Development of Artisanal Supplements, Analysis and Comparison with Industrial Supplements for Cancer Patients with Cachexia

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Desenvolvimento de Suplementos Artesanais, Análise e Comparação com Suplementos Industriais para Pacientes em Estado de Caquexia do Câncer

Desarrollo de Suplementos Artesanales, Análisis y Comparación con Suplementos Industriales para Pacientes con Caquexia por Cáncer

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ABSTRACT

Introduction: A clinical outcome that can affect approximately 80% of cancer patients is cachexia, a condition characterized by loss of muscle mass or weight, anorexia and loss or decrease of physical strength. A strategy to preserve the oral feeding pathway is nutritional supplementation. **Objective:** To elaborate artisanal oral nutritional supplements whose macronutrients are similar to industrialized and compare the nutritional composition and economic aspects of the formulations proposed with industrial supplements. **Method:** The nutritional composition was calculated from the technical data sheets, supported by the table of chemical composition of foods from "*Escola Paulista de Medicina*" and the Brazilian Table of Food Composition. The average price of industrial supplements was referred to December 2022 through the Google Shopping tool. The ingredients used in artisanal supplements were purchased in Piracicaba, SP. **Results:** Five artisanal formulations were developed, comparable to industrial formulations in caloric, energy and protein density. Predominantly, all of them use dairy as source of protein and oleic monounsaturated fatty acid as lipid source. Homemade supplements prioritize carbohydrates naturally contained in food. **Conclusion:** Homemade food supplements are economically viable alternatives with similar macronutrient profile of industrial ones.

Key words: neoplasms; cachexia; dietary supplements; nutrition therapy.

RESUMEN

Introducción: Un resultado clínico que puede afectar aproximadamente al 80% de los pacientes con cáncer es la caquexia, una condición caracterizada por la pérdida de masa muscular o peso, anorexia y la pérdida o disminución de la fuerza física. Una estrategia para preservar la vía de alimentación oral es la suplementación nutricional. **Objetivo:** Elaborar suplementos nutricionales orales artesanales cuyos macronutrientes sean similares a los industrializados y comparar las formulaciones propuestas con los suplementos industriales en relación a la composición nutricional y aspectos económicos. **Método:** La composición nutricional se calculó a partir de las fichas técnicas, con la ayuda de la tabla de composición química de los alimentos de la Escuela Paulista de Medicina y la Tabla Brasileña de Composición de Alimentos. El precio promedio de los suplementos industriales se calculó con base en los valores cobrados en diciembre de 2022, consultados en la herramienta *Google Shopping*. Los ingredientes utilizados en los suplementos artesanales fueron adquiridos en Piracicaba-SP. **Resultados:** Se desarrollaron cinco formulaciones artesanales comparables a las formulaciones industriales en densidad calórica, energética y proteica. Todas utilizan predominantemente productos lácteos como fuente de proteínas y ácidos grasos monoinsaturados oleicos como fuente de lípidos. Los suplementos caseros priorizan los carbohidratos contenidos naturalmente en los alimentos. **Conclusión:** Los complementos alimenticios caseros son alternativas económicamente viables con un perfil macronutricional similar a los industriales.

Palabras clave: neoplasias; caquexia; suplementos dietéticos; terapia nutricional.

RESUMO

Introdução: Um desfecho clínico que pode afetar cerca de 80% dos pacientes com câncer é a caquexia, condição caracterizada pela perda de massa muscular ou de peso, anorexia e perda ou diminuição da força física. Uma estratégia para preservar a via de alimentação oral é a suplementação nutricional. **Objetivo:** Elaborar suplementos nutricionais artesanais orais cujos macronutrientes sejam similares aos industrializados e comparar as formulações propostas com suplementos industriais em relação à composição nutricional e aos aspectos econômicos. **Método:** A composição nutricional foi calculada a partir das fichas técnicas, com auxílio da tabela de composição química dos alimentos da Escola Paulista de Medicina e da Tabela Brasileira de Composição de Alimentos. O preço médio dos suplementos industriais foi calculado com base nos valores praticados no mês de dezembro de 2022, consultados na ferramenta *Google Shopping*. Os ingredientes usados nos suplementos artesanais foram adquiridos em Piracicaba, SP. **Resultados:** Foram desenvolvidas cinco formulações artesanais comparáveis às formulações industriais em densidade calórica, energética e proteica. Todas utilizam predominantemente lácteos como fonte de proteína e ácido graxo monoinsaturado oleico como fonte lipídica. Os suplementos caseiros priorizam carboidratos naturalmente contidos nos alimentos. **Conclusão:** Os suplementos alimentares artesanais são alternativas economicamente viáveis e de perfil macronutricional similar aos industriais.

Palavras-chave: neoplasias; caquexia; suplementos nutricionais; terapia nutricional.

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INTRODUCTION

The National Cancer Institute (INCA) defines cancer as a general name given to a set that encompasses more than 100 diseases, with characteristics of disordered cell growth, which tend to invade neighboring tissues andorgans[1]. In Brazil, for each year of the 2023-2025 triennium, the occurrence of 704,000 cases of cancer was estimated; excluding non-melanoma skin cancer, there will be 483,000 new cases[2]. Sung et al.[3] point out that, in 2040, there will be 28.4 million people with cancer, an increase of approximately 47% compared to 2020 – being more expressive in countries with a Human Development Index considered low or medium.

