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## Elaboration of a vegetarian product type "cheese" based on white beans (*phaseolus vulgaris*) added of prebiotics

*Elaboração de produto vegetariano tipo "queijo" à base de feijão branco (phaseolus vulgaris) adicionado de prebióticos*

### Abstract

**Introduction:** Due to the increase of the number of vegetarian individuals and the consumption of food targeting this public, the elaboration of healthier plant-based products can be a good alternative for a greater diet diversity of this population. **Objective:** To elaborate a vegetable product type "cheese" based on white beans added of inulin. **Materials and Methods:** Three formulations with different concentrations (5, 10 e 15 g) of inulin were elaborated for further moisture, ash, fat matter, protein, carbohydrate, soluble and insoluble fiber analysis developed according to Instituto Adolfo Lutz, and sensory analysis, with 100 assessors following the hedonic test protocols of the Associação Brasileira de Normas Técnicas. Data were submitted to analysis of variance and Tukey test ( $p < 0.05$ ). Foods type "cheese" for vegetarians available in the market were evaluated regarding nutritional quality through labelling data and compared to the elaborated products. **Results:** The elaborated formulations stood out by protein, fiber, and total fat contents. Results of the sensory analysis showed that there was no significant difference between samples for the attributes analyzed. In relation to the commercial analyzed products, the basis used interfered on the nutritional composition of the product, especially for the vegetable products type "cheese", without protein value. **Conclusion:** Results demonstrated that the development of a vegetable product type "cheese" with nutritional quality and functional based on a legume with added inulin, a prebiotic, is possible.

**Keywords:** Vegetarian Diet. Vegetable Protein. Prebiotic. Legume.

### Resumo

**Introdução:** Em virtude do aumento no número de indivíduos vegetarianos e do consumo de alimentos voltados para esse público, a elaboração de produtos de base vegetal mais saudáveis pode ser uma boa alternativa para maior variabilidade na dieta dessa população. **Objetivo:** Elaborar um alimento vegetal tipo "queijo" à base de feijão branco acrescido de inulina. **Materiais e Métodos** Foram elaboradas três formulações com diferentes concentrações (5, 10 e 15g) de inulina para posterior análises de umidade, cinzas, lipídeos, proteínas, carboidratos, fibra solúvel e fibra insolúvel, realizadas segundo o

Instituto Adolfo Lutz, e sensorial, com 100 avaliadores seguindo os protocolos para teste hedônico das normas da Associação Brasileira de Normas Técnicas. Os dados foram submetidos a análise de variância e teste de Tukey ( $p < 0,05$ ). Alimentos tipo “queijo” para vegetarianos disponíveis no mercado foram avaliados quanto à qualidade nutricional pelos dados de rotulagem e comparados aos produtos elaborados. **Resultados:** As formulações elaboradas se destacaram pelo teor de proteínas, fibras e gordura total. Os resultados da análise sensorial mostraram que não houve diferença significativa entre as amostras para os atributos analisados. Em relação aos produtos comerciais, observou-se que a base utilizada interferiu na composição nutricional do produto, com destaque para os produtos tipo queijo vegetal, sem valor proteico. **Conclusões:** Tais resultados mostraram que é possível o desenvolvimento de um produto tipo “queijo” de origem vegetal com qualidade nutricional e funcional à base de leguminosas com adição de inulina, um prebiótico.

**Palavras-chave:** Dieta Vegetariana. Proteína Vegetal. Prebiótico. Leguminosas.

## INTRODUCTION

Vegetarian is the individual that excludes from your diet all sorts of meat, poultry, and fish and derivatives, who may have or not dairy or eggs. The vegetarianism includes the veganism, which is the practice of not using products from animal origin for any purpose (meals, hygiene, clothing, among others).<sup>1</sup>

Current studies indicate that vegetarian diets can stimulate meals with high amount of vegetables, what takes to increased intake of antioxidants and fibers and a lower intake of fat, which has been associated to a reduction of mortality of chronic non-communicable diseases, with positive results on cholesterol serum levels reduction, reduction of risk and prevalence of cardiovascular disease, arterial hypertension, diverse cancer types and diabetics type 2.<sup>1-9</sup>

It is known that having a vegetarian diet does not imply more health. Adequate food choices and adopt a healthy lifestyle are needed, also in the vegetarian diet. A vegetarian diet, if not planned, with nutrient deficit or salt and fat excess, for instance, can be a lot harmful for health.<sup>1,9-12</sup>

