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Elaboração, análise físico-química e sensorial de cuca sem glúten

Porto Alegre, 2012

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Trabalho de conclusão de curso 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.

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DEDICATÓRIA

Dedico meu trabalho de conclusão de curso (TCC) à
minha família e amigos por seu apoio,
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RESUMO

O objetivo desse trabalho foi elaborar e avaliar as características físico-químicas e sensoriais, além de sua intenção de compra de cucas elaboradas com farinhas isentas de glúten. As análises físicas e sensoriais foram realizadas no Laboratório de Técnica Dietética do curso de Nutrição da FAMED da Universidade Federal do Rio Grande do Sul e as análises químicas no Laboratório de Compostos Bioativos do ICTA da Universidade Federal do Rio Grande do Sul. Todos os ingredientes para elaboração das formulações, além da cuca de formulação com farinha de trigo, utilizada como padrão nas análises químicas e sensorial foram adquirida no mercado local de Porto Alegre - RS. Foram elaboradas cucas em cuja fórmula substituiu-se a farinha de trigo por trigo sarraceno misturado com farinhas de maçã, banana e maracujá, resultando em três tipos diferentes de cucas isentas de glúten. Realizaram-se as análises físicas, pesando-se as cucas cruas e assadas em uma balança de precisão Plenna® em triplicata. Também se aferiu a profundidade em três pontos diferentes de cada cuca, crua e assada, para se avaliar o crescimento em comparação com o padrão. As análises químicas incluíram os testes de umidade, cinzas, lipídios e proteínas, sendo todas feitas em triplicata e incluindo a cuca padrão comercializada como controle. A análise sensorial contou com 36 avaliadores não treinados, sendo eles professores e alunos desta universidade, e os atributos avaliados foram: aceitação global, aparência, cor, sabor e textura. Foi usada uma escala hedônica de 9 pontos, e também foi avaliada a intenção de compra dos produtos (escala hedônica de 5 pontos). De acordo com os resultados, as amostras cruas e assadas feitas com a combinação de trigo sarraceno e farinha de maracujá foram as mais pesadas ($P \leq 0,05$), seguidas pelas cucas de maçã e banana. A análise de profundidade das amostras cruas sugerem que a amostra com farinha de maracujá também obteve mais volume (3,06cm), seguida pela de farinha de banana (2,63cm) e pela de farinha de maçã (2,50cm) e a análise de profundidade dos produtos assados mostrou a cuca de farinha de maracujá ainda em primeiro lugar (4,53cm) e a de maçã em segundo (4,43cm), sem diferença estatística entre si ($P > 0,05$), mas sim com relação à cuca de banana (3,63cm). O tempo de forneamento também mostrou diferença estatística significativa ($P \leq 0,05$): 72 minutos para a cuca de maracujá, 64 minutos para a de maçã e 60 minutos para a de banana. Observou-se que a cuca de maracujá apresentou maior porcentagem de umidade (46,57%), com diferença significativa em relação às outras amostras ($P \leq 0,05$). O maior índice de cinzas foi encontrado na cuca de banana (1,08%), assim como o de lipídios (11,30%). A cuca comercial padrão indicou valores maiores de proteína (2,18%), com diferença estatística significativa com relação às demais amostras ($P \leq 0,05$). A cuca de maçã teve a maior pontuação em termos de aparência (7,50) e cor

(7,30). O teste de sabor sugeriu que a cuca comercial padrão teria melhor aceitação (7,50) e o de textura apontou a cuca de banana como a melhor (7,11). A cuca comercial padrão foi apontada como a mais provável de ser comprada (4,11).

Os resultados finais foram satisfatórios, sugerindo que as cucas isentas de glúten feitas neste estudo são produtos viáveis, embora mais pesquisas possam ser conduzidas, a fim de se aperfeiçoar as formulações.

Palavras-chave: trigo sarraceno, glúten, doença celíaca, panifícios

ABSTRACT

The purpose of this paper was to elaborate and evaluate the physicochemical and sensory characteristics besides purchase intention, of *cucas* made with gluten-free flours. The physical and sensory analyses were conducted at the Dietetic Technique Laboratory of the Nutrition course in the Medicine School (FAMED) of Universidade Federal do Rio Grande do Sul (UFRGS) and the chemical analysis were conducted at the Bromatology Laboratory of the Institute of Science and Food Technology (ICTA) of Universidade Federal do Rio Grande do Sul (UFRGS). All ingredients used to make the formulations and the standard *cuca* made with wheat flour, used as control in the chemical and sensory analyses, were bought at a local market of the city of Porto Alegre – RS. *Cucas* were made using buckwheat flour blended with passion fruit, apple or banana flour, instead of wheat flour, resulting in three different gluten-free *cucas*. The physical analysis was made by weighting raw and baked *cucas* in a precision scale of the brand Plenna® in triplicate. Depth was also measured in three different spots, raw and baked, to evaluate growth rate in comparison to the control. The chemical analysis included moisture, ash, fat and protein test, each made in triplicate and including the control *cuca*. The sensory analysis was made with 36 non-trained, non-coeliac people, who were teachers and students from the same university. The evaluation was made in terms of global acceptance, appearance, color, taste and texture. It was used a hedonic scale of 9 points and the purchase intention was also evaluated (5 points hedonic scale). According to the results, the raw and baked sample composed by the combination of common buckwheat flour and passion fruit flour was the heaviest ($P \leq 0.05$), followed by the apple *cuca* and the banana *cuca*. The depth analysis of the raw samples suggests that the passion fruit flour sample also obtained more volume (3.06cm), followed by the banana flour (2.63cm) and the apple flour (2.50cm) samples and the depth analyses of the baked products still shows the passion fruit flour sample in first place (4.53cm), followed by the apple flour sample (4.43cm), with no statistic differences between them ($P > 0.05$), but they had with the banana flour *cuca* (3.63cm). The baking time also showed significant statistic difference ($P \leq 0.05$): 72 minutes for the passion fruit flour one, 64 minutes for the apple flour sample and 60 minutes for the banana flour *cuca*. It was noticed that the passion fruit *cuca* had more moisture percentage (46.57%), with significant difference among all the other samples ($P \leq 0.05$). The highest ash percentage was found in the banana *cuca* (1.08%), as well as fat (11.30%). The standard commercial *cuca* had higher protein value (2.18%), with significant difference in relation to the other samples ($P \leq 0.05$). The apple *cuca* had the best score in appearance (7.50 – like moderately) and color (7.30). The taste assessment suggested that the standard commercial

cuca would have better acceptance (7.50) and the texture test pointed the banana *cuca* as the best (7.11). The standard commercial *cuca* was the most interesting of being bought (4.11).

The results were satisfactory, suggesting that the gluten-free *cucas* made in this paper are viable products, although more research can be made, in order to improve the formulation in many aspects.

Keywords: buckwheat flour, gluten-free, coeliac disease, bakery products

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SUMÁRIO

1 INTRODUÇÃO

O glúten é uma substância elástica, de característica fibrosa, formada da combinação das proteínas de farinhas como a de trigo (gliadina e glutenina) e a água, ocorrendo hidratação e formação de um complexo protéico a partir de ligações dissulfito, Van der Waals e pontes de hidrogênio. Sua função é a de reter os gases que se formam na fermentação, tornando a massa expansível, porém resistente a fissuras, que ocorrem em seu crescimento durante o assamento. Sua outra função é a de reter a umidade da massa depois de assada, ajudando a promover a maciez e elasticidade do preparo (WIESER, 2007; GALLAGHER; GORMLEY; ARENDT, 2004). Porém, o glúten é composto por peptídeos que causam reações autoimunes em pessoas portadoras da doença celíaca.