In addition to the altered metabolism due to cancer, one of the clinical outcomes that can affect about 80% of patients is cachexia, pointed out as the main cause of death for 22% to 30% of cancer patients[4,5]. Cachexia is a complex clinical condition with an impact on the morbidity and mortality outcomes of patients[6], a multifactorial syndrome that leads to continuous loss of skeletal muscle mass, and there may or may not be loss of fat mass. Conventional nutritional support does not completely reverse it, factors that lead to progressive functional impairment[7].

Although nutritional support is limited – with regard to the restoration of the cachectic condition –, nutritional intervention is important and involves strategies of dietary counseling and oral nutritional supplementation[8].

The role of oral nutritional supplements aims especially to prevent the cachectic condition, in which, in addition to loss of muscle mass, there is also anorexia and loss/decrease in physicalstrength[9,10]. Its pathophysiology is characterized by negative protein and energy balance driven by reduced food intake and abnormal metabolism[7].

The use of oral nutritional supplements in cancer patients is a strategy widely recommended by the main national and international oncology nutrition guidelines[10]. In previous studies, artisanal food supplements (SAA) or industrialized supplements (IS) were options for cancer patients in order to assist in the recovery of nutritional status[11,12].

Cachexia is a determining factor for worsening health status, and many patients may have difficulty adapting to the use of formulas for both financial and taste reasons. In this context, this study seeks to develop lower-cost formulations based on foods commonly consumed by the Brazilian population. The standardization of the preparation of SAAs and the definition of the macronutritional composition are relevant aspects, since they allow the reproducibility and diffusion of these practices in nutritional interventions in both home and hospital environments.

To preserve the physiological feeding pathway, there is a need to employ nutritional strategies to assist in food intake[13]. Whenever this intake is not met, the nutritionist or physician should institute oral nutritional supplementation[14]. For this, industrial or artisanal formulas can be used to prevent cachexia and preserve oral feeding, being alternatives to supply energy, protein and other nutrients[4,7].

This article aims to elaborate on oral AAS, whose macronutrients are similar to industrialized ones, and compare the proposed formulations with IS in relation to nutritional composition and economic aspects.

METHOD

In December 2022, a digital search was conducted for products marketed by five laboratories that produce and distribute formulas for oral nutritional therapy, namely: Abbott[15], Danone[16], Fresenius[17], Nestlé[18] and Prodiet[19]. The product portfolio is available through the *websites* of the respective manufacturers, where you can have access to the technical data sheet and other nutritional information of the formulations produced.

As inclusion criteria, the presentation must be in liquid form, ready for consumption and developed for oral nutritional therapy. For the list of ingredients criterion, the vanilla flavor was selected because it is widely available in the brands consulted, allowing evenness for comparison. For caloric density, the formulas are presented simultaneously as hypercaloric and hyperproteic.

Products for enteral and parenteral diet and formulations: pediatric, powder, pudding, isocaloric and hyperlipidic were excluded from the search.

The price research was carried out in order to compare SI – whose price survey was carried out in December 2022 by the *Google Shopping20* tool – and SAA – in which the acquisition cost of the ingredients used was taken into account.

When considering the information collected, the development of SAA formulations was then conducted. The creation of these preparations was intended to offer economic advantage and equivalence without the addition of ultra-processed foods. To calculate the weight and yield of the formulations, a Starigh® precision digital scale with a sensitivity of 1 to 5,000 g and a polypropylene volumetric beaker with a subdivision of 2 mL and a capacity of up to 250 mL were used. Macronutritional values were calculated using the food chemical composition table of the Escola Paulista de Medicina[21] and the Brazilian Food Composition Table[22].

To reproduce the homemade formulations described in this study, Table 1 details the ingredients, measures

and form of preparation. The criterion for the selection of ingredients was *fresh* or minimally processed foods. At the end of the preparation, there was a visual inspection to verify the presence of lumps, color and consistency. The preparations described are for immediate consumption. For conversion into homemade measures, the table of measures referred to for foods consumed in Brazil was adopted[23].

To calculate the cost of handmade formulations, it was considered exclusively the acquisition of ingredients in a supermarket located in Piracicaba-SP, after price quotation in three locations in December/2022.

As it does not involve human beings directly or indirectly and the data used are publicly available, according to Resolution nº. 466 of 2012 of the National Health Council24, it was not necessary to submit the project to the appreciation of an Ethics Committee in Research with human beings.

RESULTS

The analysis of the data available on the manufacturers' *websites* allowed the identification of 40 IS. After evaluation, seven formulations met the proposed methodological criteria and are characterized in Table 1, with hypercaloric supplements defined by energy density greater than 1.2 kcal/mL and the hyperproteic characteristic with at least 20% protein of the total energy value[25].

Based on the methodological criteria, SAAs were developed in order to present similar characteristics regarding the nutritional aspect. To this end, five formulations described in Table 1 were developed. The foods selected to compose the SAA were: *fresh* or dehydrated pulp or fruit, sugar, corn starch, oats, cornmeal, canola oil, olive oil and peanut paste, fluid and powdered milk, cooked egg whites and yolks, soybean extract powder and cocoa powder.

Table 2 shows the energy density, the macronutritional distribution in grams, the percentage of SAA and the cost of the ingredients of each formulation. Regarding caloric density, the SI ranged from 1.25 to 2.4 kcal/mL, averaging 1.6 kcal/mL and 160 kcal per 100 mL. The mean SAA was 1.68 kcal/mL, ranging from 1.5 to 1.8 kcal/mL. When comparing them, the SAA are higher energetically at 0.08 kcal/mL, thus both they and the SI are considered hypercaloric formulations.