The published research of the Instituto Brasileiro de Opinião e Estatística (IBOPE) (Brazilian Institute of Opinion and Statistics) showed the estimative of 15,2 million people adept of the vegetarian diet in Brazil, meaning that 8% of the Brazilian population self-declared vegetarian.<sup>13</sup> This increase has been motivated specially by animal ethics and environment preservation.<sup>14,15</sup> Current studies proof the great impact that husbandry and food choices provoke on nature.<sup>9,16,17</sup>

The introduction to new products destined to vegetarians, as food products (vegetarian alternatives like vegetable or plant-based drinks and meat analogues), fortified foods (like cereals meals), food supplements of vegetable origin and sustainable foods are in development. According to some market analysis, economic perspectives are positive and will continue to be pushed by an increasing tendency of consumption not only by vegetarians, but also by other people that seek those options.<sup>9,18</sup>

However, a vegetarian product is not necessarily healthy, but may have salt, fat or added sugar in excess in your composition. Thus, priority should be given to foods closer to the natural, with healthy and functional ingredients.<sup>9,19,20</sup>

Legumes are foods mostly consumed by this public as a protein source. Among them, the white bean (*Phaseolus vulgaris*) is characterized also by vitamins, carbohydrates and fibers.<sup>21,22</sup> The calcium amount in foods of vegetable origin is quietly discussed in the literature, but foods like the white bean, brocolli and kale can be good alternatives for individuals that do not consume foods of animal origin to obtain this micronutrient in their diet, mainly if their intake is combined to other foods that help in this mineral absorption and bioavailability.<sup>21,22</sup>

In addition to the bean, products based on legume are also outstanding by its protein content, for instance, the food of vegetable origin type “cheese”, that can be used to contribute to diet diversity.

Functional foods are important for a healthy diet maintenance, likewise diversity. These are described in the literature as healthy promoters, besides providing basic nutrition through mechanisms not foreseen by the conventional eating.<sup>23</sup>

Probiotics, not digestible food components, are one of the responsible for conferring these functional characteristics upon food. Among them, the inulin plays an influence over physiological functions of the organism, aiming at gut integrity and, at this point, it can be used for the microbiota reestablishment in cases of intestinal dysbiosis.<sup>24,25</sup>

As a result of the number of vegetarians individuals, being legume a fresh food and of important protein value, and the inulin a probiotic that confer beneficial characteristics to the individual, the present study aims at formulating and characterizing a food type “cheese”, plant-based, and based on white bean, inulin added, and compared to labelling data of other type “cheese” foods available in the market.

## METHODS

### Formulations

All raw materials were acquired in the local market of Realengo, Rio de Janeiro, for the elaboration of the food type “cheese” based on white bean. Three formulations of food type “cheese” (FTC) were elaborated with variations of the inulin amounts, 5 g, 10 g and 15 g (Table 1).

**Table 1.** Formulations proportions of the inulin amounts, respectively 5; 10 and 15g. Rio de Janeiro-RJ, 2021.

Raw material	FQF5	FQF10	FQF15
White bean (g)	250	250	250
Quinoa (g)	20	20	20
Brazil nut (g)	39	39	39
Olive oil (ml)	5	5	5
Salt (g)	5	5	5
Garlic (g)	3	3	3
Agar-agar (g)	10	10	10
Inulin (g)	5	10	15

FQF – Formulation of Food type “Cheese” with White bean added of inulin with 5; 10 and 15 g, respectively.

Source: Authors (2021).

At first, legume were sanitized and left soaking to reduce antinutritional factors.<sup>26</sup> Then, beans were cooked under pressure for 30 minutes over medium heat. After cooked, grains were smashed in water by the mixer and then, submitted to heat on medium level and added of citric acid powder to obtain the aqueous extract. Subsequently, the mixed grains were left resting to obtain the protein precipitate. After the precipitation, the aqueous extract was separated by filtration and the retained part used. Other ingredients were mixed to the retaining and, gum (agar-agar) and inulin were added at the end. The mass was then shaped and cooled at 10°C for 30 minutes.

### Microbiological analysis

Coliform heat resistant/ml, *B. cereus*/mL, *Salmonellas* sp/25mL, *coagulase* positive *Staphylococcus*/g and total molds and yeast according to the Official Analytical Methods of the Instrução Normativa n.º 62, de 26 de agosto de 2003,<sup>27</sup> defined by RDC n.º 12, de 2 de janeiro de 2001<sup>28</sup> were carried out to attest the safety of the food for consumption, as for the microbiological point of view.

