Universidade Federal do Rio Grande do Sul
Faculdade de Medicina
Graduação em Nutrição

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Elaboração e análises físico-química e sensorial de biscoitos recheados à base de alfarroba como alternativa para substituição do cacau

Porto Alegre, 2013

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Trabalho de Conclusão de Curso de graduação apresentado como requisito parcial para a obtenção do grau de Bacharel em Nutrição, à Universidade Federal do Rio Grande do Sul - Faculdade de Medicina.

Orientador: Profª Drª Viviani Ruffo de Oliveira

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Porto Alegre, 10 de dezembro de 2013.

A Comissão Examinadora, abaixo assinada, aprova o Trabalho de Conclusão de Curso, elaborado por Ludymila Schulz Barroso, como requisito parcial para obtenção do grau de Bacharel em Nutrição.

Comissão examinadora:

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Profª Drª Vanuska Lima da Silva – UFRGS

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Prof Dr Alessandro de Oliveira Rios – UFRGS

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Profª Drª Viviani Ruffo de Oliveira – Orientadora – UFRGS

Aos meus pais,
que são a base do meu castelo.

A minha orientadora.
que foi uma segunda mãe.

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"Que seu remédio seja seu alimento,
e que seu alimento seja seu remédio"
Hipócrates

RESUMO

Este estudo objetivou a elaboração e análise de diferentes formulações de biscoitos recheados elaborados com alfarroba em pó como substituta do cacau. Após testes preliminares, foram elaboradas três formulações: biscoito recheado de alfarroba, biscoito recheado de alfarroba com soja e biscoito recheado de cacau. Todos os biscoitos e recheios foram preparados com procedimento padronizado, seguindo mesma ordem de adição de ingredientes, bem como mesmos utensílios e equipamentos. Os ingredientes foram adicionados até tornarem-se homogêneos, formando a massa, que descansou por 20 minutos em temperatura ambiente e foi esticada com rolo de PVC, cortada em diâmetro de 4 cm e assada em 180ºC por 10 minutos. Realizou-se análise física de peso e diâmetro, pré e pós-forneamento, bem como rendimento unitário de cada fornada de biscoitos, com pesagem em balança de precisão e aferição de diâmetro em paquímetro. As análises químicas foram realizadas em quadriplicata e constituíram-se de análises de proteína, lipídeos totais, fibra, cinzas e umidade, já os carboidratos foram verificados por diferença e o valor calórico foi calculado por valores estipulados pela RDC 360/2003. Para a análise sensorial, 48 avaliadores não treinados analisaram a aceitabilidade e intenção de compra. Essa etapa somente foi realizada após aprovação do Comitê de Ética em Pesquisa da instituição com entrega de Termo de Consentimento Livre e Esclarecido para cada avaliador. A aceitação de cada formulação foi avaliada através de escala hedônica estruturada de nove pontos e a intenção de compra através de escala de cinco pontos. A análise estatística dos resultados foi realizada por meio do teste de Tukey, com nível de significância de 5% no software estatístico ESTAT® versão 2.0. Nas análises físicas, não foi observada diferença estatística significativa ($p>0.05$) no peso pré-forneamento, diâmetro pré e pós-forneamento e rendimento unitário entre as formulações, enquanto que o peso pós-forneamento mostrou diferença estatística significativa ($p<0,05$) entre o biscoito de alfarroba e o biscoito de cacau. Na análise química, não houve diferença estatística significativa ($p>0,05$) para cinzas, energia, lipídeos, umidade e proteínas. Enquanto que as fibras demonstraram diferença estatística significativa ($p<0,05$) para o biscoito recheado de cacau. Os carboidratos também apresentaram diferença estatística significativa ($p<0,05$) entre as três formulações. Na análise sensorial, os atributos aparência, textura, sabor, aceitação

global, assim como a intenção de compra não mostraram diferença estatística significativa ($p>0,05$) entre as formulações, apenas o atributo cor apresentou diferença estatística significativa ($p<0,05$) para o biscoito recheado de cacau. Desta forma, concluí-se que os biscoitos recheados de alfarroba e de alfarroba com soja mantêm as características sensorial e nutricional, quando comparada ao biscoito recheado de cacau, sendo uma alternativa de consumo para pessoas alérgicas ao cacau.

Palavras-chave: Alfarroba. Cacau. Biscoito. Soja.

ABSTRACT

The objective of this study was to elaborate and analyze different formulations of sandwich cookies made with carob powder such as substitution to cocoa. After preliminary tests, three formulations were elaborated: carob sandwich cookies, carob and soy sandwich cookies and cocoa sandwich cookies. All the cookies and fillings were prepared with standard procedure following an identical addiction order of ingredients, as well as the same utensils and equipments. The ingredients were added until making a homogeneous batter, then standed by for 20 minutes in ambient temperature. Later, the batter was stretched out with a roll of PVC to achieve a thickness of 0.5 cm, it was cut in 4 cm of diameter and baked at 180ºC for 10 minutes. Physical analyses of weight and diameter, before and after baking, with weighted was taken using a precision balance and measured of diameter with caliper rule. The chemical analyses were taken in quadruplicate and constituted of protein, fat-acids, fiber, ash and moisture analyses. Whereas the carbohydrates were verified for difference and the calories were calculated with stipulated values for RDC 360/2003. For sensory analysis, 48 judges analyzed the acceptability and purchase intention. This step was carried out only after approval of the Ethics Committee of the institution with delivery Informed Consent Term for each judge. The acceptance of each formulation was evaluated by 9-points hedonic scale and purchase intention through 5-point scale. The statistical analysis was performed using the Tukey's test, with significance level of 5% in ESTAT® statistical software version 2.0. In physical analyses, there was no statistically significant difference ($p>0.05$) in weight before baking, diameter before and after baking and yield unit among formulations, while the weight after baking showed statistically significant difference ($p<0.05$) between the carob cookie and cocoa cookie. In chemical analyses, there was no statistically significant difference ($p> 0.05$) for ash, energy, lipid, moisture and protein. While the fibers showed statistically significant difference ($p<0.05$) for the cocoa sandwich cookies. Carbohydrates also showed statistically significant differences ($p<0.05$) among the three formulations. In sensory analyses, the attributes appearance, texture, flavor, overall acceptance, as well as purchase intention showed no statistically significant difference ($p>0.05$) among the formulations, only the color attribute present statistically significant difference ($p<0.05$) for the cocoa sandwich

cookies. Thus, it was concluded that the carob sandwich cookies and carob and soy sandwich cookies maintaining the nutritional and sensory characteristics compared to cocoa sandwich cookies, being a consumption alternative for people allergic to cocoa.

