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Elaboração e avaliação da composição química, física e sensorial de barras alimentícias adicionadas de proteína do soro do leite *(Whey Protein)*

Porto Alegre, 2016

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Trabalho de conclusão de graduação apresentado ao Curso de Nutrição da Universidade Federal do Rio Grande do Sul, como requisito parcial para obtenção do grau de Bacharel em Nutrição

Orientadora: Profª. Drª.Viviani Ruffo de Oliveira

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RESUMO

O soro do leite é a porção aquosa formada durante a coagulação da caseína de leite e suas proteínas têm importantes propriedades nutricionais e tecnológicas que podem ser exploradas em alimentos. O objetivo deste estudo foi elaborar formulações de barras alimentícias e analisar características químicas, físicas e sensoriais para verificar as implicações da adição de proteína do soro nesse produto. Foram elaboradas três formulações com diferentes concentrações de *whey protein* (T1- 0%, T2- 25% e T3- 50%) que foram avaliadas juntamente com uma barra alimentícia industrializada (T4- I). Os resultados mostraram que adição de proteínas de soro aumentou a altura pós cocção, dureza e luminosidade. Quimicamente, a adição de proteínas de soro de leite aumentou o teor de umidade, proteína e conteúdo total de aminoácidos das barras. A análise sensorial mostrou que os avaliadores perceberam que a maior concentração de proteína do soro do leite impactou na aparência e na cor em comparação com as formulações elaboradas, no entanto, T4 foi a melhor avaliada em relação a intenção de compra e alcançou maior índice de aceitabilidade, provavelmente porque os avaliadores estão mais acostumados com características de produtos industrializados. A adição a proteína de soro de leite melhorou a composição química das barras de alimentos, mas sensorialmente apenas atingiu “gostei moderadamente”.

PLAVRAS-CHAVE: *proteína do soro do leite; barras alimentícias; elaboração de formulação; propriedades físicas e químicas; análise sensorial.*

ABSTRACT

Whey protein is an aqueous portion formed during coagulation of milk casein that has important nutritional and technological proprieties that could be explored in different types of food. The objective of this study was to develop formulations of food bars and perform chemical, physical, and sensorial analyses to assess their quality and the implications of whey protein (WP) addition to this product. There were elaborated three whey protein formulations (T1- 0%, T2- 25% and T3- 50%) that were tested along with an industrialized bar sample (T4- I). The results showed that addition whey protein increased height after baking, hardness and lightness. In relation of chemical composition, the addition of whey protein increased the moisture, protein, and total amino acid content of the bars. Sensory analysis showed that the judges noticed that the highest concentration of whey protein had an impact in appearance and color. However, industrialized bar sample had the best evaluation in terms of purchase intention and acceptability, probably because the judges are more accustomed with characteristics of industrialized products. Adding whey protein improves the chemical composition of food bars but in the sensorial assessment the formulation only achieved “slightly liked”.

KEYWORDS: *whey protein; food bars; elaboration of formulation; physical and chemical properties; sensory analysis.*

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1. INTRODUÇÃO

O soro do leite é a parte aquosa que se forma durante a coagulação da caseína do leite no fabrico de queijo ou no fabrico de caseína e representa de 80 a 90% do volume total do leite utilizado durante a produção de queijos (ALVES et al., 2014; GUIMARÃES; TEIXEIRA; DOMINGUES, 2010).

As principais proteínas do soro são: α-lactalbumina (20-25%), β-lactoglobulina (50–55%), imunoglobulina (10–15%) e o glicomacropeptideo (10–15%). Em menor quantidade, mas com aplicações comerciais importantes, estão a lactoferrina (1–2%) e a lactoperoxidase (0,5%) (HARAGUCHI; ABREU; PAULA, 2006).

Quimicamente, as proteínas do soro apresentam quantidades expressivas de cálcio e, segundo Etzel (2004), os teores de leucina, isoleucina e valina (BCAA), e de quase todos os aminoácidos essenciais estão superiores de acordo com as recomendações, exceto pelos aminoácidos aromáticos fenilalanina e tirosina, fornecendo às proteínas do soro importantes propriedades nutricionais (HARAGUCHI; ABREU; PAULA, 2006; SGARBIERI, 2004).

Industrialmente, observam-se importantes propriedades tecnológicas devido à funcionalidade das proteínas, que são classificadas em 3 grupos: a) propriedades de hidratação, depende de interações proteína – água, que influenciam a solubilidade, a viscosidade, a absorção e retenção de água; (b) propriedades de emulsificação e características de formação de espuma; (c) propriedades de geleificação e agregação, que estão relacionados com as interações proteína-proteína (BOUAOUINA et al., 2006). Entretanto, em temperaturas acima de 70°C as proteínas são irreversivelmente alteradas, sendo desnaturadas e tonando-se insolúveis. Em temperaturas entre 100°C e 150°C ocorrem reações como a de Maillard, onde há o escurecimento não enzimático, bem como o prejuízo às funcionalidades das proteínas (ARAÚJO et al., 2014; WIT, 1998; WIT; KLARENBEEK, 1984). O reconhecimento disso tem contribuído para o aumento de pesquisas na área de ciência dos alimentos (CHEN; REMONDETTO; SUBIRADE, 2006).

Estudos vem evidenciando que as proteínas do soro do leite, também conhecidas como *whey protein, são* um dos suplementos mais utilizado por praticantes de atividade física, mas que a maioria deles não possui acesso a informações sobre o uso correto e acabam utilizando de maneira errada e exagerada,

além de que muitas vezes acabam se privando do prazer sensorial, apenas diluindo o suplemento em água ou leite (BERTULUCCI et al., 2010; CORREA; NUNES, 2013; PEREIRA et al., 2009).

Barras alimentícias são amplamente consumidas e aceitas e esse mercado tem aumentado muito nos últimos anos, principalmente devido à grande preocupação dos consumidores com a saúde. Dessa forma, a adição de proteínas do soro do leite nesses produtos parece ser uma alternativa para tornar o consumo destas proteínas mais prático e sensorialmente mais agradável, considerando seu efeito positivo nas características químicas, físicas e sensoriais de produtos de panificação no geral (BOUSTANI; MITCHELL, 1990; CHAVAN et al., 2015; CORREA; NUNES, 2013). Sendo assim, estudos são necessários para avaliar a viabilidade da adição de proteínas do soro em barras alimentícias, a análise sensorial seria de suma importância para constatar, ou não, se as formulações desenvolvidas seriam promissoras, enquanto as análises químicas e físicas permitiriam avaliar as implicações decorrentes da adição de proteína do soro.

2. OBJETIVOS

2.1 OBJETIVOS GERAIS:

- ✓ Avaliar a viabilidade de se elaborar barras alimentícias com diferentes concentrações de proteínas do soro do leite, além de analisar química, física e sensorialmente as formulações desenvolvidas.

