ADDITION EFFECT OF FRUCTOOLIGOSACCHARIDES IN COCONUT COOKIES: acceptability sensory and physico-chemical composition

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ABSTRACT:
This study aimed to verify the sensory acceptability of coconut cookie enriched with fructooligosaccharides (FOS) and determine the physical-chemical composition of the traditional formulation and with the highest level of FOS and similar sensory acceptance. Were used six formulations of cookies: F1 (standard) and the others added 10% (F2), 12.5% (F3), 15% (F4), 17.5% (F5) and 20% (F6) FOS. Sensorially, F1, F2, F3 and F4 showed good acceptance, with no statistical difference between them, in all attributes. In physico-chemical composition F4 showed higher fiber concentration, carbohydrates and calories and lower moisture ($p<0.05$) than F1. Thus, the products development has demonstrated that an addition level of 15% FOS in coconut cookies was better accepted by the judges, obtaining sensory acceptance similar to standard product and good expectations of sales.
Keywords: Fibers. Unconventional sugar. Nutrition.

EFEITO DA ADIÇÃO DE FRUTOOLIGOSSACARÍDEOS EM BISCOITO DE COCO: aceitabilidade sensorial e composição físico-química

RESUMO:
Objetivou-se verificar a aceitabilidade sensorial de biscoito de coco enriquecido com frutooligossacarídeos (FOS) e determinar a composição físico-química da formulação tradicional e com maior nível de FOS e aceitação sensorial semelhante. Utilizaram-se seis formulações de biscoitos: F1 (padrão) e as demais adicionadas de 10% (F2), 12,5% (F3), 15% (F4), 17,5% (F5) e 20% (F6) de FOS. Sensorialmente, F1, F2, F3 e F4 apresentaram boa aceitação, sem diferença estatística entre si, em todos os atributos. Na composição físico-química F4 apresentou maiores concentrações de fibra bruta, carboidratos e calorias e menores de umidade ($p<0,05$) que F1. Sendo assim, a elaboração dos produtos permitiu comprovar que um nível de adição de até 15% de FOS em biscoitos de coco foi bem melhor aceito pelos provadores, obtendo-se aceitação sensorial semelhante ao produto padrão e com boas expectativas de comercialização.
Palavras-chave: Fibras. Açúcar não convencional. Nutrição.

INTRODUCTION

The people nutritional status has been affected by poor eating habits such as excessive consumption of saturated fats, high sugar intake and reduced fiber consumption, vitamins and minerals that may be the cause of an increasing incidence of chronic degenerative diseases (BRASIL, 2006). Thus,

there is a great concern with the current quality of life, resulting in a demand for healthier foods. The new food production items that may have a nutritional value higher than the original food has been increasing in the industry. To achieve this goal, a large number of alternative ingredients has emerged, for instance, the Fructooligosaccharides (FOS), which is important primarily for their functional properties (FORTES; MUNIZ, 2009).

Probiotics have their multiplication stimulated by FOS, which promote, stabilize and increase the proliferation of beneficial bacteria in the host's gastrointestinal tract which leads to a balance of intestinal microbiota, providing a number of benefits to the organism (GALLINA, 2009).

FOS are resistant carbohydrates to the salivary enzymes and intestinal action reaching intact to the colon. They are responsible for many functions in the body, such as change in bowel habits, which reduces the toxic metabolites and are also important in colon cancer prevention decreased of plasma cholesterol and hypertriglyceridemia. Also, the FOS represent about one third the sweetness of sucrose and they have low energy are not cariogenic and act as a growth factor beneficial microorganisms in the intestinal flora to be rich in fiber. Therefore, they become important ingredients for new products formulation (BÚRGIO *et al*., 2007; FORTES; MUNIZ, 2009).

Currently, cookie is a product consumed internationally by all social classes. Additionally, are well accepted by people of all ages and enables its durability to be produced in large quantities and widely sold (PEREZ; GERMANI, 2007) by becoming potential vehicles for addition to functional foods. However, if a new product is offered in the market is very important its assessment of sensory analysis, aiming its development and optimization. This interaction has been used to measure the food quality, when all the judges may give responses that indicate consumer preference, preferences and differences between samples, selecting the best process and determining the degree or product level quality. It is important to know the sensory characteristics of added ingredients should resemble the standard product or also reduce the substitution effects to obtain food with good appearance, aroma, taste, color and texture (FARIA; YOTSUYANAGI, 2008; MINIM, 2010).

