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Funding: This work was supported by the Fundo de Incentivo à Pesquisa [grant numbers FIPE-ARD 2021-UFSM and FIPE-JR 2021/UFSM, 2021].

Functional claim increases the acceptance of oat muesli by consumers

Alegação de propriedades funcionais aumentam a aceitação de um muesli de aveia por consumidores

Abstract

Background: Oats-based mueslis contain beta-glucans, a type of soluble fiber known for its hypocholesterolemic and hypoglycemic properties. The claim of these health benefits, oat muesli products may attract potential consumers. **Objectives:** This study aimed to assess the impact of a functional claim on consumers' acceptance and attitudes toward oat muesli. Additionally, the study evaluated the effects of muesli containing oats on satiety and mood perceptions. **Methods:** Two muesli products were formulated: one with oats and another with rice flakes (control) for sensory analysis. The oat muesli was presented with two codings (n=160): one with a functional food claim and another without the claim. Consumers were asked about their liking, interest in usage, and perceived benefits before and after tasting the mueslis using hedonic scales. Furthermore, a clinical trial was conducted with 9 healthy adult women subjects (average age 22 years) in a crossover design with a one-week washout period between interventions. The subjects completed a self-perceived mood and satiety questionnaire using visual analog scales (VAS) at baseline and 240 minutes after consuming the mueslis for breakfast. **Results:** The oat muesli with the functional claim was perceived as the most beneficial product among the samples (p<0.05), receiving high scores for liking and interest in use. However, oat muesli consumption did not significantly influence participants' average mood and satiety during the trial (p>0.05), as no significant differences between interventions were found. **Conclusion:** The inclusion of a functional claim positively affected the acceptance of the health benefits associated with oat muesli.

Keywords: Beta-glucans. Consumer behavior. Functional food. Appetite. Functional claim. Oat

Resumo

Introdução: Mueslis de aveia contêm betaglicanas, uma fibra solúvel com propriedades hipocolesterolêmicas e hipoglicêmicas. Os benefícios do muesli de aveia podem ser alegados em produtos para atrair potenciais consumidores. **Objetivos:** Este estudo avaliou a influência de uma alegação funcional na aceitação de um muesli de aveia. Além disso, avaliou-se o efeito da aveia do muesli sobre as percepções de saciedade e humor. **Métodos:** Formularam-se dois produtos: muesli de aveia e muesli de flocos de arroz (controle), para a realização do estudo. Para os testes sensoriais, o muesli de aveia foi apresentado com duas codificações: uma com alegação de alimento funcional e outra sem alegação. Aos consumidores (n=160) foram abordadas questões sobre gosto, interesse de consumo e benefício antes e depois da degustação do mueslis, utilizando escalas hedônicas. Para entender os efeitos do muesli na saciedade e humor, foi realizado um ensaio clínico com 9 mulheres adultas saudáveis (aproximadamente 22 anos). Um delineamento crossover foi usado, com um período de washout de uma semana entre as intervenções. Os

indivíduos preencheram um questionário de humor e saciedade usando escalas analógicas visuais antes e após consumir o mueslis no café da manhã. **Resultados:** O muesli de aveia com alegação foi apontado como o produto mais benéfico entre as amostras ($p < 0,05$), apresentando maiores escores para gosto e interesse de uso. O consumo de muesli de aveia não influenciou o humor e a saciedade dos participantes pois não foram encontradas diferenças significativas entre as intervenções ($p > 0,05$). **Conclusão:** A alegação funcional influenciou a aceitação dos benefícios do muesli de aveia para a saúde dos consumidores.

Palavras-chave: Beta-glucanas. Comportamento do Consumidor. Alimento funcional. Apetite. Alegação de Propriedades Funcionais. Aveia.

INTRODUCTION

The consumption of food that promotes satiety and well-being has been encouraged, as those feelings are important targets for controlling appetite and energy intake.^{1,2} However, the lack of options for a variety of functional food available in the market, leads industries to the need for innovation and consumers to search for new products.