Regarding the price (Tables 1 and 2), the IS packages were presented in individual portions, with the lowest price being R$10.79 and the highest being R$34.71 – unit average of R$14.77 and R$23.08, respectively. As for the SAA, the cost of the ingredients used varies from R$2.51 to R$5.61, with an average value of R$3.91. When comparing them, the price paid by the industrialized was at least 3.8 times higher than the cost of elaborating the handicraft.

Table 2 refers to the list of SI ingredients. It is noted the presence of vitamins and minerals and also the presence of food additives, such as thickeners, emulsifiers and flavorings.

It can be seen from the list of ingredients that the lipid source of SI is based on vegetable oils: canola, sunflower,

Table 1. Characteristics of industrial supplements

Product	Abbott Ensure® Plus Advance (AEPA) 220 mL	Abbott Ensure® Protein (AEP) 220 mL	Danone Cubitan® (DC) 200 mL	Danone Nutridrink® Compact Protein (DNCP) 125 mL	Danone Nutridrink® Protein (DNP) 200 mL	Fresenius-Kabi Fresubin® (FF) 2 kcal Drink 200 mL	Nestlé Novasource® Proline (NNP) 200 mL
Energy density (kcal/mL)	1.50	1.25	1.28	2.40	1.50	2.00	1.37
Caloric distribution	24% PTO 29% LIP 46% CHO	25% PTO 24% LIP 51% CHO	30% PTO 25% LIP 45% CHO	24% PTO 35,3% LIP 40,7% CHO	24,5% PTO 31% LIP 44,5% CHO	20% PTO 35% LIP 45% CHO	29% PTO 24% LIP 47% CHO
Calorie kcal/100 mL	150	125	128	240	150	200	137
Protein g/100 mL	9,00	7.90	10.0	14.0	9.20	10.0	10.0
Price Range (BRL)	19.99 to 29.61	10.79 to 24.27	18.90 to 25.00	13.75 to 14.99	13.89 to 15.99	10.90 to 17.00	15.18 to 34.71

Captions: PTO = protein; LIP = lipid; Cho = carbohydrate.

Chart 1. Ingredients and method of preparation of handmade foodsupplements[21]

Ingredients	Home cooking measurements	Weight (g)	Step-by-step Instructions
Formulation 1			
Acai, frozen pulp[22]	1 unit	100	Blend the ingredients in a blender until homogenized Ingest next
Water	1/3 cup	50	
Skimmed milk powder	5 tablespoons	50	
Canola oil	1 teaspoon	5	
Sanding Sugar	1 teaspoon	5	
Formulation 2			
Semi-Skimmed Milk	1 cup	196	Mix in a saucepan milk, starch, cocoa and sugar Thicken over mild fire Beat the cream in the blender with the other ingredients Ingest next
Corn starch	1 tablespoon	9	
Cocoa powder	1 spoon (dessert)	5	
Sanding Sugar	1 spoon (dessert)	7	
Skimmed milk powder	3 tablespoons	30	
Canola oil	2 teaspoons	10	
Formulation 3			
Water	1/2 cup	75	Mix in a saucepan water, egg white, soy extract, oats and sugar Thicken over mild fire Beat the cream with the peanut butter in the blender Ingest next
Soybean, soluble extract, powder[22]	1 tablespoon	12	
Fine rolled oats	1 tablespoon	20	
Sanding Sugar	1 tablespoon	12	
Peanut butter	1 spoon (dessert)	10	
Egg white	1 unit	33	
Formulation 4			
Water	1/2 cup	75	Blend the ingredients in a blender until homogenized Ingest next
Dehydrated pitted plum	2 units	19	
Papaya papaya mashed pulp	1/2 cup (tea)	90	
Skimmed milk powder	5 tablespoons	50	
Canola oil	2 teaspoons	10	
Formulationn 5			
Water	1/2 cup	75	Mix the ingredients in a saucepan Cooking over low heat Ingest next
Semi-Skimmed Milk	1/3 cup (tea)	75	
Cornmeal[22]	2 tablespoons	24	
Egg yolk	1 unit	17	
Olive oil	1 teaspoon	5	
Skimmed milk powder	3 tablespoons	30	
Salt	1 Sachet	1	

Note: Thenutritional values set out in total in Table 1 were consulted at the Paulista School of Medicine: Federal University of São Paulo[21], except[22] which appears in the Brazilian Table of Food Composition.

corn and soybean. SAA was formulated with canola oil, peanut butter, and olive oil.

Evaluating the source of lipids, both SI and SAA are considered normolipids, containing on average 29% and 30%, respectively, of this macronutrient, in addition to favoring oils with oleic monounsaturated fatty acid content. In all SI and SAA formulations, the lipid content does not exceed that of carbohydrate. The macronutrient distribution reference *Dietary Reference Intakes* (DRI)[26] recommends that total fats be between 20%-35% of the percentage of total energy.

The analysis of the protein source of IS comes from dairy products: casein, caseinate and wheyprotein[27]. Three of the supplements analyzed contain exclusively dairy

Table 2. Macronutritional characteristics of artisanal food supplements and cost of ingredients

	Formulations				
	1	2	3	4	5
Total energy (kcal)	307.90	389.40	262.40	363.30	347
Yield (mL)	192	208	172	208	188
Caloric density (kcal/100 mL)	1.60	1.80	1.50	1.70	1.80
Protein (Total)	18,88	19.59	13.48	18.91	18.23
Protein (g/100 mL)	9.90	9.40	7.80	9	9.70
Protein %	25	20	21	21	21
AVB protein (g/yield)	18,10	18,60	3.60	18.08	13.55
Total lipid (g)	9.29	14,80	9,66	10.69	11.68
Lipid %	27	34	33	26	30
Total Carbohydrate (g)	37.19	44.46	30.39	47.87	42.24
Carbohydrate %	48	46	46	53	49
Addition sucrose (g/100 mL)	2.62	3.35	8.10	0	0
Cost of ingredients (R$)	5,61	3.02	2.51	5.30	3,11

Caption: AVB = high biological value.

protein source. Another four have a source of soybean vegetable protein, one of them in association with pea protein.