Keywords: Carob. Cocoa. Cookie. Soy.

SUMÁRIO

1 INTRODUÇÃO

A alfarrobeira – *Ceratonia siliqua* – é nativa da região do Mediterrâneo (BATLLE, TOUS, 1997; DAKIA, WATHELET, PAQUOT, 2007). Seu fruto é uma vagem composta por sementes, as quais são retiradas e processadas industrialmente para utilização na alimentação humana como espessante e estabilizante. Após a remoção das sementes, o restante da vagem é a polpa (BARRACOSA, CAETANO, BATISTA, 2009; SABATINI et al., 2011).

A polpa da alfarroba também é utilizada na alimentação humana, na forma de farinha (alfarroba em pó), após secagem, torrefação e trituração. Além do aroma e da coloração serem semelhantes ao cacau, a alfarroba em pó possui outros pontos positivos em relação ao cacau como, por exemplo, reduzido teor de compostos antinutricionais como cafeína e teobromina, aliado ao baixo teor de lipídeos (MEDEIROS, LANNES, 2009; SABATINI et al., 2011). Ainda, Sabatini et al. (2011) sugerem que a alfarroba em pó parece ser uma ótima fonte de ferro, possuindo 13 mg do mineral em 100 g de farinha.

Papagiannopoulos et al. (2004) e Grundel et al. (2006) relatam ainda efeitos benéficos da goma das sementes de alfarroba à saúde, por possuir ótima capacidade antioxidante. Já, Barracosa, Caetano, Batista (2009) sugerem que a alfarroba em pó parece modular o perfil lipídico sanguíneo em humanos, podendo ter um efeito preventivo no tratamento de níveis elevados de colesterol.

Estudos já destacaram o uso de alfarroba em pó como substituta do cacau na formulação de achocolatados, bebidas lácteas, biscoitos, bolos e sorvetes (MEDEIROS, LANNES, 2009; YOUSSEF, ABD EL-MALAK, MOUSSA, 2009). Sendo assim, uma boa alternativa para pessoas com alergia ao cacau.

Zuskin et al. (1994) relatam que Maslansky, Wein (1971) encontraram sintomas clínicos de alergia em 38% dos sujeitos do estudo após ingestão de cápsulas de cacau. Os principais sintomas verificados em pacientes com sensibilidade ao chocolate foram alterações cutâneas, respiratórias e gastrointestinais (FRIES, 1966). Sole et al. (2007) observaram que pediatras brasileiros referiram em 6,7% o chocolate como desencadeante de alergia alimentar.

A soja e os seus produtos também vêm sendo amplamente estudados devido, não apenas ao seu valor nutricional, mas também às suas propriedades funcionais

na indústria de alimentos, pois exerce ação moduladora em determinados mecanismos fisiológicos através de suas proteínas e das isoflavonas (CIABOTTI et al., 2006).

Na tentativa de se elevar o consumo de fibras e minerais, além de reduzir o consumo de lipídeos hidrogenados na população brasileira, estimulando a ingestão de alimentos menos processados, propõe-se a elaboração de biscoitos recheados com qualidade sensorial semelhante e melhor valor nutricional, quando comparado aos biscoitos recheados comerciais que são consumidos em larga escala pela população brasileira.

1.1 OBJETIVO GERAL

Elaborar e analisar físico, química e sensorialmente diferentes formulações de biscoitos recheados elaborados com alfarroba em pó como substituta do cacau.

1.2 OBJETIVOS ESPECÍFICOS

a) Avaliar a intenção de compra dos biscoitos recheados.

2 REFERENCIAL TEÓRICO

2.1 CACAU

O cacaueiro – *Theobroma cacao* – é uma árvore nativa da América do Sul, que se propagou naturalmente para a América Central (BEARDEN et al., 2000). Suas flores, pequenas e avermelhadas, unidas ao tronco, originam as bagas ou frutos, os quais medem de 15 a 30 cm de comprimento (Figura 1). Cada fruto contém entre 20 e 40 sementes envoltas em uma polpa mucilaginosa, e quando maduros, adquirem tonalidade alaranjada, amarela ou roxa, de acordo com a variedade (LAJUS, 1982).

Figura 1 – Fruto do cacaueiro.
Fonte: ICCO, 2004

Os maias e os astecas utilizavam as sementes de cacau torradas e moídas na preparação de uma bebida chamada “xoxocoalt”, “cacahualt” ou “chocolatl”, a qual era reservada para os que ocupavam as mais altas classes sociais. O nome escolhido pelo botânico Linnaeus como gênero da árvores, *Theobroma*, é traduzido como “comida dos Deuses”, uma vez que os nativos acreditavam ser uma árvore de origem divina (DILLINGER et al., 2000).

Atualmente, o cacau é consumido predominantemente na forma de chocolate, que representa aproximadamente 90% do mercado do cacau. Os demais 10% são utilizados na produção de bebidas e cosméticos (DONOVAN, 2006). Mundialmente,

o consumo de cacau e produtos derivados aumentou cerca de 2 milhões de toneladas por ano, de 1960 a 2004 (ICCO, 2004), mantendo um consumo mundial de 3,7 milhões de toneladas em 2008 (ICCO, 2008). No Brasil, registrou-se um incremento anual de 10% no consumo de chocolates desde 1993 (DONOVAN, 2006).

O paladar brasileiro sempre foi mais acostumado a um produto adocicado, geralmente com alto teor de açúcar e gordura hidrogenada. Assim, na infância e mesmo entre os adultos, a preferência brasileira é pelo chocolate ao leite, o qual contém, em média, 25 a 30% de cacau (HERMÈ, 2006). Em função de cada vez mais as pessoas buscarem alimentos mais saudáveis, essa predileção vem aos poucos mudando e é crescente o número de consumidores de chocolates com altas concentrações de cacau (acima de 60%), os quais são mais ricos em compostos fenólicos e com propriedades antioxidantes que geram benefícios à saúde (VINSON, PROCH, ZUBIK, 1999).

