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I CONGRESSO BRASILEIRO ONLINE DE CIÊNCIAS DOS ALIMENTOS

COMMERCIAL SPECIAL BREAD: EVALUATION OF TEXTURE, COLOR, MOISTURE CONTENT, WATER ACTIVITY AND NUTRITIONAL LABELING

Pães especiais comerciais: Avaliação de textura, cor, conteúdo de umidade, atividade de água e informações nutricionais

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ABSTRACT: Three types of special bread (WB: bread with whole-wheat flour, LWB: 'light' bread with whole-wheat flour, and MB: bread with multi-cereals) were purchased in the local market, and moisture content was analyzed as well as the following parameters water activity (aw), instrumental texture, and instrumental color of the bread (crust and crumb) using spectrophotometer with CIELab system (n=10). The chroma or C * value and the hue angle were also calculated. The labels of the bread were analyzed according to Resolution-RDC nº 360, which provides information about nutritional labeling of packaged foods. The three breads presented in their composition whole wheat flour and wheat fiber, which are indispensable ingredients for the loaves to be considered "special bread". The compression force applied to cause disruption in the bread was higher in WB (3.88 N) without significant difference with MB (3.79 N) and lower in LWB (2.85 N). The color parameters of the breads showed that WB was darker (lower value of L * = 34.44 in the crust) than the others.

Key words: Compression force. Loaves. Luminosity. Functional Foods.

RESUMO: Três tipos de pão especial (WB: pão com farinha de trigo integral, LWB: pão light com farinha de trigo integral e MB: pão com cereais múltiplos) foram comprados no mercado local, e o teor de umidade, atividade de água (aw), textura instrumental e cor instrumental do pão (crosta e miolo) utilizando espectrofotômetro com sistema CIELab (n = 10), foram analisados. O valor de croma ou C * e o ângulo de matiz também foram calculados. Os rótulos do pão foram avaliados de acordo com a Resolução-RDC nº 360, que fornece informações sobre rotulagem nutricional de alimentos embalados. Os três pães apresentavam em sua composição farinha de trigo integral e fibra de trigo, que são ingredientes indispensáveis para que os pães sejam considerados "pão especial". A força de compressão aplicada para causar ruptura no pão foi maior no WB (3,88 N) sem diferença significativa com MB (3,79 N) e menor no LWB (2,85 N). Os parâmetros de cor dos pães mostraram que WB se apresentou mais escuro (menor valor de L* = 34,44 na crosta) que os demais.

Palavras-chave: Força de compressão. Fatias de pão. Luminosidade. Alimentos funcionais.

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INTRODUCTION

Consumers are searching for healthy diet foods containing whole grains as these have high nutritional value and protective effects against various chronic diseases (DEWETTINCK et al., 2008). And to serve this consumer market, the bakery food industry has sought to innovate in products known as “wholegrain”, that is, containing wholegrain cereal or cereal fiber. However, the addition of large amounts of fiber is known to negatively modify the dough and decrease bread volume as well as crumb texture, and thus the bread quality is lower, which impacts consumer acceptability (CURTI et al., 2016). The characteristics of volume, texture, and moisture content in breads normally determine their durability and acceptability.

Bread is considered one of the most consumed products in the world, with more than 9 billion kilograms being produced annually (HEENAN et al., 2008). However, the bread formulated with whole wheat grains has lesser consumer acceptance than bread made from refined wheat flours even though it presents the beneficial effect, so efforts are needed to improve the performance of whole-wheat in products (IZZREEN et al., 2016). Whole wheat flours contain more vitamins, minerals, antioxidant compounds, and other nutrients than normal flours (white), because these compounds are concentrated in the outer portions of the grain. These flours obtained from whole grains can have beneficial effects on cardiovascular diseases, diabetes, and weight-body loss, but the public's acceptance of whole wheat food products is limited, mainly due to taste and texture (LIU et al., 2015).

The aim of the work was to evaluate the physicochemical properties of special bread commercialized in the city of Rio Verde-Goiás: i) WB: bread with whole-wheat flour, ii) LWB: ‘light’ bread with whole-wheat flour (food with 25% less nutrients or energy value), and iii) MB: bread with multi-cereals.

MATERIAL E METHODS

The information of the bread label was also analyzed according to the RDC nº 360 on the nutritional labeling of packaged foods (BRAZIL, 2003).

