

## ORIGINAL ARTICLE

### Artisanal oral hypercaloric and hyperprotein supplement for low weight elderly people: bromatological and financial cost analysis

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## Abstract

**Introduction:** Anorexia of aging causes elderly individuals to chronically reduce their food intake and present significant nutritional deficiencies in proteins and calories. **Objective:** To develop a high-calorie and high-protein homemade oral supplement (HOS) for underweight elderly individuals and to evaluate its nutritional composition and financial cost. **Methods:** This is an experimental study with bromatological analysis. The following ingredients were used to prepare the HOS: powdered milk (60 g), powdered albumin (20 g), peanut butter (50 g), rolled oats (15 g), 50% cocoa chocolate powder (25 g), and filtered water (200 ml). Macronutrient analyses were performed by the Adolfo Lutz Institute. For comparative analysis of the nutritional composition regarding carbohydrates (g), proteins (g), lipids (g), caloric density (kcal/ml), and the financial cost of the homemade supplement made with industrialized supplements. **Results:** HOS had a high caloric density of 3.7 kcal/mL and a high amount of proteins, with the following percentage distribution of macronutrients: 24.14% proteins, 64.78% carbohydrates and 11.03% lipids. HOS had approximately three times more calories (370 kcal X 116 kcal) and approximately twice as much protein (22g X 9g) compared to industrialized products. Regarding the financial cost, HOS was 42% more affordable compared to industrialized supplements

(R\$ 3.05 X R\$ 5.32). *Conclusion:* HOS had a high amount of proteins, high caloric density and low production cost, and can be used as an alternative to industrialized supplements, especially by elderly people with low weight and less favored socioeconomic status.

**Keywords:** Aging; Malnutrition; Nutritional Status; Dietary Supplements.

## Resumo

### **Suplemento artesanal oral hipercalórico e hiperproteico para pessoas idosas com baixo peso: análise bromatológica e de custo financeiro**

*Introdução:* A anorexia do envelhecimento faz com que pessoas idosas diminuam cronicamente a sua ingestão alimentar e apresentem déficits nutricionais importantes de proteínas e calorias. *Objetivo:* Elaborou-se um suplemento artesanal oral (SAO) hipercalórico e hiperproteico para pessoas idosas com baixo peso e avaliou-se a composição nutricional e o custo financeiro. *Métodos:* Trata-se de um estudo experimental com análise bromatológica. Para elaboração do SAO foram utilizados os ingredientes: leite em pó (60g), albumina em pó (20g), pasta de amendoim (50 g), aveia em flocos (15 g), chocolate em pó 50% cacau (25g) e água filtrada (200 ml). As análises dos macronutrientes foram realizadas pelo Instituto Adolfo Lutz. Para análise comparativa da composição nutricional referente aos carboidratos (g), proteínas (g), lipídeos (g), densidade calórica (kcal/ml) e do custo financeiro do suplemento artesanal elaborado com os suplementos industrializados. *Resultados:* O SAO apresentou alta densidade calórica de 3,7 kcal/mL e alta quantidade de proteínas, com a seguinte distribuição percentual de macronutrientes: 24,14% de proteínas, 64,78% de carboidratos e 11,03% de lipídeos. O SAO apresentou cerca de três vezes mais calorias (370kcal X 116 kcal) e cerca de duas vezes mais: proteínas (22g X 9g) comparado aos produtos industrializados. Com relação ao custo financeiro, o SAO apresentou-se 42% mais acessível comparado aos suplementos industrializados (R\$ 3,05 X R\$ 5,32). *Conclusão:* O SAO apresentou alta quantidade de proteínas, elevada densidade calórica e baixo custo de produção, podendo ser utilizado em alternativa aos suplementos industrializados, principalmente pelas pessoas idosas com baixo peso e condição socioeconômica menos favorecida.