Muesli is a Swiss meal based on cereals, seeds, and dried fruits, added to a dairy drink, and studied for its role in improving satiety.³ When made of oats or rye, muesli could be considered a source of soluble fibers, such as beta-glucan,⁴ which are linked to hypoglycemic effects in both diabetic and healthy subjects,³ as well as to hypocholesterolemic properties, with a reduction in the LDL-cholesterol.⁵ The functional properties of the beta-glucans present in oat could be claimed on their product labels, to favorably impact the perception and attitudes of consumers toward them.⁶

The consumer's attitude is influenced by several factors related to it, such as gender, age, and education, factors related to the product, such as healthiness, familiarity, and label, or the context in which it operates.⁷⁻⁹ When a product has a functional property claim, it generates a different effect on the perception of potential consumers, so that they pay more attention to the beneficial values inherent to these products (utility factor) than to sensory, or hedonic factors, such as taste and appearance.^{7,10-12} However, not all consumers can understand the utilitarian factor of functional products to enjoy their benefits. Potential consumers of foods with functional properties are usually those reasonably well-informed, observant, and circumspect regarding social, cultural, and linguistic factors, which comprise functional claims, the so-called "average consumers".^{13,14}

In this sense, it is necessary to understand the degree of influence of the functional property claim and hedonic factors on the attitude of potential consumers of functional foods. Therefore, this study aimed to evaluate the influence of the functional claim of oat muesli on the acceptance and attitudes of consumers. Furthermore, subjective perceptions of satiety, mood, and well-being were assessed after oat muesli consumption.

METHODS

The study was organized in two phases. In the first phase, two muesli formulations were elaborated, and sensory analysis was carried out. In the second phase, crossover, and randomized controlled clinical trial was performed.

The present study was approved by the Human Research Ethics Committee at UFSM (CAAE: 11672919.2.0000.5346; and 26492719.8000.5346), and UFPEL (CAAE 78603517.2.0000.5316).

Formulations

Two mueslis were prepared: one with oats, based on popular Swiss muesli, and a second with rice flakes (control), as follows: The dry ingredients (Table 1) were weighed and mixed homogeneously. Twenty minutes before serving, the wet ingredients were added (Table 1), to soften the grains. The formulations were adjusted to a similar amount of ingredients, providing from 3 to 3.5 g of beta-glucans per serving

Table 1. Muesli formulations. Palmeira das Missões, RS, Brazil, 2019.

Ingredient	Oat Muesli		Control Muesli	
	(g)	%	(g)	%
<i>Dry ingredient</i>				
Oat flakes	50	24.2	-	
Rice flakes	-	-	50	24.9
Pumpkin seeds (shell-less)	15	7.3	15	7.2
Brown flaxseed	10	4.8	10	4.8
Flame raisin	15	7.3	15	7.2
Cinnamon powder	1.5	0.7	1.5	0.7
<i>Wet ingredient</i>				
Honey	15	7.3	15	7.2
UHT whole milk	100	48.4	100	48.00
Total (serving)	206.5	100	206.5	100

Sensory tests

For the sensory tests, 160 consumers were recruited. The sample included students and employees of two Federal Universities. The inclusion criteria were adults aged between 18-60 years, and the exclusion criteria were smoking and veganism. For the sensory analysis tests, oat muesli received two random three-digit encodings, and rice flakes muesli only one encoding; totaling 3 samples: 1) rice flakes (control) muesli without claim, 2) oat muesli without claim, 3) oat muesli with claim (Table 2). The tests took place in individual booths, where approximately 20 g of each sample was given to the consumer, presented simultaneously in a randomized order, under white light, at room temperature (around 25 °C). The sensory test design was based on a previous study,⁶ and the claim of product functionality following Brazilian regulations for functional foods (www.gov.br/anvisa).

Table 2. Muesli samples and health claim. Palmeira das Missões, RS, Brazil, 2019.

