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## Abstract

**Purpose** – The purpose of this paper is to substitute wheat flour by passion fruit peel flour in Brazilian honey bread (pão de mel), with evaluation of the breads' sensory features, chemical composition and physical properties.

**Design/methodology/approach** – Honey breads with wheat flour (standard) and with replacement of this ingredient by 10 to 50 per cent passion fruit peel flour were produced. Two sensory tests were applied, to identify how different formulations with passion fruit peel flour were when compared to the standard formulation, and also the acceptability of the products. The selected honey breads, through sensory results, were evaluated regarding to chemical composition and physical properties.

**Findings** – Formulations with 10 and 20 per cent substitution were the least different to formulations with only wheat flour, and were as acceptable as the wheat flour sample. Physical and chemical characteristics of breads with 10 and 20 per cent passion fruit peel flour were similar; however, honey bread with 20 per cent passion fruit peel flour had higher fibre content, ash quantity and hardness value; a lower specific volume; and a different colour from the wheat flour sample.

**Practical implications** – This study offers an opportunity to food industries through utilization of an agro-industrial by-product on the formulation of a Brazilian traditional product.

**Originality/value** – This study presents the feasibility of using an agro-industrial by-product to Brazilian honey bread, enhancing the nutritive value of this product and reducing the impact of passion fruit peel flour on the environment.

**Keywords** Product development, Consumers, Sensory attributes

**Paper type** Research paper

## 1. Introduction

The passion fruit is a fruit from the Passifloraceae family. It is well-adapted to tropical climates and is valued for its unmistakable aroma and flavour. Brazil is the world's major producer of passion fruit, with a production area of 58 hectares and a harvest of more than 838 tonnes in 2013 (IBGE, 2015). It is estimated that 60 per cent of all passion fruit crops grown are sold raw, and that 40 per cent are used in the juice or pulp industry. The production of *Passiflora edulis* f. *flavicarpa* represents 97 per cent of passion fruit

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cultivation; because of its acidity levels, it is the main raw material in the production of industrialized passion fruit juices (Pimentel *et al.*, 2009).

Industrialized passion fruit juice represents approximately 8.5 per cent of all ready-to-drink juices in the Brazilian market. As a result of this processing, around 60 per cent of fruit weight (which is represented by the peel and seeds) is considered industrial by-product (Coelho *et al.*, 2011). Because of its spongy tissue, the passion fruit peel is easily dehydrated. It represents approximately 50 per cent of passion fruit weight. Passion fruit peel has been the focus of studies which consider it for human consumption, as it includes carbohydrates, proteins, fibres (particularly insoluble fibre), niacin (vitamin $B_3$), iron, calcium, phosphorus and antioxidant compounds (Coelho *et al.*, 2011; Cazarin *et al.*, 2014).

The feasibility of using agro-industrial residue and by-products in foods and incorporating them into human nutrition has been investigated by several authors (Mohapatra *et al.*, 2010; Babbar *et al.*, 2011; Paiva *et al.*, 2012). Passion fruit peel flour may be added to many foods, and its addition to baked goods has been found to be very feasible. The fusion between baked goods and confectionery ingredients has led to many types of food products, including honey bread. Although it is referred to as a "bread", Brazilian honey bread (*pão de mel*) is more similar to a cake, and honey is as an essential ingredient which gives the product a unique flavour. Though honey bread is widely consumed in many varieties in the Brazilian market, there is no specific legislation regarding the standard identity, quality or fabrication of this product, and no studies on Brazilian honey bread were found in the scientific literature. Thus, more studies must be performed to provide information on this product.

The development of new products which are both nutritious and meet consumers' expectations has been one of the main goals of the food industry. Moreover, the incorporation of agro-industrial by-products for the benefit of human nutrition can have a significant and positive impact on the environment. However, the incorporation of new ingredients in foods, mainly those ingredients which are rich in fibres as passion fruit peel flour, may cause changes on a variety of characteristics of the products, mainly sensory features. Therefore, this study aimed to produce Brazilian honey breads which contained passion fruit peel flour as a wheat flour substitute and to then evaluate the sensory features, chemical composition and physical properties of the products.

## 2. Materials and methods

### *2.1 Materials*

Passion fruit peel flour was purchased from a specialized natural products shop, and honey bread aroma was supplied by the Duas Rodas company. The other ingredients used to prepare the honey breads (wheat flour, refined sugar, honey, egg, cocoa powder, vegetable shortening, sodium bicarbonate and baking powder) were purchased in a local shop and standardized in that the same brand was used.

### *2.2 Honey bread processing*

Ingredient quantities, mixing time, baking time and temperature were defined using a standard formulation made with only wheat flour. Formulations with passion fruit peel flour rather than wheat flour were processed in the same way as the standard formulation, with variations in the quantities of wheat flour, passion fruit peel flour and water (Table I). More water was necessary for formulations with 40 and 50 per cent

passion fruit peel flour replacement. This increase in water was likely due to the high rate of water absorption by fibres present in the flour, a change which was expected (Ktenioudaki and Gallagher, 2012).