Fluid milk and milk powder were selected as the protein source of the homemade formulations, which also occurs in SI – respectively, one based on food and the other on modular proteins. In formulation 3, boiled egg white and powdered soy extract were adopted.

Regarding the protein percentage, the AAS present, in the comparison between the means, 1.6% more than the IS – the weight content for each 100 mL is 9.16 g and 10 g, respectively, both considered hyperproteic[25]. SAA have, on average, 14.39 g of high biological value protein in their total content. The DNCP formula has 14 g/100 mL.

Regarding the distribution of protein in SI, there is a variation of 20%-30%, with an average of 25.2%; its weight ranges from 7.9 to 14 g presenting an average of 10 g/100 mL.

From the perspective of analyzing the carbohydrate content, the list of ingredients in Table 2 allows us to observe the presence of sucrose, commonly known as table sugar, present in six of the seven SI analyzed – in only one of them with the name of sugar itself. It is worth noting that the following are considered added sugars: sucrose, glucose, lactose, fructose, dextrose, invert sugar, syrups, maltodextrins, among others[28].

The distribution of carbohydrates in SI is in the range of 40.70%-51%, with an average value of 45.6%, and the distribution of SAA is 48.3% on average, with a variation of 46%-53%.

As for the added sugar content – as shown in Table 3 – SAA have an average of 15.1% and SI on average 30.9%. Thus, SAAs contain 48.9% less addition sugar than SI, with formulations 4 and 5 being without addition. This is a relevant aspect, since homemade formulations prioritized carbohydrates naturally contained in food.

DISCUSSION

Oral dietary supplements are important forms of energy and protein intake for patients with cancer cachexia. Patients who can eat should be instructed on protein intake, fractionation of meals throughout the day and, if necessary, use nutritional supplements – this dietary advice aims to improve energy intake and promote weight gain[29].

The criterion for the indication of supplementation in nutritional therapy for such patients, according to the Oncological Nutrition Consensus10, recommends that oral supplements should be the first option when food intake is <75% of the recommendations within five days, with no expectation of improvement in intake; if oral intake is <60% of the recommendations, tube feeding should be initiated, not discussed in this study.

From the results of the present study, we highlight the selection of ingredients to compose the SAA aiming at the enrichment of the preparations and acting as energy and protein additives, with the purpose of improving oral intake[30]. The use of *fresh*, minimally processed foods was prioritized – without the addition of food additives and/or nutrient modules, given the proposal not to contain ultra-processed foods. The Ministry of Health[31] defines ultra-processed products as industrial formulations made entirely or mostly of substances extracted from food,