Code	Ingredients	Health Claim
726 (Control Muesli)	Contains rice flakes, pumpkin seeds, brown flaxseed, raisins, cinnamon powder, honey, and milk	None
831 (Oat Muesli)	Contains oat flakes, pumpkin seeds, brown flaxseed, raisins, cinnamon powder, honey, and milk	None
904 (Oat Muesli)	Contains oat flakes, pumpkin seeds, brown flaxseed, raisins, cinnamon powder, honey, and milk	"This product regulates the levels of cholesterol, glucose, and the bowel function".

Before the sensory assessment, participants answered questionnaires about gender, age, schooling, lifestyle, and consumption frequency of whole-grain products. The attention levels to health regarding cholesterol, glucose, and intestinal health were assessed using a 9 cm unstructured scale anchored by the extremes "do not pay attention at all" and "I pay extremely much attention". Then, in the sensory analysis, the consumer was asked about how much they liked, their interest in consumption, and their perception of the benefits of the product, before and after consuming the samples. All sensory tests were performed using a 9 cm unstructured hedonic scale anchored of extremes of "not at all" and "extremely much". Before consumption, consumers were aware of the ingredient list of the samples.

Clinical trial

A clinical trial was conducted with 9 female subjects (aged 21.63 ± 1.99 -years-old), adults, with no history of any disease, with BMI between 20 to 29.9 kg/m^2 and blood pressure between 120/80 mmHg to 90/60 mmHg (Table 3).

A crossover design was used with a 1-week washout period between interventions.¹⁵ Twelve subjects were recruited, 11 joined the study, but only 9 completed the experiments. Subjects attended the Laboratory of Sensory Analysis 2 times within 2 weeks. On the night (09:30 pm) before each experimental day, the volunteers ate a standardized amount of white bread. After that, at 10:00 pm, they started a 10-hour fasting period until they arrived at the investigation unit (at 7:45 am) in the morning. Soon after arrival, blood pressure, body weight, and height were measured (Table 3), and participants returned food diaries for the preceding 48h. Before consumption, subjects were aware of the ingredient list of the two samples as shown in Table 2. In addition, for this analysis, the participants were not exposed to health claims and only ate two samples: the control muesli and the oat muesli.

Table 3. Average health parameters of participants before each intervention in the clinical study (N=9)*. Palmeira das Missões, RS, Brazil, 2019.

Characteristic	Mean \pm Standard deviation	
	Control	Oat Muesli
Height (m)	1.64 ± 0.07	1.64 ± 0.07
Weight (kg)	62.79 ± 10.77	62.63 ± 10.76
BMI (kg/m^2)	23.18 ± 2.99	23.12 ± 2.96
Blood pressure (systolic)	109 ± 6.91	113 ± 8.28
Blood pressure (diastolic)	71 ± 5.10	71 ± 5.75
Heart rate (bpm)	71 ± 13.60	79 ± 11.39

* All participants were female, aged 21.62 ± 1.99 years old.

A self-perceived mood questionnaire, using 100 mm visual analog scales (VAS), was applied at baseline and repeated 30, 90, 180, and 240 min after consuming the formulations. The average mood was calculated as follows: Average Mood (mm) = [mental alertness + happiness + calmness + concentration capability + energy + (100 – sadness) + (100 – tenseness) + (100 – effort) + 198 (100 – weariness) + (100 – sleepiness)]/10.

Subjective signs of appetite were also assessed using 100 mm VAS at baseline and after consuming the formulations (15, 30, 60, 90, 120, 180, and 240 min) for breakfast. Participants consumed the muesli servings (Table 1) within 10-15 minutes (8:00 am). In addition, a palatability questionnaire was carried out using a 100 mm VAS that assessed the following items: pleasure in consumption, portion, acceptance, appearance, aroma, taste, palatability, aftertaste, thirst, and nausea. The average satiety (mm) was calculated = [(100-hunger) + (100-desire to eat) + fullness + satiety + (100 - prospective consumption) + (100-thirst)] /

Statistical analysis

The results of the sensory and satiety/mood analysis that had the treatment and time variables were submitted to two-way ANOVA and Bonferroni; or when they presented only the treatment variable, they were analyzed by the Student's *t*-test, or one-

way ANOVA, always using $p < 0.05$. All statistical analyzes were performed using GraphPad Prism software version 5.0 (GraphPad Software, Inc. La Jolla, CA, USA).