Entretanto, o cacau também pode provocar sintomas clínicos de alergia em alguns indivíduos como observado por Fries (1966), Zuskin et al. (1994) e Sole et al. (2007). Fries (1966) observou sintomas cutâneos como urticária, *rash* eczematoso, prurido local ou generalizado, entre outros; sintomas respiratórios como obstrução nasal, espirros, tosse e chiado no peito; e, sintomas gastrointestinais como dor abdominal, vômitos, coceira na boca e na garganta. Zuskin et al. (1994) mencionaram um estudo que observou sintomas alérgicos em 38% dos sujeitos após a ingestão de cápsula de cacau. Enquanto, Sole et al. (2007) aplicaram um questionário padrão sobre alergias alimentares a pediatras brasileiros, principalmente das regiões Sudeste e Sul, os quais mencionaram o chocolate como um dos alimentos desencadeantes de alergias alimentares (6,7%). Krecisz et al. (2011) descreveram um relato de caso de um adolescente de 14 anos com dermatite sistêmica de contato, atribuindo esta reação ao níquel presente no cacau, em altos níveis.

2.2 ALFARROBA

A alfarrobeira – *Ceratonia siliqua* – pertence à família das leguminosas. É nativa da região do Mediterrâneo (BRAND,1984; BATLLE, TOUS 1997; DAKIA, WATHELET, PAQUOT, 2007). Sua produção mundial gira em torno de 400 mil toneladas por ano em 200 hectares (FLETCHER, 1997; ROUKAS 1999; MAKRIS, KEFALAS, 2004). Os maiores produtores e exportadores de alfarroba são Espanha (42%), Itália (16%), Portugal (10%), Marrocos (8%), Grécia (7%), Chipre (6%) e Turquia (5%) (FLETCHER, 1997).

A vagem de alfarroba (Figura 2) mede, aproximadamente, entre 10 e 17 cm de comprimento. É composta por sementes, as quais são retiradas e processadas industrialmente para utilização como aditivo natural – principalmente, espessante e estabilizante na alimentação humana, devido ao alto número de polissacarídeos (galactomananas) que as mesmas possuem. Após a remoção das sementes, o restante da vagem é chamado de polpa, a qual é torrada e triturada em farinha para alimentação humana (BARRACOSA, CAETANO, BATISTA, 2009; SABATINI et al., 2011).

Figura 2 – Fruto da alfarrobeira.
Fonte: Migravent, 2012

Na Turquia, a polpa de alfarroba é comumente transformada em farinha de forma caseira, mas também é processada industrialmente e vendida em supermercados locais (ROUKAS, 1999; YOUSIF, ALGHZAWI, 2000; AYAZ et al., 2007; BINER et al., 2007).

Estudos já destacaram o uso de alfarroba em pó como substituta do cacau na formulação de achocolatados, bebidas lácteas, biscoitos, bolos e sorvetes (MEDEIROS, LANNES, 2009; YOUSSEF, ABD EL-MALAK, MOUSSA, 2009).

Em relação ao valor nutricional, a alfarroba em pó possui quantidade reduzida de compostos estimulantes responsáveis por efeitos fisiológicos adversos, como cafeína e teobromina, que são encontrados em níveis mais elevados no cacau, (CRAIG, NGUYEN, 1984; BONVENÍ, COLL, 2000). Sabatini et al. (2011) avaliaram os níveis destes compostos, incluindo a teofilina, na alfarroba (0,41%) e no cacau (1,09%).

A alfarroba em pó é caracterizada por um alto conteúdo de açúcar (acima de 50%), sendo que cerca de 75% ou mais encontra-se na forma de sacarose (BINDER et al., 1959; MACLEOD, FORCEN, 1992; AYAZ et al., 2007). Yousif e Alghzawi (2000) verificaram que a quantidade de açúcar é vinte vezes maior na alfarroba em pó quando comparada com o cacau em pó e a quantidade de cinzas, lipídeos, proteínas e taninos é menor.

Dentre os minerais, Ayaz et al. (2007) encontraram maiores níveis de potássio e cálcio e dentre os elementos traços, encontraram ferro, manganês, zinco e cobre. E ainda, em 2009, os mesmos autores verificaram ômega-9 como o ácido graxo mais abundante e quantidades expressivas de ômega-6 e ômega-3.

Além disso, tem sido descrita a capacidade da alfarroba em pó modular o perfil lipídico do sangue em humanos (GRUENDEL et al., 2006) podendo ter um efeito preventivo no tratamento de níveis elevados de colesterol total e fração LDL (ZUNFT et al., 2003).

2.3 SOJA

A soja – *Glycine max* – é nativa de uma região da China, pertencente a família das leguminosas. Seus frutos são vagens achatadas de cor cinza, amarela palha ou preta (Figura 3), as quais contêm de duas a cinco sementes e nascem, geralmente, em agrupamento de três a cinco, podendo encontrar-se até 400 vagens por vegetal. A soja espalhou-se pelo mundo por intermédio de viajantes ingleses e imigrantes japoneses e chineses (MISSÃO, 2006).

Figura 3 – Fruto da soja.
Fonte: Rural Centro, 2013

A soja é bastante versátil na alimentação humana, podendo ser consumida na forma de grãos integrais ou triturados, farinha, proteína texturizada, extrato de soja, tofu, fermentados, entre outros produtos (RIBEIRO, 2006).

Além de ser muito utilizada como fonte de óleo vegetal, a soja possui 40% de proteínas de alto valor biológico, 20% de lipídeos, 34% de carboidratos como glicose, frutose, sacarose e oligosacarídeos, e 5% de minerais como cálcio, fósforo, ferro, magnésio, sódio, potássio, cobre, entre outros (MANDARINO, RUFINO, 2002).

Algumas pesquisas utilizando farinha de soja com outras farinhas vêm demonstrando a sua contribuição na melhoria das propriedades funcionais dos alimentos como, por exemplo, aumento do teor de proteínas (NASCIMENTO et al., 2007; DANTAS et al., 2009). Segundo Mandarino e Rufino (2002), a adição de 20% de farinha de soja a pães, biscoitos e massas dobra o conteúdo proteico destes alimentos.

Além disso, a farinha de soja e a proteína texturizada de soja também são adicionadas aos alimentos para melhorar características sensoriais como, por exemplo, a textura. Dessa forma, a proteína texturizada de soja, que é obtida pelo processo de extrusão a partir do farelo branco desengordurado de soja, é acrescentada nas novas formulações (FERNANDES, 2007).

Atualmente, pode-se observar ainda que, na alimentação humana, a farinha de soja compõe vários produtos como chocolates, embutidos, temperos para saladas, entre outros. E ainda, pode participar na formulação de biscoitos.

2.4 BISCOITOS

Biscoito ou bolacha é o produto obtido pela mistura de farinha(s), amido(s) e/ou fécula(s) com outros ingredientes, submetidos a processos de amassamento e cocção, fermentados ou não. Podem apresentar cobertura, recheio, formato e textura diversos (BRASIL, 2005).