**Palavras-chave:** Envelhecimento; Desnutrição; Estado Nutricional; Suplementos Nutricionais.

## Resumen

### **Suplemento oral artesanal hipercalórico e hiperproteínico para personas mayores de bajo peso: análisis de costo bromatológico y financiero**

*Introducción:* La anorexia del envejecimiento provoca que las personas mayores reduzcan crónicamente su ingesta de alimentos y presenten deficiencias nutricionales significativas en proteínas y calorías. *Objetivo:* Se desarrolló un suplemento oral casero hipercalórico e hiperproteico (SAO) para adultos mayores con bajo peso y se evaluó su composición nutricional y costo financiero. *Métodos:* Se trata de un estudio experimental con análisis bromatológico. Los siguientes ingredientes se utilizaron para preparar el SAO: leche en polvo (60 g), albúmina en polvo (20 g), mantequilla de maní (50 g), avena arrollada (15 g),

chocolate en polvo con 50% de cacao (25 g) y agua filtrada (200 ml). Los análisis de macronutrientes fueron realizados por el Instituto Adolfo Lutz. Para el análisis comparativo de la composición nutricional en cuanto a carbohidratos (g), proteínas (g), lípidos (g), densidad calórica (kcal/ml) y el costo financiero del suplemento artesanal elaborado con suplementos industrializados. *Resultados:* La SAO presentó una alta densidad calórica de 3,7 kcal/mL y una alta cantidad de proteínas, con la siguiente distribución porcentual de macronutrientes: 24,14% proteínas, 64,78% carbohidratos y 11,03% lípidos. El SAO tenía aproximadamente tres veces más calorías (370 kcal X 116 kcal) y aproximadamente el doble de proteínas (22 g X 9 g) en comparación con los productos industrializados. En cuanto al costo financiero, el SAO fue 42% más accesible en comparación a los suplementos industrializados (R\$ 3,05 X R\$ 5,32). *Conclusión:* La SAO presentó alta cantidad de proteínas, alta densidad calórica y bajo costo de producción, pudiendo ser utilizada como alternativa a los suplementos industrializados, especialmente por personas mayores con bajo peso y nivel socioeconómico menos favorecido.

**Palabras-clave:** Envejecimiento; Desnutrición; Estado Nutricional; Suplementación Dietética.

## Introduction

In Brazil, most elderly people are dependent on pensions and/or retirement benefits, and a large part of this income is used for medical expenses such as the purchase of medicines, tests, and therapeutic procedures. This scenario involves the acquisition of foods with lower nutritional quality due to their low cost and favors dietary monotony, resulting in the development of chronic nutritional deficiencies [1]. From this perspective, a higher prevalence of underweight is observed in elderly people with lower per capita monthly income and education, conditions that directly interfere with elderly people's access to food [2].

Underweight in elderly people is associated with several negative outcomes such as increased functional disability, hospitalizations, susceptibility to infections, and mortality [3]. In the Brazilian Study of Frailty in Elderly People (FIBRA), carried out in seven Brazilian cities, the authors sought to identify the prevalence of underweight in community-dwelling elderly people and the associated factors. A prevalence of 10 to 18% of underweight was found in the age groups of 65 to 80 years or older,

ranging from 10 to 18%, being significantly higher in elderly people aged 80 years or older, without a spouse, who reported loss of appetite and income of up to 1 minimum monthly wage when compared to those who received three minimum wages [4].

These findings corroborate and demonstrate that socioeconomic conditions and the development of anorexia of aging are factors associated with low weight in community-dwelling elderly individuals. Anorexia of aging is a phenomenon inherent to the senescence process, which contributes to a chronic decrease in food intake in elderly individuals. The etiology of this phenomenon is multifactorial and involves decreased perception of the smell and taste of food, reduced stomach capacity for compliance due to decreased nitric oxide production that generates early satiety, slowed gastric emptying that generates prolonged postprandial fullness, pronounced increase in anorexigenic hormones such as cholecystokinin (CCK), glucagon-like-peptide 1 (GLP-1), leptin, and decreased orexigenic hormones such as ghrelin and neuropeptide Y (NPY), among other factors such as depression,

social isolation, polypharmacy, and socioeconomic conditions [5].