RESULTS

Sensory tests

The average age of consumers in the first phase of the study was 24.99 ± 8.67 years old. Most participants were female and had between 12 and 16 years of schooling (Table 4).

Table 4. Characteristics of participants of the sensory tests, consumption habits, and health care. Palmeira das Missões, RS, Brazil, 2019.

Characteristic		N	%
Gender	Female	117	73.13
	Male	43	26.88
Years of study	0-12	8	5.00
	12-16	127	79.38
	17 or more	25	15.63
Whole grains Consumers	Regular consumer	100	62.50
	Not regular	60	37.50
Consumption frequency	>3x/week	34	21.25
	2-3x /week	42	26.25
	1x/week	29	18.13
	1-2x/month	35	21.88
	Rarely	20	12.50
Knowledge of muesli	Didn't know	105	65.63
	Knew	55	34.38
Parameter		Mean	Standard Deviation
Attention to health (score)	Cholesterol	7.76a	1.76
	Glucose	7.84a	1.71
	Gut health	7.72a	1.59

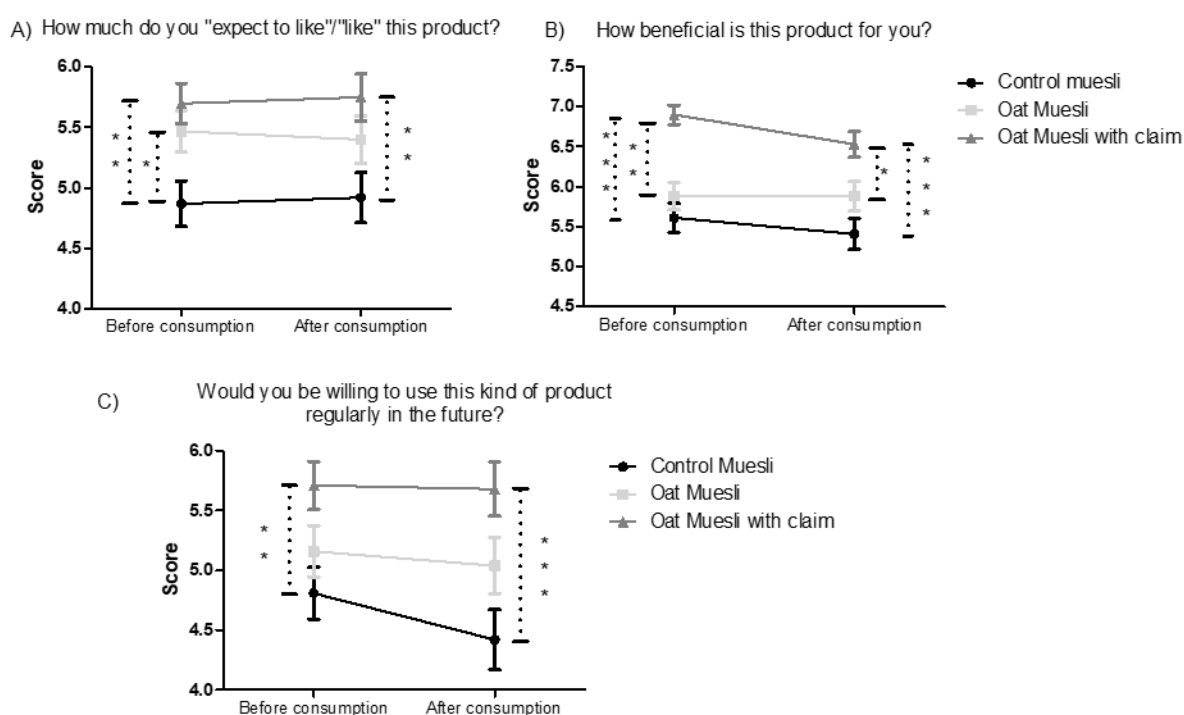
The same letter indicates non-statistical differences among the values of attention to health analyzed by one-way ANOVA ($p > 0.05$)