Dentre as doenças do intestino delgado, destaca-se a doença celíaca, uma doença autoimune também conhecida como enteropatia sensível ao glúten. Estima-se que o surgimento da doença celíaca tenha ocorrido em meados de 10.000 a.C., quando o homem primitivo passou a cultivar seu próprio alimento, plantando cereais, tais como o trigo e o centeio. Porém, a determinação da causa das reações sofridas por pacientes celíacos e seu posterior tratamento dietético só ocorreu com as observações do pediatra holandês W.R. Dicke, que notou melhoras ao se retirar o pão da dieta de seus pacientes com essa doença, seguido de piora ao se reintroduzir tal alimento, durante e após a Segunda Guerra Mundial (SHILS et al., 2006).

Na doença celíaca, determinadas porções de peptídeos de proteínas presentes no trigo, na cevada e no centeio (gliadina, hordeína e secalina, respectivamente), sofrem modificações durante a absorção, alterando sua conformação e disparando uma resposta imune local, que também pode vir a ser sistêmica. Com o consumo insistente de alimentos compostos de glúten, começa a ocorrer dano à mucosa do intestino delgado, causando achatamento das vilosidades nas porções proximal e média, comprometendo a secreção de neuropeptídeos e prejudicando as funções digestivas, como a capacidade absortiva. Os danos compreendem deficiências em dissacaridases e peptidases das células da borda em escova, importantes para a digestão, assim como diminuição de hormônios peptídicos, prejudicando as secreções pancreáticas e de bile. Outro fator a ser considerado são os danos nos carreadores, que fazem o transporte de nutrientes na corrente sanguínea (MAHAN; ESCOTT-STUMP, 2004).

O diagnóstico é feito através de diversos exames clínicos, histológicos e laboratoriais, mas é com a biópsia do intestino delgado que se tem certeza de que o paciente é portador ou não. Por se tratar de uma doença crônica, a exclusão do glúten na dieta é permanente, visando evitar tais efeitos negativos no metabolismo do indivíduo. Entre as manifestações extra-intestinais da doença estão a anemia ferropriva, esteatose hepática, síndromes psiquiátricas, hipoplasia de esmalte dental e artrite (MAHAN; ESCOTT-STUMP, 2004).

Uma alternativa para a exclusão de trigo é o trigo sarraceno, pois não contém glúten. Embora seja chamado de "trigo" devido a semelhanças com o trigo comum em termos de composição química (ACQUISTUCCI; FORNAL, 1997 apud SILVA et al., 2002), ele está mais para a família do arroz. O trigo sarraceno é fonte de fibras e contém flavonóides, como a rutina, que tem ação antioxidante (SILVA et al., 2002).

Na cultura gaúcha existem diversas preparações típicas. Além do churrasco e do chimarrão, há a cuca, espécie de pão adocicado que aparece com frequência nos cafés coloniais e, em alguns locais, tais como Santa Cruz do Sul, até acompanha o churrasco à mesa. Inicialmente uma receita alemã – chamada de *kuchen* – foi trazida à região do Vale dos Sinos e arredores pelos imigrantes. Ao longo dos anos, a receita sofreu mudanças, adaptando-se às condições locais e ingredientes disponíveis. Essas mudanças foram tantas que atualmente não existe uma formulação definitiva para a cuca, mas sim diversos modos de preparo que resultam em produtos muito semelhantes.

Dentre os ingredientes da cuca, a farinha de trigo é a principal. Devido ao glúten em sua composição, o consumo torna-se inviável para portadores da doença celíaca. Uma formulação de cuca isenta de glúten, de fácil preparação e de boa aceitação pode favorecer a qualidade de vida de tais pacientes oferendo maior diversidade em sua alimentação e ao mesmo tempo também auxiliaria o paciente a se sentir aceito no grupo ao qual está inserido. Assim, o celíaco terá mais uma opção em panifício para sua dieta, trazendo um pouco da cultura do Rio Grande do Sul para sua mesa.

2 OBJETIVOS

2.1 Objetivo geral

Elaborar formulações de cucas isenta de glúten utilizando farinhas de maçã, banana e maracujá combinadas com o trigo sarraceno.

2.2 **Objetivos específicos**

Realizar as análises físicas e químicas das diferentes formulações de cucas elaboradas;

Analisar sensorialmente as amostras de cucas elaboradas;

Avaliar a intenção de compra das formulações de cucas elaboradas.

3 REVISÃO BIBLIOGRÁFICA

Doença Celíaca

A doença celíaca (DC) foi definida por Kagnoff (2007) como sendo uma doença causadora de "lesão na mucosa do intestino delgado e má absorção de nutrientes em indivíduos geneticamente suscetíveis em resposta à ingestão do glúten do trigo e proteínas similares na cevada e no centeio".

Na Irlanda, Mylotte (1973) identificou uma incidência de 1:300 e nos Estados Unidos foi constatada a relação de 1:10000 em um estudo de Talley (1994) e a prevalência tende a aumentar quando se trata de parentes em primeiro grau de doentes celíacos, onde a frequência chega a ser até 20 vezes maior que na população geral (BONAMICO et al., 2006) e ainda maior entre as mulheres, na proporção de 2:1 (KOTZE, 2006).

O diagnóstico da doença celíaca é uma ferramenta imprescindível para se confirmar a suspeita de tal condição. A biópsia do intestino delgado proximal é necessária para o diagnóstico, sendo considerado o padrão ouro. Mas têm-se ressaltado a importância de testes sorológicos, tanto no diagnóstico quando em outras etapas da vida do paciente celíaco, como o rastreamento e o monitoramento (SHILS et al.,2006).

De acordo com Hill et al. (2005), a DC reflete no organismo diversos problemas e sintomas, sendo o principal é a diarreia crônica. Além disso, há evidências de que crianças apresentam baixo ganho de peso e reduzida mineralização óssea.

Em outro estudo, usando-se o Registro Médico de Nascimentos Dinamarquês e que abrangeu 1.504.342 nascimentos de 836.241 mães, Kashan et al. (2010) concluíram que puérperas que não trataram a doença celíaca aumentam o risco de baixo peso ao nascer e nascimento a pré-termo, enquanto que as que foram tratadas não apresentaram diferenças em relação à população em geral.

Para Kotze (2006), o tratamento é apontado como sendo basicamente modificar a dieta, excluindo-se definitivamente o glúten encontrado no trigo, na cevada, centeio e aveia.

Dieta

O doente celíaco necessita de uma dieta isenta de glúten a fim de manter a integridade de sua mucosa intestinal e uma boa absorção de nutrientes. Ao se excluir o glúten da alimentação, as lesões começam a regredir e a membrana da borda em escova recupera suas funções. Embora esse processo de recuperação possa durar dias ou semanas, a restauração histológica pode levar meses ou até mesmo anos, principalmente em adultos (LEE et al., 2003 apud GREEN; CELLIER, 2007).

Tursi e Brandimarte (2003), em um estudo com 35 pacientes com suspeita de doença celíaca, com lesões diagnosticadas por biópsia do intestino delgado, motivaram os pacientes a aderirem a uma dieta livre de glúten, no qual apenas 23 seguiram tal recomendação. Após um período que variou entre 8 e 12 meses, foi feita nova biópsia de todos os pacientes, mostrando uma melhora drástica nas lesões de mucosa intestinal daqueles que aderiram à dieta, com os sintomas praticamente tendo desaparecidos. Nos pacientes que não seguiram a recomendação, 7 foram reavaliados, tendo 6 deles nenhuma mudança nas lesões e 1 apresentando piora nos sintomas e nas lesões intestinais.