2.2 OBJETIVOS ESPECÍFICOS**:**

- ✓ Desenvolver formulação de barra alimentícia e testar a adição de diferentes teores de proteína do soro do leite
- ✓ Avaliar altura e peso pré e pós forneamento das barras alimentícias desenvolvidas
- ✓ Analisar instrumentalmente a cor e a textura das barras alimentícias desenvolvidas e de uma formulação comercial industrializada

- ✓ Caracterizar a composição centesimal das barras alimentícias desenvolvidas e de uma formulação comercial industrializada
- ✓ Determinar o aminograma das barras alimentícias desenvolvidas e de uma formulação comercial industrializada
- ✓ Avaliar aceitabilidade e intenção de compra das barras alimentícias desenvolvidas e de uma formulação comercial industrializada

3. REVISÃO BIBLIOGRÁFICA

Soro do leite

O soro do leite é a parte aquosa que se forma durante a coagulação da caseína do leite e representa de 80 a 90% do volume total do leite utilizado durante a produção de queijos (ALVES et al., 2014; GUIMARÃES; TEIXEIRA; DOMINGUES, 2010). Durante décadas esse componente era considerado um resíduo industrial, sendo descartado ou então incorporado em rações para animais (HARAGUCHI et al., 2006). Vários países introduziram uma legislação rigorosa de proteção do ambiente forçando um replanejamento na indústria de laticínios, no que diz respeito à eliminação de soro de leite, e encorajando a investigação das suas propriedades físicas, químicas, nutricionais e biológicas (SMITHERS, 2008).

O soro de leite pode ser obtido na indústria por três processos principais: a) pelo processo de coagulação enzimática, resultando no coágulo de caseínas e soro "doce"; b) precipitação ácida no pH isoelétrico (pI), resultando na caseína isoelétrica, que é transformada em caseinatos e no soro ácido; c) separação física das micelas de caseína por microfiltração, obtendo-se um concentrado de micelas e as proteínas do soro, na forma de concentrado ou isolado protéico (HALL, 1996; KIKA; KORLOS; KIOSSEOGLOU, 2007; ZINSLY et al., 2001).

As principais proteínas do soro do leite, também conhecidas como *"whey proteins*" (*WP*), são: α-lactalbumina (20-25%), β-lactoglobulina (50–55%), imunoglobulina (10–15%) e o GMP (10–15%). Em menor quantidade, mas com aplicações comerciais importantes, estão a lactoferrina (1–2%) e a lactoperoxidase (0,5%) (HARAGUCHI et al., 2006).

Concentrados proteicos do soro do leite

O soro do leite pode ser utilizado na sua forma original ou, devido ao seu alto teor de água, também pode ser concentrado, levando a formação de produtos proteicos que podem ser utilizados na indústria alimentar como ingredientes para melhorar as propriedades tecnológicas e funcionais de alimentos. Este processo ocorre através da aplicação de diferentes tecnologias de separação por membrana (utilizado para o fracionamento de componentes do leite, ja que muitos destes podem ser separados por diferença de tamanho) e secagem por "*spray drying*" (pulverização aplicada para obtenção de pó), que permitem a obtenção de produtos lácteos diferenciados: concentrados e isolados de proteína, que têm um alto valor de mercado (ALVES et al., 2014; BRANS et al., 2004; CROGUENNEC et al., 2006;).

O concentrado de proteínas de soro do leite ou *Whey Protein Concentrate (WPC)* é o produto obtido através da remoção dos constituintes não proteicos de soro de modo que o produto final contenha teor de proteína entre 35% e 80%, enquanto o isolado de proteínas do soro do leite, ou *Whey Protein Isolate (WPI),* contém teor de proteína entre 80 a 95%, e é considerada uma das mais puras formas comerciais de *WP* (BRANS, 2006). Além disso, ainda pode-se obter proteína de soro hidrolisada, *Whey Protein Hidrolysated (WPH),* resultado da hidrólise das moléculas de proteínas do soro, que forma segmentos proteicos menores, tais como aminoácidos e peptídeos de baixo peso molecular (SINHA et al., 2017).

Propriedades químicas das proteínas do soro do leite e benefícios à saúde

Quimicamente as proteínas do soro apresentam quantidades significativas de cálcio e, segundo Etzel (2004), os teores de leucina, isoleucina e valina (BCAA) e de quase todos os aminoácidos essenciais são superiores às recomendações, com exceção dos aminoácidos aromáticos fenilalanina e tirosina, fornecendo a estas proteínas importantes propriedades nutricionais que, por diferentes vias, favorecem a hipertrofia muscular e o ganho de força, otimizando o treinamento e o desempenho físico (HARAGUCHI et al., 2006; SGARBIERI, 2004).

Estudos demonstram que as proteínas do soro são absorvidas mais rapidamente do que outras proteínas, como por exemplo a caseína, e, desta forma,

as concentrações plasmáticas de muitos aminoácidos atingem valores elevados logo após a sua ingestão. Além disso, o consumo destas proteínas aumenta a concentração de insulina no sangue, favorecendo a captação de aminoácidos para o interior da célula muscular e estimulando a síntese de proteínas teciduais. Com isso, estudos consideram que o consumo de *whey protein* é adequado para situações onde haja estresse metabólico, no qual a reposição de proteínas ao organismo se torna emergencial (HARAGUCHI et al., 2006; PATEL, 2015; SGARBIERI, 2004; TERADA et al., 2009).

Apesar das proteínas do soro do leite possuírem alto valor nutricional, muitas pessoas as estão utilizando de forma exagerada e se privando do prazer sensorial, apenas diluindo esse alimento na água ou no leite (CHAVAN et al., 2015; CORREA; NUNES, 2013). Bertulucci et al. (2010) analisaram o consumo de suplementos alimentares por praticantes de atividade física em academias em São Paulo e verificaram que o *whey protein* é o suplemento mais utilizado, entretanto essa indicação é predominantemente oriunda de educadores físicos ou amigos. Estudos também demonstram que o uso das proteínas do soro vem auxiliando praticantes de atividade física a atingirem seus objetivos, mas que a maioria deles não possui acesso à informações sobre o uso correto desses suplementos e acabam utilizando de maneira errada e até exagerada (PEREIRA et al., 2009; SANTOS, 2013).

Propriedades tecnológicas das proteínas do soro do leite e suas aplicações

Industrialmente, observam-se importantes propriedades tecnológicas nas proteínas do soro do leite devido às suas funcionalidades, que são classificadas em 3 grupos: (a) propriedades de hidratação, depende de interações proteína – água, que influenciam a solubilidade, a viscosidade, a absorção e retenção de água; (b) propriedades de emulsificação e características de formação de espuma; (c) propriedades de geleificação e agregação, que estão relacionados com as interações proteína-proteína (BOUAOUINA, 2006).