Chronic reduction in food intake generates significant nutritional deficiencies in calories, proteins and micronutrients that predispose to weight loss and consequently malnutrition. From this perspective, high-calorie and high-protein oral food supplements are indicated for elderly people who are unable to meet their nutritional needs through their usual diet. The use of oral food supplements by elderly people can increase daily calorie intake by up to 50% and is associated with a lower risk of complications, fewer hospital readmissions, greater

handgrip strength, higher protein and energy intake and improved body weight [6].

However, commercially available industrialized oral food supplements aimed at elderly people are, for the most part, expensive and financially inaccessible. Therefore, food supplements developed with easily available ingredients can be very useful in meeting the nutritional needs of elderly people because they are low cost and well accepted [7]. A hypercaloric and hyperprotein homemade oral supplement (SAO) was developed for underweight elderly people and its nutritional composition and financial cost were evaluated.

## Methods

### *Study design*

This is an experimental study in which the bromatological analyses were performed in a private laboratory in Brasília - Distrito Federal (DF).

### *Preparation of the SAO*

The following ingredients were used to prepare the SAO: instant powdered milk, unflavored powdered albumin (20 g), peanut butter (50 g), rolled oats (15 g), 50% cocoa chocolate powder (25 g) and filtered water (200 ml).

The ingredients were weighed on a precision scale SF-400®. The ingredients were placed in a blender and processed for 5 minutes. Subsequently, the mixture was transferred to a 500 ml glass container with a lid and sent to the bromatological analysis laboratory. A preparation technical sheet was prepared to evaluate the nutritional composition and financial cost of the recipe.

### *Bromatological analyses*

The SAO sample was sent to a private laboratory for bromatological analyses located in

Brasília-DF. The bromatological analyses were performed based on the methodology proposed by the Adolfo Lutz Institute (2008) for the physical-chemical analysis of foods [8]. To analyze the amount of proteins, total nitrogen was first quantified by the micro-Kjeldahl method, using a factor of 6.25 for conversion to protein. The lipid fraction was determined by the direct extraction method in Soxhlet. Carbohydrate was calculated by the difference between 100 (total percentage) and the sum of the percentages found for moisture, ash, protein fraction and lipids. The total caloric value (TCV) was calculated using the conversion factors for each macronutrient, being [(protein x 4 kcal/g) + (lipids x 9 kcal/g) + (carbohydrates x 4 kcal/g)].

### *Comparative analysis of nutritional composition and financial cost*

For comparative analysis of the centesimal nutritional composition regarding carbohydrates (g), proteins (g), lipids (g) and caloric density (kcal/ml) of the SAO prepared with industrialized supplements, three commercially available

liquid supplements indicated for use by the elderly were selected using a simple random sampling technique. For this selection, a search was conducted on the Google search platform using the terms “Liquid hypercaloric and hyperproteic supplement for elderly people” and all supplements that met the criteria were listed in a spreadsheet in Microsoft Excel 2013 software. Subsequently, numbers were assigned to the supplements and the random selection of three supplements was applied in the Bioestat 5.3 software.

For analysis of the financial cost in reais (R\$), 100ml portions were standardized for all supplements. The value of the standardized portion of SAO obtained through the preparation technical sheet was compared with the values of the standardized portions of industrialized supplements available on the internet.

To analyze the financial impact of the daily use of supplements by elderly people in relation to the

2021 minimum wage, which is R\$1,100 reais, a simulation of daily use of 200 ml of supplements was performed for a period of 1 consecutive month (30 days) and the amount spent during this period of use was calculated.

The sensory analysis was performed using the overall acceptance and acceptance index. The supplement acceptability test was performed using a structured 7-point hedonic scale (1 = I really disliked it, 7 = I really liked it). Based on the average overall acceptance score, the product’s acceptability index (AI) was calculated (average overall acceptance x 100 / 7), with a minimum of 70% AI being considered the limit to consider that the supplement was well accepted by elderly people.

The results of the bromatological analyses and financial cost were entered into a spreadsheet in Microsoft Excel 2013 ® software. Data evaluation was performed using descriptive statistics.