The color (crumb and crust of the bread) was determined using spectrophotometer with CIELab system whith parameters L* (luminosity, 0 = black and 100 = white), a* (chromaticity, positive = red and negative = green), and b* (positive = yellow and negative = blue). The cylindrical coordinates H* and C* were calculated using the Equations 1 and 2, respectively. C* defines the chromaticity (color intensity, the chrome values close to zero determine neutral colors and those nearer to sixty determine vivid colors), and H* is the tonality (0 = red, 90 = yellow, 180 = green, and 270 = blue) (MINOLTA, 1993).

$$\text{Chroma}\ (C^*) = ((a^*)^2 + (b^*)^2)^{1/2} \qquad (1)$$

$$h_{ab} = \tan^{-1}\left(\frac{b^*}{a^*}\right) \qquad (2)$$

The evaluation of the moisture content of the bread was performed by the gravimetric method (method 925.09), in which 3-5 grams of bread crumb were weighed and oven dried with air circulation at 105 ºC for 24 hours (AOAC, 2007).

The water activity (a_w) was determined using the thermohygrometer equipment (Rotronic Instruments, Hygropalm Model Aw1, Huntington, NY, USA). Three replicates of each treatment of the bread crumb (7.0 g) were placed individually on the equipment and packed in BOD (Biochemical Oxygen Demand) at 25 °C.

The instrumental texture of the breads was determined using method 74-09.01 of the AACC (2009) with texturometer (CT3, Brookfield, Middleboro, MA, USA). The acrylic cylindrical probe with diameter of 38.1 mm x 20 mm of height (TA4/1000) and sample supported by retangular plataform (TA-BT-KIT) were used. Texture analysis was performed by compression force up to deformation of 40 % in relation to initial sample height using the following test parameters: pre-test speed: 1.0 mm/s, test speed: 1.0 mm/s, and post-test speed: 10.0 mm/s. The results of firmness were expressed in Newton (N). The slices of bread were removed from the packaging one at a time to avoid drying out the crust and crumb when exposed to the environment. Due to the sensitivity of the texturometer, this procedure was performed to prevent the ambient humidity from interfering in the texture result. The evaluation was performed in triplicate considering three packages (n = 9) by compression with the cylindrical probe in central slices arranged horizontally on the platform.

The statistical analysis was carried out using ASSISTAT® 7.7 (2016) software including the parameter estimation and analyses of variance for multiple linear regressions at a 5% level of significance.

RESULTADOS E DISCUSSÃO

Currently, the Brazilian Legislation does not regulate the minimum percentage of addition of wheat bran and/or germ in refined wheat flours so that the products can be labeled as whole-wheat. The RDC nº 269 (BRAZIL, 2005) is in the process of revision and it is expected that it will present criteria to designate a product as whole-wheat. The breads of this study were presented in their composition of whole wheat flour and wheat fiber, indispensable ingredients for the bread to be considered as “special bread”.

Every product packaged and destined for human consumption must be labeled in accordance with RDC nº 360, which defines nutrition labeling as any description to inform the consumer of the nutritional composition of a food where the energy value and nutrients (carbohydrate, protein, total fat, saturated fat, trans fat, dietary fiber, and sodium contents) must be declared (BRAZIL, 2003). The nutritional information should appear grouped in the same and visible place in label, structured in table form, with the values and the units in columns, written in legible characters with a contrasting color with the background where it is printed, which official language of the country. Regarding label information, it was verified that the three treatments analyzed were in accordance with the Brazilian legislation. All evaluated products contained the description "contains gluten" were according to the obligation to Law nº 10.674 (BRAZIL, 2003) in label.

The Table 1 presents the results of colorimetric analysis, moisture, and water activity of bread evaluated.

Table 1 - Colorimetric analysis (color parameters L*, a*, b*, C*, and hab), moisture content, and water activity (Aw) evaluated in bread

Parameters	WB	LWB	MB
Crumb bread			
L*	60.33[a]	57.11[b]	60.07[a]
a*	6.45[b]	7.05[a]	5.26[c]
b*	22.52[a]	21.91[a]	20.45[b]
C*	23.43	23.01	21.11
h_{ab}	74.01	72.16	75.57
Crust bread			
L*	34.44[c]	45.67[a]	37.97[b]
a*	12.84[b]	13.82[a]	9.82[c]

WB: bread with whole-wheat flour; LWB: "light" bread with whole-wheat flour; MB: bread with multi-cereals
Averages followed by the same letter do not differ significantly from each other (p<0,05).

In the bread crumb, LWB presented lower luminosity (L*) with significant difference with MB and WB. Meanwhile, LWB presented higher luminosity in bread crust, showing that it was the lighter bread of the evaluated treatments. Breads with the addition of green banana flour presented L* value lower than evaluated in this work for bread crumb and crust (GOMES et al., 2016).

In the CIELab system, the a* color parameter indicates the variation of green to red (-120 to +120). The a* color parameter is considered important to represent browning, because the brown color is a result of the degradation of sugars (caramelization reaction) or enzymatic reactions (presence of phenolases). In the bread crumb and crust, the a* color parameter indicates reddish tone and higher browning. Different from that, Ouazib et al. (2016) added chickpea flour (10 and 20 %) in wheat bread and presented negative a* color parameter. This demonstrates that the bread color is directly related to the color of the flour used to make bread. The b* color parameter indicates the variation of blue to yellow (-120 to +120). In this work, a yellow tendency in the bread crust and the crumb was found.