Chart 2. Ingredient list of industrialized supplements

Product	Ingredient Checklist
AEPA	Water, corn syrup, Na caseinate, sucrose, canola oil, sunflower oil, milk protein isolate, minerals, corn oil, soy protein isolate, vitamins, dextrose, maltodextrin, sunflower oil, emulsifiers (soy lecithin, sodium carboxymethylcellulose, microcrystalline cellulose), flavorings, acidity regulators and gellan gum thickener
AEP	Water, sucrose, maltodextrin, Na caseinate, protein isolated from milk, soy protein isolate, Ca caseinate, highly oleic sunflower oil, canola oil, soybean oil, potassium citrate, Na citrate, magnesium chloride, Ca carbonate, Ca phosphate, choline chloride, potassium chloride, l-ascorbic acid, dextrose, ferrous sulfate, corn or sunflower oil, dl-alpha-tocopheryl acetate, zinc sulfate, niacinamide, Ca d-pantothenate, manganese sulfate, thiamine chloride hydrochloride, pyridoxine hydrochloride, cupric sulfate, retinyl palmitate, riboflavin, n-pteroyl-l-glutamic acid, potassium iodide, Na molybdate, chromium chloride, Na selenate, phylloquinone, d-biotin, cholecalciferol, cyanocobalamin, Na chloride, potassium phosphate, stabilizers: microcrystalline cellulose, sodium carboxymethylcellulose and gellan gum, flavoring, emulsifier: soy lecithin, acidity regulators: potassium hydroxide and citric acid
DNCP	Water, casein, maltodextrin, sugar, vegetable oils (canola oil and sunflower oil), caseinate, magnesium phosphate, choline chloride, vitamin C, potassium citrate, potassium phosphate, ferrous lactate, vitamin E, vitamin A, copper gluconate, zinc sulfate, manganese sulfate, pantothenic acid, Na selenite, biotin, chromium chloride, vitamin D, vitamin B1, folic acid, vitamin B6, niacin, vitamin B12, vitamin K, emulsifier: soy lecithin, flavoring and natural curcumin coloring
FF	Water, glucose syrup, Ca caseinate, sunflower oil, milk protein, sucrose, canola oil. maltodextrin, tripotassium citrate, choline hydrogen tartrate, potassium carbonate, Na chloride, Na carbonate, magnesium oxide, l-ascorbic acid, iron pyrophosphate, nicotinamide, zinc sulfate, manganese chloride, Ca d-pantothenate, dl- α-tocopheryl acetate, copper sulfate, riboflavin-5′-phosphate Na, thiamide hydrochloride, beta-carotene, retinyl palmitate, n-pteroyl-l-glutamic acid, chromium chloride, Na molybdate, potassium iodide, Na selenite, phytomenadione, d-biotin, cholecalciferol, cyanocobalamin. natural vanilla-like aroma, emulsifiers: fatty acid monoglycerides and soy lecithin, and acidity regulator: hydrochloric acid
DC	Milk protein concentrate, water, maltodextrin, sucrose, vegetable oils (canola and sunflower), l-arginine, Na l-ascorbate, mixture of carotenoids (β-carotene, α-carotene, lycopene, lutein, γ-carotene, zeaxanthin), magnesium hydrogen phosphate, choline chloride, dipotassium hydrogen phosphate, dl-α-tocopherol, potassium citrate, magnesium hydroxide, ferrous lactate, potassium chloride, zinc sulfate, potassium hydroxide, Na selenite, copper gluconate, manganese (II) sulfate, Na chloride, nicotinamide, retinyl acetate, n-pteroyl-l-glutamic acid, Ca d-pantothenate, pyridoxine hydrochloride, chromium (III) chloride, riboflavin, d-biotin, cholecalciferol, thiamine chloride hydrochloride, Na molybdate, Na fluoride, potassium iodide, phytomenadione, cyanocobalamin, acidity regulator: citric acid, flavoring and emulsifying: soy lecithin
DNP	Milk protein, water, maltodextrin, vegetable oils (canola and sunflower), sucrose, soy protein isolate, pea protein isolate, potassium citrate, potassium hydroxide, Ca chloride, magnesium hydroxide, Na l-ascorbate, dl-α-tocopheryl acetate, ferrous lactate, nicotinamide, zinc sulfate, retinyl acetate, cholecalciferol, Na selenite, manganese sulfate, copper gluconate, Ca d-pantothenate, d-biotin, pyridoxine hydrochloride, thiamine chloride hydrochloride, n-pteroyl-l-glutamic acid, potassium iodide, chromium chloride, Na fluoride, riboflavin, phytomenadione, flavoring, acidity regulator: citric acid and turmeric dye
NNP	Water, maltodextrin, tapioca starch, glucose syrup, Ca caseinate, soy protein isolate, concentrated whey protein, low erucic canola oil, l-arginine, soy oil, l-proline, vitamins (Na l-ascorbate, choline bitartrate, dl-α-tocopheryl acetate, nicotinamide, Ca d-pantothenate, pyridoxine hydrochloride, thiamine hydrochloride, riboflavin, retinyl acetate, n-pteroyl-l-glutamic acid, phylloquinone, d-biotin, cyanocobalamin, and cholecalciferol), minerals (magnesium salts of citric acid, Na chloride, dibasic Ca phosphate, tribasic Ca phosphate, monobasic potassium phosphate, zinc oxide, ferrous sulfate, manganese sulfate, copper sulfate, Na selenite, potassium iodide, chromium chloride, and Na molybdate), stabilizers: potassium citrate, microcrystalline cellulose, carrageenan, and sodium carboxymethylcellulose, regulator of acidity: citric acid, flavorings, emulsifier: lecithin soybean, sweetenants: sucralose and potassium accessorylum sulfate, and polysiloxane antimethylsidane

Captions: AEPA = Abbott Ensure® Plus Advance; AEP = Abbott Ensure® Protein; DC = Danone Cubitan®; DNCP = Danone Nutridrink® Compact Protein; DNP = Danone Nutridrink® Protein; FF = Fresenius-Kabi Fresubin®; NNP = Nestlé Novasource® Proline; Na = Sodium; Ca = Calcium.

Table 3. Identification of the carbohydrate source of industrial and artisanal supplements

Industrial supplements		Handmade food supplements	
Product	**Carbohydrate source**	**Formulation**	**Carbohydrate source**
AEP	60% sucrose, 40% maltodextrin	**1**	69.9% lactose, 16.7% fruit pulp, 13.4% sucrose
AEPA	62% corn syrup, 33% sucrose, 5% fructo oligosaccharides	**2**	59.3% lactose, 18.5% corn starch, 15.8% sucrose, 6.4% other carbohydrates
DC	53% maltodextrin, 35% sucrose, 12% lactose	**3**	46.1% sucrose, 39.4% oats, 14.5% other carbohydrates
DNCP	50% maltodextrin, 49% sucrose, 1% other carbohydrates	**4**	sucrose free, 54.3% lactose, 45.7% fruit pulp
DNP	56% maltodextrin, 26% sucrose, 18% other carbohydrates	**5**	sucrose free, 46.7% lactose, 44% cornmeal, 9.3% other carbohydrates
FF	85% glucose syrup, 13% sucrose, 2% maltodextrin		-
NNP	39% maltodextrin, 31% tapioca starch, 30% glucose syrup		-

Captions: AEPA = Abbott Ensure® Plus Advance; AEP = Abbott Ensure® Protein; DC = Danone Cubitan®; DNCP = Danone Nutridrink® Compact Protein; DNP = Danone Nutridrink® Protein; FF = Fresenius-Kabi Fresubin®; NNP = Nestlé Novasource® Proline; Na = Sodium; Ca = Calcium.

derived from food constituents or synthesized in the laboratory.

If, on the one hand, ultra-processed ingredients can be bound to SI, on the other hand, SAAs can be prepared without the addition of stabilizers, emulsifiers, defoamers, artificial flavors or nutrient modules.

