodologies.

DISCUSSION

Children's nutritional needs from the sixth month of life onwards are not exclusively met by breast milk, requiring the inclusion of complementary foods. New foods must be presented in a plurality of colors, flavors, textures and aromas.⁸ There is not a sufficient amount of evidence that addresses the ideal methodology for introducing the foods; thus, those responsible for the children must choose the most viable way for their realities, being attentive to the signs of hunger and satiety of their children.¹⁹

There are participatory approaches among the new proposals for starting food introduction, such as baby-led weaning (BLW) and baby-led introduction to solids (BLISS), whose advantages are: allowing the child to guide their own feeding; work on children's autonomy and family participation in meals; include healthy foods, enabling to develop healthy eating habits; and encouraging chewing.^{20,21} However, it is noteworthy that the Brazilian Society of Pediatrics,⁷ the Ministry of Health (*Ministério da Saúde*) through the Food Guide for Children Under Two Years of Age,⁸

the American Academy of Pediatrics,²² the European Society for Pediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN)¹⁹ and the World Health Organization (WHO)²³ still do not recommend these new approaches with confidence and recommend the traditional approach for food introduction, but which allows the child to interact with food.

Food introduction from a traditional approach should be started with food in a pasty consistency and gradually increased. Exclusive breastfeeding up to the 6th month of life is recommended, and the first main food should be introduced in this age group, and the second main food from the 7th to 8th month. Tubers, vegetables, legumes, cereals and a protein source of high biological value should constitute these multiple mixtures.²⁴

It is not recommended that foods be liquefied or strained, as the child's taste buds are in the process of building. Thus, the foods must be presented in a way that the child can learn the foods individually in their consistencies, flavors and colors. Furthermore, if the food is liquefied, there may be damage to the chewing quality by the child due to the non-stimulation of this process.^{2,24} There is no difference in offering separate or mixed foods in the nutritional aspect, but when mixed foods are presented to the child, it is possible this can contribute to them becoming more selective in their food choices in the future.²⁴ It is noteworthy that all of the MMMPs prepared with regional foods in this study had the food kneaded with a fork, different from industrialized porridge in which all foods are in a smooth and homogeneous consistency.²⁵

The formulations developed in this study have the advantage of presenting all food groups, in accordance with the recommendations of the Food Guide for Children Under Two Years of Age¹⁶ and the Brazilian Society of Pediatrics,^{6,7} of being developed with regional foods without preservatives, with availability of layered and unmixed foods, allowing the child to know/learn the foods, and to be planned according to the nutritional needs of children aged 6-8 months, based on the estimated average amount of breastmilk consumption in this age group.

In a study by Silva & Pereira Netto¹⁰ in which two brands of industrialized baby food were analyzed, the presence of salt, little use of natural seasonings and the presence of additives, in addition to the absence of some food groups in the formulations were found. Thus, in comparing these characteristics, the MMMPs formulated herein are more appropriate for infant feeding than those already on the market.

According to the WHO,¹⁷ the energy intake recommendation for the first two years of life based on the calories needed for total energy expenditure plus those demands for the growth of breastfed children is on average 682 kcal/day for the age group of 6-8 months. It is estimated that breast milk provides an average of 473 kcal/day for children aged 6-8 months who are breastfed, with the rest of the energy requirement (on average 209 kcal/day) to be supplied by complementary foods.

Complementary foods offered in the food introduction process must contain at least an energy density of 70 kcal/100 ml, according to the Food Guide for Children Under Two Years of Age.¹⁶ In this study, it was decided to consider a MMMP portion with at least 90 kcal based on the estimated average requirement (EAR) of energy for the age group of 6-8 months and the average amount of breast milk consumption in this age group (both according to the WHO),¹⁶ as well as the maximum number of MMMPs recommended for this period (two meals).^{7,8} Therefore, one portion of 90 Kcal would be indicated for a six-month-old child and two portions from the seventh month of life onwards.