Carvalho et al. (2003) realizaram um estudo com 30 pacientes em dieta isenta de glúten, sendo 17 crianças (em média 6 meses de idade) e 13 adolescentes (13 a 16 anos) e 23 indivíduos saudáveis, sendo 12 crianças e 11 adolescentes, todas regulando de idade com os pacientes celíacos. Foi realizada dosagem sérica de cálcio total, cálcio ionizado, fósforo, magnésio, fosfatase alcalina e paratormônio. Os resultados apontam uma média de peso, estatura e densidade óssea dos adolescentes celíacos como sendo inferior à dos controles, não havendo diferenças estatisticamente significativas nas crianças.

Assim, Kotze et al. (1999) realizaram um estudo para investigar a presença de anticorpos antiendomísio (EmA-IgA) e anti-reticulina (ARA-IgA) em 56 pacientes celíacos,

dos quais 17 tinham recém sido diagnosticados, 24 já tinham aderido a dieta isenta de glúten e 15 apresentavam episódios de transgressão à dieta. Foi detectado positividade de 100% em todos os pacientes recém diagnosticados e em todos os pacientes que transgrediram a dieta para EmA-IgA e 59,4% para ARA-IgA. Nos pacientes aderentes à dieta não foram detectados nenhum dos anticorpos. Esses mesmos autores concluíram que a associação dos dois testes não aumentou os índices de positividade total nas amostras. Assim, a pesquisa dos EmA-IgA pode constituir teste sorológico de escolha, tanto em seguimento quanto diagnóstico, devido ao seu alto valor preditivo, alta sensibilidade e especificidade, associados a um baixo custo. Dessa forma, esses resultados realçam a importância da aplicabilidade dos anticorpos antiendomísio na detecção de enteropatias causadas pela sensibilidade ao glúten. Porém, como a sensibilidade dos EmA é maior que a dos ARA (100% contra 59,4%) e a associação de ambos não resultou em aumento dos índices de positividade, consideraram o uso do ARA dispensável. Tal estudo ressalta a característica autoimune da doença celíaca, apontando outros fatores na biópsia além das modificações nas vilosidades do intestino delgado, tais como a presença de anticorpos.

Em contrapartida, Mariani et al. (1998) examinaram os hábitos alimentares de 47 adolescentes com doença celíaca e 47 pacientes controle, de idades condizentes. Todos fizeram um registro alimentar de 3 dias, o que permitiu que se determinasse a ingestão de energia, de macronutrientes e de ferro, cálcio e fibras, e, dos 47 celíacos, 25 seguiram a dieta restritiva e 22 a transgrediram. As análises dos registros verificaram que esses adolescentes possuem uma dieta hiperprotéica e hiperlipídica e baixa em carboidratos complexos. Além disso, apenas 20% de todos esses adolescentes apresentavam aportes adequados de ferro, cálcio e fibras. Esses dados refletem, na verdade, um estilo de vida comum dessa idade, em centros urbanos de países desenvolvidos. Essas diferenças nutricionais foram mais discrepantes no grupo que não transgrediu a dieta, devido a limitações na escolha da alimentação. Além disso, esse grupo também apresentou uma porcentagem de sobrepeso e obesidade maiores (72%) do que o grupo que não seguiu a dieta (51%) e do que o grupo controle (47%). Isso demonstra que ainda é necessário melhorar a aceitação a dieta isenta de glúten e que é preciso haver um controle do balanço nutricional desses pacientes, onde alternativas, como panifícios sem glúten, podem ajudar a combater escolhas alimentares prejudiciais.

Panifícios sem glúten

Os ingredientes comumente utilizados como substitutos dos cereais não permitidos em preparações sem glúten são: amido de milho; farinha ou fécula de batata e mandioca e farinha de arroz. Entretanto, pacientes com DC devem ser instruídos a utilizarem produtos contendo outros tipos de ingredientes em sua alimentação, evitando possíveis deficiências de alguns nutrientes no organismo (AUTODORE; JATLA, 2009).

Além das frutas e hortaliças, vários alimentos podem ser encorajados como outras opções isentas de glúten, como: amaranto, farelo de milho, quinoa, sorgo, farinha de leguminosas e trigo sarraceno (NIEWINSKI, 2008).

Desse modo, estudos têm buscado formulações de alimentos, como o pão, livres de glúten, mas com textura, aroma, aparência e sabor agradáveis. Schober et al. (2005) compararam a qualidade de pães elaborados com 10 tipos de farinhas de sorgo. Todas as formulações usaram como base amido de milho, água, sal, açúcar e levedura seca. Os pães tiveram pouca diferença em volume, altura, perdas no forneamento e atividade de água. Ao se aumentar os níveis de água, notou-se um crescimento no volume do pão.

Outro estudo buscou produzir biscoitos livres de glúten usando-se farinha de amêndoa e amendoim, suplementadas com ferro. Os biscoitos foram elaborados com ovos brancos, sacarose, creme de leite integral UHT, amendoim torrado e amêndoa torrada (ambas trituradas até tornarem-se farinha). Os biscoitos apresentaram índices de aceitação de 80% (amendoim) e 85% (amêndoa), sendo que ambos tiveram grande aceitação (GRANATO; ELLENDERSEN, 2009).

Já Egashira et al. (1986) sugeriram duas formulações livres de glúten, sendo elas o macarrão de sarraceno e o pão de mandioca. Tais formulações, embora referidas no estudo como sendo as mais difíceis, estão longe de serem impossíveis de se produzir, obtendo, inclusive, bons resultados e aceitação, apesar de não terem sido feitos testes de análise sensorial. Esse estudo destaca a importância de se criar alimentos isentos de glúten, tanto para aumentar a variabilidade da dieta quanto por questões psicológicas, devido à dieta monótona do jovem celíaco.

Trigo sarraceno

Existem dois tipos de trigo sarraceno cultivados no mundo todo: o trigo sarraceno comum (*Fagopyrum esculentum* Moench) – objeto deste estudo – e o tartárico (*Fagopyrum*

tataricum Gaertn). Existem cerca de 10 espécies identificadas, incluindo espécies selvagens do gênero *Fagopyrum*. Considera-se a China como tendo a maior área de cultivo de trigo sarraceno comum, com cerca de 1,5 milhão de hectares, seguida pela Rússia, Ucrânia, Canadá, Estados Unidos e Polônia. O Japão também possui uma vasta área de cultivo, com aproximadamente 30.000 hectares, contudo, sua produção não é suficiente e 80% da demanda vêm da China e outros países de maior produção (HIROSE; UJIHARA, 1998).

Quanto à suas propriedades, vale ressaltar suas características antioxidantes. Segundo Morishita, Yamaguchi e Degi (2007), ele possui antioxidantes como a rutina, quercetina e catequinas, que protegem o organismo contra danos oxidativos causados por radicais livres.

O trigo sarraceno parece ser uma boa alternativa boa para uso em preparo de alimentos livres de glúten. Mukai et al. (1979) já tinha testado a aceitação de preparos à base de trigo sarraceno com 18 crianças celíacas em remissão, em dieta livre de glúten há um ano, obtendo boa aceitação em 50% dos casos, regular em 28% e má em 22%.