As proteínas do soro apresentam tais propriedades no seu estado nativo e também, em alguns casos, após tratamento físico, químico ou enzimático, em função das várias estruturas conformacionais que possuem e/ou adquirem. O processamento tem influência sobre a estrutura proteica, em temperaturas acima de 70°C as proteínas são irreversivelmente alteradas, sendo desnaturadas e tonando-se insolúveis; em

temperaturas entre 100°C e 150°C ocorrem o prejuízo às funcionalidades das proteínas e reações como a de Maillard, caracterizada pela junção do grupo carbonila dos açúcares redutores com o grupo amínico das proteínas, peptídios ou aminoácidos, formando compostos de coloração escura, promovendo escurecimento não enzimático (ARAÚJO et al., 2014; WIT, 1998; WIT; KLARENBEEK, 1984). O reconhecimento disso tem contribuído para o aumento de pesquisas na área de ciência dos alimentos (CHEN; REMONDETTO; SUBIRADE, 2006).

As proteínas do soro do leite podem ser utilizados de diversas formas em produtos alimentícios, tais como: fórmulas infantis, sobremesas, crostas de gelo, produtos cárneos, sopas, molhos, bebidas à base de leite e destinadas à atletas. Estudos vem evidenciando a influência positiva da aplicação destas proteínas em produtos de panificação, em relação à melhora não só da composição química mas também das características tecnológicas e sensoriais, como aroma, sabor e textura (ALVES et al., 2014; BALDISSERA et al., 2011; CHAVAN et al., 2015; MARQUES et al., 2016).

Barras alimentícias são amplamente consumidas e aceitas, de fácil consumo, além de serem fonte de nutrientes. Elas surgiram há aproximadamente vinte anos atrás e esse mercado tem aumentado cada vez mais nos últimos anos, principalmente devido à grande preocupação dos consumidores com a saúde. A maior parte delas é oferecida em três tipos: as que contêm uma combinação proporcional de carboidrato, proteína e gordura, as que contêm muito carboidrato e pouca gordura, e as que enfatizam as proteínas (BOSQUESI, 2016; BOUSTANI; MITCHELL, 1990).

De acordo com Hogan et al. (2012), os ingredientes mais utilizados nas barras com alto teor proteico são as proteínas de soja e as do soro do leite mas, infelizmente, existem irregularidades relativas a declaração da composição destes produtos: a variação da quantidade de nutrientes declaradas no rótulo, quando comparada com a real composição química do alimento, muitas vezes ultrapassa o limite estabelecido pela legislação vigente (20% a mais ou a menos). Isso evidencia a necessidade de um controle melhor por parte da indústria e uma fiscalização mais efetiva, para garantir que a veracidade das informações presentes nos rótulos (BOSQUESI, 2016; BRASIL, 2003).

4. ARTIGO A SER SUBMETIDO À REVISTA *LWT - Food Science and Technology*

Elaboration and evaluation of the chemical, physical and sensory characteristics of food bar added of whey protein

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Highlights:

- Whey protein can be used in bakery products, enhancing their characteristics.
- Food bar can be elaborated with different amount of whey protein.
- Whey protein addition improved physical characteristics and chemical composition of food bars, but sensorially the formulation did not achieve high scores.

Elaboration and evaluation of the chemical, physical, and sensory characteristics of a food bar added of whey protein

Abstract: Whey protein is an aqueous portion formed during coagulation of milk casein that has important nutritional and technological proprieties that could be explored in different types of food. The objective of this study was to develop formulations of food bars and perform chemical, physical, and sensorial analyses to assess their quality and the implications of whey protein (WP) addition to this product. There were elaborated three whey protein formulations (T1- 0%, T2- 25% and T3- 50%) that were tested along with an industrialized bar sample (T4- I). The results showed that the addition of whey protein increased height after baking, hardness and lightness. In relation of chemical composition, the addition of whey protein increased the moisture, protein, and total amino acid content of the bars. Sensory analysis showed that the judges noticed that the highest concentration of whey protein had an impact in appearance and color. However, industrialized bar sample had the best evaluation in terms of purchase intention and acceptability, probably because the judges are more accustomed with characteristics of industrialized products. Adding whey protein improves the chemical composition of food bars but in the sensorial assessment the formulation only achieved “slightly liked”.

KEYWORDS: *whey protein*; *food bars elaboration; physical properties; chemical properties*; *sensorial analysis*

1 INTRODUCTION

Whey protein (WP) is an aqueous portion of milk casein formed during the coagulation process of cheese or casein production and comprises about 80% to 90% of the total volume of milk used for cheese production (Alves et al., 2014; Guimarães, Teixeira & Domingues, 2010). The main WP are β-lactoglobulin (50–55%), α-lactalbumin (20-25%), immunoglobulin (10–15%), and glycomacropeptide (10–15%). Other proteins, although in less quantities, also have important commercial

applications, such as lactoferrin (1–2%) and lactoperoxidase (0,5%) (Haraguchi, Abreu & Paula, 2006). Therefore, the level of leucine, isoleucine, and valine, as most essential amino acids, are above the average when compared to other protein sources (Etzel, 2004; Sgarbieri, 2004). Biologically, these components have the potential means to increase the lean body mass in conjunction with appropriated training, as well as a potential to aid in weight loss and body fat loss due to calcium, a mineral present in large quantities in their composition (Ha & Zemel, 2003; Haraguchi et al., 2006; Patel, 2015).

Regarding the industrial perspective, important technological proprieties related to protein functionalities were observed. They are classified in 3 groups: moisturizing properties, which are relative protein – water interactions, that influences the solubility, viscosity, and water retention; emulsification properties and foaming characteristics; and gelation properties, which are relative protein- protein interactions (Bouaouina, Desrumaux, Loisel & Legrand, 2006). These properties are mainly present in the native state because denaturation results in linear conformation changes in a globular protein, with tertiary structure loss of the peptide chain and the formation of new bonds between molecules (Walstra, Wouters & Geurts, 2006). At temperatures above 70ºC, the proteins are irreversibly altered, being desaturated and becoming insoluble. At temperatures between 100ºC and 150ºC, the Maillard reaction is triggered, leading to non-enzymatic browning and protein functionality damage (Araújo, Montebello, Botelho & Borgo, 2014; Wit, 1998; Wit & Klarenbeek, 1984). This fact has contributed to the increase of researches in food science (Chen, Remondetto & Subirade, 2006).