Os principais biscoitos comercializados são do tipo: doces, biscoitos salgados, biscoitos recheados e tipo *waffer*. O Brasil é o segundo maior produtor mundial de biscoitos em geral, com 1,25 milhões de toneladas produzidas em 2012, o que representou 2,5% de crescimento sobre 2011. O consumo *per capita* em 2012 foi de 6,18 kg, enquanto em 2011 foi de 6,09 kg (ANIB, 2013).

Os biscoitos pertencem ao grupo de alimentos não-essenciais, sendo classificados como alimento para lanches (BROWN, LANGLEY, BRAXTON, 1998). Esses produtos geralmente são consumidos para satisfazer as necessidades sensoriais, e não nutricionais. Sendo assim, a qualidade sensorial é o principal fator na determinação da aceitação e da preferência do consumidor por esses produtos, devendo-se conhecer os parâmetros sensoriais considerados importantes (ORMENESE et al., 2001).

Os biscoitos são compostos, principalmente, por farinha de trigo, gordura e açúcar. Esses ingredientes assumem importância na qualidade final. O açúcar, por exemplo, contribui tanto para a textura, quanto para o sabor e a cor do biscoito. Assim como, a quantidade de água e de amido influenciam a crocância (MANOHAR, RAO, 1997).

Segundo Brown, Langley e Braxton (1998) os biscoitos apresentam elevado consumo e boa aceitação, principalmente entre as crianças, contudo atualmente têm sido formulados com a intenção de torná-los fonte de fibras ou proteínas, devido ao grande apelo existente nos dias atuais para a melhoria da qualidade da dieta; tendo em vista, que grande parte dos adultos também possui um consumo regular desse produto.

3 ARTIGO CIENTÍFICO A SER SUBMETIDO A REVISTA "ADVANCE JOURNAL OF FOOD SCIENCE AND TECHNOLOGY"

Research paper - Advance Journal of Food Science and Technology

Elaboration, physicochemical and sensory analysis of sandwich cookies the base of carob powder

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Abstract

The objective of this study was to elaborate and analyze different formulations of sandwich cookies made with carob powder such as substitution to cocoa. After preliminary tests, three formulations were elaborated: carob sandwich cookies, carob and soy sandwich cookies and cocoa sandwich cookies. All the cookies and fillings were prepared with standard procedure. Conducted physical analyses: weight and diameter, before and after baking;

chemical analyses: protein, fat-acids, fiber, ash, moisture, carbohydrates and calories; sensory analysis: acceptability and purchase intention, with 48 judges; and statistical analysis: Tukey's test. In physical analyses, there was statistically significant difference in weight after baking between the carob cookie and cocoa cookie. In chemical analyses, the fibers showed statistically significant difference for the cocoa sandwich cookies, and carbohydrates also showed statistically significant differences among the three formulations. In sensory analysis, the attributes appearance, texture, flavor, overall acceptance, as well as purchase intention showed no statistically significant difference among the formulations, only the color present statistically significant difference for the cocoa sandwich cookies. Thus, it was concluded that the carob sandwich cookies and carob and soy sandwich cookies maintaining the nutritional and sensory characteristics compared to cocoa sandwich cookies, being a consumption alternative for people allergic to cocoa.

INTRODUCTION

Carob (*Ceratonia siliqua*) belongs to the subfamily Caesalpinioideae of the Leguminosae family, it is a typical tree of the semiarid environments in the Mediterranean area (Batlle and Tous, 1997; Biner *et al.*, 2007). The fruit of carob tree is composed by pod (90%) and seeds (10%) (Tous *et al.*, 1995), which has a high content of insoluble fiber and polyphenols (tannins), with supposed beneficial effects for human health (Zunft *et al.*, 2001). In rodents studies, carob powder preparations demonstrated a cholesterol-lowering effect and an increase excretion of cholesterol and bile acids (Pérez-Olleros *et al.*, 1999 a, b) and in humans, the supplementary intake of carob fiber shows beneficial effects on total and LDL cholesterol levels (Zunft *et al., 2003*).

Carob seeds are mostly used in food industry for production of gum due to high levels of galactomannans, used as thickening agent in food preparations (Batlle and Tous, 1997; Santos *et al.*, 2005). The carob powder is composed only of its pod, which is rich in sugars (48–56%), but it also contains a large amount of condensed tannins (16–20%). In addition, it contains about 18% cellulose and hemicelluloses, 3–4% protein, and 0.4–0.8% lipids (Bravo *et al.*, 1994; Yousif and Alghzawi, 2000).

The carob pulp is roasted and milled to produce carob powder and it is sold as a substitute for cocoa. Its flavor and appearance is similar to cocoa. In terms of nutrition, carob powder has a high sugar content, moderate protein content and low fat content compared to cocoa powder. Additionally, it is well established that carob powder is free of the two anti-nutrients found in cocoa: cafeine and theobromine (Craig and Nguyen, 1984; Yousif and Alghzawi, 2000) and contain nutritionally important amino acids (aspartic and glutamic acids, alanine, valine) and minerals (K and Ca) (Ayaz *et al.*, 2007). Therefore, carob powder has been used in the production of cookies, cakes, and beverages containing milk "chocolate" (Arrighi *et al.*, 1997). Thus, it's an alternative for people with cocoa allergy. Sole *et al.* (2007) observed that Brazilian pediatrician attributed to chocolate (6.7%) as being the starter food allergy.

The cookies are made mainly with wheat flour, fat and sugar (Manohar and Rao, 1997) and they are as part of the group of non-essentials food are classified as snack food (Brown *et al.*, 1998), generally are very much appreciated specially by kids and adolescent. These products are usually eaten to satisfy sensory expectation instead of nutritional needs, besides the sensory quality is the main factor in determining the acceptance and consumer preference for these kinds of products (Ormenese *et al.*, 2001).

The objective of this study was to make different carob sandwich cookies and analyze their physical, chemical and sensory characteristics.

MATERIALS AND METHODS

The physical and sensory analysis were conducted in the Dietetic Technique Laboratory of the Nutrition course in the Medicine School (FAMED) of Universidade Federal do Rio Grande do Sul (UFRGS).

Source of materials: The carob powder was supplied by Carob House Company and the other ingredients were acquired in a local market in Porto Alegre – RS, Brazil.

Preparation of sandwich cookies: The sandwich cookies were elaborated with cocoa powder being replaced by carob powder, resulting in three different formulations. Some changes had to be made to the original formulation in order to adapt the recipes to that carob powder during the tests. The ingredients used can be found in Table 1.