Like this, the goal of this study was to evaluate the sensory acceptability of formulations in coconut cookies added with fructooligosaccharides and determine the physical and chemical composition of traditional product and one with a higher FOS content and similar acceptance to the standard.

MATERIAL AND METHODS

Raw material acquisition

The products were purchased in supermarkets in Guarapuava, PR and the FOS was donated by local companies' partner.

Cookie's formulation

Were made six formulations of coconut cookies, where: F1 standard (0%), and the other added 10% (F2), 12.5% (F3) 15% (F4) 17.5% (F5) and 20 % (F6) of FOS. These percentages were defined after primary sensory tests with the product. In Table 1 can be verified the coconut cookies formulations added with FOS.

Table 1. Formulation's ingredients of the coconut cookies added with fructooligosaccharides (FOS)

Ingredients	F1	F2	F3	F4	F5	F6
Refined wheat flour (%)	41.6	41.6	41.6	41.6	41.6	41.6
Refined sugar (%)	20.0	10.0	7.5	5.0	2.5	0.0
Margarine (%)	16.0	16.0	16.0	16.0	16.0	16.0
Coconut flakes (%)	8.0	8.0	8.0	8.0	8.0	8.0
Eggs (%)	7.2	7.2	7.2	7.2	7.2	7.2
Whole milk (%)	5.2	5.2	5.2	5.2	5.2	5.2
Vanilla extract (%)	2.0	2.0	2.0	2.0	2.0	2.0
FOS (%)	0.0	10.0	12.5	15.0	17.5	20.0

The formulations were prepared individually in Technical Dietetics Laboratory from Nutrition Department at UNICENTRO.

The weighing of all ingredients was performed on a digital scale (Filizola®, Brazil) with a precision of 0.1 g and a maximum capacity of 15 kg. First, the ingredients were mixed: white wheat flour, sugar, eggs, coconut, margarine and FOS. Soon after, the dough was rolled into strips of 30 cm and cut into cylinders of 1 cm in diameter. Then, the cookies were placed in aluminum forms and baked in an oven (Brastemp®, Brazil) preheated for 30 minutes at 200 °C for 50 minutes.

Sensory analysis

The sensory evaluation was performed at the Sensory Analysis Laboratory, Food Engineering Department at UNICENTRO in individual booths with white lighting.

Participated in this research 60 untrained judges, with students and workers on Campus CEDETEG (UNICENTRO) from both sexes, aged between 18 and 40 years.

The sensory tests evaluated these product attributes: appearance, aroma, taste, texture and color. The judges evaluated the acceptance of samples through hedonic scale of 9 points (1: "extremely disliked", 9: "extremely liked") according to Dutcosky (2011). Were also applied, global acceptance and purchase intention analyzed using a hedonic scale of 9 (1: "extremely disliked", 9: "extremely liked") and 5 points (1 "would not buy" to 5 "would buy definitely"), as suggested by Minim (2010).

Each judge received a portion of each sample (approximately 10 g, 1 biscuit) in white plastic dishes coded with three-digit numbers, randomized and balanced order, with a glass of water to perform the blank between samples. The formulations were offered to judges in a sequential monadic way.

Acceptability Index (AI)

The calculation for AI of five formulations was performed according to Dutcoski (2011) by the following formula: *AI (%) = 100 x A/B (A: average score for the product obtained, B: maximum score given to the product).*

Physico-chemical analyzes

Analysis of physico-chemical composition was performed at the Food Analysis Laboratory, Food Engineering Department at UNICENTRO.

The following determinations physico-chemical was performed in triplicate in standard biscuit (F1) and formulation with higher FOS levels, which obtained a similar pattern sensory acceptance:

The moisture was performed according to AOAC (2011), which consists of 105 °C to constant weight. The percentage ash was determined in oven at 550 °C, as AOAC (2011) methodology. The protein determination of products was performed by evaluating the total nitrogen by the Kjeldahl method (AOAC, 2011). The conversion factor used for protein nitrogen was 6.25. To evaluate the lipid samples passed through a cold extraction method of Bligh and Dyer (1959). The determination of carbohydrate products was performed by theoretical calculation (by difference) results, including fiber, according to the formula: *% Carbohydrates = 100 - (% moisture + % protein + % fat + % ash + dietary fiber).* Dietary fiber: the theoretical calculation of the formulations was carried out using the *Avanutri*® (Version 4.5.111) program. The total calories (kcal) were calculated using the next values: to lipids (8.37 kcal/ g), to

proteins (3.87 kcal/ g), and carbohydrates to (4.11 kcal/ g) (MERRILL; WATT 1973).