### Nutrition composition of the elaborated products

Proximate analysis of moisture, protein, fat, ashes, soluble and insoluble fibers of the formulations were carried out in the Universidade Federal do Estado do Rio de Janeiro, according to the guidelines established by Instituto Adolfo Lutz.<sup>29</sup>

## Sensory analysis

The research fulfilled the guidelines and standards of the Resolução nº 466/2012 of the Conselho Nacional de Saúde (National Health Council) and began only after the Research Ethnical Committee for Human Being approval, registered under number 2.838.962-2018. Only participants that signed electronically the Informed Consent Form took part in the research.

## Consumer profile and attitudes

First, to evaluate the possibility of the vegetable product insertion in market, 100 potential consumers were recruited by e-mail and requested to answer an online questionnaire in Google Forms, a free platform, structured with ten open and close-ended questions related to functional foods and cheese consumption. Some of the questions of the questionnaire were: age; food constraints (yes/no); knowledge about functional foods (yes/no); food considered mostly functional; knowledge about vegetarian foods (yes/no); liking for cheeses (yes/no); considered cheeses as healthy foods (yes/no); mostly used criteria to choose a type of cheese; types of cheese mostly consumed and would try a “vegetable” cheese (yes/no). The aim was to understand the possibilities of the inclusion of a type of “cheese”, vegetable food, to the general population.

Afterwards, an online questionnaire was elaborated using the same platform, addressed to 102 vegetarian individuals, with four questions: vegetarian diet pattern classification (egg lacto vegetarian/ egg vegetarian/ lacto vegetarian/ strict vegetarian); food that represents your great source of protein; vegetarian products (industrialized) of higher consumption; and legume that you mostly consume.

## Food type “cheese” added of inulin assessment

Sensory analysis was carried out in individual booths, in the Sensory Laboratory of the Universidade Castelo Branco, Realengo, Rio de Janeiro. Three formulations were sensory evaluated, with 100 assessors participating in a hedonic test: Health Science Bachelors’ students, of both sex, with the minimal and maximum age of 18 and 60, respectively.<sup>30</sup> Participants’ selection for this analysis followed the same criteria of the first applied questionnaire, not considering only individuals with vegetarian diets patterns, but the population in general, respecting only the criteria established and already mentioned above.

Three samples with different proportions of inulin (FQF5, FQF10 and FQF15) were presented in 1 cm cubes, monadically in a balanced order and served in dischargeable white plates coded with random three-digit numbers, served with a glass of water at room temperature and unsalted biscuits. The acceptance score sheets had structured hedonic scale of five points, where 1 was “I disliked very much” and 5 meant “I liked very much”. Attributes evaluated were: appearance, color, texture, bitterness, cheese aroma, bean aroma, cheese flavor, bean flavor, salty taste and residual flavor.<sup>31</sup>

## Nutritional quality of commercial foods type “cheese” assessment

Labels and nutritional information of commercialized products type “cheese” in Brazil available online were collected, in supermarket websites and specialized stores. Selection criteria of those data were: availability of those foods in the e-commerce and the absence of animal origin products in its composition. The nutritional composition analysis was carried out for 100g of the product. It was calculated the variation

of the energy (kcal), proteins (g), carbohydrates (g), fibers (g) and total fat (g) among the different brands. Nutrition facts and the list of ingredients available on selected products' label were evaluated.

### Statistics analysis

Results obtained were submitted to analyze of variance (ANOVA), and the comparison of the means between treatments was developed by using Tukey test, considering the significance level of 5%, using XLSTAT software version 2021.

## RESULTS AND DISCUSSION

### Microbiological analysis

In Table 2, the results of the evaluation of the *Salmonella* sp, heat resistant coliforms, positive *coagulase Staphylococcus*, *Bacillus cereus*, molds and yeasts' populations are shown. Although there is no specific rules for foods type "cheese" based on white beans, in order to compare to data already established by law for products of vegetable origin, values referring to rules for products based on soy were used, specially item b, that regards to "tofu and similar, defatted or not".<sup>28</sup>

**Table 2.** Results of *Salmonella* sp, heat resistant coliforms, positive *Coagulase Staphylococcus*, *Bacillus cereus* and molds and yeasts, for foods type "cheese" FQF5 (5 g of inulin), FQF10 (10 g of inulin) and FQF15 (15 g of inulin). Rio de Janeiro-RJ, 2021.