Whey concentration leads to protein products formation, which can be used as ingredients in the industry to improve the technological and functional properties of different kinds of food. This process occurs by the application of different membrane separation technologies (used for fractioning milk constituents, as many of them can be separated by size difference) and spray drying (applied to obtain powder), which allows to obtain differentiated dairy products: concentrate and isolate protein, which has a high market value. (Alves et al., 2014; Brans, Schroën, Van deer Sman & Boom, 2004; Croguennec, Renault, Bouhallab & Pezennec, 2006). Whey Protein Concentrate (WPC) is the product obtained by removal of the non-protein constituents of the serum, so that the final product contains between 35% to 80% protein content, while Whey Protein Isolate (WPI) contains 80% to 95% protein and is considered one of the purest commercial forms of WP (Brans et al., 2006). In addition, a Hydrolyzed Whey Protein

(HWP) can be obtained by protein molecules hydrolysis, which forms smaller segments of protein such as amino acids and low molecular weight peptides (Sinha, Cheruppanpullil, Prakash, & Kaultiku, 2017).

Food bars are largely consumed and accepted due to consumers' great concern regarding health. High protein bars are available in the market and, according to Hogan, Chaurin, O'Kennedy and Kelly (2012), the most commonly used ingredients are whey and soy proteins. The literature indicates that WP improves aroma, flavor, and texture, which makes it a good ingredient in bakery preparations. However, the nutritional value specified on protein bars nutrition facts of often does not match their actual composition, reinforcing the need to develop products with more rigorous quality control (Bosquesi, Camisa & Santos, 2016; Boustani & Mitchell, 1990; Freitas & Moretti, 2006; Marques, São José, Silva, D. & Silva, E., 2016). Therefore, this study developed formulations of food bars and performed chemical, physical, and sensory analyses to evaluate quality and implications of WP addition to these products.

2 MATERIAL AND METHODS

2.1 FOOD BAR ELABORATION

Three food bar formulations were developed with different amounts of ingredients and WPI: T1 (0% WPI); T2 (25% WPI), and T3 (50% WPI) (see Table 1). WPI, (REACTION HPRO - ADS Total Nutrition) and the other ingredients were purchased in local markets (Porto Alegre, RS, Brazil). Was also acquired a traditional industrialized food bar (T4), without addition of proteins, banana and honey flavor, to be analyzed and compared with the developed formulations.

The preparation of the developed formulations occurred at the Dietetic Technique Laboratory (LTD) of the Nutrition course in the Medicine School (FAMED) of Universidade Federal do Rio Grande do Sul (UFRGS). All ingredients were weighed on a digital scale (model UX-6200H - SHIMADZU®), mixed, molded on a baking pan and baked at 180°C for about 10 minutes in an oven (model 84411 - DAKO®).

<Table 1>

2.2 PHYSICAL ANALYSIS

2.2.1 Analysis of height and weight before and after baking

Three different batches of each elaborated formulation were assessed to verify the food bars' height and weight before and after baking. The evaluation was conducted at LTD/FAMED/UFRGS, accordingly to the American Association of Cereal Chemists methodology (AACC, 1995).

2.2.2 Texture Assessment

The analysis was performed at the Bioactive Compounds Laboratory of the Institute of Food Science and Technology (ICTA)/UFRGS. The work of cutting and hardness assessment of the three elaborated formulations and the industrialized food bar (T4) were determined by a texturometer (A-XT2 plus, Stable Micro Systems, Surrey - England) using a "probe" craft knife A/ECB (10mm) at the speed of 2mm/s. The work of cutting evaluation was defined by the maximum force necessary to break the food bar samples and the hardness was measured by the penetration of the samples, being the maximum force determined in the first compression cycle. All analyses were performed in triplicate.

2.2.3 Color Assessment

Color analysis of the food bars was conducted at the Bioactive Compounds Laboratory, ICTA/UFRGS. The color of the samples T1, T2, T3, and T4 was determined by a colorimeter (Minolta®), comprising three parameters: *L** (lightness), +*a** (redness), and +*b** (yellowness).

2.3 CHEMICAL ANALYSIS

2.3.1 Proximate Composition

The samples T1, T2, T3, and T4 were analyzed at the Bioactive Compounds Laboratory, ICTA/UFRGS. Moisture, protein (using a correction factor of 6,38), total fat and ash contents were determined accordingly to the standard methods (AOAC 2005).

All analyses were performed in triplicate. The results are expressed as grams per 100g of dry matter (DM).

2.3.2 Analysis of Amino Acid Composition

The samples T1, T2, and T3 were analyzed for their amino acid content at the Laboratory of Biophysical Methods of Analysis - UFRGS using a ternary pump system, model HPLC System 525; a column thermostat, model HPLC 582 Column Thermostat (Bio Teck Instruments, Germany); a column Hi-Chrom C18 (model HI-5C18-250A, Hi-Crom, United Kingdom), a Fluorescence detector PNA-LIF (ISB Indústria e Comércio Ltda., Brasil); and an injection valve Valco Cheminert, model C1, with 10 µL loop (Valco Instruments Co. Inc., USA). Data analysis of the acquisition module was performed by CHROMuLAN, version 0.90 (Jindrich Jindrich PIKRON Ltda, 2002).

2.4 SENSORY ANALYSIS

The samples T1, T2, T3, and T4 were submitted to the sensory analysis of 50 untrained judges, recruited at FAMED/UFRGS. The tests were conducted individually at the LTD, FAMED/UFRGS. The judges received random 5-gram-samples of each treatment, coded with a three-digit number, a glass of mineral water, and an evaluation form. This form comprised an acceptability test, with a 9-point hedonic scale (9 = like extremely, 5 = neither like nor dislike, and 1 = dislike extremely), which evaluates sensory attributes included appearance, color, texture, taste, aroma, and overall acceptability. These samples were also evaluated for purchase intention, using a 5-point scale (5 = would certainly buy it, and 1 = would certainly not buy it) (Dutcosky, 2013). The positive purchase intention was calculated accordingly to the percentage of judges who attributed scores from 4 to 5. In addition, percentage distribution histograms of the scoring were created (Meilgaard, Civille & Carr, 1999). The index of acceptability (IA) was calculated using the following equation: IA (%) = A x 100 / B, being A = average scores obtained for the overall acceptability of the product and B = maximum score given for the overall acceptability of the product. To be considered as having a good effect, the IA should be ≥ 70%.

This study was approved by the Ethics Committee of UFRGS, process number CAAE: 31060414.6.0000.5347, and all the participants were informed of every detail of the study.

2.5 STATISTICAL ANALYSIS

All the experiments were conducted in triplicate. The results were submitted to analysis of variance (ANOVA) and Tukey's test, to compare the averages among the samples, at a 5% significance level. Statistical analyses were conducted using the software ASSISTAT, version 2.0 (Silva, F. & Azevedo, 2014).