In bread with 3-9 % of linseed, the chroma values in crumb bread was lower that WB, LWB, and MB. Meanwhile, the chroma values in crust bread were lower than WB, LWB, and MB, except for bread with 9% of linseed (MOURA et al., 2015).

The bread has intermediate range of moisture content (approximately 40%) that effect on the perception of product quality. The freshness perceived by the consumer is higher as much as moisture content in the crumb bread. With retrogradation during storage there is a decrease in moisture content of bread (CAUVAIN; YOUNG, 2010).

Wheat fibers are indicated as ingredients responsible for absorbing high amounts of water in the baking process due to the presence of cellulose and hemicellulose (insoluble fractions of dietary fiber) (ISHIDA; STEEL, 2014). This demonstrates that the higher fiber content in the mixture result in high moisture content to be added in the bread formulation, and consequently, the higher the moisture content of the final product. The moisture found in this work are in agreement with other works of bread making with wheat and quinoa flour (ISHIDA; STEEL, 2014), bread with baru flour (ROCHA; SANTIAGO, 2009) and bread supplemented purple sweet potato powder (SANTIAGO et al., 2015).

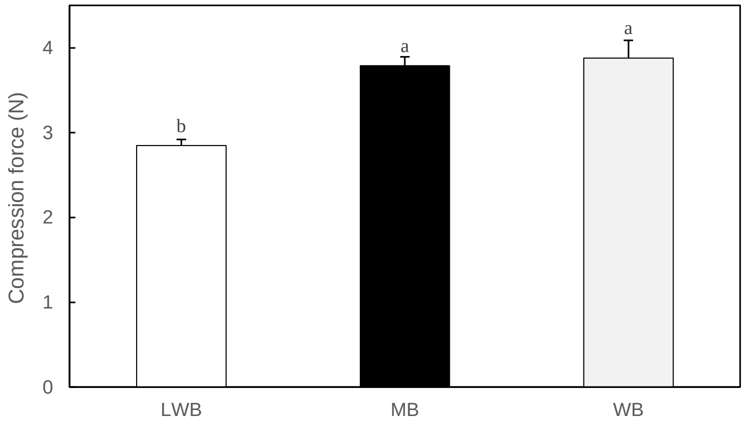
The water activity in the bread presented high (> 0.9) (Table 1) and similar the related to bread with green banana flour (GOMES et al., 2016). Available water contributes to the growth of microorganisms and chemical reactions of deterioration, are susceptible, for example, growth of fungi on the surface and for this reason these little shelf-life.

All the samples evaluated were within the validity period, but MB presented fungi in loaf of bread, showing microbial deterioration. This treatment was produced from a mixture ready and only roasted by the local market. Often these markets packing the hot product after the baking, which can cause condensation of vapors and accumulate on the surface of the bread, facilitating the development of fungi.

The firmness of bread is related to the force applied to cause deformation or rupture of the sample and can be correlated with human chewing. The maximum strength evaluated for baked products depends on the formulation (flour quality, amount of sugars, fats, emulsifiers, enzymes, gluten addition and flour improvers), dough moisture, and preservation (time of manufacture of the product and packaging) (MOURA *et al.*, 2015). The texture is an important indicator of food quality, and firmness is one of the most observed characteristics of texture, influencing the acceptability of the product (BRESSIANI et al., 2017).

The texture analysis showed a significantly lower value for LWB (2.85 N) in relation to MB and WB (3.79 and 3.88 N, respectively) (Figure 1). These values were higher than reported for bread with linseed flour (1.09 N) (OLIVEIRA *et al.*, 2007). Chang *et al.* (2015) observed that the hardness of bread generally increased with increasing lemon flour substitution with higher water absorption in dough making and consequently increase of the final moisture of the product.

Figure 1. Compression force test on breads



The increase of pomegranate seed flour in formulation (0 to 10%) of bread increased the firmness (2488.7 to 5311.1 g or 24.41 to 52.10 N), the a* color parameter (-0.3 to 5.5), and the fiber content (5.4 to 9.7 %), as well as decreased L* color parameter (63.7 to 44.4) and loaf volume (562.8 to 357.8). The results revealed that the breads enriched by a pomegranate seed flour were taken significantly low sensory scores than the control bread with increasing pomegranate seed flour content (GÜL; ŞEN, 2017). Thus, for breads it is important that the physical, chemical, technological and sensorial analyzes are related to determine the quality of the product.

CONCLUSIONS

The bread presented the ingredients composition to be considered as "special bread". The compression force of the bread was lower in bread with whole-wheat flour. The color parameters of the bread with whole-wheat flour presented more browning.

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