Ainda em Mukai, os alimentos - bolo, macarrão, panqueca, pão, empanados, tortas, pizzas, pastel e mingau – foram preparados pelas mães, sendo que algumas mostraram certa resistência (psicológica, por falta de habilidade na cozinha, etc). Porém, outras não só mostraram interesse como se dispuseram a adaptar e até criar novas formulações. Possivelmente, a aceitação ao trigo sarraceno possa aumentar com a adição de outras farinhas como as propostas pelo presente estudo.

Trigo sarraceno x farinha de trigo

Quando comparado à farinha de trigo, o trigo sarraceno apresenta bons valores de macro e micronutrientes, superando a de trigo em vários parâmetros. Isso significa que não se tem “desvantagens” ao se usar o trigo sarraceno ao invés da farinha de trigo. Considerando-se a porção convencional de 100g, o trigo sarraceno (*buckwheat flour, whole groat*) oferece 335 kcal contra os 364 kcal da farinha de trigo (*wheat flour, white, all-purpose, unenriched*).

Pode-se dizer que o trigo sarraceno aparece em desvantagem, assim como nos parâmetros de carboidratos, apresenta 70,5g contra 76,31g. Porém, o trigo sarraceno oferece valores maiores em relação a outros macro e micronutrientes: as proteínas ficam em 12,6g contra 10,33; lipídeos 3,1g contra 0,98g. O ferro também aparece em maiores quantidades, sendo 4,06mg contra 1,17mg, o cálcio 41mg contra 15mg e o sódio 11mg contra 2mg. Faz-se

necessário destacar as 10g de fibras que constituem o trigo sarraceno, contra 2,7g da farinha de trigo (USDA, 2007).

Tabela I: Composição da farinha de trigo integral e do trigo sarraceno:

Parâmetros	**Farinha de trigo integral**	**Farinha de trigo sarraceno**
Calorias (Kcal)	364	335
Proteínas (g/100)	10,33	12,6
Lipídeos (g/100)	0,98	3,1
CHO (g/100)	76,31	70,5
Fibras (g/100)	2,7	10
Cinzas (g/100)	0,47	2,54
Cálcio (mg/100)	15	41
Ferro (mg/100)	1,17	4,06
Magnésio (mg/100)	22	251
Potássio (mg/100)	107	577
Sódio (mg/100)	2	11
Zinco (mg/100)	0,7	3,12
Vitamina C (mg/100)	0	0
Vitamina B-12 (mcg/100)	0	0
Vitamina A (mcg/100)	0	0
Ácido fólico (mcg/100)	0	0
Ácidos graxos monoinsaturados (g/100)	0,087	0,949
Ácidos graxos poli-insaturados (g/100)	0,413	0,949
Ácidos graxos saturados (g/100)	0,155	0,677

USDA food search for Windows, Version 1.0, database versionSR16.

5. Artigo a ser submetido à revista *International Journal of Food Sciences and Nutrition*

Elaboration, physicochemical and sensory analysis of a sweet bread made with buckwheat and fruit flours

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Abstract

As more and more people become aware of coeliac disease, it is important to increase the options in terms of gluten free bakery products. The adaptation of a bakery product – *cuca* – to gluten free versions can be justified for its role in preventing coeliac problems. Wheat flour was substituted by common buckwheat flour mixed with fruit flours, and their physicochemical characteristics were evaluated, compared to a standard *cuca*, with wheat flour in its composition. The passion fruit *cuca* had the highest percentage of humidity, with significant difference among the other formulations ($P \leq 0.05$). Ash and lipids had the highest amount in the banana sample, and proteins showed its highest value in the standard *cuca* ($P \leq 0.05$). A sensory analysis was conducted, with good results. It was also evaluated the purchase intention, indicating that these products are viable and worth buying.

Keywords: *gluten-free, coeliac disease, bakery products, cuca.*

INTRODUCTION

Gluten is an elastic, fibrous substance, formed by the combination of flours proteins (such as gliadin and glutenin) and water, resulting in hydration and formation of a protein complex by disulphide and hydrogen bonds. Its purpose is to retain gases that are formed by fermentation, turning the dough/batter expandable but resistant to cracks, which makes possible for it to grow during bakery. Its other purpose is to retain humidity from the batter even after baking, helping to ensure its elasticity and softness (Wieser 2007; Gallagher, Gormley and Arendt 2004). However, gluten comprises peptides, which cause autoimmune reactions on people with coeliac disease (Moore et al. 2006). Among the extra-intestinal manifestations, there are iron deficiency anemia, hepatic steatosis, psychiatric syndromes, dental enamel hypoplasia and arthritis (Mahan and Escott-Stump 2005).

An alternative to wheat is the common buckwheat (*Fagopyrum esculentum* Moench), which lacks gluten in its composition. Although called buck*wheat* due to its chemical composition similarities to wheat (Acquistucci and Fornal 1997 apud Silva et al. 2002), the buckwheat tends to the rice family.

It is a good source of fiber and also contains flavonoids, such as rutin, which is known by its antioxidant properties (Silva et al. 2002; Yang, Guo and Yuan 2008), polyunsaturated essential fatty acids, fagopyratol and sterols. It has a high rate of vitamins, amino acids, vitamins and minerals (Kalinova and Dadakova 2009). It also has functional components, which assists in the cholesterol and blood sugar regulation, reduces high blood pressure and even helps to prevent the risk of cancer (Wojcicki et al. 1995; Kim, Kim and Park 2004).

Cuca is originary from Germany, where it is known as *kuchen*, and was brought to Rio Grande do Sul by immigrants, who settled firstly in the *Vale dos Sinos* region, spreading later to other parts of the state. During the years, the recipe went through changes, adapting itself to

local conditions and available ingredients, until it became the current version, so traditional in Rio Grande do Sul. Among the ingredients of *cuca*, wheat flour is the main one.

Due to the fact that there is gluten in its composition, coeliac people are not able to consume such dish. There are a lot of products that are gluten free, and buckwheat is becoming a very common ingredient in products such as pasta, bread, cookies, noodles, and spaghetti (Manthey et al. 2004).

A *cuca* formulation bearing the characteristics of being gluten-free, easy to prepare and with a good acceptability would provide improvements in the life quality of such patients, offering a wider range of food choices in their diet.

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).

***Cuca* formulation**

The *cuca* loafs were elaborated with wheat flour being replaced by common buckwheat flour mixed with passion fruit, apple or banana flour, resulting in three different gluten free formulations. Some changes had to be made to the original formulation in order to adapt the recipes to those flours during the tests. The ingredients used can be found in Table I.

All ingredients were weighed using a Plenna® precision scale. The common buckwheat, passion fruit, apple or banana flours were available at the Dietetic Technique Laboratory of the Nutrition course in the Medicine School (FAMED) of Universidade Federal do Rio Grande do Sul (UFRGS). All the ingredients were bought at a local market, as was a standard *cuca*, made with wheat flour, which was used as control sample.

The elaboration consisted in firstly preheating the Dako® oven, Luna model. Then, egg whites were beaten with a Top Mixer mixer, Sield® brand. Using the same mixer, sugar, vegetable oil, and the yolks were mixed until a cream was formed. Common buckwheat flour, each fruit flour, yeast and milk, were added to this cream, which was being mixed all along. When the batter was homogenized, the beaten egg whites were added, mixed slowly with a spreader. The batter was, then, poured on a greased baking dish and the sugar crust was added on top of it. The batter with the sugar crust was then taken to the Dako® oven, Luna model, at 180ºC, for approximately one hour.