3 RESULTS AND DISCUSSION

3.1 PHYSICAL ANALYSIS

3.1.1 Height and weight before and after baking

The results of height and weight analyses, before and after baking, are shown in Table 2.

<Table 2>

There was no significant difference in height before baking ($p > 0.05$) in the three evaluated samples. After baking, T1 (1.06cm) had significant lower average height when compared to T2 (1.50 cm) and T3 (1.60cm). No significant difference in weight was observed before nor after baking, showing that WPI addition can change the height of bars, but the addition of 50% WPI did not cause changes in weight. The major increase in the food bars height with WPI could be due to protein functionalities, such as foaming, which could help incorporating air to the composition, in addition to the moisturizing property and water retention (Sgarbieri, 1996).

3.1.2 Texture Assessment

As can be observed in Table 2, the lower average in hardness was found in the T4 sample (1927.94 g), and higher in the T3 sample (15857.19 g), while T1 (6437.79 g) and T2 (6157.58 g) had no significant difference between each other, showing that WPI addition interfered in food bar texture.

According to Zhou, Liu and Labuza (2008), protein concentration is directly correlated to hardness. In protein bars, it occurs due to a wide range of chemical, physical, and thermodynamic factors, such as solvent rearrangement, disulfide bonds formation, non-covalent interactions, and Maillard reaction. The variety of ingredients used can also foster interactive effects (Hogan et al., 2012; Purwanti, van der Goot, Boom & Vereijkena, 2010).

In the work of cutting assessment, the averages of all treatments show significant difference among each other (see Table 2). Sample T3 had the lower average (82483.05 g.s) and, in sequence, T2 (35726.96 g.s), T1 (24422.53 g.s), and T4 (5393.69 g.s). The protein type or the proteins combination used may have an important influence on the bars texture, providing a wide range of textures to be chosen by the consumer (Hogan et al., 2012; Imtiaz, Kuhn-Sherlock & Campbell, 2012). McMahon, Adams and McManus (2009) verified in their study that bars made with WPH were softer than bars made with WPI. According to Freitas (2005), high cutting resistance and hardness values in food bars are not always associated to low acceptance of the product.

3.1.3 Color Assessment

Samples lightness (*L**) of varied between 54.65 (T3) and 43.93 (T1) (see Table 2), being the higher average observed in the T3 (54.65) and T4 (53.32), showing significant difference ($p>0.05$) in relation to T1. The results also pointed that T2 (48.25) had similar characteristics to the other samples. WPI addition increased bars *L** but Pérez, Matta, Osella, Torre and Sánchez (2013) found in their study the occurrence of browning in cookies with added WPC, a result attributed to the presence of lactose (absent in the WPI) and free amino acids incorporated to the protein ingredient.

To *a** parameter, T3 (6.88) achieved higher averages (redness), followed by T2 (4.42) (see Table 2). T1 (2.15) and T4 (2.67) obtained lower averages, with no significant difference ($p>0.05$). To b* parameter, only T1 (9.26) and T3 (19.95) obtained significant difference between each other, while T2 (14.46) and T4 (15.37) maintained similar characteristics through all treatments (see Table 2). Despite the statistical difference among the samples, all of them fit into the blue spectrum. WPI addition increased the mean of parameters *a** and *b**, corroborating Wani, Gull, Allaie and Safapur (2015), when assessing this effects of the WPC addition to cookies.

3.2 CHEMICAL ANALYSIS

3.2.1 Proximate Composition

Table 3 shows the proximate composition of the elaborated and the industrialized food bars.

<Table 3>

The lowest moisture mean score was observed in T4 (11.75 g/100g) ($p<0.05$) while T3 (23.30 g/100g) had the highest average when compared to T1 (21.31 g/100g), with statistically significant difference. By evaluating the results, it is possible to notice that the addition of WPI increases the formulation's moisture, probably due to the hygroscopic property of its proteins (Sgarbieri, 1996). High levels of moisture favors microbial growth and reduces the crunchiness of cereals, an important feature for the acceptability of the product (Chirife, Buera & Labuza, 1996; Takeuchi, Sabadini & Cunha, 2005).

There was a significant difference in the protein content for all treatments. The sample T3 has the highest protein content (28.17g/100g), exceeding the average obtained by T4 (5.47/100g), highlighting the influence of the addition of WPI to protein content of food bars. Baú, Cunha, Cella, Oliveira and Andrade (2010) and Freitas and Moretti (2006) developed high protein food bars using textured soy protein and both obtained products with values between 15g and 16g/100g, a smaller amount than the ones present in formulations T2 (22.1g/100g) and T3 (28.17g/100g) developed in this study.

Also, T1 (12.88g/100g) obtained more than twice the protein value of T4 (5.47g/100g). Since both have no WPI in their compositions, this result must be due to the nutritional quality of the ingredients that compound these formulations: T4, the industrialized sample, consists predominantly of refined cereal flakes (rice and corn flour), while T1, the standard formulation developed, was prepared with golden linseeds and black sesame, rich in lipids, but with considerable high protein content; whole wheat flour, which has a higher protein content than refined flour and quinoa, which calls for attention due to its higher protein content when compared to other cereals (Novello & Pollonio, 2012; Silva, E. et al., 2011; Silva, F., Pante, Prudêncio & Ribeiro 2011).

The highest lipid levels were found in samples T1 (9.76 g/100g) and T2 (10.42 g/100g), which showed no statistically significant differences between each other, followed by T3 (7.28 g/100g) and T4 (3.74 g/100g) ($p < 0.05$). Although T4 presents the lowest lipid content, the formulation contains palm fat, which is derived from a interesterification process responsible for changing the lipid melting point, producing a saturated fatty acid, with hard physical characteristics and producing harmful effects to the consumer's health (Grimaldi, Gonçalves & Ando, 2005; Santos et al., 2013). In contrast, the lipid is derived from linseed and sesame seeds in the developed formulations, as well as Brazil nut, a source of mono and polyunsaturated fatty acids, which brings huge benefits to health (Costa & Jorge, 2011; Santos et al., 2013).

Samples T1 (2.49 g/100g), T2 (2.26 g/100g), and T3 (1.98 g/100g) showed no statistically significant differences, but they had higher amounts of ash than T4 (0.90 g/100g) ($p<0.05$). This suggests that the formulated food bars have better nutritional quality than the industrialized one, mostly due to the higher minerals content in the ingredients used in its formulation. The averages of ash content in T1, T2, and T3 are similar to the ones found in food bars with high protein content, as showed in Baú et al. (2010) and Freitas and Moretti (2006) studies.

3.2.2 Total amino acid content

Table 4 shows the results of the amino acid composition analysis.