Daily Reference Value (RV)

The RV was calculated for 50 g of the sample, based on average values, recommended for adults 18 to 48 years (DRI, 2005), resulting in: 1944.42 kcal/ day, 250.6 g/ day carbohydrate, 47.6 g/ day protein, 70.6 g/ day lipid and 15,98 g/ day dietary fiber.

Statistical analysis

The data were analyzed using Statgraphics Plus® software, version 5.1, through variance analysis (ANOVA), and the average comparison test was Tukey's test and t of student with a level of significance of 5%.

Ethical issues

This study was approved by the Research Ethics Committee from UNICENTRO, opinion number No. 49549/2012. However, as exclusion criteria were considered the following factors: having allergy to any ingredient used in the cookies preparation, have age less than 18 years and people who have not signed the Informed Consent Form Document (ICFD).

RESULTS

Sensory analysis

Table 2 shows the sensory acceptability for cookies formulations standard and added of FOS.

Table 2. Average of the affective sensory test and purchase intent for cookies made of standard coconut and added of 10.0, 12.5, 15.0, 17.5 and 20.0% of fructooligosaccharides (FOS)

Formulations/	**F1**	**F2**	**F3**	**F4**	**F5**	**F6**
Attributes	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD
Appearance	7.48±1.06^{a}	7.48±1.16^{a}	7.48±0.84^{a}	7.38±1.31^{a}	7.23±1.16^{a}	7.25±1.01^{a}
Aroma	7.52±1.07^{a}	7.38±1.10^{a}	7.37±0.97^{a}	7.06±1.22^{a}	7.06±1.99^{a}	7.01±1.36^{a}
Taste	7.51±1.32^{a}	7.48±1.26^{a}	7.17±0.94^{a}	7.17±1.03^{a}	6.44±1.33^{b}	6.25±1.31^{b}
Texture	7.39±1.18^{a}	7.37±1.04^{a}	7.21±0.71^{a}	7.29±1.15^{a}	7.06±0.97^{a}	7.18±1.26^{a}
Color	7.29±1.27^{a}	7.25±1.40^{a}	7.21±1.22^{a}	7.06±1.40^{a}	7.02±1.27^{a}	6.96±1.17^{a}
Global acceptance	7.19±1.17^{a}	7.19±1.21^{a}	6.96±1.03^{a}	6.90±1.15^{a}	6.53±1.21^{a}	6.75±1.34^{a}
Purchase intent	3.89±0.94^{a}	3.88±0.92^{a}	3.86±0.91^{a}	3.36±0.99^{ab}	3.31±0.87^{b}	3.25±0.94^{b}

Different letters in the line indicate significant difference by Tukey's test ($p<0.05$); SD: Standard deviation; F1: standard; F2: 10.0% FOS; F3: 12.5% FOS; F4: 15.0% FOS; F5: 17.5% FOS; F6: 20.0% FOS.

There was no meaningful difference ($p>0.05$) in the attributes appearance, aroma, texture and color, as well as global acceptance for the six formulations, being well accepted by the evaluators. The addition percentages up to 15% FOS (F1, F2, F3 and F4) had the highest scores for taste attribute ($p<0.05$) when compared to F5 and F6.

Table 2 also shows the higher levels addition of FOS (17.5 and 20%) had lower ($p<0.05$) purchase intention than the formulations containing 10 and 12.5% of this ingredient.

In Figure 1, it is verified AI cookies added with FOS in relation to appearance, aroma, taste, texture and color. All attributes evaluated in six formulations, presented AI higher than 70% by the judges.