Sugar crust formulation

The ingredients were homogenized in a metal bowl and mixed with the fingertips till it turned into many irregular "lumps".

Table I: *Cuca* formulation

Physical analysis

The physical analyses occurred at the Dietetic Technic Laboratory, where depth was measured with a scale in three different spots of each formulation already on their respective baking dish, before and after baking. The formulations were also weighted, three times each, before and after baking, using a precision scale.

Chemical analysis

The chemical analyses were conducted at the Bioactive Compounds Laboratory of the Institute of Food Science and Technology (ICTA) of Universidade Federal do Rio Grande do Sul (UFRGS). Moisture, ash, lipids, proteins analyses were performed following Adolfo Lutz

Institute's protocols (2008), with three samples. For comparison parameters, a standard *cuca* loaf was used, bought at a local market.

Sensory analysis

This study was approved by the Ethics Committee of Universidade Federal do Rio Grande do Sul (UFRGS), process number 20556. The sensory analysis was conducted at the Dietetic Technic Laboratory and was performed by 36 non-trained, non-coeliac people, after signing an informed consent form. The participants of the survey were students and teachers from the university. The *cuca* loafs were evaluated in terms of global acceptance, texture, color, flavor, and appearance. The sensory analysis was conducted isolated with each evaluator, at ambient temperature, using white plastic dishes, numbered with four random digits, which corresponded to each respective flour (passion fruit, apple or banana flour).

The evaluators received water to drink before evaluating each *cuca* sample. A hedonic scale of 9 points was used, each point meaning: 1-dislike extremely, 2-dislike very much, 3-dislike moderately, 4-dislike slightly, 5-neither like or dislike, 6- like slightly, 7- like moderately, 8-like very much and 9-like extremely.

The evaluator's purchase intention of the products was also evaluated, 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.

Statistical analyses

The statistical analyses were made using the program ESTAT, version 2.0, with the Tukey's test, considering a 5% error probability. The results are given as means $\pm$ standard deviation based on three measurements for each sample. There were considered as being statistically significant the results that had differences with $P \leq 0.05$.

Results

Physical analysis

The physical analysis showed that the raw and baked sample composed by the combination of common buckwheat flour and passion fruit flour was the heaviest ($P \leq 0.05$), followed by the apple *cuca* loaf and the banana *cuca* loaf (Table II).

Table II: Physical analysis of *cuca* loafs made using common buckwheat flour mixed with different fruit flours.

The depth analysis of the raw samples suggests that the passion fruit flour sample also obtained more volume (3.06cm), followed by the banana flour (2.63cm) and the apple flour (2.50cm) samples. However, no significant differences were found ($P>0.05$). The depth analyses of the baked products are as follows: passion fruit flour sample (4.53cm) and apple flour sample (4.43cm), without significant differences between them ($P>0.05$), but presenting a significant difference in relation to the banana flour *cuca* loaf (3.63cm – $P \leq 0.05$).

The baking time also presented significant statistic difference: 72 minutes for the passion fruit flour sample, 64 minutes for the apple flour one and 60 minutes for the banana flour one, with an average of 65.3 minute baking time.

Chemical analysis

The chemical analysis (Table III) suggests that the passion fruit sample had a higher moisture percentage (46.57%), with statistically significant difference ($P \leq 0.05$) in regard to the other samples. The banana sample indicated a higher ash percentage (1.08%), although without significant difference ($P>0.05$) when compared to the passion fruit *cuca* loaf. The fat test showed the banana sample as having the highest percentage of all (11.30%), with statistically significant difference in regard to the other samples ($P \leq 0.05$), which did not have

a significant difference among themselves (P>0.05). Proteins percentage indicated the standard *cuca* loaf as having the highest value (2.18%), with significant differences in regard to all the other samples (P≤0.05).

Table III: Mean chemical composition of *cucas* created using common buckwheat flour mixed with different fruit flours.

Sensory analysis

The sensory analysis of the *cuca* samples showed a good acceptability rate of the ones made with common buckwheat flour and fruit flour (Table IV). Both apple and banana samples had good results in global acceptability (6.20 and 6.28 respectively, which means "like slightly", according to the hedonic scale), with no significant differences between them or even in comparison to the standard one, which still had the best result of all (7.22 – like moderately).

The apple *cuca* was the one with the best score in terms of appearance (7.50 – like moderately), with no significant differences (P>0.05) in relation to the standard commercial sample (6.66 – like slightly). The color evaluation presented a good score for all samples, with no significant differences (P>0.05) among the samples with the exception of the banana one, which had the lowest result.

Table IV: Sensory analysis of *cuca* samples made using common buckwheat flour mixed with different fruit flour.

The standard commercial *cuca* had the best result in the taste assessment (7.50 – like moderately), with significant differences (P≤0.05) in relation to the other *cuca* loafs. The apple and banana samples had the following results: 5.80 (neither like or dislike) and 6.19 (like slightly) respectively, with no significant differences (P>0.05) between them.

The results concerning texture indicated the banana *cuca* loaf as the best one (7.11 – like moderately), but without significant differences (P>0.05) in relation to the apple *cuca* loaf (6.97 – like slightly) and the standard *cuca* one (6.77 – like slightly).

Evaluator's purchase intention

Table V presents the evaluator's purchase intention test, which indicated the standard commercial *cuca* as the most likely of being bought (4.11), with significant differences ($P \leq 0.05$) in relation to the other *cuca* loafs, followed by the banana (3.31) and the apple samples (3.30).

Table V: Evaluator's purchase intention of gluten free and standard commercial *cuca* loafs.

Discussion

Cuca loafs made in this study presented lower growth rate when compared to the standard commercial one. Ács, Kovacs and Matuz (1996a, 1996b) studied the viability of using various binding agents, such as guar, xanthan, tragant, and locust bean gum as substitute for gluten in gluten-free corn starch bread. These tests showed a significant increase in those products' loaf volume. It is possible that a gluten-free *cuca* formulation added of such binding agents could improve its growth rate. Bonafaccia and Kreft (1994) also had similar results while experimenting bread formulations blended with increasing amounts of buckwheat flour. By the photographs showed in that study, it is clear that, as the percentage of buckwheat flour increases in the blending, the height gradually decreases, due to the decrease of the gluten matrix in the composition.

Moisture percentage was higher in all buckwheat *cuca* samples than in the standard one. This can be due to the higher water-binding feature of the buckwheat starch, which is

superior to wheat (Wijngaard and Arendt 2006). Also, Hager et al. (2012), in a study to investigate the quality, sensory, and ultrastructure characteristics of gluten-free bread, found that the moisture content was related to the amount of water added to the dough samples. This could be attributed to the extra milk volume added to the passion fruit *cuca* batter. On the other hand, moisture content is very important when regarding deterioration of baking quality, which is less in lower moisture percentage due to decrease in activity and respiration of microorganisms (Staudt and Zeigler 1973). This could jeopardize the shelf life of the gluten-free *cucas* made in this study.

The gluten-free *cuca* loafs presented an increase in ash percentage in relation to the control sample. Bilgiçli (2008) also found an ash amount increase in buckwheat flour, corn starch, and rice flour pasta formulations when compared to a wheat flour control pasta . As the buckwheat flour amount increased from 40g to 60g, so did the ash amount. Another study by Bonafaccia and Kreft (1994) also noticed higher ash percentage in a 100% buckwheat flour pasta in comparison to a 50% buckwheat flour + 50% wheat flour pasta. Nevertheless ash percentage could also be related to the fruit flours, as the apple *cuca* sample presented lower ash percentage than the standard commercial one.