Regarding lipids, it is noteworthy that, with the use of technologies, there are new types on the market such as high oleic sunflower oil, low erucic canola oil, oils with low or no saturated fat content, with a modification in the lipid profile from w-6 tow-9[32]. These products are available for industrial use and are used in IS, not being an easy option to purchase for use in SAA.

The selection of lipids to compose SAA prioritized canola oil for naturally presenting monounsaturated fatty acid: 58% oleic (w-9) and polyunsaturated fatty acid: 26% linoleic (w-6) and 10% linolenic (w-3)[32]. Olive oil was used for its 77% oleic content[33] and peanut butter for presenting 40% w-9[34], both add desirable organoleptic characteristics to the preparations.

These sources were chosen to compose SAA because, in the population's diet, the consumption of linoleic acid present in corn, sunflower and soybean oils has prevailed. This consumption is unfavorable, especially in situations where there is an exacerbated inflammatory response[35].

When considering the list of ingredients, sugar acts as an energy source and also adds sweetness to the palate. It is important to consider that a sweeter taste can contribute to taste fatigue and early satiety[13]. According to a study by Maniglia et al.[36], sweet foods were perceived with greater intensity by cancer patients. In fact, concentrated sweets can cause flatulence and gastrointestinal discomfort[37].

As for the protein content of the DNCP formula (14 g/100 mL), it is observed that it is difficult for SAA to reach this amount of protein without the use of isolated proteins, concentrates or *whey protein*. As one of the objectives of the study was to develop formulations that did not contain ultra-processed products, such modules were not adopted.

These modular proteins are considered as an alternative to meet individual needs when the patient has a digestive or absorptive disorder, since the proteins contained are presented in elemental or pre-digested forms, thus avoiding discomfort and facilitating the absorption of essential aminoacids[13,14,37].

The handmade formulations seek to meet the energy, protein, and taste demands of the patient with cachexia. There is, however, always a need to consider the uniqueness of each to create such preparations. The creative use of imagination can contribute to achieving the goal, leading to increased oral intake, which may avoid the need for more complex forms of nutritional therapy[8].

In addition, considering the changes in taste and smell that can limit food intake – regardless of the side effects of cancer treatment[4] –, the patient presents important signs and symptoms, such as nausea, vomiting, mucositis, diarrhea or constipation, change in taste and dry mouth; such changes can lead to reduced food intake[38]. Thus, the

formulations developed take this reality into account, and, based on the consensus, seek, as far as possible, to contribute to the reduction of gastrointestinal complaints, considering, above all, that they are palatable to the patient[4,10,29,39].

Thus, the use of frozen pulp, contained in SAA, formulation 1, aims to assist in the issue of nausea; with regard to early satiety, in formulation 3, there are fibers modified through cooking[10]. Formulation 4 was developed in order to have a laxative effect because, in addition to the impact of cancer treatment, constipation has been associated with a low-fiber diet, low hydration, physical immobility, morbidities, and polypharmacy[40].

Formulations 3 and 4 offer 2.1 g and 2.8 g of fiber, respectively, contributing to the daily recommendation of 14 g for every 1,000 kcal ingested[26]. In addition, the World Health Organization (WHO)[41] recommends the intake of at least 400 g (equivalent to 5 servings) of fruits and vegetables per day, a criterion that served as the basis for the development of formulations 1 and 4.

Considering the taste changes and the fact that sugar is an element that contributes to taste fatigue andsatiety13, formulation 5 has a salty taste.

The recommendation is to offer palatable hypercaloric and hyperproteic intake to the patient two to three times a day[6]. In the event that the patient consumes a supplement twice a day, the average weekly expenditure with IS, considering the average of the lowest price, would be R$206.78 and with SAA of R$54.74, therefore, 3.8 times more on account. In the study by Alves et al.[12], AAS were five times cheaper than IS.

In previous studies, both IS and SAA were hyperproteic and hypercaloric, being considered adequate for the recovery of nutritional status[11,12].

Regarding the cost of the SAA, costs with gas, water, cleaning products, electricity and labor were not considered, being a limitation of the study with regard to the economic aspect.

The positive aspects of IS regarding microbiological and bromatological safety and stability14,37 stand out, in addition to the adequate supply of micronutrients.

The advantages of SAAs are individualization of formula and volume, and lower ingredient acquisition cost. As a disadvantage, difficulty in formulating a specialized diet, possible need for micronutrient supplementation, and risk of microbiological contamination are mentioned.

As a limitation of the study, since it is a comparative study based on data, there is a need to perform the sensory evaluation of the proposed supplements together with nutritional evaluation, in order to verify their effects with regard to dietary intervention in patients with cancer cachexia, in addition to evaluating the micronutrient content.

CONCLUSION

SAAs allow modification in flavors, and thus contribute to variability and individualization of the treatment according to the patient's taste. They are economically viable options with a macronutritional profile similar to industrial ones, in addition, they value the palatable aspect and the use of foods familiar to the patient.

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CONTRIBUTION

Priscila Silva Arthur participated in all stages of the construction of the article, from its conception to the approval of the final version to be published.

DECLARATION OF CONFLICT OF INTERESTS

There is no conflict of interest to declare.