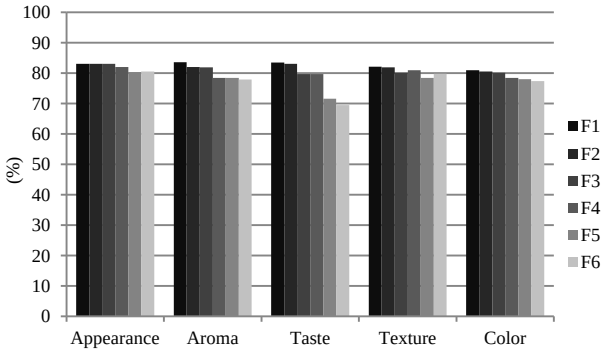
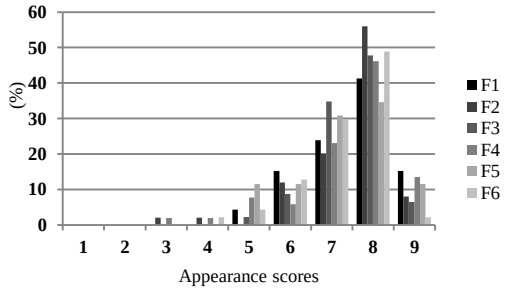


Figure 1. Acceptability index (%) of standard coconut cookies (F1) and added with 10.0 (F2), 12.5 (F3) 15.0 (F4), 17.5 (F5) and 20.0% (F6) of fructooligosaccharides (FOS).

Through Figure 1 it is verified, in general, the higher AI were for formulations F1, F2, F3 and F4, primarily for taste attribute.

Figure 2 shows the values distribution hedonic judges for each sensory attribute.



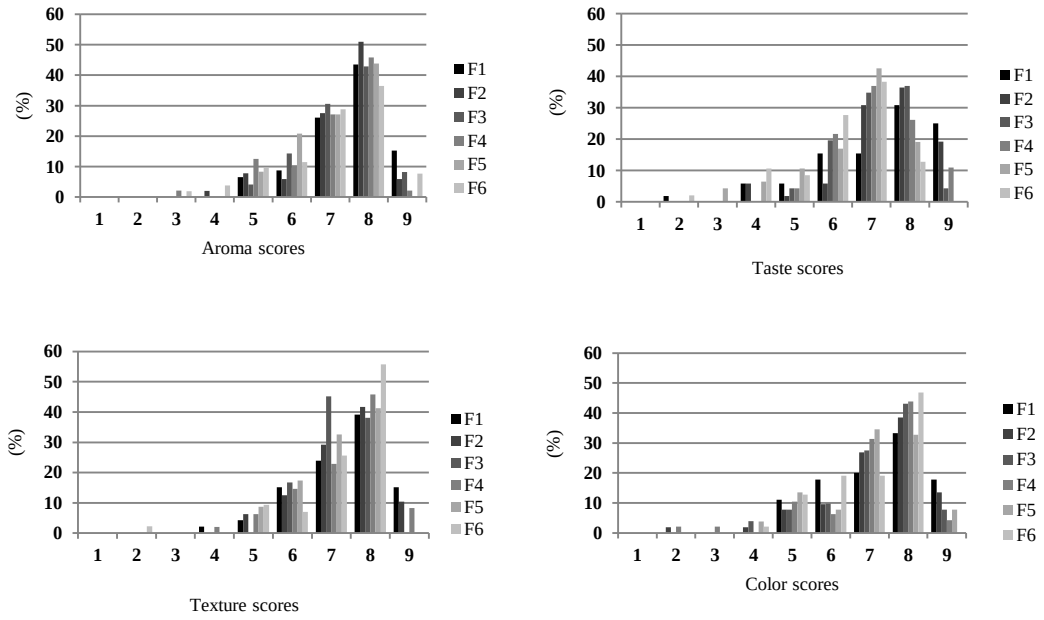


Figure 2. Judges distribution by the values obtained in the hedonic attributes of appearance, aroma, taste, texture and color of standard coconut cookies (F1) and added with 10.0 (F2), 12.5 (F3) 15.0 (F4), 17.5 (F5) and 20.0% (F6) of fructooligosaccharides (FOS).

It is possible to verify that the highest scores frequencies remained between 7 ("liked moderately") and 8 ("really liked"), which shows the formulations in general were well accepted by the judges.

Physico-chemical analyzes

In Table 3 it is observed the physico-chemical composition and recommended daily values (VD) standard cookies and added with 15% FOS, compared to a reference product.