Filipčev et al. (2011) using increasing amounts of buckwheat to substitute wheat flour in 30%, 40%, and 50% in ginger nut biscuit, found higher rates in fat percentage, although with no significant difference ($P>0.05$). This could partially explain our findings in fat content being higher in gluten-free *cuca* samples than in the standard commercial one, as the first ones were made with whole milk. Jozinović et al. (2012) added different amounts of buckwheat flour to corn meal (ratio meal : flour = 70:30, 50:50 and 30:70), in order to determine its effects in extruded and non-extruded samples. There was an increase in fat percentage in non-extruded samples following buckwheat flour ratio.

Levels of protein were lower in all buckwheat flour *cuca* samples. Although wholegrain buckwheat flour contains higher protein percentage when compared to wheat flour (Bonafaccia, Marocchini and Kreft 2003), it is also known that refined buckwheat flour has lower protein content than refined wheat flour. Rayas-Duarte et al. (1996), while studying the quality of spaghetti containing buckwheat, amaranth, and lupin flours mixed with durum flour, found that the higher the percentage of buckwheat, the lower the amount of protein the pasta would have. Unfortunately, there are only a few reports on the technological quality of buckwheat (Ikeda et al. 1997).

Bilgiçli (2008), when studying the utilization of buckwheat flour in the production of gluten-free egg noodle, noticed that the color acceptability of the control sample was better than the buckwheat samples' one. That was not the case in this study, where the passion fruit and apple samples had the highest acceptability rates. This could be related to color changing due to the fruit flours, which caused a darker appearance to the *cuca* loafs. Nowadays, dark colored food tends to attract consumers' attention, since it is usually attributed to higher amounts of dietary fiber, as noticed by Chillo et al. (2008), when adding buckwheat flour and durum wheat bran to spaghetti.

Lin et al. (2009) reported that buckwheat improved wheat bread's color because it contains more phenolic compounds, which could inhibit the browning processes during baking.

Baljeet, Ritika and Roshan (2010) also had low score in tasting evaluation of cookies incorporated with buckwheat. The authors suggest that this probably happened due to higher concentrations of rutin, which gives a bitter taste to buckwheat flour products. On the other hand, according to Chlopicka et al. (2011), sensory quality analysis of bread samples made with pseudocereal flours (especially buckwheat) blended with wheat flour may increase acceptability attributes such as taste, color, and odor. These observations suggest that the

addition of buckwheat flour to bread can improve not only antioxidant but also sensory properties of bread.

Purchase intention suggests that the commercial standard *cuca* is more likely to be bought. However, there could be an assessment bias since the evaluators were all non-coeliac people and, therefore, could have considered a gluten product more to their liking. Nevertheless, the banana and apple *cuca* samples received a good purchase intention score. The passion fruit sample, on the other hand, received the lowest score, which suggests that more research can be done to improve its acceptability.

Conclusion

Changing wheat flour for common buckwheat flour demanded a few adaptations on products formula. *Cuca* formulations usually include candied fruit or fruit jelly, which made us consider adding fruit flour to the recipe a viable option. This also helped to give a different flavor to each *cuca* and made it possible for us to elaborate more than one recipe. The results were satisfactory, with good batter growth, good taste, and overall acceptability. Although more research is necessary to improve these products, we believe that these gluten-free *cuca* loafs are viable products.

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Table I: *Cucas* formulation

Ingredients	Banana *cuca*	Passion fruit *cuca*	Apple *cuca*	Household measures
Common buckwheat flour	300g	300g	300g	2 full tea cups
Banana flour	180g	-	-	1 full tea cup
Passion fruit flour	-	180g	-	1 full tea cup
Apple flour	-	-	180g	1 full tea cup
Eggs	2	2	2	-----
Refined sugar	170g	170g	170g	1 full tea cup
Vegetable oil	90mL	90mL	90mL	1 full tablespoon
Biologic yeast	10g	10g	10g	1 shallow tablespoon
Milk	600mL	1200mL	600mL	2 full tea cups/4 full teacups
Sugar crust formulation				
Common buckwheat flour	80g	80g	80g	4 full tablespoons
Banana flour	40g	-	-	2 full tablespoons
Passion fruit flour	-	40g	-	2 full tablespoons
Apple flour	-	-	40g	2 full tablespoons
Butter	85g	85g	85g	4 ½ tablespoons
Refined sugar	144g	144g	144g	6 full tablespoons

Table II: Physical analysis of gluten free and standard commercial *cucas*.

***Cuca* samples**	**Raw weight (Kg)**	**Baked weight (Kg)**	**Raw depth (cm)**	**Baked depth (cm)**	**Baking time (min)**
Passion fruit	2.09 $\pm$0.01^{a}	2.26 $\pm$0.01^{a}	3.06 $\pm$0.1^{a}	4.53 $\pm$0.1^{a}	72^{a}
Apple	1.82 $\pm$0.01^{b}	2.00 $\pm$0.01^{b}	2.63 $\pm$0.1^{a}	4.43 $\pm$0^{a}	64^{b}
Banana	1.48 $\pm$0.01^{c}	1.78 $\pm$0.01^{c}	2.50 $\pm$0.1^{a}	3.63 $\pm$0^{b}	60^{c}

Same superscript in same columns indicate that there is no significant difference between the results, for $P \leq 0.05$.

Table III: Mean chemical composition of gluten free and standard commercial *cucas*.

***Cuca* samples**	**Moisture (g%)**	**Ash (g%)**	**Lipids (g%)**	**Proteins (g%)**
Passion fruit	46.57 $\pm$0.088^{a}	1.05 $\pm$ 0.026^{a}	8.12 $\pm$0.47^{b}	1.05 $\pm$0.047^{c}
Apple	31.51 $\pm$1.17^{c}	0.38 $\pm$0.02^{c}	8.95 $\pm$0.28^{b}	1.44 $\pm$0.14^{b}
Banana	37.11 $\pm$1.3^{b}	1.08 $\pm$0.53^{a}	11.30 $\pm$0.93^{a}	1.51 $\pm$0.01^{b}
Commercial *cuca* (Standard)	17.90 $\pm$0.85^{d}	0.86 $\pm$0.07^{b}	7.8 $\pm$0.39^{b}	2.18 $\pm$0.08^{a}

Same superscript in same columns indicate that there is no significant difference between the results, for $P \leq 0.05$.

Table IV: Sensory analysis of gluten free and standard commercial *cucas*.

***Cuca* samples**	**Global acceptability**	**Appearance**	**Color**	**Taste**	**Texture**
Passion fruit	4.28 ±1.99[b]	6.13 ±1.83[b]	6.58 ±1.68[a]	3.55 ±1.82[c]	5.69 ±2.29[b]
Apple	6.20 ±1.81[a]	7.50 ±1.1[a]	7.30 ±1.45[a]	5.80 ±2.03[b]	6.97 ±1.57[a]
Banana	6.28 ±1.79[a]	5.72 ±1.9[b]	5.16 ±2.02[b]	6.19 ±1.98[b]	7.11 ±1.42[a]
Commercial *cuca* (Standard)	7.22 ±1.35[a]	6.66 ±1.69[ab]	6.55 ±1.69[a]	7.50 ±1.44[a]	6.77 ±1.79[ab]

Same superscript in same columns indicate that there is no significant difference between the results, for P≤0,05.