There were no differences among the scores given to attention to cholesterol, glucose levels, or gut health ($p > 0.05$) (Table 4). The mean score obtained was approximately 8 for all health parameters, which is a satisfactory care score.

The results of the consumer profile questionnaire showed that regarding the intake of whole-grain products, most consumers declared themselves as regular consumers. However, the frequency of consumption was considered low, as only 34 participants (21.25%) consumed whole grains more than three times a week (Table 4). Regarding knowledge about muesli, for 105 participants (65.6%), the product was considered unknown.

Consumers attributed scores between 4 and 7 to the 3 samples of muesli for the judgments of liking, perceived benefits, and interest in use before consuming them (Figure 1). Regarding how much they expected to like the mueslis, the two oat samples had better score compared to control muesli, both before and after tasting ($p<0.05$). Regarding the perception of benefit, the oat sample with claim had higher scores than the others, before and after consumption ($p<0.05$; Figure 1). The interest in consumption was greater in oat muesli with the claim before and after tasting ($p<0.001$).

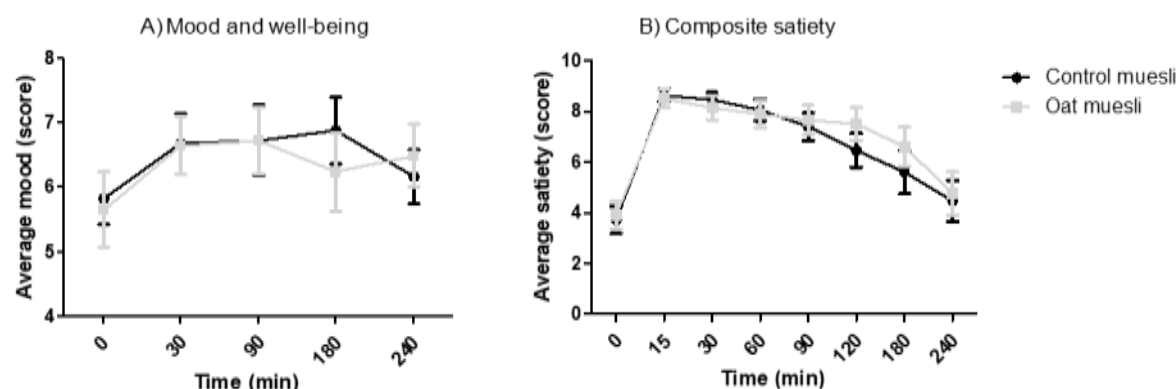
Figure 1. Liking (A), benefits (B), and interest in use (C) of muesli formulations with or without oats, or claim, before and after tasting. *Indicates significant difference among the samples * $p<0.05$; ** $p<0.01$; *** $p<0.001$; according to the two-way ANOVA and Bonferroni tests; N=160.