Microrganisms	FQF5	FQF10	FQF15	Current legislation*
<i>Salmonella</i> sp	absent/25g	absent/25g	absent/25g	absent/25g
Heat resistant coliforms	< 10 <sup>2</sup> CFU/g	< 10 <sup>2</sup> CFU/g	< 10 <sup>2</sup> CFU/g	10 <sup>2</sup> CFU/g
Positive <i>Coagulase Staphylococcus</i>	< 10 <sup>2</sup> CFU/g	< 10 <sup>2</sup> CFU/g	< 10 <sup>2</sup> CFU/g	5 x 10 <sup>3</sup> CFU/g
<i>Bacillus cereus</i>	< 10 <sup>2</sup> CFU/g	< 10 <sup>2</sup> CFU/g	< 10 <sup>2</sup> CFU/g	5 x 10 <sup>3</sup> CFU/g
Molds and yeasts	2.3x 10 <sup>2</sup> CFU/g	5.0 x 10 <sup>2</sup> CFU/g	1.8 x 10 <sup>2</sup> CFU/g	-

CFU = *Colony Formed Units* / \* Resolução Anvisa – n° 12, de 2 de janeiro de 2001 (Brasil, 2001). Comparação com produtos à base de soja.

Source: Authors (2021).

Thus, all foods type "cheese" elaborated, added of inulin in different proportions, are in accordance with the parameters established by this rule when compared to products based on soy. These results are extremely important, once the product is on market, there must be no concern with the integrity of the consumers' health.

### Nutritional composition of the elaborated products

Results of the moisture, ashes, soluble and insoluble fibers of the formulations of the foods type "cheese" with different inulin additions are disposed in Table 3.

**Table 3.** Medium values of the physical-chemical analysis type "cheese" of white bean according to the foods type "cheese" FQF5 (5 g of inulin), FQF10 (10 g of inulin) and FQF15 (15 g of inulin). Rio de Janeiro-RJ, 2021.

Analysis	FQF5	FQF10	FQF15
Moisture (g/100g)	68.76±0.66 <sup>a</sup>	66.46±0.88 <sup>b</sup>	66.35±0.15 <sup>b</sup>
Ashes (g/100g)	2.27±0.13 <sup>b</sup>	2.32±0.02 <sup>b</sup>	3.34±1.15 <sup>a</sup>
Protein (g/100g)	4.44±0.10 <sup>a</sup>	4.59±0.14 <sup>a</sup>	3.81±0.22 <sup>b</sup>
Soluble fibers (g/100g)	3.49±1.23 <sup>c</sup>	4.64±1.09 <sup>b</sup>	5.33±0.79 <sup>a</sup>
Insoluble fibers (g/100g)	2.47±0.48 <sup>b</sup>	1.62±0.32 <sup>c</sup>	3.10±0.14 <sup>a</sup>
Fat (g/100g)	4.20±0.02 <sup>a</sup>	1.60±0.30 <sup>b</sup>	0.80±0.10 <sup>b</sup>
Carbohydrate (g/100g)	14.37±0.00 <sup>b</sup>	18.77±0.00 <sup>a</sup>	17.27±0.10 <sup>a</sup>
Energy value (kcal/100g)	113.04±0.00 <sup>a</sup>	107.84±0.00 <sup>a</sup>	91.52±0.00 <sup>b</sup>

Mean and standard deviation of the results obtained. Same letter in the same row indicate there was no significant difference in the significance level of 5%.

Source: Authors (2021).

Prebiotic addition in formulations of the foods type "cheese" promoted significant changes in the increase of the ashes, soluble and insoluble fibers amounts, and decrease of the moisture, fat and, consequently, total energy value. Current studies indicate that inulin is more and more used in dairy and non-dairy products processed in the industry, because it is an agent of volume for usage in fat replacement, texture changes and sensory improvements.<sup>32-35</sup>

Regarding the moisture content, a lower amount was already expected for FQF15 formulation, knowing that one of the fiber function is to link to water and with this to promote the moisture control.<sup>33,35,36</sup> For the fat amount reduction, the inulin has the capacity to stabilize the structure of the aqueous phase, which creates a better creamness.<sup>34</sup> Besides, the inulin presents a high fat absorption, what permits it to be used as a fat replacer and improve sensory characteristics. The ash level has shown higher in the sample with the higher concentration of inulin (FQF15) – 100 g of inulin presenting in average 2.58 g of ashes.<sup>32</sup>