< Table 4 >

To total amino acids T3 (67.09 mg/100g) had the highest average, followed by T2 (65.96 mg/100g), T1 (53.38 mg/100g) and T4 (26.75 mg/100g), which obtained the lowest mean ($p\leq0.05$), showing that WPI addition increased the amino acid content of food bars. Amino acids are essential to regulate protein turn over and skeletal muscle anabolism, enabling the increase of lean mass with exercises and to attenuate the loss of lean mass during periods of energy deficit (Churchward-Venne, Murphy, Longland & Phillips, 2013).

T4 (I) was the sample that showed the lowest average to evaluate amino acids, except to histidine and threonine. The highest levels ($p<0.05$) of serine, glycine, alanine, methionine, and leucine + isoleucine were found in T3 (50%). According to Etzel (2004), WP is a source of branched-chain amino acids (BCAA) leucine,

isoleucine, and valine. Therefore, it was expected that these would be higher in the T3 sample, but higher valine values were found in T2, as well as aspartate, glutamate, and phenylalanine ($p<0.05$). Despite this, T2 and T3 showed higher averages for these 3 amino acids than T1, with statistical difference, demonstrating the influence of the addition of WPI.

3.3 SENSORY ANALYSIS

Table 5 presents the scores for the sensory attributes evaluated, the purchase intention, the percentage of positive purchase intention and the acceptability index.

<Table 5>

The appearance attribute showed that the 50% WPI addition caused a significant statistical difference between sample T3 and the other samples. The average scores assigned to formulations T1 (6.02) and T2 (6.00) did not show significant difference between each other and they were lower when compared to other samples ($p < 0.05$). The formulations T1, T2, and T3 were made in laboratory, which may explain the lower appearance average (6.02; 6.00; 6.80). It is worth mentioning that the expectation of the judges, related to their consumption habits of industrialized products, may have had influence in this result. Wani et al. (2015) produced cookies with different amounts of WPC and the sample with higher addition had a better evaluation in relation to its appearance.

Regarding the color attribute, the bar with the addition of 50% of whey protein and the industrialized bar reached average above 7.0 ("like moderately"). It is important to notice that the samples T1, T2, and T3 have absence of chemical additives, especially colorants, while T4 is an industrialized product that contains caramel coloring (Honorato, Batista, Nascimento & Pires, 2013). Since this study has prioritized the development of healthier food bars, it was decided that colorings would not be used due to possible adverse effects.

No influence of WPI addition to texture, taste and overall acceptability was observed, with T4 showing the highest texture averages than the other samples ($p < 0.05$). In the aroma attribute, all treatments achieved a mean above 6 and had no statistically significant difference among each other. Marques et al. (2016) found that

the cookie sample with 25.9g WPC / 100g, which was the one with less addition of protein, had a better evaluation. Moreover, the formulations (25.9g WPC/100g, 54.1g WPC/100g, and 40g WPC/100g) did not present significant difference among each other, as was also found in this study, but they were better evaluated and achieved an average higher than 7.

For the purchase intention (Table 5), T4 had an average higher than 4 (4.12) in a 5 points scale, indicating that the judges would probably buy it. The samples T1, T2, and T3 did not show significant difference among their averages (2.9; 3.32; 3.34). However, in Table 5 and Figure 1, it can be observed that the positive purchase intention (considering only 4 and 5 grades) of T1 (32%) was lower than T2 and T3, which showed similar percentages (50% and 48%, respectively). Baú et al. (2010) developed a food bar formulation with high protein content using albumin and obtained promising results, considering that 38.18% of the judges affirmed they “definitely would buy it” and 43.64% “would probably buy it”, making the positive purchase intention above 80%.

Acceptability index (see Table 5) evidenced that T4 (86%), T3 (73%) and T2 (72%) reached a promising percentage, above 70%. T1 was the only sample which, although close to, was below the satisfactory acceptability index. According Gutkoski et al. (2007), healthier and natural products have been marketed and well accepted by consumers, thus, some adjustments in the formulations, like increased row banana and honey content, may improve sensory characteristics and increase bar acceptability.

<Figure 1>

4 CONCLUSION

The results showed that WP addition increased height after baking, hardness and lightness. In the chemical analysis, while T4 presented lower average for most of evaluated chemical parameters, T3 had higher averages for moisture and showed higher protein and total amino acid content, reaching the desired nutritional profile.

Sensory analysis showed that T4 was the best sample evaluated regarding purchase intention and reached the higher acceptability index, probably because the judges are more used to the characteristics of industrialized products. About the elaborated formulations, the judges noticed that the higher concentration of whey protein had an impact in appearance and color attributes. The overall acceptability only achieved “like slightly”, but the acceptability index of samples with whey protein addiction (T2 and T3) was higher than 70%, satisfactory percentage. Thus, some adjustments in the formulations could be made to improve the sensory characteristics.

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Table 1 – Food bars formulations

Ingredients	Food bars formulations (g)		
	T1 (0%)	**T2 (25%)**	**T3 (50%)**
Raw banana	120	120	120
Brazilian nut	37.5	37.5	37.5
Golden Linseed	75	56.25	37.5
Whole wheat flour	66	49.5	33
Black sesame	51	38.25	25.5
Quinoaflakes	45	33.75	22.5
Oatsthinflakes	37.5	28.12	18.75
Whey Protein Isolated	-	68.6	137.25

Table 2 – Physical measurements of the elaborated and the industrialized food bars

Analysis		T1 (0%)	T2 (25%)	T3 (50%)	T4 (I)
Height (cm)	Before baking	0.93 ± 0.05[a]	1.03 ± 0.05[a]	1.03 ± 0.05[a]	-
	After baking	1.06 ± 0.15 [b]	1.50 ± 0.00[a]	1.60 ± 0.10[a]	-
Weight (g)	Before baking	559.47 ± 5.45[a]	562.71 ± 11.42[a]	560.17 ± 2.94[a]	-
	After baking	535.04 ± 3.36[a]	535.02 ± 6.01[a]	526.41 ± 2.53[a]	-
Texture	Hardness (g)	6437.79 ± 1200.70 [b]	6157.58 ± 2192.62 [b]	15857.19 ± 1804.43[a]	1927.94 ± 743,21 [c]
	Work of cutting (g.s)	24422.53 ± 6252.93 [c]	35726.96 ± 5283.32 [b]	82483.05 ± 2521.22[a]	5393.69 ± 1206,76 [d]
Color parameters	*L**	43.93 ± 1.81 [b]	48.25 ± 1.84[ab]	54.65 ± 3.83[a]	53.32 ± 4.48[a]
	*a**	2.15 ± 0,56 [c]	4.42 ± 0.58 [b]	6.88 ± 0.95[a]	2.67 ± 0.18 [c]
	*b**	9.26 ± 0.44 [b]	14.46 ± 1.82[ab]	19.95 ± 1.08[a]	15.37 ± 6.63[ab]

Notes: Results are expressed as mean ± standard deviation. Standard deviation with same superscripts in a same line are not significantly different (*p < 0.05).