## Results

The results of the bromatological analyses are described in Table 1. Based on the bromatological analysis, the nutritional composition of SAO presented hypercaloric characteristics with a high caloric density of 3.7 kcal/mL and hyperprotein with the following percentage distribution of macronutrients: 24.14% proteins, 64.78% carbohydrates and 11.03% total fats. No bromatological analyses of dietary fiber and micronutrients were performed on SAO.

Different macronutrient values were found between the preparation technical sheet and the bromatological analysis. The data contained in the 2014 Brazilian Food Composition Table (TACO) [9] were used to calculate the macronutrients of the ingredients whole milk powder and rolled oats. The

ingredients peanut butter, 50% cocoa chocolate powder and albumin powder were not included in the TACO and therefore, the data contained in the manufacturer’s label were used. Anvisa’s RDC No. 360 of 2003 [10] allows nutritional labels to contain a variation of more or less 20% of the macronutrient values declared by the manufacturer. From this perspective, it is proposed that this would be the reason why the macronutrient values were discrepant between the bromatological analysis and the preparation technical sheet.

It is worth noting that bromatological analysis is an experimental method that has a high degree of accuracy in determining the nutritional composition of foods [8].

**Table 1 - Centesimal nutritional composition of the chocolate-flavored homemade oral supplement obtained from the preparation technical sheet and bromatological analysis**

Composition	Preparation technical sheet	Bromatological analysis
Carbohydrates	16,36g	60,9g
Proteins	13,3g	22,7g
Lipids	11,38g	4,61g
Total caloric value	221kcal	376 kcal
Caloric density	2,1 kcal/mL	3,7 kcal/mL

The data regarding the comparison of the nutritional composition and financial cost of SAO with the three selected industrialized supplements are described in Table 2. SÃO presented 375 kcal, approximately three times more than the average of the industrialized supplements (116 kcal), high quantity of carbohydrates (60.9g) when compared to the average carbohydrates of the industrialized supplements

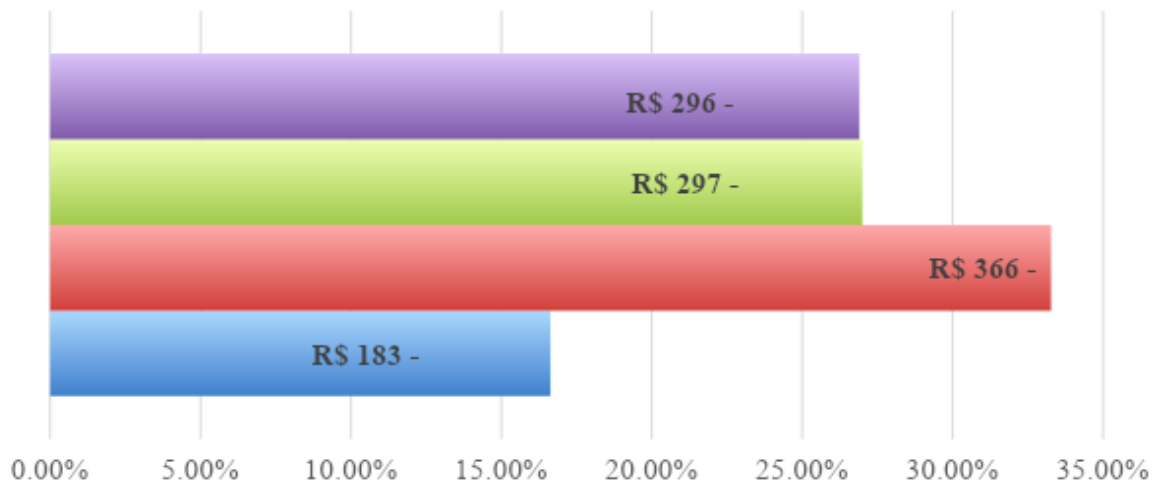
(12.6g), high quantity of proteins (22.7g), having approximately twice as much protein as the average of the industrialized supplements (9.30g) and quantity of lipids (4.61g) similar to the average of the industrialized supplements (5.0g). Regarding the financial cost, SAO presented the cost of R\$ 3.05, being 42% more affordable when compared to the average of the industrialized supplements (R\$ 5.32).