Table 3. Physico-chemical composition and Daily Reference Value - RV* (50 grams middle portion) of standard coconut cookies (F1) and added 15% of fructooligosaccharides (FOS) (F4), compared to a reference product**

Evaluation	**F1**	**RV (%)***	**F4**	**RV (%)***	**Reference****
	Mean±SD		Mean±SD		
Moisture (%)	10.41±0.08[a]	-	8.96±0.02[b]	-	10.60
Ash (g.100g^{-1})	0.91± 0.02[a]	-	0.93±0.01[a]	-	1.00
Proteins (g.100g^{-1})	9.01±0.16[a]	9.47	8.63±0.42[a]	8.64	3.60
Lipids (g.100g^{-1})	7.81±0.09[a]	5.53	7.67±0.03[a]	5.43	12.70

Carbohydrate (g.100g^{-1})	71.85±0.15^{b}	14.34	74.23±0.44^{a}	14.81	72.20
Calorie value (kcal.100g^{-1})	395.58±0.94^{b}	10.12	401.11±0.27^{a}	10.31	404.00
Dietary fiber (g.100g^{-1})***	1,39±0.02^{b}	4,32	15,36±0.12^{a}	48,06	1,80

Different letters in the line indicate significant difference by student's test ($p<0.05$); *RV: nutrients evaluated by the mean of the DRI (2005) with base in a diet of 1944.42 kcal/day; **Values compared with "Biscuit, home recipe (flour, coconut and sugar)" (USDA, 2001); Results expressed in humid base; ***Theoretical calculation; SD: Standard deviation.

There was no meaningful difference between the levels of ash, proteins and lipids between the two formulations. The FOS addition to cookies (F4) increased the dietary fiber content, carbohydrates and calories ($p<0.05$), reducing the moisture content compared to F1.

DISCUSSION

Sensory analysis

The reduction in taste and purchase intention of products from the addition of 17.5% FOS can be explained, because this ingredient has 50% of the sweetness of sugar, in spite of having also similar properties (MADRONA *et al*., 2009). It is important to say that FOS have had great impact on the food industry due to their functional characteristics, besides its physical, physiological and sensory features, contributing to the products development with good acceptance (FORTES; MUNIZ, 2009).

It is possible to verify, also, that judges showed no statistical difference between the overall acceptability of samples, confirming research from Vopini-Rapina *et al*. (2012) that assessed the orange cakes preference orange added with inulin and oligofructose (8.3 and 9%). Similarly, Moscatto *et al*. (2004) also found no difference ($p>0.05$) in color, smoothness and overall acceptability attributes in different cakes formulations added with yacon flour (20 and 40%) and inulin (5%), with the standard sample.

According to Morris and Morris (2012), which evaluated the inulin and FOS effects in texture and sensory bread properties, was observed that hedonic ratings tend to decrease with inulin/FOS addition, presumably due to the products development with less volume and more dark colors, features that were also observed in this study.

Evaluating the AI cookies samples (Figure 1), all attributes showed good acceptability, except F6 (taste), because they had a rating higher than 70% by the judges (TEIXEIRA *et al*., 1987).

In Figure 2 there is a high judges distribution who marked the scores 7 and 8 for all formulations. Similar data were reported by Moscatto *et al*. (2004) found that seven scores above and acceptability

percentage of 83% for chocolate cake containing 20% yacon flour, 89% to 40% cake flour yacon and 94% for the standard cake, which proves also good acceptability by the judges. Capriles and Arêas (2010) evaluating amaranth bars enriched with fructans (17%) reported that over 80% of the judges assigned acceptance values above 6.7 for products.

According to Alamanou *et al*. (1996) attributes such as aroma and taste are probably the most important characteristics which influence the sensory properties of food products added with different ingredients. As a result, the sample F4 (15%) was selected for comparison purposes, with the standard (F1), being the one with the highest FOS content and acceptance similar to the standard (taste attribute).

Physico-chemical analyzes

The reduction in moisture content in F4 can be explained because FOS is a carbohydrate soluble in water with solubility dependent on temperature, thus at higher temperatures (90 °C) the solubility decreases to 35% (SILVA, 1996). According to RDC No. 12, July 24th, 1978, the National Health Surveillance Agency (ANVISA) (BRASIL, 1978), the maximum moisture and ash allowed value for sweet cookies are 14.0% w/w to 3.0% w/w, respectively, and thus F1 and F4 are presented according to the law.

The low proteins, lipids and ash present in both FOS as well as in sucrose (USDA 2001; MAPRIC®, 2014), explain the similarity in results ($p>0.05$) from the two formulations (Table 3). Similar effects were observed in studies of Brasil *et al*. (2011) who evaluated the inulin addition (6 and 10%) in bread, but observed a 85% reduction in lipid content added to the product of 6% inulin and 86% for the bread with addition of 10% inulin, which was mainly due to the hydrogenated vegetable fat exemption in the breads dough containing inulin.