The MMMPs presented in jars contained less than one portion of food as calculated, making it necessary to consume a unit and a half of the jars to ingest one portion. However, it is noteworthy that the main mixtures elaborated were planned and calculated for children who are still being breastfed, as they were designed to cover part of the nutritional needs, with the remainder being offered through breast milk.⁸

The composition of breast milk is adequate for the nutritional needs of infants in the first six months and remains an important source in the second year of life.²⁶ At this age, 500 mL, corresponding to two cups of breast milk, provide 95% of the infant's vitamin C needs, 45% vitamin A, 38% protein and 31% total energy.²⁷

It is necessary to consume varied foods and food groups in order to have an adequate food plan, as nutrients and bioactive compounds are found in foods in different amounts.²⁶ The Food Guide for the Brazilian Population (*Guia Alimentar para a População Brasileira*) is a document with assumptions and guidelines to encourage adequate and healthy food choices,²⁸ which presents foods by caloric equivalents according to the children's food pyramid for the age group 6-23 months, only taking into account the calories of the food groups, and thus not including the composition of micronutrients. Differently, *TACO*¹⁴ presents the detailed nutritional composition of the most consumed foods in Brazil. The data provided come from careful laboratory analyses.

In this study, it is observed that the formulations cover an important portion of the macronutrient and micronutrient recommendations, considering that the rest of the needs must be supplemented through ingesting breast milk on demand and the other two recommended fruit-based meals for complementary feeding.^{7,8}

A study by Carvalho et al.²⁹ aimed to conduct a systematic review of studies addressing food consumption and nutritional adequacy in Brazilian children. Of the studies found that evaluated children's energy intake, four had high energy consumption, and three had low energy consumption. Thus, the authors concluded that children's food intake in Brazil is characterized by inadequate consumption of micronutrients, as well as excess energy related to the low quality of the food plan of these children, early weaning from breast milk, inadequate complementary feeding and excess consumption of processed foods.

In a study carried out with the purpose of knowing the adequacy of energy consumption and macronutrients in the diets of children under six years of age in the urban area of Pelotas, Rio Grande do Sul, Brazil, Bonotto et al.³⁰ obtained results that children in this age group aged equal to or less than six months had caloric intake below the recommended level. These results were similar to those found in a study carried out by Menezes & Osório³¹ in the state of Pernambuco, with 948 children aged less than five years, in which children aged 0-6 months showed a 49.0% predominance of energy deficiencies.

Foods are classified for energy density as: very low (0-0.7 kcal/g); low (0.7-1.5 kcal/g); medium (1.5-4 kcal/g); and high (4-9 kcal/g).³² Thus, according to the analysis carried out by the Food Guide for Children Under Two Years of Age,¹⁶ the preparations have low energy density, while by *TACO*¹⁴ they present medium energy density. This difference in results can be attributed to the fact that the two references used for comparison in this study present different methodological principles, considering that the Food Guide for Children Under Two Years of age¹⁶ performs an analysis by portion of the food groups, using it as a reference to assess the caloric value of foods; this is a different table from the Food Composition Table on which *TACO* is based,¹⁴ given that it evaluates foods per 100g.

Thus, the importance of this study is highlighted in aiming to develop alternative formulations to industrialized ones; without preservatives; with regional foods with adequate energy density; supplying an important portion of the micronutrient and macronutrient requirements recommended for the age group of 6-8 months; with presentation in layers and texture according to healthy recommendations for the intake of food groups and nutrients.

In view of the importance of introducing food, as well as its impacts on adult life, this study can provide support for families who will start complementary infant feeding, and it can contribute to science with the development of more studies in this research area. It is noteworthy that further studies are essential to develop and expand the area of MMMP studies for children who are not breastfeeding.

CONCLUSION

Multiple-mixture main porridges made with regional foods contain all food groups recommended for children aged 6-8 months and are available in the consistency and presentation form recommended by regulatory bodies.

The preparations are nutritionally adequate as complementary foods, covering the recommendations for children in the analyzed age group and meeting the recommended needs by both the Food Guide for Children Under Two Years of Age and by *TACO*. The formulations cover an important part of the micronutrient recommendations, with the rest of the needs being complemented by ingesting breast milk.

The analyzed formulations were characterized as low density by the Food Guide for Children Under Two Years of Age, and medium energy density by *TACO*. It should be noted that only one jar of the BBCP and FBBC preparations does not provide a complete portion, unlike the CBPR formulation which provides a complete portion in a single jar.