Table V: Evaluator's purchase intention of gluten free and standard commercial *cucas*.

***Cuca* samples**	**Purchase intention**
Passion fruit	$1.66 +0.89^{c}$
Apple	$3.30 +1.21^{b}$
Banana	$3.31 +1.21^{b}$
Commercial *cuca* (standard)	$4.11 +0.85^{a}$

Same superscript in same columns indicate that there is no significant difference between the results, for $P \leq 0,05$.

6. Normas da Revista *International Journal of Food Sciences and Nutrition*

Manuscript Preparation:

File preparation and types:

Manuscripts are preferred in Microsoft Word format (.doc files). Documents must be double-spaced, with margins of one inch on all sides. Tables and figures should not appear in the main text. Specific instructions for their submission are given below. References should be given in Harvard style (see References section for example).

Manuscripts should be compiled in the following order: title page; abstract; key words; main text; acknowledgments; declaration of interest statement; appendices (as appropriate); references; tables with captions (on separate pages); figures; figure captions (as a list).

Cover Letter

A letter of submission from the corresponding author is required. The cover letter must report any existing financial arrangement between an author and a company whose product figures prominently in the submitted manuscript and a statement about any author‟s work being concurrently published or reviewed that is relevant to the review of the manuscript being submitted to The Journal. The cover letter must also include the following statements:

- That the corresponding author and all of the authors have read and approved the final submitted manuscript
- That no portion of the work has been or is currently under consideration for publication elsewhere
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Title Page

A title page should be provided comprising the manuscript title plus the full names and affiliations of all authors involved in the preparation of the manuscript. One author should be clearly designated as the corresponding author and full contact information, including phone number and email address, provided for this person.

Key Words

Three to six key terms that are not in the title should also be included on the title page. The keywords will assist indexers in cross indexing your article.

Abstract

All reviews should start with an abstract of 150 or fewer words, summarising the central core of knowledge that is the focus of the paper. It should be written in an informative style permitting its use, without revision, by abstracting services, give essential details of research findings without further reference to the text, and avoid generalisations and nonessential information.

Main Text

The article types considered by the International Journal of Food Sciences and Nutrition are as follows:

- Research Papers
- Brief Communications
- Comprehensive Reviews (max 1 per issue)
- Commentaries
- Gap-bridging research

Research papers

These are complete studies dealing with one of the covered topics. The body of the article should include the following distinct sections: introduction; methods; results; discussion; conclusions. Please do not merge these sections.

Introduction: This section should state the relevance and background to the study, and its rationale and purpose.

Methods: This section should include only information that was available at the time the plan or protocol for the study was being written. Please identify the methods, apparatus and procedures in sufficient detail to allow others to reproduce the results, and describe statistical methods with enough detail to enable a knowledgeable reader with access to the original data to verify the reported results.

Results: Present your results in logical sequence in the text, tables, and illustrations.

Discussion: This should include implications of the findings and their limitations, with reference to all other relevant studies and the possibilities these suggest for future research.

Conclusions: This must summarize the main paper. Ensure that extrapolations are reasonable and that conclusions are justified by the data presented, and indicate if the study design can be generalized to a broader study population.

Comprehensive reviews

These articles are intended to be full-length critical appraisals of topics that would be of long-term archival value. Emphasis should be placed on late-breaking advances. The body of a review article should be a comprehensive, scholarly evidence-based review of the literature, accompanied by critical analysis and leading to reasonable conclusions. Wherever appropriate details of the literature search methodology should be provided, i.e. the databases searched, the search terms and inclusive dates, and any selectivity criteria imposed.

Wherever possible, use primary resources, avoiding “Data on File”, “Poster” or other unpublished references.

Letters to the Editor

Letters to the Editor will be considered for publication subject to Editor approval and provided that the content relates to articles published in International Journal of Food Sciences and Nutrition. Letters should be received shortly after publication of the original work in question. Each letter will be submitted to the author of the original paper in order that any reply may be published simultaneously with the letter.

Commentaries

Commentaries should be knowledge-based or consensus-type articles (e.g. working group statement) expressing objective opinions, experiences or perspectives on an important area related to food science or nutrition.

Brief Communications

Brief Communications are short research articles intended to present exciting findings that will have a major impact in food science and nutrition. Brief Communications are limited to 3,500 words, including the abstract, introduction, materials and methods, results, discussion, references and figure legends. The total word count must be listed on the title page.

Additionally, Brief Communications may include no more than 3 figures and/or tables, which together may occupy no more than one full page. Brief communications should be organized as described for Research papers and the abstract, introduction, and discussion must adhere to the word limits listed for Research papers. Brief communications will be immediately rejected if they do not conform to these guidelines,.

Gap-bridging research

Gap-bridging research articles cover extremely recent topics, with the main aim of indicating to the reader what new research is needed to increase the scientific knowledge in specific areas of food science and nutrition. This article type is specifically linked with the evaluation and approval of “health claims” by public institutions and should be the inspiration and basis for future research.

Acknowledgments and Declaration of Interest Sections

Acknowledgments and declaration of interest sections are different, and each has a specific purpose.

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Expression of food composition data

Data expression of the reported compositional data

• Always give a precise description of the data denominator, examples:

• per 100 g fresh weight of edible food

• per 100 g dry matter of edible food

• per g protein of edible food

• per g total lipid of edible food

• per 100 g fresh weight of total food (edible and inedible food)

• per 100 g dry matter of total food

• per g protein of total food

• per g total lipid of total food

• If data are not expressed „per 100 g fresh weight of edible food", additional data are needed to be reported so that values can be calculated as per 100 g edible portion:

• Edible conversion factor needs to be reported if data are expressed per total food.

• Water (or dry matter) content per 100 g fresh food is needed if data are expressed per percentage or g dry matter.

• Lipid content per 100 g fresh food is needed if data are expressed per percentage or g fat/lipid, or the total fatty acids (FA) content is provided per 100 g edible portion.

• Protein content per 100 g fresh food is required if data are expressed per percentage or g protein.

• Expression such as „individual AA in g per 100 g" should be avoided, as it is not clear whether they refer to „per 100 g edible portion" or „per 100 g protein".

• When the sum of FAs percentage totals 100, it can be assumed that all FAs are reported; if the sum is below 100, it should be stated that not all FAs were reported, or it could mean that FAs are expressed in relation to total lipids.

• For FAs, it should be stated explicitly if they are expressed as FA or fatty acid methyl ester (FAME); data expressed in FAME need to be transformed through the Sheppard

factor to fatty acid content. This is important especially for short chain FAs, as it changes the values considerably. For long-chain FAs, the difference would be less than 5 percent.

• In some cases, two fat values are reported, e.g. using the Soxhlet or Folch methods; it should be clearly stated if FA data are reported in relation to the value obtained by the Soxhlet or Folch methods.

• In some cases, inconsistencies were found in the data presentation between tables and the texts, e.g. the text refers to FAME while the table refers to FA.

• The use of the unit ppm should be avoided; it is preferable to use mg/kg or mcg/g. In general, for food composition purposes, the use of g/100g or mg/100g or mcg/100g is recommended.

• If data are presented in a figure/graph, it would be useful to mention the related values in the text.

Precision of data description (food, sampling, analytical method)

• It is important to describe food properly, always indicate:

• If with or without inedible part (and describe inedible part since refuse/waste depends on tradition/culture and personal preference). Examples: was the fish whole, or were fish fillets analysed with or without skin, including bones, visible fat removed)? Or for fruit: was it analysed with/without skin and with/without kernels?