The carbohydrate, calorie content and dietary fiber of F4 increased when compared to F1 ($p<0.05$). This fact is justified because the FOS has high carbohydrate levels (97.40%) in their chemical composition (MAPRIC®, 2014) when compared to wheat flour (75.10%) (TACO, 2011). In spite of this increase in the carbohydrates amount in F4, it is emphasized that these are "complex" and, with a molecular configuration that makes them resistant to the hydrolytic action of the salivary and intestinal enzyme, not being absorbed by the human body (FORTES; MUNIZ, 2009).

It stands out as the main result of this work the fiber content found in the formulation F4 (15.36 g.100g^{-1}), expressing a meaningful increase of 1005% compared to F1. This is due mainly to the high fiber content presented in FOS (93.10%)

(MAPRIC®, 2014). These results turn the product into an excellent option for patients with diseases such as Diabetes Mellitus, because the fibers aid in delaying the carbohydrates absorption, leading to decreased blood glucose (CARVALHO *et al*., 2012). Due to its functional FOS features, the product becomes also, a good choice for food population with other disorders such as hypercholesterolemia, hypertriglyceridemia, constipation prevention and colon cancer (FORTES; MUNIZ, 2009).

According to Resolution 27 of January, 13rd 1998 (BRASIL, 1998), a food is considered as a source of dietary fiber when presents at least 3% in food fiber, and high content in fiber when it has at least 6%. Thus, knowing that the method of determining crude fiber used in this study underestimates the value of dietary fiber in the products (HERNANDEZ *et al*., 1995) can be considered both formulations with high fiber content.

CONCLUSION

The products development has demonstrated that an addition level of 15% fructooligosaccharides in coconut cookie was well accepted by the judges to get sensory acceptance similar to standard product.

The addition of 15% FOS provided reduction in moisture content and an increase in carbohydrate and calories content. It is noteworthy that the FOS addition allowed a high fiber intake, improving the nutritional profile of the product. The conclusion is that FOS can be an ingredient with potential functional properties for the addition to the cookies and the like, and may be offered to consumers with good expectations of market acceptance.

REFERENCES

ALAMANOU, S.; BLOUKAS, J.G.; PANERAS, E.D.; DOXASTAKIS, G. Influence of protein isolate from lupin seed (*Lupinus albus.* ssp. Graecus) on processing and quality characteristics of frankfurters. **Meat Science**, v.42, n.1, p.79-83, 1996.

AOAC International. **Official Methods of Analysis of AOAC International**. 18 ed. 4 rev. Gaithersburg: AOAC, 2011.

BLIGH, E.G.; DYER, W.J. A rapid method of total lipid extraction and purification. **Canadian journal of biochemistry and physiology**, v.37, n.8, p.911-917, 1959.

BRASIL, J.A.; SILVEIRA, K.C.; SALGADO, S.M.; LIVERA, A.V.S.; FARO, Z.P.; GUERRA, N.B. Effect of the addition of inulin on the nutritional, physical and sensory parameters of Bread. **Brazilian Journal of Pharmaceutical Sciences**, v.47, n.1, p.185-191, 2011.

BRASIL. Agência Nacional Da Vigilância Sanitária - ANVISA. **Portaria n º 27**, de 13 de janeiro de 1998. Disponível em: http://www.anvisa.gov.br/legis /portarias/ 27_98.htm. Acesso em: 14/01/2016.

BRASIL. Agência Nacional da Vigilância Sanitária - ANVISA. **Resolução - CNNPA nº 12**, de 1978. Disponível em: http://www.anvisa.gov.br/legis/resol/12_78_biscoitos.htm. Acesso em: 05/02/2016.

BRASIL. Ministério da Saúde. Secretaria de Atenção à Saúde. **Guia Alimentar para a população brasileira: promovendo a alimentação saudável**. Brasília: Ministério da Saúde, 2006.

BÚRIGO, T.; FAGUNDES, R.L.M.; TRINDADE, E.B.S.M.; VASCONCELOS, H.C.F.F. Efeito bifidogênico do frutooligossacarídeo na microbiota intestinal de pacientes com neoplasia hematológica. **Revista de Nutrição**, v.20, n.5, p.491-497, 2007.