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REFERENCES

1. World Health Organization - WHO. Guidance on ending the inappropriate promotion of foods for infants and young children: implementation manual. Geneva, 2017.
2. Brasil. Ministério da Saúde. Secretaria de Atenção à Saúde. Departamento de Atenção Básica. Dez passos para uma alimentação saudável: guia alimentar para crianças menores de dois anos: um guia para o profissional da saúde na atenção básica. 2ª ed. Brasília: Ministério da Saúde, 2013.
3. Scarpatto CH, Forte GC. Introdução convencional versus introdução com BLW. *Clin Biomed Res*. 2018;38(3):292-296. <https://doi.org/10.4322/2357-9730.83278>.
4. Sociedade Brasileira de Pediatria. Guia prático de atualização: a alimentação complementar e o método BLW (Baby Led Weaning). Departamento Científico de Nutrologia, Rio de Janeiro, RJ: SBP, 2017.
5. Gomez MS, Novaes APT, Silva JP, Guerra LM, Possobon RF. Baby-Led Weaning, panorama da nova abordagem sobre introdução alimentar: revisão integrativa de literatura. *Rev Paul Pediatr*. 2020; 38:1-7. <https://doi.org/10.1590/1984-0462/2020/38/2018084>.
6. Sociedade Brasileira de Pediatria. Manual de orientação para a alimentação do lactente, do pré-escolar, do escolar, do adolescente e na escola/Sociedade Brasileira de Pediatria. Departamento de Nutrologia, 3ª. ed. Rio de Janeiro, RJ: SBP, 2012.
7. Sociedade Brasileira de Pediatria. Manual de Alimentação: orientações para alimentação do lactente ao adolescente, na escola, na gestante, na prevenção de doenças e segurança alimentar / Sociedade Brasileira de Pediatria. Departamento Científico de Nutrologia. 4ª. ed., São Paulo: SBP, 2018.
8. Brasil. Ministério da Saúde. Secretaria Primária de Atenção à Saúde. Departamento de Promoção da Saúde. Guia alimentar para crianças brasileiras menores de dois anos. Brasília: Ministério da Saúde, 2019.
9. Balem TA, Alves EO, Coelho JC, Mello ALP. As transformações alimentares na sociedade moderna: a colonização do alimento natural pelo alimento industrial. *Revista Espacios*. 2017;38(47):1-13.
10. Silva JCP, Pereira Netto M. Papinhas industrializadas na introdução alimentar de lactentes e suas características. *Nutrição Brasil*. 2018;17(2):127-135. <https://doi.org/10.33233/nb.v17i2.1072>.