• If raw or cooked (and described cooking method).

• If fresh or transformed (e.g. dried/sun-dried, frozen, salted, smoked, canned etc.).

• Food parts, e.g. leaf, tuber, root, meat cut, fillet, with or without skin or visible fat, from which animal, fat content, etc.

• For more information on food description, please see Module 3 of the Food Composition Study Guide (which can be downloaded from the INFOODS website:

(http://www.fao.org/infoods/publications_en.stm).

• Indicate the sample collection site (e.g. country, region, etc.) as well as important sampling details (e.g. season, samples number per analytical sample, covering shops, markets, market share, etc.).

• Number of samples (n) should correspond to the number of individual samples analysed; however, „n" is often used in misleading manner, i.e. to express the analytical replicates number or the food item number initially sampled, but then analysed as composite sample.

• The component analytical method needs to be described correctly, especially if different methods are providing significantly different results (please see Module 4.b of the Food Composition Study Guide).

• Conversion factors and definitions should be indicated either in the text or as foot notes in table, e.g. nitrogen conversion factors, fatty acid conversion factors, energy conversion factors or vitamin conversion factors when used in vitamin equivalents (existing for niacin, vitamin E, vitamin D, vitamin A and folate. In these cases, the vitamin equivalent formula should be provided as well).

Examples for consistency checks

• The sum of proximates should ideally total 100. (Suggested acceptable ranges are 97-103 (Greenfield and Southgate, 2003) or 95-105. Proximates are: water, protein, fat, carbohydrates, dietary fibre (except if total carbohydrates are used), alcohol and ash.

• The sum of individual amino acids (AA) should be similar to the protein content.

• The sum of fatty acid (FA) should not be lower than the total lipid content.

Illustrations

Illustrations (line drawings, halftones, photos, photomicrographs, etc.) should be submitted as digital files for highest quality reproduction and should follow these guidelines:

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- Legends or captions for figures should be listed on a separate page, double spaced
-

Notes on Style

Style

Abbreviations and nomenclature

For abbreviations and nomenclature, authors should refer to The Proceedings of the Nutrition Society (1972: 31, 239-247) reproduction of "Conversion Factors and Nomenclature in Nutritional and Food Sciences". All vitamin names should adhere to these standards. Please provide scientific names (and references where applicable) for animals, microorganisms, and plants, including the full generic name at first mention. Full names should also be provided in captions, section heads, and keywords. All enzymes should be accompanied by its EC number.

Units/ Mathematical Modelling of Nutritional Processes

Data, including dosage forms, enzyme activity, and dietary ingredients, should be provided in SI units only, and energy values should be provided in both, kilocalories and kilojoules. Vitamin measurements must use the units mg, not IU. In all, units are year, month, week, d, h, min, s, kg, g, mg, mg, litre, ml, ml, fl. Please spell out the word "liter" whenever possible. Temperatures should be reported in degrees celsius.

Statistics

All methods of statistical analysis (and their software packages) should be described in the text. Both confidence intervals (CI) or significance assessments (provide p-values) are acceptable; standard deviation should only be used in instances in which emphasis needs to be given on varying individual values.

Solutions and Concentrations

Please use Metric Units, Conversion Factors and Nomenclature in Nutritional and Food Sciences. London: The Royal Society, 1972 for style requirements. Analytes in blood and other body fluids should be reported as molar concentrations (e.g. mmol/l).

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APÊNDICE A - Ficha para avaliação sensorial de bolos

Data: ___/___/___

Você está recebendo quatro amostras de cucas elaborados com farinhas de trigo sarraceno, banana, maracujá e maçã. Por favor, avalie cada um dos produtos separadamente e atribua notas na tabela para cada característica avaliada 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° 258**	**Amostra n° 369**	**Amostra n° 417**	**Amostra n° 526**
Aparência				
Cor				
Textura				
Sabor				
Aceitação global				

APÊNDICE B – Ficha para avaliação de intenção de compra

Data: ___/___/___

Você está recebendo quatro amostras de cucas elaborados com farinhas de trigo sarraceno, banana, maracujá e maçã. 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° 258	**Amostra n° 369**	**Amostra n° 417**	**Amostra n° 526**

APÊNDICE C - TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO

Projeto: Elaboração, análise física e sensorial de cuca sem glúten a partir de farinha de trigo sarraceno associado à farinha de maçã, banana e maracujá.

Pesquisadores: Prof. Dra.Viviani Ruffo de Oliveira (orientadora) / Claudio Schroeder Möller (graduando)

Sujeitos envolvidos: Alunos e funcionários da Universidade Federal do Rio Grande do Sul (UFRGS).

Data: ___/___/___

I. Justificativa e Objetivos:

Dentre os ingredientes da cuca, a farinha de trigo é a principal. Devido ao glúten em sua composição, o preparo torna-se inviável para portadores da doença celíaca. Uma formulação de cuca isenta de glúten, de fácil preparação e de boa aceitação favoreceria a qualidade de vida de tais pacientes oferecendo maior diversidade em sua alimentação e ao mesmo tempo também auxiliaria o paciente a se sentir aceito no grupo ao qual está inserido Assim, o celíaco terá mais uma opção em panifício para sua dieta, trazendo um pouco da cultura do Rio Grande do Sul para sua mesa.
Os objetivos do presente trabalho são: elaborar e realizar a análise física e sensorial de cuca sem glúten a partir de farinha de trigo sarraceno associado à farinha de maçã, banana, maracujá e laranja.

II. Os procedimentos a serem utilizados:

Este consentimento está relacionado com a avaliação sensorial de formulações de cuca preparada com farinha de trigo sarraceno associada à farinha de maçã, maracujá e banana.
Os sujeitos serão convidados aleatoriamente a participar da avaliação sensorial no Laboratório de Técnica dietética da Faculdade de Medicina/UFRGS. Os participantes receberão as amostras simultaneamente, codificadas com três 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: textura, cor, sabor, odor e aparência. Também será analisada a intenção de compra do produto, a qual será avaliada através de uma escala de 5 pontos.

III. Desconfortos e riscos:

Esses procedimentos de avaliação somente serão realizados se os participantes tiverem disponibilidade e concordância em participar deste estudo. Avaliadores que sejam alérgicos a trigo sarraceno, ou que tenham aversão às farinhas de frutas ou à cuca não participarão da pesquisa.

IV. Os benefícios que se pode obter:

Elaboração de cucas isentas de glúten, a fim de se obter uma preparação a mais na dieta do indivíduo celíaco.

V. Garantia de privacidade:

Os seus dados de identificação serão mantidos em sigilo e as informações colhidas serão analisadas estatisticamente, e poderão ser publicadas posteriormente em alguma revista científica, nacional ou internacional, da área de alimentos. Afirmo que a sua participação poderá ser suspensa a qualquer momento caso você deseje, sem prejuízo para a sua integridade.

VI. Garantia de resposta a qualquer pergunta e liberdade de abandonar a pesquisa:

Eu,_____fui informado dos objetivos do estudo realizado pelo acadêmico Claudio Schroeder Möller e, 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 a pesquisadora Viviani Ruffo de Oliveira no telefone (51) 9165-0705 ou ao Comitê de Ética da UFRGS no telefone (51) 3308-4085.

Declaro que tenho conhecimento do presente Termo de Consentimento.

_____ _____

Assinatura do participante Assinatura do pesquisador