All ingredients were weighted using a Plenna® precision scale (graduation 0.1 g). For all treatments, the cookies were prepared as follows: the butter was heated in a Brastemp® microwave oven for 30 seconds, after that it was homogenized manually with the egg. Furthermore, refined sugar was manually added in order to make a uniform batter. Latter, in this batter was slowly added whole wheat flour, white wheat flour and corn starch until making it homogeneous. Then, for each formulation added the ingredient such as: for sandwich cookie of carob powder (CC) only carob powder; for sandwich cookie of carob powder and textured soy protein (CSC) carob powder and textured soy protein; and for sandwich cookie of cocoa powder (CoC) only cocoa powder was added.

Once ready, the batter standed by for 20 minutes in ambient temperature, after that it was stretched out with a roll of polyvinyl chloride (PVC) to achieve a thickness of 0.5 cm

(Figura 4) and it was cut in 4 cm of diameter. The cookies were baked in the preheating Dako® oven, Luna model in an aluminum baking pan greased with butter (Figura 5), for 10 minutes at 180°C and cooled at room temperature for 10 minutes in a stainless steel pholate.

To prepare the filling of CC and CSC, it was added in a blender, boiling water, refined sugar, milk powder and carob powder to obtain a totally homogenous filling. Later, that filling was cooked on low flame, into a stainless pan, with the butter until reaching non sticking point. For the filling of CoC, the carob powder was replaced by cocoa powder. The sandwich cookies were finished with one tablespoon of filling (5 g) between two cookies.

Table 1: Ingredients of sandwich cookies formulations

Physical analyses: The physical analyses carried out were: weight and diameter of cookies before and after baking. Three cookies from different batches were chosen to analyses. They were also weighted in Plenna® precision balance (graduation 0.1 g) and measured of diameter with Vernier® caliper rule (150 mm x 0.5 mm). In addition, the yield for each treatment was quantified with three batches.

Chemical analyses: The chemical analyses were conducted at the Animal Nutrition Laboratory of the Animal Science Department of UFRGS, in quadruplicate. Moisture, ash, lipids, proteins and crude fiber analyses were performed following AOAC (1996), while carbohydrate was determined by difference (Ihekoronye and Ngoddy, 1985). The calories were obtained by the values stipulated by RDC n° 360/2003, 4.0 kcal for 1 g carbohydrate, 4.0 kcal for 1 g protein and 9.0 kcal for 1 g lipid. These values were multiplied by each macronutrient and finally were summed to obtain the total caloric value.

Sensory analysis: The sensory analysis was performed by 48 non-trained judges after signing the Informed Consent Form (APÊNDICE A). The judges were students and teachers from the university. The three sandwich cookies samples were evaluated in terms of global acceptance, texture, color, flavor, and appearance (APÊNDICE B). The sensory analysis was conducted isolated with each judge, at ambient temperature, using white plastic dishes, numbered with three random digits, which corresponded to each sample. The judges received water to drink before evaluating each sample. A 9-points hedonic scale of was used, each point meaning: 1 - dislike extremely, 2 - dislike very much, 3 - dislike moderately, 4 - dislike slightly, 5 - neither like nor dislike, 6 - like slightly, 7 - like moderately, 8 - like very much and 9 - like extremely.

It was also evaluated the purchase intention (APÊNDICE B), using the following scale: 1 - would certainly not buy it, 2 - would probably not buy it, 3 - not sure if would buy it, 4 - would probably buy it and 5 - would certainly buy it. This study was approved by the Ethics Committee of UFRGS, process number 150.778.

Statistical analysis: The statistical analysis was made using the program ESTAT®, version 2.0, with the Tukey's test, considering a 5% error probability. The results were given as means plus standard deviation. There were considered as being statistically significant the results that showed differences with $p < 0.05$.

RESULTS AND DISCUSSION

Physicals analyses: As shown in table 2, there was no statistically significant difference ($p > 0.05$) in relation to weight before baking, diameter before and after baking and yield among samples. Only weight after baking showed statistically significant difference ($p < 0.05$) between CoC and CC, and that the CoC was the heaviest. This difference can also have

influenced on yield although statistically significant difference was not observed, because the CC had the highest yield. This change may have been influenced the texture batter of cookies, showing different stretch.

Table 2: Physical characteristics of the cookies formulations before and after baking

According to Fasolin *et al*. (2007), cookies elaborated with green banana flour, also haven't statistically significant differences between the samples for weight and diameter before baking, whereas weight and diameter after baking showed statistically significant difference ($p < 0.05$) between samples.

From Larrea *et al*. (2005), the study with cookies supplemented with different percentages of extruded orange pulp not showed statistically significant difference ($p < 0.05$) for weight before and after baking between the samples.

Chemicals analyses: Table 3 presents the results of chemical characteristics of all sandwich cookies evaluated. Thus, it is possible to observe that there was no statistically significant difference ($p > 0.05$) among samples for moisture, ash, protein, lipids and calories per portion. However, for crude fiber it was observed statistically significant differences ($p < 0.05$) which CoC had the highest amount of fiber between CC and CSC. Carbohydrates also presented statistically significant differences ($p < 0.05$) among all the samples. CC presented, CSC and CoC had the lowest amount.

Table 3: Chemical parameters of the sandwich cookies formulations

Yousif and Alghzawi (2000) founded that the fat, ash and protein values of carob powder (0.74%, 2.48%, 5.82%, respectively) was lower than those of cocoa powder (22.88%, 6.40%, 22.9%, respectively) and that the sugar were higher in carob powder (38.7%) than those of cocoa powder (2.16%). The study according to Youssef *et al.* (2009). Whereas Ayaz *et al*. (2007) observed the lowest value of protein in carob powder (4.45%).

In accordance with Rababah *et al*. (2013), in carob powder were found to contain high concentrations of carbohydrate (71.4 g/100 g), moderate amounts of protein and fiber (5.9 and 8.2 g/100 g, respectively), and low amounts of fat and ash (1.2 and 2.7 g/100 g, respectively).

Lar *et al.* (2012) used carob powder as substitute of wheat flour in tarhana formulation, which is an Asian traditional fermented cereal food. The carob powder showed a high ash, Ca and K contents when compared with wheat flour.

Salem and Fahad (2012) prepared the milk chocolate substituting the cocoa for carob powder (25, 50, 75 and 100%). This study showed highly significant differences in fiber contents among milk chocolate samples contained 25, 50, 75 and 100% carob powder of their weights than the control (free carob powder) sample. Wherein, there was a progressive increment as a result of increase the carob powder amount. The same model was also achieved in case of ash contents of the milk chocolate samples provided by carob powder. Already, the fat and carbohydrates were low whereas increased the carob powder amount, which contradicts the earlier studies cited than showed the high level carbohydrates in carob powder.