11. Bielemann RM, Motta JVS, Minten GC, Horta BL, Gigante DP. Consumo de alimentos ultraprocessados e impacto na dieta de adultos jovens. *Rev Saúde Públ.* 2015;49(28): 1-10. <https://doi.org/10.1590/S0034-8910.2015049005572>.
12. Monteiro CA, Cannon G, Levy RB, Moubarac JC, Louzada MLC, Rauber F et al. Ultra-processed foods: what they are and how to identify them. *Public Health Nutr.* 2019;1-6. <https://doi.org/10.1017/S1368980018003762>.
13. Rossetti FX, Winnie LWY, Silva MV. O Programa Nacional de Alimentação Escolar (PNAE) e o desafio da aquisição de alimentos regionais e saudáveis. *Segurança Alimentar e Nutricional.* 2016;23(2):912-923. <https://doi.org/10.20396/san.v23i2.8647528>.
14. Universidade Estadual de Campinas - UNICAMP. Tabela brasileira de composição de alimentos - TACO. 4. ed. rev. e ampl. Campinas: UNICAMP/NEPA, 2011.
15. National academies of sciences, engineering, and medicine. *Dietary Reference Intakes for sodium and potassium.* Washington (DC): The National Academies Press, 2019. <https://doi.org/10.17226/25353>.
16. Brasil. Ministério da Saúde. Organização Pan-Americana da Saúde. Guia alimentar para crianças menores de 2 anos. Brasília: Editora do Ministério da Saúde, 2005.
17. World Health Organization - WHO. *Complementary feeding of young children in developing countries: a review of current scientific knowledge.* Geneva: WHO, 1998a.
18. Brasil. Ministério da Saúde. Agência Nacional de Vigilância Sanitária – ANVISA. Resolução – RDC N° 216, de 15 de setembro de 2004. Aprova Regulamento Técnico de Boas Práticas para Serviços de Alimentação. *Diário Oficial da União.* 15 de set de 2004.
19. Fewtrell M, Bronsky J, Campoy C, Domello FM, Embleton N, Mis NF, Hojsak I, et al. Complementary feeding: A position paper by the European Society for Pediatric Gastroenterology, Hepatology, and Nutrition (ESPGHAN) Committee on Nutrition. *J Pediatr Gastroenterol Nutr.* 2017;64(1):119-132. <https://doi.org/10.1097/MPG.0000000000001454>.
20. Cameron SL, Taylor RW, Heath ALM. Development and pilot testing of Baby-Led Introduction to Solids - a version of Baby-Led Weaning modified to address concerns about iron deficiency, growth faltering and choking. *BMC Pediatrics.* 2015;15(99):1-11. <https://doi.org/10.1186/s12887-015-0422-8>.
21. Arantes ALA, Neves FS, Campos AAL, Pereira Netto M. Método Baby-Led Weaning (BLW) no contexto da alimentação complementar: uma revisão. *Rev Paul Pediatr.* 2018;36(3): 353-363. <https://doi.org/10.1590/1984-0462/2018;36;3;00001>.
22. Kleinman RE. American Academy of Pediatrics recommendations for complementary feeding. *Pediatrics.* 2000;106(5):1274.
23. World Health Organization - WHO. *Complementary feeding: Report of the global consultation Summary of guiding principles.* Geneva, 2002.
24. Brasil. Procuradoria-Geral da República. Secretaria de Serviços Integrados de Saúde. Guia prático da alimentação complementar. Brasília: MPF, 2016.
25. Nestlé Brasil Ltda. Nestlé NaturNes® Papinha sabor Carne com Legumes[Acesso em 23 de fev de 2021]. Disponível em: <<https://www.nestle.com.br/marcas/nestle-naturnes/naturnes-6-legumes-carne>>.
26. Brasil. Ministério da Saúde. Secretaria de Atenção à Saúde. Departamento de Atenção Básica. *Saúde da criança: aleitamento materno e alimentação complementar.* 2. ed. Brasília: Ministério da Saúde, 2015.
27. World Health Organization - WHO. Collaborative study team on the role of breastfeeding on the prevention of infant mortality: effect of breastfeeding on infant and child mortality due to infectious diseases in less developed countries: a pooled analysis. *Lancet.* 2000;355(9202):451-455.
28. Pereira M.D, Sousa APM, Sousa JG, Perricone PMB, Carvalho CMRG, Santos MM. Análise comparativa dos guias alimentares para a população brasileira e argentina. *Saúde e Pesqui.* 2019;12(3):563-572. <https://doi.org/10.17765/2176-9206.2019v12n3p563-572>.
29. Carvalho CA, Fonsêca PCA, Priore SE, Franceschini SCC, Novaes JF. Consumo alimentar e adequação nutricional em crianças brasileiras: revisão sistemática. *Rev Paul Pediatr.* 2015;33(2): 211-221. <https://doi.org/10.1016/j.rpped.2015.03.002>.

30. Bonotto GM, Schneide BC, Santos IS, Gigante DP, Assunção MCF. Adequação do consumo energético e de macronutrientes de crianças menores de seis anos. *Rev Paul Pediatr.* 2012;30(4): 513-519. <https://doi.org/10.1590/S0103-05822012000400009>.
31. Menezes RCE, Osório MM. Consumo energético-proteico e estado nutricional de crianças menores de cinco anos, no estado de Pernambuco, Brasil. *Rev Nutr.* 2007;20 (4):337-347. <https://doi.org/10.1590/S1415-52732007000400001>.
32. Can eating fruits and vegetables help people to manage their weight? – CDC. Research to Practice Series, No. 1, 2005. [acesso em 12 de abril 2021]. Disponível em: <https://www.cdc.gov/nccdphp/dnpa/nutrition/pdf/rtp_practitioner_10_07.pdf>.

Contributors

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