In accordance to Manso et al.,<sup>37</sup> the inulin has been used as ingredient in bioactive functional foods, to enable the emergence of bifid and other beneficial microorganisms, providing health to the intestinal microbiota for the human organism with prebiotic effect. Based in the Portaria nº 75<sup>38</sup> of the Ministério da Saúde (Health Ministry), for a ready product, solid, be considered with high content of fibers, it must contain a minimal of 5 g of fiber/100 g of the product. Food formulations type "cheese" with 5, 10 and 15 g of inulin present approximately 6 g of total fibers in 100 g of product, thus, being considered as products with high levels of fibers.<sup>37</sup>

The protein is also emphasized, to be an important nutrient in vegetarian preparations. It is known that when legume's grain are heated, the proteins are easily denaturated by heat, modifying the molecules' structure; as a consequence, the most sustainable linkages of the protein nest are damaged.<sup>39</sup> The

elaboration of vegetable products type “cheese” with protein is important to make individuals’ diets diverse, that seek for a healthy, practical, fast and tasty diet. Products elaborated showed proteins levels of 4.44, 4.59 and 3.81% for FQF5, FQF10 and FQF15, respectively.

## Sensory analysis

### *Consumers’ profile and attitudes*

Results obtained in the online questionnaire demonstrated that 64.29% of the respondents were 18 and 29 years old. Among them, 100% had no food intolerance or allergies; 48% know what functional foods mean, and within the ones listed as functional, flaxseed (38%), probiotics (18%) and bean (11%) were highlighted. Only 59% knows what a vegetarian food is. When asked about cheeses, 60% stated that not all cheeses can be considered as healthy, then, depending on the type of cheese, but 40% eat some sort of cheese daily.

About the attributes that must be observed in the cheese’s choice, being able to select more than one option, 54% stated that the flavor is the most important, followed by “type cheese” (47%), “appearance” (22%) and “sodium/salt amount” (22%). Regarding the types of cheese mostly consumed: minas cheese (63%) and mussarela (54%). Finally, participants were asked about the possible consumption of vegetable “cheese”, and 73% stated that they would like to try the product.

In relation to the questionnaire for the vegetarians, there was 102 interviewers with ages between 18 and 61 years old, being 45% egg lactovegetarians, 47% strict vegetarians, 3% lactovegetarians and 5% egg vegetarians. Those results are similar to others found in studies, confirming the predominance of egg lactovegetarians in the Brazilian population.<sup>40-42</sup>

All further sentences permitted the selection of more than one option. When asked about what food they consider the greater source of protein of the vegetarian diet, 84% stated legume, being the black bean the most consumed (83%), followed by chickpea (69%), lentil (52%), soy (35%), pea (26%) and white bean (18%). However, when asked about the products source of protein mostly consumed, pea protein (43%), mushrooms (34%), tofu (32%) and food type “cheese” (23%) were cited. National and International Food Guidelines highlights the importance of the legume consumption as source of protein for the vegetarian population;<sup>1,9,19</sup> but, mushrooms, contrary to what many people believe, are not considered protein source.<sup>43</sup>

Data obtained in the online questionnaires indicate that a product important to vegetarians is the food type “cheese”, and that the main source of proteins is the bean, despite the little consumption of white bean by participants. Besides this data, there is the fact that no vegetarians (omnivores) would like to try a vegetable product type “cheese”. Thus, the elaboration of food type “cheese” based on a legume not much known as the white bean is interesting for the vegetarian market growth.

### *Acceptance of the food type “cheese” added of inulin*

The means of the responses of the acceptance test of the sensory analysis of the type “cheese” of white bean added of inulin are presented in Table 4. Results demonstrated that there was no significant difference in a level of 5% of significance for none of the attributes evaluated, despite sample FQF15, with the highest inulin concentration, showing the highest mean for overall liking. It is suggested that, due to the sweet taste of the inulin, the bitterness and the residual flavor of the products might be masked.<sup>21,44</sup> Inulin addition in

products, with the purpose of taking advantage of its technology proprieties, have influenced positively on their sensory characteristics.<sup>32-35</sup>

**Table 4.** Means of the scores of the assessors for the liking attributes of products type "cheese" with inulin concentrations of 5, 10 and 15 g, respectively, using the hedonic scale of 5 points. Rio de Janeiro-RJ, 2021.