Table 3 – Chemical composition of the elaborated and the industrialized food bars, in dry basis

Food bars	Moisture	Protein	Lipid	Ash
	(g/100g)			
T1 (0%)	21.31 ± 0.59 [b]	12.88 ± 0.16 [c]	9.76 ± 1.12[a]	2.49 ± 0.60[a]
T2 (25%)	22.14 ± 0.62[ab]	22.10 ± 0.30 [b]	10.42 ± 0.61[a]	2.26 ± 0.03[a]
T3 (50%)	23.30 ± 0.97[a]	28.17 ± 0.95[a]	7.28 ± 0.28 [b]	1.98 ± 0.63[a]
T4 (I)	11.75 ± 0.05 [c]	5.47 ± 0.24 [d]	3.74 ± 0.08 [c]	0.90 ± 0.08 [b]

Notes: Results are expressed as mean ± standard deviation. Standard deviation with same superscripts in a column are not significantly different (*p < 0.05).

680 **Table 4 –** Amino acid composition of the elaborated and the industrialized food bars, in dry basis

Aminoacids	Food bars (g/100g)			
	T1 (0%)	T2 (25%)	T3 (50%)	T4 (I)
Histidine	1.94[a]	1.86[a]	1.53[ab]	0.98 [b]
Argenine	6.44[a]	5.44 [b]	5.37 [b]	1.97 [c]
Serine	3.31 [c]	5.02 [b]	6.68[a]	1.46 [d]
Aspartate	5.51 [b]	6.50[a]	5.04 [b]	2.83 [c]
Glutamate	11.44 [b]	12.67[a]	11.53 [b]	5.81 [c]
Threonine	1.89[ab]	2.38 [a]	2.25 [a]	1.39 [b]
Glycine	3.10 [b]	2.96 [b]	3.70[a]	1.24 [c]
Tyrosine	2.33 [a]	2.84 [a]	2.85[a]	0.83 [b]
Alanine	2.80 [c]	4.05 [b]	4.78[a]	1.68 [d]
Methionine	0.97 [c]	1.78 [b]	2.65[a]	0.25 [d]
Valine	3.18 [c]	4.49[a]	3.83 [b]	2.06 [d]
Phenylalanine	3.55 [b]	4.35[a]	3.59 [b]	1.93 [c]
Leucine + Isoleucine	6.94 [c]	11.60 [b]	13.31[a]	4.33 [d]
Total	53.38 [c]	65.96 [b]	67.09[a]	26.75 [d]

681 **Notes**: Results are expressed as mean ± standard deviation. Standard deviation with same
682 superscripts in a same line are not significantly different (*p < 0.05).
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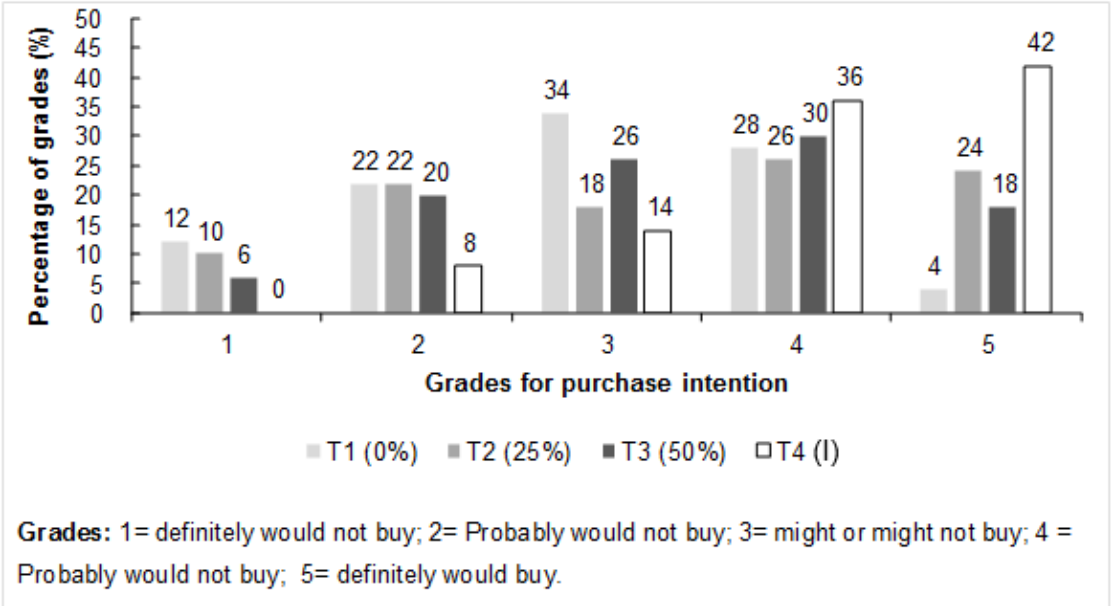
699 **Table 5** - Acceptability and purchase intention analysis of the elaborated and the industrialized food
700 bars

Analysis		Food bars			
		T1 (0%)	T2 (25%)	T3 (50%)	T4 (I)
Attributes	Appearance	6.02 ± 1.8 ^{c}	6.00 ± 1.7 ^{c}	6.80 ± 1.6 ^{b}	7.62 ± 1.2^{a}
	Color	5.86 ± 1.85 ^{b}	5.90 ± 1.91 ^{b}	7.06 ± 1.34^{a}	7.60 ± 1.2^{a}
	Texture	6.72 ± 1.73 ^{b}	6.74 ± 1.86 ^{b}	6.00 ± 1.98 ^{b}	7.78 ± 1.34^{a}
	Taste	5.96 ± 1.80 ^{b}	6.34 ± 1.80 ^{b}	6.42 ± 1.80 ^{b}	7.56 ± 1.26^{a}
	Aroma	6.42 ± 1.31^{a}	6.44 ± 1.51^{a}	6.78 ± 1.48^{a}	6.86 ± 1.42^{a}
	Overall acceptability	6.22 ± 1.47 ^{b}	6.50 ± 1.60 ^{b}	6.60 ±1.48 ^{b}	7.72 ± 0.96^{a}
Purchase Intention		2.90 ± 1.07 ^{b}	3.32 ± 1.36 ^{b}	3.34 ± 1.17 ^{b}	4.12 ± 0.93^{a}
% Positive purchase intention		32	50	48	78
Acceptability index (%)		58	66.4	66.8	82.4

701 **Notes**: Results are expressed as mean ± standard deviation. Standard deviation with same
702 superscripts in a same line are not significantly different (*$p < 0.05$).