CAPRILES, V.D.; ARÊAS, J.A.G. Barras de amaranto enriquecidas com frutanos: aceitabilidade e valor nutricional. **Archivos Latinoamericanos de Nutrición**, v.60, n.3, p.291-297, 2010.

CARVALHO, F.S.; NETTO PIMAZONI, A.; ZACH, P.; SACHS, A.; ZANELLA, M.T. Importância da orientação nutricional e do teor de fibras da dieta no controle glicêmico de pacientes diabéticos tipo 2 sob intervenção educacional intensiva. **Arquivos Brasileiros de Endocrinologia e Metabologia**, v.56, v.2, p.110-119, 2012.

DIETARY REFERENCE INTAKES (DRI). **Dietary Reference Intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein and amino acids**. Washington, D.C.: The National Academies Press, 2005.

DUTCOSKY, S.D. **Análise sensorial de alimentos**. 3 ed. Curitiba: Champagnat, 2011.

FARIA, E.V.; YOTSUYANAGI, K. **Técnicas de análise sensorial**. Campinas: ITAL/LAFISE, 2008.

FORTES, R.C.; MUNIZ, L.B. Efeitos da suplementação dietética com frutooligossacarídeos e inulina no organismo humano: estudo baseado em evidências. **Comunicação em Ciências da Saúde**, v.20, n.3, p.241-252; 2009.

GALLINA, D.A. Leites fluídos disponíveis no mercado brasileiro: algumas considerações. **Revista Indústria de Laticínios**, v.79, n.1, p.38-44, 2009.

HERNÁNDEZ, T.; HERNÁNDEZ, A.; MARTINEZ, C. Concepto, propriedades y metodos de analisis. **Revista Alimentaria**, v.4, n.261, p.19-30, 1995.

MADRONA, G.S.; TERRA, C.O.; PENHA, C.B. Efeito da substituição do açúcar por oligofrutose em bebida láctea achocolatada. **Revista Brasileira de Tecnologia Agroindustrial**, v.3, n.2, p.29-37, 2009.

MAPRIC®. FOS - **Frutooligossacarídeo**. Disponível em: http://www.mapric.com.br/anexos/boletim451_17092007_161640.pdf. Acesso em: 10/03/2016.

MERRILL, A.L.; WATT, B.K. **Energy values of foods: basis and derivation**. Agricultural Handbook, n.74, Washington: USDA, 1973.

MINIM, V.P.R. **Análise sensorial: estudo com consumidores**. Viçosa: UFV, 2010.

MORRIS, C.; MORRIS, G.A. The effect of inulin and fructo-oligosaccharide supplementation on the textural, rheological and sensory properties of bread and their role in weight management: A review. **Food Chemistry**, v.133, n.2, p.237–248, 2012.

MOSCATTO, J.A. PRUDÊNCIO-FERREIRA, S.H.; HAULY, M.C.O. Farinha De yacon e inulina como ingredientes na formulação de bolo de chocolate. **Ciência e Tecnologia de Alimentos**, v.24, n.4, p.634-640, 2004.

PEREZ, P.M.P.; GERMANI, R. Elaboração de biscoitos tipo salgado, com alto teor de fibra alimentar, utilizando farinha de berinjela (*Solanum melongena, L.*). **Ciência e Tecnologia de Alimentos**, v.27, n.1, p.186-192, 2007.

SILVA, R.F. Use of inulin as a natural texture modifier. **Cereal Foods World**, v.41, n.10, p.792-799, 1996.

TABELA BRASILEIRA DE COMPOSIÇÃO DOS ALIMENTOS (TACO). **Tabela brasileira de composição dos alimentos**. 4 ed. Campinas: NEPA; 2011.

TEIXEIRA, E.; MEINERT, E.; BARBETTA, P.A. **Análise sensorial dos Alimentos**. Florianópolis: UFSC, 1987. 180p.

UNITED STATE DEPARTMENT OF AGRICULTURE (USDA). **Nutrient Database for Standard Reference**, Release 14. Washington: USDA, Jul 2001.

VOLPINI-RAPINA, L.F.; SOKEI, F.R.; CONTI-SILVA, A.C. Sensory profile and preference mapping of orange cakes with addition of prebiotics inulin and oligofructose. **Food Science and Technology**, v.48, n.1, p.37-42, 2012.