Caracteristics	FQF5	FQF10	FQF15
Appearance	3.41±1.02 <sup>a</sup>	3.54±0.98 <sup>a</sup>	3.31±1.21 <sup>a</sup>
Color	3.27±1.23 <sup>a</sup>	3.32±1.16 <sup>a</sup>	3.37±1.14 <sup>a</sup>
Texture	3.66±1.13 <sup>a</sup>	3.63±1.10 <sup>a</sup>	3.61±1.11 <sup>a</sup>
Bitter taste	3.65±1.03 <sup>a</sup>	3.54±1.14 <sup>a</sup>	3.40±1.32 <sup>a</sup>
Cheese aroma	2.92±1.23 <sup>a</sup>	2.95±1.32 <sup>a</sup>	2.87±1.28 <sup>a</sup>
Bean aroma	3.05±1.17 <sup>a</sup>	3.11±1.32 <sup>a</sup>	2.84±1.15 <sup>a</sup>
Cheese flavor	2.95±1.02 <sup>a</sup>	3.01±1.28 <sup>a</sup>	2.91±1.38 <sup>a</sup>
Bean flavor	3.14±1.23 <sup>a</sup>	2.97±1.26 <sup>a</sup>	3.04±1.22 <sup>a</sup>
Salty taste	3.81±1.03 <sup>a</sup>	3.73±1.11 <sup>a</sup>	3.70±1.08 <sup>a</sup>
Residual flavor	3.28±1.17 <sup>a</sup>	3.33±1.22 <sup>a</sup>	3.35±1.02 <sup>a</sup>

Mean and SD – standard deviation of the samples of the FQF – Food type "cheese" with White bean and percentages referring to inulin concentration. \*there was no significant difference between samples.

Source: Authors (2021).

The color is one of the attributes that could have been influenced because of the inulin concentration. But no effect of such concentration was observed. It is well know that the color is one of the sensory propriety most important, and many times the color and the flavor are directly related, since the appearance of the food is what ensures the consumption initiative.<sup>45</sup>

One of the characteristics of the legume is to confer greater hardness, firmness and chewiness to the preparations.<sup>46,47</sup> In regard to the texture, it is a determinant factor for the quality of the product. The sample with the addition of 5 g (FQF5) was the one that showed the greater mean for the attribute; thus, it would be the one that the consumers liked most based on this attribute. However, there was no statistic significant difference between samples.

In relation to the bitter taste, it was proportional to the residual flavor. It is known that the bitter and the residual flavors are directly related, due to the lipid oxidation; and the inulin, by its sweet taste, it could dissimulate the legume's flavor.<sup>48,49</sup>

*Nutritional information of commercial foods type "cheese" for vegetarians*

The nutritional information values of the commercial foods type "cheese" for vegetarian are shown in Table 5. In Table 6, the variation of nutrients available on the labels of the commercial products type "cheese" is presented. In Table 7 there is a list of ingredients available on the labels of the commercial products type "cheese".

**Table 5.** Nutritional information values of commercial food type "cheese" addressed to vegetarians. Rio de Janeiro-RJ, 2021.

Cheese type	Brand	Energy value (kcal/100g)	Carbohydrate (g/100g)	Protein (g/100g)	Total fat (g/100g)	Saturated fat (g/100 g)	Trans fat (g/100g)	Fiber (g/100g)
Cheddar	A	248.00	19.00	3.50	17.40	10.00	0.30	1.60
Cheddar	B	299.00	21.50	4.60	21.80	13.90	1.60	1.30
Catupiry	C	240.00	6.67	2.00	20.00	3.33	0.00	1.67
Minas frescal	D	273.33	25.00	4.00	22.33	3.67	0.00	8.33
Minas standard	D	273.33	25.00	4.00	22.33	3.67	0.00	8.33
Parmesan vegan	E	350.00	28.00	0.00	26.00	13.00	0.00	0.00
Provolone vegan	C	143.33	4.00	2.67	14.00	13.67	0.00	0.67
Parmesan vegan	C	394.00	23.00	13.00	31.00	0.00	0.00	3.00
Chèvre	C	1396.67	18.00	9.67	28.33	0.00	0.00	1.67
Mussarela	C	196.67	6.67	3.00	18.67	0.00	0.00	0.67
Cheddar	E	296.67	21.33	0.00	23.33	10.33	0.00	0.00
Prato	E	296.67	21.33	0.00	23.33	10.33	0.00	0.00
Mussarela	E	296.67	21.33	0.00	23.33	10.33	0.00	0.00
Prato	F	361.87	18.53	3.57	22.45	7.09	0.15	2.09

Source: The authors, based on package labels.