Salem and Farhad (2012) showed that the control sample of the milk chocolate (carob free) possessed the highest amount of caffeine (2720.26 mg/100kg). Addition of the carob powder (25, 50 and 75%) gradually significantly lowered the milk chocolate contents of caffeine (to be 22382.44, 1059.16 and 740.678 mg/100kg, respectively). The milk chocolate sample by 100% carob pod powder was caffeine free. Medeiros and Lannes (2009) showed

methylxanthines (caffeine and teobromine) levels highest in cocoa powder (1.09%) when compared to carob powder (0.24 – 0.41%).

Properties sensory: In sensory analysis of the sandwich cookies samples, the attributes appearance, texture, flavor and global acceptability did not show statistically significant difference ($p > 0.05$) among all samples (table 4), although the CC and CSC samples presented lower rates when compared to CoC sample.

The attribute color showed statistically significant difference ($p < 0.05$) between samples CoC (like moderately) and CC and CSC (like slightly).

Table 4: Properties sensory of sandwich cookies formulations

Table 5 presents the evaluator's purchase intention test, which indicated no statistically significant difference ($p > 0.05$) among the samples. That's indicates a good acceptability and similar sensory quality of CC and CSC when compared a CoC.

Table 5: Evaluator's purchase intention of the sandwich cookies formulations

Fernandes (2007) mentioned the texture soy protein such as improving texture in the formulations. The sandwich cookies made with carob powder and texture soy protein showed this result when compared to sandwich cookies made with only carob powder, but did not show this result when compared to sandwich cookies made with only cocoa powder.

Youssef *et al.* (2009) prepared hot drinks and cakes with carob powder, utilizing different times and temperatures for roast, to compare the ones made with cocoa powder. The hot drinks were prepared with roasted carob powder for 30 minutes at 160ºC had a rate of

same overall acceptability, texture similar, odor, taste and color major when compared to the hot drink made with cocoa powder. The cakes were made with roasted carob powder showed the same results with the roast for 30 minutes at 160ºC.

According to Atasoy (2009), the sensory analysis of the yoghurts made with carob juice concentrate (10 mL) had taste and flavor rate major than those the standard, while texture and appearance had a similar rate in comparison to the standard.

Lar *et al*. (2012) founded that addition of 3% of carob powder in tarhana as substitute of wheat flour showed a major rate to taste and color attributes, and equal grittiness and overall acceptability when compared to control.

Salem and Farhad (2012), showed that in milk chocolates with carob powder there was a significant difference in general appearance attribute between the control sample and the other samples. It was also found that there were significant differences among the carob powder samples as a result of increasing the carob amounts.

Sabatini et al. (2011) prepared the ice cream with carob powder and submitted to sensory analysis. The attributes appearance, flavor and global acceptability showed approximated average 8 (“like very much”). Regarding the purchase intention, 54% said "Certainly I would buy", 39% "Probably I would buy", 6% "Maybe I would buy" and 2% "Probably I would not buy". With these results, it is observed that 93% of the tasters would buy the ice cream prepared in the study.

CONCLUSION

The CC and the CSC showed similar physicochemical and sensory characteristics when compared to CoC.

In terms of physical characteristics, the weight before baking, diameter before and after baking and yield showed similar characteristics for all the samples. The CoC was the heaviest one.

Moisture, ash, protein, lipids, calories per portion showed similar chemical characteristics for all the samples. The CoC presented the highest content of crude fiber.

The CC presented highest content of carbohydrate, however the CSC showed the highest content of proteins and the less content of lipids.

The attributes appearance, texture, flavor and global acceptability showed similar characteristics for all the samples. The attributed color was more presented in CoC, nevertheless the purchase intention was similar for all the samples.

Thus, the carob powder is a good alternative such as substitution of cocoa in elaborated of sandwich cookies. Therefore, the sandwich cookies elaborated in this study are made with whole wheat flour and they are fat-acidy-*trans* free, which is generally found in sandwich cookies commercial.

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Table 1: Ingredients of sandwich cookies formulations

INGREDIENTS	CC	CSC	CoC
Cookies			
Refined sugar (g)	64	64	64
Corn starch (g)	30	30	30
Cocoa powder (g)	-	-	20
Carob powder (g)	20	20	-
White wheat flour (g)	40	40	40
Whole wheat flour (g)	64	64	64
Butter (g)	30	30	30
Egg (g)	46	46	46
Textured soy protein (g)	-	8	-
Filling			
Refined sugar (g)	105	105	105
Boiling water (ml)	80	80	80
Cocoa powder (g)	-	-	10
Carob powder (g)	10	10	-
Milk powder (g)	90	90	90
Butter (g)	10	10	10

CC = sandwich cookies only with carob powder;
CSC = sandwich cookies with carob powder with textured soy protein;
CoC = sandwich cookies only with cocoa powder.

Table 2: Physicals characteristics of the cookies formulations before and after baking

Characteristics	CC	CSC	CoC
Weight before baking (g)	9.57 ± 0.75 [a]	10.51 ± 0.87 [a]	10.77 ± 1.00 [a]
Weight after baking (g)	9.11 ± 0.00 [b]	10.11 ± 1.00 [a b]	11.22 ± 1.00 [a]
Diameter before baking (g)	4.32 ± 0.10 [a]	4.58 ± 0.12 [a]	4.47 ± 0.12 [a]
Diameter after baking (g)	4.71 ± 0.10 [a]	4.60 ± 0.12 [a]	4.56 ± 0.15 [a]
Yield (units)	28 ± 2.65 [a]	27 ± 1.73 [a]	26 ±1.15 [a]

Values with different superscripts within the same row are significantly different ($p \leq 0.05$).
CC = cookies only with carob powder;
CSC = cookies with carob powder with textured soy protein;
CoC = cookies only with cocoa powder.