Figure 1. Percentage grades distribution for purchase intention of the elaborated and the industrialized food bars



Grades: 1= definitely would not buy; 2= Probably would not buy; 3= might or might not buy; 4 = Probably would not buy; 5= definitely would buy.

5. NORMAS DA REVISTA *LWT - Food Science and Technology*

GUIDE FOR AUTHORS

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APÊNDICE 1 - Termo de Consentimento Livre e Esclarecido

Termo de Consentimento Livre e Esclarecido

Projeto: Avaliação química, física e sensorial de barras de alimentícias adicionadas de proteínas do soro do leite

Pesquisadores: Profª. Drª. Viviani Ruffo de Oliveira, Nutricionista Dra. DivairDoneda e Acadêmica de Nutrição Gabriela Lucciana Martini

Sujeitos envolvidos: Alunos e servidores da UFRGS Data:___/___/___

I. Justificativa e Objetivos: As proteínas do soro do leite (*whey protein*) são extraídas durante o processo de transformação do leite em queijo. Elas apresentam relevante teor de cálcio e aminoácidos essenciais, especialmente os de cadeia ramificada. A incorporação de *whey protein* na dieta pode conferir vantagem à desportistas, vegetarianos e idosos, os quais podem encontrar dificuldade em garantir o aporte adequado de aminoácidos essenciais em suas dietas. Algumas pessoas não toleram as características sensoriais do *whey protein* isoladamente, mas poderão aceitar alimentos enriquecidos com ela. Dessa forma, foram estabelecidos para essa pesquisa os seguintes objetivos: desenvolver alimentos com adição de *whey* em diferentes concentrações, a fim de dinamizar seu consumo; avaliar as características físicas e bioquímicas dos mesmos; comparar os dados obtidos através de análises laboratoriais com as provenientes de tabelas de composição de alimentos e realizar a análise sensorial das preparações mais promissoras.

II. Os procedimentos a serem utilizados: Esse consentimento está relacionado com a avaliação sensorial de preparações com adição de *whey protein*. Os sujeitos serão convidados por cartazes a participar da avaliação sensorial no Laboratório de Técnica dietética da Faculdade de Medicina/UFRGS. Os participantes receberão as amostras simultaneamente, codificadas com 3 dígitos aleatórios, um copo de água para limpeza das papilas gustativas e uma ficha sensorial com uma escala hedônica de 9 pontos para se julgar os atributos: aparência, cor, sabor, textura e aceitação global. Também será analisada a intenção de compra do produto, a qual será avaliada através de uma escala de 5 pontos. Para o teste de preferência das amostras será utilizada uma escala hedônica de nove pontos para avaliar os atributos aparência, textura, cor, sabor e aceitação global.

III. Desconfortos e riscos: Esses procedimentos de avaliação serão realizados com pacientes sadios e somente procederá com a concordância do sujeito em participar do estudo, caso contrário será prontamente respeitado. Acredita-se, assim, que esse estudo seja de risco reduzido, pois não será realizada análise sensorial com pacientes com intolerância a lactose ou com alergia a qualquer outro ingrediente da formulação. Esses procedimentos de avaliação somente serão realizados se os participantes tiverem disponibilidade e concordância em participar deste estudo. Caso o participante tenha alergia alimentar a algum dos componentes da formulação, não poderá participar do estudo. A pesquisadora fica responsável ainda de prontamente encaminhar o participante ao serviço de saúde se o mesmo apresentar qualquer problema relacionado a essa análise sensorial. Os participantes terão direito de abandonar este estudo, caso se sintam prejudicados ou tenham se arrependido de participar, e em qualquer momento terão liberdade de solicitar novas informações. Este trabalho terá total sigilo quanto aos resultados que venham a envolver o avaliador.

IV. Os benefícios que se pode obter: Será avaliada a melhor forma de processamento em relação ao aspecto sensorial pelo grupo em questão, associando adições maiores e menores de *whey protein* com as propriedades sensoriais.

V. Garantia de privacidade: Os seus dados de identificação serão mantidos em sigilo e as informações colhidas serão analisadas estatisticamente, e podem ser publicadas posteriormente em alguma revista científica. Afirmo que a sua participação poderá ser suspensa a qualquer momento caso você deseje, sem prejuízo para a sua pessoa.

VI. Garantia de resposta a qualquer pergunta e liberdade de abandonar a pesquisa: Eu,_____ fui informado dos objetivos do estudo realizado pelas pesquisadoras Viviani Ruffo de Oliveira, Divair Doneda e a acadêmica de Nutrição Gabriela Lucciana Martini, portanto concordo em participar deste projeto. Sei que em qualquer momento poderei solicitar novas informações e modificar minha decisão se assim eu desejar. Caso tiver novas perguntas sobre este estudo, posso recorrer à pesquisadora Dra. Viviani Ruffo de Oliveira no telefone (51) 33085610. Declaro que tenho conhecimento do presente Termo de Consentimento

_____ _____

Assinatura do participante Assinatura do pesquisador

APÊNDICE 2 - Ficha de Avaliação Sensorial de Barras Alimentícias com Diferentes Concentrações de *Whey Protein*

Ficha de Avaliação Sensorial de Barras Alimentícias com Diferentes Concentrações de *Whey Protein*

Data: ___/___/___

Você está recebendo amostras de preparações com adição de *whey protein*. Por favor, avalie cada um dos produtos separadamente e atribua notas na tabela para cada atributo avaliado de acordo com o seguinte critério:

(1) Desgostei muitíssimo
(2) Desgostei muito
(3) Desgostei moderadamente
(4) Desgostei ligeiramente
(5) Indiferente
(6) Gostei ligeiramente
(7) Gostei moderadamente
(8) Gostei muito
(9) Gostei muitíssimo

ATRIBUTOS A SEREM AVALIADOS

Característica	Amostra n°484	Amostra n° 506	Amostra n° 690	Amostra n° 722
Aparência				
Cor				
Textura				
Sabor				
Odor				
Aceitação global				

APÊNDICE 3- Ficha para avaliação de intenção de compra

Ficha para avaliação de intenção de compra

Data: ___/___/___

Você está recebendo amostras de preparações com adição de *whey protein*. Por favor, avalie cada um dos produtos separadamente e atribua notas na tabela para avaliação de intenção de compra

1) Certamente não compraria
(2) Provavelmente não compraria
(3) Tenho dúvida se compraria
(4) Provavelmente compraria
(5) Certamente compraria

INTENÇÃO DE COMPRA

Amostra n° 484	**Amostra n° 506**	**Amostra n° 690**	**Amostra n° 722**