**Table 2 - Comparison of the centesimal nutritional composition and financial cost of the homemade oral supplement in relation to the three selected industrialized food supplements**

COMPOSIÇÃO NUTRICIONAL DE 100ML DOS SUPLEMENTOS						
Supplement	Carbohydrates	Proteins	Lipids	Kcal	Caloric Density	Financial cost
Artisanal	60,9g	22,7g	4,61g	376 kcal	3,7 kcal/mL	R\$ 3,05
SAI1*	12,4g	10,0g	6,7g	150 kcal	1,5 kcal/mL	R\$ 6,10
SAI2*	16,0g	10,0g	5,3g	150 kcal	1,5 kcal/mL	R\$ 4,95
SAI3*	9,4g	8,0g	3,2g	100 kcal	1 kcal/mL	R\$ 4,93

\*SAI1- Industrialized food supplement 1 - \*SAI2- Industrialized food supplement 2 - \*SAI3- Industrialized food supplement 3 – Financial cost: price survey of industrialized supplements carried out on 01/04/2021.





Percentage spent of minimum wage of R\$1,100.00 in 30 days of using 200ml of supplements.

■ Artesanal ■ SAI1 ■ SAI2 ■ SAI3

\*SAI1- Industrialized food supplement 1 - \*SAI2- Industrialized food supplement 2 - \*SAI3- Industrialized food supplement 3.

**Figure 1 - Financial impact on the 2021 minimum wage with the daily use of 200ml of supplements during the 30-day period**

Twenty volunteer testers of both sexes, aged between 60 and 90 years, participated in the test. The average acceptance rate was  $6.08 \pm 1.57$  and the AI was 83.43%, showing that the supplement was well accepted by the elderly.

The analysis of the financial impact on the minimum wage with the daily use of 200 ml of the supplements is described in figure 1. The use of

200 ml of SAO for 30 days resulted in an expense of R\$183 reais, an amount corresponding to 16% of the minimum wage. Compared to the average expense with the use of industrialized supplements of R\$319 reais, an amount corresponding to 29% of the minimum wage, SAO was 13% more accessible and less expensive than the industrialized supplements.

## Discussion

It has currently been proposed that increasing daily protein and caloric intake represents an effective strategy for maintaining and/or gaining weight, muscle mass and strength in elderly individuals, as it contributes to positive nitrogen and energy balance.

Muscle protein synthesis in elderly individuals is maximally stimulated when protein intake is between 0.4 g of protein/kg/meal or between the

threshold of 20 and 30 g per meal [11,12]. From this perspective, the scientific community has recommended that healthy elderly individuals consume a diet with 1.1 to 1.2 g of protein/kg/day, those with acute or chronic diseases should consume 1.2 to 1.5 g/kg/day, and those with severe diseases or malnutrition should consume 2 g/kg/day [13,14].

With regard to calories, a hypercaloric diet with 30 kcal/kg of body weight per day is recommended,

and this value should be adjusted in relation to the nutritional status, associated diseases and level of physical activity of the elderly individual [6]. The SAO produced had a high amount of protein in its composition (22g in 100ml). According to current scientific recommendations, this amount of protein ingested per meal would be ideal to “overcome” anabolic resistance in elderly people and to stimulate muscle protein synthesis to the maximum [11]. In addition, another important factor is that anorexia of aging, through various hormonal mechanisms and changes in gastrointestinal motility, promotes early satiety in elderly people, making them feel full after ingesting a small amount of solid food and/or liquids [5].

Since SAO contains 22g of protein in a small volume of 100ml, it could be possible and tolerable for elderly people to consume it in total daily. The ingredients milk powder, albumin powder and peanut butter were strategically chosen because they contain a high amount of protein, and specifically, milk and albumin powder because they contain proteins of high biological value.

Cow's milk is a protein blend, with its natural composition consisting of whey proteins ( $\beta$ -lactoglobulin,  $\alpha$ -lactalbumin and lactoferrin), also known as Whey Protein, and Caseins [15]. These cow's milk proteins are rich in branched-chain amino acids (BCAAs), especially the amino acid leucine, which has the ability to promote intracellular signaling in skeletal muscle to stimulate protein synthesis by activating the mTOR pathway.