Table 3: Chemical parameters of the sandwich cookies formulations

Parameters	CC	CSC	CoC
Moisture (%)	2.70 ± 0.15 [a]	3.27 ± 0.67 [a]	2.68 ± 0.50 [a]
Ash (%)	1.55 ± 0.07 [a]	1.73 ± 0.08 [a]	1.73 ± 0.11 [a]
Protein (%)	9.65 ± 0.82 [a]	10.64 ± 0.47 [a]	10.03 ± 0.49 [a]
Lipids (%)	12.15 ± 1.28 [a]	11.90 ± 1.16 [a]	13.04 ± 1.17 [a]
Crude fiber (%)	1.30 ± 0.10 [b]	1.33 ± 0.05 [b]	1.85 ± 0.17 [a]
Carbohydrate (%)	75.35 ± 0.43 [a]	74.41 ± 0.13 [b]	73.36 ± 0.53 [c]
Calories per portion of 25g (kcal)	112.32 ± 1.65 [a]	111.81 ± 2.24 [a]	112.71 ± 1.69 [a]

Values with different superscripts within the same row are significantly different ($p \leq 0.05$).
CC = sandwich cookies only with carob powder;
CSC = sandwich cookies with carob powder with textured soy protein;
CoC = sandwich cookies only with cocoa powder.
25g is the weight of two cookies plus filling

Table 4: Properties sensory of the sandwich cookies formulations

Attributes	CC	CSC	CoC
Appearance	6.92 ± 1.51 [a]	6.79 ± 1.33 [a]	7.21 ± 1.47 [a]
Color	6.71 ± 1.53 [b]	6.58 ± 1.65 [b]	7.48 ± 1.18 [a]
Texture	6.60 ± 1.67 [a]	6.75 ± 1.79 [a]	7.08 ± 1.65 [a]
Flavor	6.85 ± 1.50 [a]	6.75 ± 1.74 [a]	7.31 ± 1.68 [a]
Global acceptability	6.87 ± 1.36 [a]	6.81 ± 1.41 [a]	7.25 ± 1.49 [a]

Values with different superscripts within the same row are significantly different ($p \leq 0.05$).
CC = sandwich cookies only with carob powder;
CSC = sandwich cookies with carob powder with textured soy protein;
CoC = sandwich cookies only with cocoa powder.

Table 5: Evaluator's purchase intention of the sandwich cookies formulations

	CC	CSC	CoC
Purchase intention	3.54 ± 1.03 [a]	3.44 ± 1.20 [a]	3.94 ± 1.12 [a]

Values with different superscripts within the same row are significantly different ($p \leq 0.05$).
CC = sandwich cookies only with carob powder;
CSC = sandwich cookies with carob powder with textured soy protein;
CoC = sandwich cookies only with cocoa powder.

4 NORMAS DA REVISTA "ADVANCE JOURNAL OF FOOD SCIENCE AND TECHNOLOGY" PARA SUBMISSÃO DE ARTIGOS CIENTÍFICOS

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4.4.1 Title

a) The title page should start with the journal name (Like Asian Journal of medical Sciences) and type of manuscript (Research, Review Article, Short

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b) The title, name(s) of the author(s) and affiliations and mailing address, an asterisk (*) should be added to the right of the corresponding author's name. When there are two or more authors and they belong to more than one affiliation, the connection between each author;

c) His or her affiliation should be indicated by superscripts 1, 2, 3 … placed after each author's name and before each affiliation.

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a) The abstract consists not more than 250 words in one paragraph and containing the main findings and conclusions;

b) Summarize the relevant results in a brief but understandable form, beginning with a clear statement of the objective and ending with the conclusions;

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d) Please make sure names of genes are in italics whereas proteins are in normal font. Et al., in vivo, in vitro, drosophila, xenopus etc. should be in italics.

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a) List up to 6 key words including the species, variables tested and the major response criteria. Which clearly identify the paper's subject, purpose and spotlight;

b) The first letter of each key word is lowercase (unless a proper noun);

c) Key words are separated by commas and presented in alphabetical order;

d) Words from title should avoid repeating as key words.

4.4.4 Introduction

a) Keep the introduction short;
b) Precise the introduction in a significant manner and exclude the all subheadings;
c) The basic principles of research, background earlier work and the purpose of the present studies should be described in the introduction;
d) Introduction should be briefly justifies the research, specifies the hypotheses to be tested and gives the objective(s). Extensive discussion of relevant literature should be included in the Discussion.

4.4.5 Materials and Methods

a) A clear description or specific original reference is required for all biological, analytical and statistical procedures;
b) All modifications of procedures must be explained;
c) Appropriate statistical methods should be used although the biology should be emphasized;
d) A statement of the results of the statistical analysis should justify the interpretations and conclusions.

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a) The results are presented in the form of tables or figures when feasible;
b) If data are discussed in the text but not presented in the tables or figures, specify, “data not shown” in the text;

c) The text should explain or elaborate on the tabular data, but numbers should not be repeated within the text;
d) Sufficient data, all with some index of variation attached, should be presented to allow the reader to interpret the results of the experiment;
e) The discussion should interpret the results clearly and concisely in terms of biological mechanisms and significance and also should integrate the research findings with the body of previously published literature to provide the reader with a broad base on which to accept or reject the hypotheses tested;
f) Focused on the interpretation of the results rather then a repetition of the results section;
g) Explain how the results relate previous findings, weather in support, contradiction, or simply as added data;
h) Highlight the significant/unique findings of the research under conclusion;
i) Precise whole discussion portion in a significant manner and give some Recommendations;
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a) Special characters (e.g., Greek and symbols) should be inserted using the symbols palette available in iis font;
b) Complex equations should be entered using Math-Type or an equation editor;
c) Tables and figures should be placed in separate sections at the end of the manuscript (not placed in the text);
d) Authors should prepare their manuscript in Microsoft Word and upload the manuscripts using the fewest file possible to facilitate the review and editing processes.

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a) Only one figure, table, or chart should appear on one page of an A4-sized paper (both portrait and landscape paper orientations can be used);
b) Provide self-explanatory captions of all tables and figures in a separate page;
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d) Put all figures and tables in ascending order;
e) Label x-axis and y-axis of figures;
f) All figures legends should be clearly explained;
g) Each column must have a heading (e.g., Item, Ingredient, Trait, Fatty acid);
h) In the body of the table, references to footnotes should be numerals. Each footnote should begin on a new line;
i) The final quality of your illustrations as they appear in the journal, depends on the quality with which you send them to us. If poor resolutions figures re sent, poor quality images are reproduced;
j) Always take the primary photographs with maximal resolution (for digital cameras, set the resolution option to maximum);
k) As a general, manipulate images as little as possible, so as to avoid losing resolution, and always accompany your submission with original format of the file before exporting to other formats such as JPG, JPEG, PNG, TIFF, EPS (for photograph and screen dumps) EPS, PDF (for line drawings);
l) If exporting images to other applications, ensure that you export at maximal resolution (not at 72 dpi);
m) Always submit a set of good, photographic quality hart copies of your artwork with the final version of the accepted paper;
n) If scanning photos, do so with the resolution of 300 B 600 dpi.