**Table 6.** Variation of nutrients available on commercial food label type "cheese" addressed to vegetarians (n=14). Rio de Janeiro-RJ, 2021.

Analysis	Mean± Standard deviation	Variation (min - max)
Energy value (kcal/100g)	361.87±886.25	143.33 – 1396.67
Carbohydrate(g/100g)	18.52±16.97	4 – 28
Protein (g/100g)	3.57±9.19	0 – 13
Total fat (g/100g)	22.45±12.02	14 – 31
Saturated fat (g/100g)	7.09±9.83	0 – 13.9
Trans fat (g/100g)	0.15±1.13	0 – 1.6
Fiber (g/100g)	2.09±5.89	0 – 8.33

Source: The authors, based on package labels.

**Table 7.** Ingredients' list available on commercial food type "cheese" labels addressed to vegetarians. Rio de Janeiro-RJ, 2021.

Cheese type	Brand	Ingredients
Cheddar	A	water, potato starch, non-hydrogenated vegetable fat (sustainable palm), soy protein, thickening: carragenin, alfarroba gum; yeast extract, vegetable oil (colza), salt, natura aroma, calcium fosfate, natural color: carotene
Cheddar	B	Water, oils and non-hydrogenated vegetable fat (coconut, sunflower oil), potato starch, fruit juice, rice flour, yeast, peanut butter (100% almonds), gross salt, flavouring (vegetable), biding (carragenin), spices, antioxidant (ascorbic acid), coloring (turmeric, beta-carotene).
Catupiry	C	Water, cashew nut, coconut oil palmiste, manioc starch, lime juice, marine salt and xantan gum.
Minas frescal	D	Water, cashew nut, modified potato starch, extra virgem oil coconut, Himalaia salt, yeast extract, vitamins (B6 and B12), stabilizers: gums carragena and alfarroba, natural flavoring, thickening: mono and diglycerids and acidulant: latic acid (vegan).
Minas standard	D	Water, cashew nut, modified potato starch, extra virgem oil coconut, Himalaia salt, yeast extract, vitamins (B6 and B12), stabilizers: gums carragena and alfarroba, natural flavoring, thickening: mono and diglycerids, acidulant: latic acid (vegan) and natural coloring: turmeric and urucum.
Parmesan	E	Water, potato starch, palm vegetable oil, carrot, apple and pumpkin concentrates, low-sodium salt, parmesan vegan cheese aroma.
Provolone	C	Cashew nut, water, coconut oil, nutritional yeast, liquid smoke, marine algae extract, sweet manioc flour, cultures, and salt.
Parmesan vegan	C	Cashew nuts, filtered water, coconut oil, nutritional yeast, cultures, and salt.
Chèvre	C	Cashew nuts, filtered water, coconut oil, cultures, and salt.
Mussarela	C	Cashew nuts, filtered water coconut oil, nutritional yeast, liquid smoke, marine algae extract, sweet manioc flour, cultures, and salt.
Cheddar	E	Filtered water, potato starch, palm vegetable oil, carrot, apple and pumpkin concentrates, low-sodium salt, cheddar cheese aroma of high technology
Prato	E	Filtered water, potato starch, palm vegetable oil, carrot, apple and pumpkin concentrates, low-sodium salt, prato cheese aroma
Mussarela	E	Potato starch, palm vegetable oil, carrot, apple and pumpkin concentrates and low-sodium salt.
Prato	F	Vegetable cheese based on cashew nuts, type prato.

Source: The authors, based on package labels.

The raw materials that were mainly used for the vegetarian products' manufacturing were cashew and soy nuts, what had directly influenced the energy value of the product. The mussarela cheese showed the lowest value, 89 kcal, and the Chèvre cheese, with 1,397 kcal, the highest energy value (Table 5).

Regarding the protein, it varied from 2.0 to 13.0 g, while four foods type "cheese" (26.6%) did not show any amount of this nutrient, because they were not added of any protein ingredient. The protein amount of these foods must be taken into consideration once the consumer understand that these "cheeses" are source of proteins.