For maximum stimulation of protein synthesis by this amino acid, leucine intake must be 1.7 to 2.5g per meal, a dose that is achieved when high-quality protein intake is between 20 and 30g [15]. SAO presented 22g of high-quality proteins in its centesimal composition, thus, it could be possible to reach the leucine threshold with its consumption.

In the study by Garófolo [7] with the objective of developing 8 formulations of homemade oral supplements for cancer patients, evaluating the nutritional composition and acceptance of the supplements, it was evidenced in the analysis that the supplements presented high caloric density, adequate amount of proteins and good acceptance. They concluded that homemade oral supplements can be a viable alternative in situations where there are not enough resources to purchase industrialized supplements.

In Brazil, underweight is highly prevalent among elderly individuals with less favorable socioeconomic conditions, and is more prevalent among elderly individuals living in the Northeast and Central-West regions. From this perspective, elderly individuals have limited access to food in satisfactory quantity and quality, leading to nutritional deficiencies in calories, proteins, vitamins, and minerals, as well as malnutrition [2]. In a population-based study by Venturini [16], conducted in the city of Porto Alegre (RS), with the aim of evaluating the food consumption of elderly individuals living in the community, it was found that elderly individuals were in negative energy balance, with an average caloric intake of 1,320 to 1,564 kcal, and that their estimated daily energy requirement was approximately 1,700 kcal.

In this context of negative energy and nitrogen balance, when caloric and protein intake from regular diet alone is lower than the nutritional needs of the elderly individual, hypercaloric and hyperprotein supplementation is indicated [6]. However, industrialized supplements intended for elderly people are largely expensive and financially inaccessible.

In the present study, it was demonstrated through the consumption simulation for 30 days that the daily use of 200ml of industrialized supplements would have an average financial impact of 29% on the 2021 minimum wage, a condition



that would make the use of this supplementation unfeasible for most elderly people, considering that this population has lower purchasing power and also a large part of the income is destined to medical expenses that are increased in this age group, such as the purchase of medicines, consultations, exams, etc. [17].

In contrast, daily use of 200 ml of SAO would have a financial impact of only 16% on the 2021 minimum wage, less than half the average cost of industrialized supplements. Thus, the developed SAO is less expensive and financially more accessible for elderly people whose socioeconomic status is less favored. In addition, the ingredients used to prepare the supplement are easy to acquire, most of the ingredients are already part of the daily diet of most elderly Brazilians, and the production of the

SAO recipe is low complexity. However, it is worth noting that because there is greater manipulation to produce SAO, there is less microbiological control when compared to the industrialized supplement, which is already ready for consumption, which can be compensated by nutritional guidance aimed at the microbiological safety of the product.

Providing creative, palatable and affordable options to SUS users is a challenge that affects every health professional. The study was conducted to demonstrate that supplements produced with natural ingredients, in an artisanal way and at low cost are a viable possibility in the recovery of the nutritional status of the elderly. Disclosing this possibility of supplementation will help other professionals in the search for solutions to recover the nutritional health of the elderly.

## Conclusion

The homemade supplement developed presented in its nutritional composition a high quantity of proteins, high caloric density and low production cost, and can be used as an alternative to industrialized supplements, especially by elderly people who are underweight and have less favorable socioeconomic conditions. Dietary supplements are great allies for elderly people to meet their daily nutrient requirements and maintain and/or gain weight. In this sense, the formulations of homemade oral supplements made with low-cost ingredients and with characteristics of being rich in calories and proteins, can be of great therapeutic use.

### Conflicts of interest

The authors declare no conflicts of interest of any nature.

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### Authors' contributions

*Conception and design of the research: Pinheiro HA, Faria MR, Cerceau VR; Data collection: Faria MR, Pinheiro LA; Analysis and interpretation of the data: Faria MR; Writing of the manuscript: Pinheiro HA, Cerceau VR, Silva MC, Pinheiro LA; Critical review of the manuscript for important intellectual content: Pinheiro HA, Cerceau VR.*

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