4.4.9 Nomenclature

The nomenclature used for chemical compounds shall be in accordance with the nomenclature rules.

4.4.10 Appendixes

To provide readers with numerical examples or give extensive detail of analytical procedures, an appendix or appendices can be included.

4.4.11 Acknowledgement

Acknowledgement section may be included if author wants to acknowledge to the funding agency of to an scientist(s).

4.4.12 References

a) In the text body of the manuscript, refer to authors as follows: Smith and Jones (1992) or Smith and Jones (1990, 1992);
b) If the sentence structure requires that the authors' names be included in parentheses, the proper format is: (Smith and Jones, 1982; Jones, 1988a, b; Jones et al., 1993);
c) When there are more than 2 authors of an article, the first author's name is followed by the abbreviation et al. More than 1 article listed in the same sentence or parentheses must be in chronological order first and alphabetical order for 2 publications in the same year;
d) Published articles and not abstracts should be cited whenever possible; if the work was originally described in an abstract, the author(s) should use a literature search to determine if the work has been published as a peer-reviewed article;

e) Work that has not been accepted for publication shall be listed in the text as "J.E. Jones (institution, city and state or country, personal communication)";
f) The author's own unpublished work should be listed in the text as "(J. Smith, unpublished data)";
g) Personal communications and unpublished data must not be included in the references list;
h) To be listed in the references list, papers must be published or accepted for publication (in press);
i) In the references list, references are listed alphabetically by the author(s)' last name(s) and then chronologically;
j) The year of publication follows the authors' names. As with text citations, 2 or more publications by the same author or set of authors in the same year shall be differentiated by adding lowercase letters after the date;
k) All authors' names must appear in the references list. Journals shall be abbreviated according to international standard format;
l) Inclusive volumes, page numbers and editions must be provided.

4.4.13 Format of References List

a) Journal Articles: Ouyang, D., J. Bartholic and J. Selegean, 2005. Assessing sediment loading from agricultural croplands in the Great Lakes Basin. J. Am. Sci., 1(2): 14-21;
b) A Book: Michael, B., S. Richard, J. Gelles and A. Levine, 1984. Socioiogy: An Introduction. 2nd Edn., Random House, New York;
c) AOAC., 1990. Official Methods of Analysis. 15th Edn. Association Official Analytical Chemists.Washington D.C., pp: 805-845;
d) NRC., 1989. Nutrient Requirements of Dairy Cattle. 6th Rev. Edn. Natl. Acad. Press, Washington, D.C., pp: 90-110;
e) A Chapter in a Book: Leach, J., 1993. Impacts of the Zebra Mussel (Dreissena polymorpha) on Water Quality and Fish Spawning Reefs of Western Lake Erie. In: Zebra Mussels: Biology, Impacts and Control. Nalepa, T. and D. Schloesser (Eds.). Ann Arbor, MI: Lewis Publishers, pp: 381-397;

f) A Report: Makarewicz, J.C., T. Lewis and P. Bertram, 1995. Epilimnetic phytoplankton and zooplankton biomass and species composition in Lake Michigan, 1983-1992. U.S. EPA Great Lakes National Program, Chicago, IL. EPA 905-R-95-009;

g) Conference/Proceedings: Muhammad, B.F. and R. Kwali, 2005. Prospects and constraints to small scale yoghurt production in Bauchi Metropolis. Proceeding of the 10th Annual Conference of the Animal Science Association of Nigeria. University of Ado-Ekiti, Sep. 12-15, pp: 234-236;

h) A Thesis: Strunk, J.L., 1991. The extraction of mercury from sediment and the geochemical partitioning of mercury in sediments from Lake Superior, M.S. Thesis, Michigan State Univ., East Lansing, MI.

4.4.14 Abbreviations, symbols and style

a) Use only international standard abbreviations. In decimals, use the decimal point, not the comma. Use no Roman numerals;

b) Foreign words, Latin names of genera, species, mathematical symbols, etc. should be italicized indicated by single underlining. Personal names after Latin names should not be italicized;

c) Units: The following units should be used: length (m, cm, m, mm, nm, Å), mass (kg, g, mg, mg, ng, pg, mol, mmol), Volume (l, ml, ml), time (s, min, h, d), temperature (°C, K), radiation (Bq, Ci, dpm, Gy, rad) and concentration (M, mM, mol/l, mmol/l, mg/ml, mg/ml, %, % (v/v), % (w/v), ppm, ppb.

4.5 PROOFS & REPRINTS

Electronic proofs would be uploads into the account of corresponding author as a PDF file. Page proofs are considered to be the final version of the manuscript. With the exception of typographical or minor clerical errors, no changes will be made in the manuscript at the proof stage. Authors will have free electronic access to the

full text (in both HTML and PDF) of the article. Authors can freely download the PDF file from which they can print unlimited copies of their articles.

4.6 FEES & CHARGES

Authors are required to pay a $300 handling fee. Publication of an article in the MAXWELL SCIENCE PUBLICATION is not reliant upon the author's ability to pay the charges. Handling fee would be charged after acceptance the manuscript. Authors may still request (at the time of submission) that the editorial office waive some of the handling fee under special circumstances.

5 CONSIDERAÇÕES FINAIS

Considerando a boa aceitação sensorial dos biscoitos recheados de alfarroba em comparação aos biscoitos recheados de cacau, é indicada a realização de um estudo sensorial com crianças e adolescentes também, visto que são o maior público consumidor destes produtos. Com boa aceitação sensorial e boas características químicas, pode-se cogitar sobre maneiras de inclusão destes biscoitos recheados no Programa de Alimentação Escolar do Governo Federal.

Tendo em vista as características químicas da alfarroba em pó, observadas em estudos discutidos anteriormente e neste estudo em si, é conveniente realizar outras preparações incluindo-a como substituta do cacau, até mesmo para fim dietoterápico aos indivíduos alérgicos ao cacau. Ainda, estudos específicos de micronutrientes, antioxidantes e tipos de ácidos graxos também são recomendados em relação à alfarroba em pó. Assim como, investigar seu potencial de modulação lipídica em humanos. Além disso, vale ressaltar o baixo teor de compostos antinutricionais como cafeína e teobromina encontrado, por diversos outros estudos, na alfarroba e pó, em comparação com o cacau em pó. Do mesmo modo, a comercialização dos biscoitos recheados de alfarroba também é uma possibilidade promissora a se avaliar.

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