Clinical trial

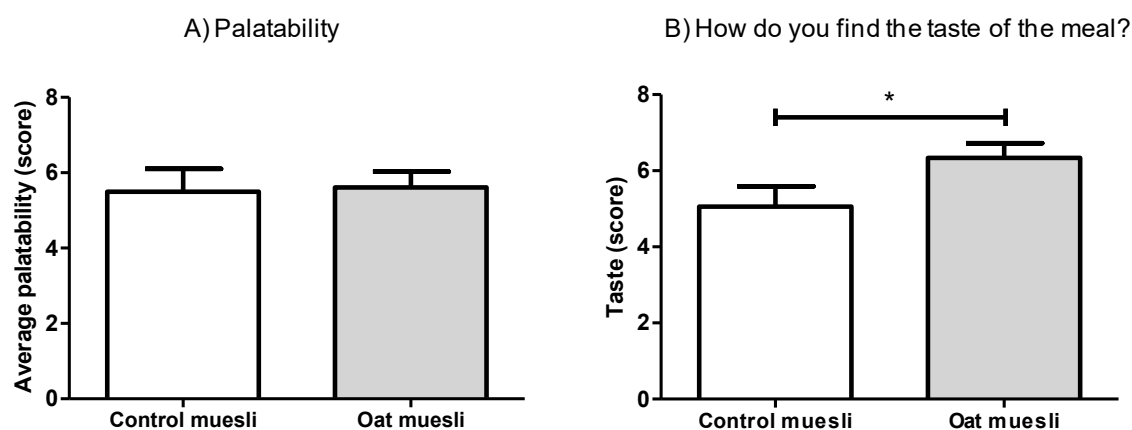
Perceived mood and satiety results showed that eating the serving of the muesli products at breakfast improved average mood (mean score range 5.6 to 6.9) and average satiety (mean score range 3.7 to 8.6) of the participants during the postprandial period ($p<0.05$), but there were no significant differences for the intervention and interaction between the variables ($p>0.05$), as shown in Figure 2.

Figure 2. Average mood and satiety after consuming muesli formulations by healthy subjects using 10cm visual analog scales (VAS). There were no statistical differences according to the two-way ANOVA and Bonferroni tests; N=9.



The palatability questionnaire showed no significant differences among mueslis for the average palatability. However, when asked how the volunteers find the taste of the meals, the subjects of the clinical trial scored a lower rate for the control muesli compared to the oat muesli ($p < 0.01$), as shown in Figure 3.

Figure 3. Average scores of responses to the palatability questionnaire after consumption of mueslis formulations. A) Average palatability; B) Taste. * Indicates statistical difference according to Student's *t*-test ($p < 0.05$), N= 9.



DISCUSSION

The present study showed the influence of functional property claims on consumers' attitudes. The results of the sensory analysis demonstrated that the utilitarian values of the products are more important for the consumers than the hedonic factors.

In this study, it was noticed that the functional property claim influenced the perceived benefit of the oat muesli. One of the hypotheses for this finding is that the study was composed mostly of women, and they are more concerned with the healthiness of foods than men, being potential consumers of functional foods.^{7,16,17} Furthermore, as all participants gave high scores for healthcare levels concerning blood glucose, bowel health, and cholesterol, oat muesli claims related to these parameters were expected to influence the judgment (Table 4).

Participants had mostly 12-16 years of schooling, which is more than the Brazilian average (<<https://ourworldindata.org/grapher/mean-years-of-schooling>>), being considered potential average consumers, which influences the level of understanding of the claim of functional property.^{13,14,16}

Even though the consumers read the ingredients of what they were eating, they two identical products differently, due to the presence of a claim in one of them. As such, consumer reliance on claims of functional product ownership can also lead consumers to error. This study contributes to the reflection on the vulnerability of consumers in reading, identifying, and correctly understanding product labels with functional properties.^{7,18,19} Previous studies demonstrated that consumers believed that the claim could improve the quality of their dietary choices.²⁰⁻²² Therefore, it is important to understand how the functional food market uses functional property claims in a way that benefits consumer understanding, ensuring label reading that influences them to make healthier choices.

The higher interest in consuming muesli with a functional property claim by the consumers showed the value of claims for the consumption of functional products. The sensory experiences were also important for the interest in oat muesli in this study since oat is already known as healthy food, facilitating lower interest in the consumption of the control muesli. The regular consumption of whole grains (62.5% of the participants) and better taste, may also have influenced the choice of oat muesli.^{12,20} As well as noticed in the clinical trial by the volunteers, a pilot study showed better acceptance of oat muesli in comparison to rice flakes muesli (data not shown) when sensory attributes (appearance, aroma, flavor, texture, overall impression) were investigated.