Carbohydrates vary from 6.2 g to 28.0 g and were directly influenced by the addition of starch in your composition. The starch is one of the main polysaccharides available in foods and of great technological importance, due to your capacity to retain water and, in situations of heating, form gel or conferring viscosity.<sup>50</sup> Such proprieties must be capable to explain the starch in the ingredients constantly present in ingredients of the analyzed products, by permitting that expected consistency and sensory characteristics for a product type "cheese" can be achieved.

Fibers varied from 0 to 8.3%. In general, all variations occurred due to the use of gums in the formulations, what allow the significant increase of this component important to reduce the risk of any chronic diseases development, such as diabetes, hypertension, coronary arterial diseases, and gastrointestinal disorders.<sup>37,51</sup> The formulations that had the highest amount of fibers had the addition of carrageenan and alfarroba gum. Those are soluble fibers that absorb or retain water, leading to the increase of the viscosity and thickening, configuring the gel formation. They are fermented in the gut by the microbiota, a process that interferes positively in the intestinal motility and the pH colon. Besides, there is the generation of subproducts that have important metabolic functions.<sup>37,51</sup>

In relation to the saturated fat, the amount varies in accordance with the stabilizers and addition of nuts. In agreement to the Food Composition Table, 100 g of cashew nuts have 7.7 g saturated fat. The "cheeses" that showed lower percentage of saturated fat, had in your composition cashew nut.<sup>43</sup>

Comparing the formulated product to the commercialized from the market ones, the formulations showed similar protein amounts, superior values towards the fibers' mean, lower fat amounts and values close to the mean found for the carbohydrates (Table 6). This demonstrates that they are an alternative for vegetarian and no vegetarian individuals, taking into consideration that the food type "cheese" formulated has its composition more balanced, showing higher nutritional quality, besides being a functional product.

It was observed that, since there is no specific legislation in Brazil for these products, there is a great variety of ingredients and, consequently, of nutritional value, what turns the products' choice, by the consumers, confusing and insecure. Additionally, products of the same brands change only the aromatizing/flavoring and use of different labels. Another possibility is that theses commercial labels are not correct, having the need to be checked, to ensure the consumers' choice power.

The information is a right enshrined by the Código de Defesa do Consumidor (Consumer Defense Code) (Lei Federal 8.078/1990) that, in this specific case, it is related mainly with the health's protection and the choice rights.<sup>52</sup> Therefore, it is necessary a proposition of labeling for vegetarian products that protects the consumer and at the same time be practical and accessible for the producer.<sup>52</sup>

Hence, the elaboration of the products with reasonable sensory characteristics and that may transmit to the consumer security for their choice is important. Moreover, the choice of the base of the vegetable food type "cheese" is essential to guarantee to the consumer a product with adequate sensory and nutrition characteristics for the incorporation in the healthy diet. In this context, with emphasis in the cheese

elaborated in this study, using white bean. Other studies, with the objective to enrich products increasing the nutritional value, with muffin added of bean,<sup>53</sup> bread without gluten with white bean powder<sup>54</sup> and vegetarian biscuits with white bean<sup>55</sup> were also carried out and presented the importance and the positive results of the usage of the white bean in products.

## CONCLUSIONS

Studies carried out demonstrated that it is possible to elaborate a food type “cheese” based on white bean added of inulin. Emphasis should be given to the fact that no addition of ingredients of animal origin permits that the vegetarian population can be reached, corresponding to the aim of the study.

Regarding the addition of inulin in the formulation, it was observed a significant increase of the fibers' amount, especially the soluble fibers, mostly when compared to other commercialized vegetable products.

In addition, the inclusion of prebiotic in food had as a result an improvement of the sensory profile, permitting greater variability in diets with functional food, rich in fibers and with proteins. Microbiological analysis of the foods type “cheese” showed that the consumption is safe, in the hygiene-sanitary point of view, and the inulin did not interfere on the analyzed parameters.

New studies with foods addressed to vegetarians, including research of labels that promote new proposals for the commercial labeling, capable of ensuring food and nutrition security of vegetarians.

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Espírito Santo AAA, Cravo CO, Lopes JCR, Oliveira TIS, Ayres EMM e Lima ECS participated in all stages, from the conception of the study to the revision of the final version of the article.

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