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REFERENCES

1. Instituto Nacional de Câncer José Alencar Gomes da Silva. ABC do câncer: abordagens básicas para o controle do câncer [Internet]. 2. ed. rev. atual. Rio de Janeiro: INCA; 2012 [acesso 2022 jan 30]. Disponível em: https://bvsms.saude.gov.br/bvs/publicacoes/inca/abc_do_cancer_2ed.pdf
2. Santos MO, Lima FCS, Martins LFL, et al. Estimativa de incidência de câncer no Brasil, 2023-2025. Rev Bras Cancerol. 2023;69(1):e-213700. doi: https://doi.org/10.32635/2176-9745.RBC.2023v69n1.3700
3. Sung H, Ferlay J, Siegel RL, et al. Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin. 2021;71(3):209-49. doi: https://doi.org/10.3322/caac.21660
4. Fearon KCH, Glass DJ, Guttridge DC. Cancer cachexia: mediators, signaling, and metabolic pathways. Cell Metab. 2012;16(2):153-66. doi: https://doi.org/10.1016/j.cmet.2012.06.011
5. Onesti JK, Guttridge DC. Inflammation based regulation of cancer cachexia. Biomed Res Int. 2014;2014:168407. doi: https://doi.org/10.1155/2014/168407

6. Instituto Nacional de Câncer José Alencar Gomes da Silva. Inquérito luso-brasileiro de nutrição oncológica do idoso: um estudo multicêntrico [Internet]. Rio de Janeiro: INCA; 2015 [acesso 2022 jan 25]. Disponível em: https://www.inca.gov.br/sites/ufu.sti.inca.local/files//media/document//inquerito-lusobrasileiro-de-nutricao-oncologica-completo.pdf
7. Fearon K, Strasser F, Anker SD, et al. Definition and classification of cancer cachexia: an international consensus. Lancet Oncol. 2011;12(5):489-95. doi: https://doi.org/10.1016/S1470-2045(10)70218-7
8. Chao PC, Chuang HJ, Tsao LY, et al. The Malnutrition Universal Screening Tool (MUST) and a nutrition education program for high risk cancer patients: strategies to improve dietary intake in cancer patients. Biomedicine (Taipei). 2015;5(3):17. doi: https://doi.org/10.7603/s40681-015-0017-6
9. Dunne RF, Roussel B, Culakova E, et al. Characterizing cancer cachexia in the geriatric oncology population. J Geriatr Oncol. 2019;10(3):415-9. doi: https://doi.org/10.1016/j.jgo.2018.08.008
10. Instituto Nacional de Câncer José Alencar Gomes da Silva. Consenso nacional de nutrição oncológica. 2. ed. rev. ampl. atual. Vol. 2. Rio de Janeiro: INCA; 2016 [acesso 2022 fev 18]. Disponível em: https://www.inca.gov.br/sites/ufu.sti.inca.local/files/media/document/consenso-nutricao-oncologica-vol-ii-2-ed-2016.pdf
11. Garófolo A, Alves FR, Rezende MAC. Suplementos orais artesanais desenvolvidos para pacientes com câncer: análise descritiva. Rev Nutr. 2010;23(4):523-33. doi: https://doi.org/10.1590/S1415-52732010000400003
12. Alves FR, Garófolo A, Maia PS, et al. Suplemento artesanal oral: uma proposta para recuperação nutricional de crianças e adolescentes com câncer. Rev Nutr. 2010;23(5):731-44. doi: https://doi.org/10.1590/S1415-52732010000500004
13. Maham LK, Escott-Stump S, Raymond JL. Krause: alimentos, nutrição e dietoterapia. 13. ed. Rio de Janeiro: Elsevier; 2013.
14. Isosaki M, Cardoso E, Oliveira A. Manual de dietoterapia e avaliação nutricional: serviço de nutrição e dietética do Instituto do Coração – HCFMUSP. 2. ed. São Paulo: Atheneu; 2009.
15. Abbott [Internet]. [Rio de Janeiro]: Abbott; c2023 [acesso 2022 jan 6]. Disponível em: https://www.abbottbrasil.com.br
16. Academia Danone Nutricia [Internet]. São Paulo: Danone Nutricia; c2020 [acesso 2022 jan 6]. Disponível em: https://www.academiadanonenutricia.com.br
17. Fresenius Kabi [Internet]. São Paulo: Fresenius Kabi Brasil; c2023 março [acesso 2022 jan 6]. Disponível em: https://www.fresenius-kabi.com/br
18. Avante Nestlé [Internet]. [São Paulo]: Nestlé Health Science; c2020 [acesso 2022 jan 6]. Disponível em: https://www.avantenestle.com.br
19. Prodiet Medical Nutrition [Internet]. Curitiba (PR): Prodiet; [data desconhecida]. [acesso 2022 jan 6]. Disponível em: https://prodiet.com.br/produtos
20. Google Shopping [Internet]. California: Google; 2002 [acesso 2022 dez 1]. Disponível em: https://shopping.google.com.br
21. TABNUT [Internet]. São Paulo: Universidade Federal de São Paulo, Escola Paulista de Medicina, Departamento de Informática em Saúde; [data desconhecida]. Alimentos: grupo de alimentos: todos os grupos; [atualizado 2016 mar 10; acesso 2022 fev 1]. Disponível em: https://tabnut.dis.epm.br/alimento
22. Núcleo de Estudos e Pesquisas em Alimentação, Universidade Estadual de Campinas. Tabela brasileira de composição de alimentos [Internet]. Versão 1. Campinas (SP): NEPA, UNICAMP; 2004 [acesso 2022 fev 1]. Disponível em: http://189.28.128.100/nutricao/docs/taco/tab_bras_de_comp_de_alim_doc.pdf
23. Instituto Brasileiro de Geografia e Estatística. Pesquisa de orçamentos familiares 2008-2009: tabela de medidas referidas para os alimentos consumidos no Brasil [Internet]. Rio de Janeiro: IBGE; 2011 [acesso 2022 fev 1]. Disponível em: https://biblioteca.ibge.gov.br/visualizacao/livros/liv50000.pdf
24. Conselho Nacional de Saúde (BR). Resolução nº 466, de 12 de dezembro de 2012. Aprova as diretrizes e normas regulamentadoras de pesquisas envolvendo seres humanos. Diário Oficial da União, Brasília, DF. 2013 jun 13; Seção 1:59.
25. Waitzberg DL. Nutrição oral, enteral e parenteral na prática clínica. 5 ed. Rio de Janeiro: Atheneu; 2017.
26. Institute of Medicine. Dietary reference intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein, and amino acids. Washington (DC): National Academy Press; 2005. doi: https://doi.org/10.17226/10490
27. Agência Nacional de Vigilância Sanitária (BR). Relatório de análise das contribuições da CP nº 457/2017: Gerência-Geral de Alimentos - GGALI [Internet]. Brasília (DF): ANVISA; 2018 jun [acesso 2022 fev 15]. Disponível em: http://antigo.anvisa.gov.br/documents/10181/3898888/Relat%C3%B3rio+de+An%C3%A1lise+de+Contribui%C3%A7%C3%B5es+-+CP+457-2017/1de3eb36-b152-4d3d-9411-5d2b5ac68290
28. Agência Nacional de Vigilância Sanitária (BR). Resolução de Diretoria Colegiada - RDC nº 429, de 08 de outubro de 2020. Dispõe sobre a rotulagem nutricional dos alimentos embalados [Internet]. Diário Oficial da União, Brasília, DF. 2020 out 9 [acesso 2022 fev 22]; Edição: 195; Seção 1:106. Disponível em: http://bvsms.saude.gov.br/bvs/saudelegis/anvisa/2020/RDC_429_2020_.pdf
29. Arends J, Strasser F, Gonella S, et al. Cancer cachexia in adult patients: ESMO Clinical Practice Guidelines. ESMO Open. 2021;6(3):100092. doi: https://doi.org/10.1016/j.esmoop.2021.100092