The clinical study showed that there were no significant differences regarding intervention nor significant interaction between time and intervention. One of the hypotheses for this finding of mood was that the researchers did not control the environment in which the participants were in the postprandial period. Ideally, these participants should be isolated during the hours of investigation.² Despite this, the result is interesting to simulate the reality of the participants' routine.

Another hypothesis that explains the non-difference of subjective mood according to the intervention refers to the mechanism of action of dietary fibers on mood. The fermentation process of dietary fibers in the intestine leads to a selection and greater diversity of the intestinal microbiota, which will act in the production of serotonin, improving mood and promoting well-being.²³ However, such an effect is linked to regular consumption, so that, over a longer period, the interaction of dietary fibers with the gut microbiota promotes a change in mood.^{24,25}

As much as the participants declared themselves consumers of whole grains, most of them had a low frequency of consumption (Table 4). Therefore, this interaction in a short-term intervention with dietary fiber-rich foods did not generate different physiological responses expected for the consumption of oat, when compared to the rice muesli. Perhaps, a long-term study would bring more results in this regard to understand the effect of beta-glucans present in muesli.^{26,27}

A study carried out in Sweden showed that 4 g of beta-glucan in oat muesli would be a critical dose for a significant decrease in glucose and insulin responses in healthy people.³ The mechanism behind this effect would be the ideal increase in viscosity of the intestinal lumen by beta-glucan, which would lead to prolonged digestibility and absorption of carbohydrates, increasing satiety. Therefore, it is recommended to increase the amount of oats in the portion offered, since the amount of beta-glucans in this study was estimated at approximately 3.5g, according to studies on oats produced in Brazil,^{28,29} and might not have been enough to promote satiety.

Another hypothesis that explains the non-difference in the satiety response would be the lack of familiarity with muesli among Brazilians. Only 34.38% of participants in the first stage of this study knew the product. This is important because familiarity with the food results in a greater perception of benefit in physiological responses.³⁰

The other muesli ingredients, such as milk and seeds, influence satiety,²⁷ and only replacing one ingredient (oats) in an acute intervention was not enough to generate different responses between control and oat mueslis.²⁷ It is known that milk proteins increase satiety when consumed alone, or with carbohydrates.^{2,31} Also seeds and fiber-rich ingredients of muesli could increase carbohydrate absorption time, acting to increase satiety.^{32,33}

In addition, the serving size for all products was perhaps larger than what they were used to and therefore there were no significant differences between interactions. After consumption, the volunteers found it moderately difficult to consume the serving size of the muesli offered in the palatability questionnaire (mean score 6.3-6.4; $p>0.05$). Also, some volunteers verbally reported that they had difficulty finishing the portions. A study that considers individualized portions could elucidate this issue.

The present study showed promising prospects concerning the market for products with functional value, such as oat muesli. The functional food market should exploit better the claims of functional property to promote healthier eating, as consumers care about utilitarian product factors, while also considering hedonic characteristics. As such, the results raise the need for surveillance of functional claims on packaging by regulatory agencies, as this can be misleading for consumers. The need for nutritional education of consumers is perceived, so that they know the ingredients that attribute functionality to the products, as well as that they get used to understanding the nutrition facts and ingredients list of a product.

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Contributors

Miranda KS and Rodrigues J participated in the analysis and interpretation of data, review and approval of the final version; de Quadros EB and Lemos participated in the analysis and interpretation of data, revision and approval of the final version; Maievas HA participated in the review and approval of the final version; Batista AG participated in the conception and design, analysis and interpretation of data, revision and approval of the final version.

Conflict of Interest: The authors declare no conflict of interest.

Received: July 1, 2023

Accepted: July 13, 2023