30. Horie LM, Barrére APN, Castro MG, et al. Diretriz BRASPEN de terapia nutricional no paciente com câncer. BRASPEN J [Internet]. 2019 [acesso 2022 fev 21];34(Suppl 1):2-32. Disponível em: http://bit.ly/2WuxAkF

31. Ministério da Saúde (BR). Guia alimentar para a população brasileira [Internet]. 2. ed. Brasília (DF): Ministério da Saúde; 2014 [acesso 2022 fev 23]. Disponível em: https://bvsms.saude.gov.br/bvs/publicacoes/guia_alimentar_populacao_brasileira_2ed.pdf

32. Damodaran S, Parkin KL, Fennema OR. Química de alimentos de Fennema. 4. ed. Porto Alegre: Artmed; 2010.

33. Badolato ESG, Maio FD, Tavares M. Composição em ácidos graxos de óleos vegetais comestíveis comercializados no Estado de São Paulo. Rev Inst Adolfo Lutz. 1992;52:1-2. doi: https://doi.org/10.53393/rial.1992.v52.35966

34. Codex Alimentarius Commission. Standard for named vegetable oils: CXS 210-1999 [Internet]. Italy: FAO/WHO; 1999 [revised in 2001, 2003, 2009, 2017, 2019; amended in 2005, 2011, 2013, 2015, 2019, 2021; last updated 2023 Feb 1; cited 2022 Feb1]. Available from: https://www.fao.org/fao-who-codexalimentarius/sh-proxy/ar/?lnk=1&url=https%253A%252F%252Fworkspace.fao.org%252Fsites%252Fcodex%252FStandards%252FCXS%2B210-1999%252FCXS_210e.pdf

35. Thompson WA, Lowry SF. Effect of nutrition on inflammatory mediators. In: Zaloga GP. Nutrition in critical care. St Louis: Mosby; 1994. p. 505-23.

36. Maniglia FP, Cruz LC, Costa LCM, et al. Avaliação da percepção do paladar de pacientes oncológicos: relação com variáveis pessoais e clínicas e comparação com um grupo controle. Rev Bras Cancerol. 2021;67(1):e-11994. doi: https://doi.org/10.32635/2176-9745.RBC.2021v67n1.994

37. Caruso L, Silva ALND, Simony RF. Dietas hospitalares: uma abordagem na prática clínica. São Paulo: Atheneu; 2002.

38. Ravasco P. Aspects of taste and compliance in patients with cancer. Eur J Onc Nurs. 2005;9(Suppl 2):S84-91. doi: https://doi.org/10.1016/j.ejon.2005.09.003

39. Roeland EJ, Bohlke K, Baracos VE, et al. Management of cancer cachexia: ASCO guideline. J Clin Oncol. 2020;38(21):2438-53. doi: https://doi.org/10.1200/JCO.20.00611

40. Norton C. Constipation in older patients: effects on quality of life. Br J Nurs. 2006;15(4):188-192. doi: https://doi.org/10.12968/bjon.2006.15.4.20542

41. World Health Organization. Diet, nutrition and the prevention of chronic diseases: report of a joint WHO/FAO expert consultation [Internet]. Geneva: WHO; 2003 [cited 2022 Feb 24]. (WHO technical report series, 916). Available from: https://apps.who.int/iris/bitstream/handle/10665/42665/WHO_TRS_916.pdf;jsessionid=BBE701BB5A8D4A8C4770F48199B6BD13?sequence=1

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