All ingredients except sodium bicarbonate and baking powder were mixed in a KitchenAid stand mixer (model BEA30ABAIM) on speed setting 6 for 10 min. Next, the sodium bicarbonate and baking powder were added to the dough, and the dough was mixed for 30 s on speed setting 1 of the same mixer. The dough was then placed on individual cake tins for honey bread and baked in a preheated (20 min at 180°C) Pasiani oven (Turbo Classic model 240) for 20 min at 180°C.

The honey breads were cooled at room temperature for 15 min, covered with polyvinyl chloride film and stored at room temperature until the sensory analysis and physical tests were performed 24 hours later. Other samples were frozen for subsequent chemical analyses.

*2.3 Sensory analyses of honey breads*

The sensory analyses were performed at the Sensory Analysis Laboratory of Department of Food Engineering and Technology of Institute of Biosciences, Literature, and Exact Sciences of Sao Paulo State University. This study was approved by the Research Ethics Committee of the same Institute (Opinion Report 56318).

The tests were conducted with 57 untrained panellists (57 per cent female and 43 per cent male, and 62.7 per cent were from 18 to 25 years old) in individual booths. The panellists were kept under a white light, at a temperature of 22°C. The samples were coded with random, three-digit numbers and were presented in a monadic, balanced and random manner (MacFie and Bratchell, 1989). Two sensory tests were applied during two days (morning and afternoon): a difference-from-control test and a test of acceptability.

The difference-from-control test was applied to identify how different formulations with passion fruit peel flour were when compared to the standard formulation. Samples were evaluated on a nine-point scale which ranged from "no difference from control" (later transformed to 0 on the scale) to "extremely different to control" (later transformed to 8 on the scale) (Meilgaard *et al.*, 1999). Each panellist received a sample of the honey bread made using the standard formulation, which was identified as the control formulation. They also received the five honey breads with passion fruit flour, and an

| Ingredient | S | 10% | 20% | 30% | 40% | 50% |
|---|---|---|---|---|---|---|
| Wheat flour (g) | 700 | 630 | 560 | 490 | 420 | 350 |
| Passion fruit peel flour (g) | 0 | 70 | 140 | 210 | 280 | 350 |
| Refined sugar (g) | 490 | 490 | 490 | 490 | 490 | 490 |
| Water (ml) | 400 | 400 | 400 | 400 | 550 | 550 |
| Honey (ml) | 300 | 300 | 300 | 300 | 300 | 300 |
| Egg (unit) | 5 | 5 | 5 | 5 | 5 | 5 |
| Cocoa powder (g) | 25 | 25 | 25 | 25 | 25 | 25 |
| Hydrogenated vegetable fat (g) | 21 | 21 | 21 | 21 | 21 | 21 |
| Sodium bicarbonate (g) | 20 | 20 | 20 | 20 | 20 | 20 |
| Baking powder (g) | 10 | 10 | 10 | 10 | 10 | 10 |
| Honey bread aroma (g) | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 |

**Table I.** Formulations of the standard honey bread (S) and of honey breads containing 10 to 50% passion fruit peel flour as a wheat flour substitute

additional standard honey bread as a codified sample. The panellists were included or excluded based on their evaluations: those who did not attribute a score of 0 to 2 (from "no different from control" to "slightly different from control") to the codified standard formulation sample were excluded. Therefore, ten panellists were excluded from the sensory panel, as they attributed scores which were higher than 3 to the codified standard formulation sample.

The honey bread formulations were also evaluated on a nine-point hedonic sensory scale to measure sensory acceptability. The options ranged from "dislike extremely" to "like extremely" (Meilgaard *et al.*, 1999). The attributes of appearance, aroma, texture and flavour, along with overall acceptability, were the sensory parameters measured.

The honey breads which received the highest acceptability scores were characterized based on their chemical compositions and physical properties.

### *2.4 Chemical analyses of honey breads*

The chemical composition of both the standard honey bread and of those which received the highest acceptability scores was analysed. Moisture content was quantified based on evaporation at 105°C, protein content was established using the micro-Kjeldahl method, lipid content was determined via Soxhlet extraction and quantity of ash was established via incineration in a muffle furnace at 550°C (AOAC, 1997). Finally, insoluble, soluble and total dietary fibres were quantified using the enzymatic and gravimetric method (Prosky *et al.*, 1988) and the TDF100A enzymatic kit (Sigma-Aldrich, Saint Louis, USA). The available carbohydrates were calculated as the difference between 100 and the sum of moisture, protein, lipid, ash and total dietary fibre content. Analyses were performed in triplicate.

### *2.5 Physical analyses of honey breads*

Both the standard honey bread and those which received the highest approval scores were analysed in terms of the following factors:

- *Texture profile analysis using a TA.XT Plus Texture Analyser (Stable Micro Systems, Godalming, England)*: Ten replicates of each honey bread were compressed to 50 per cent height using a cylindrical probe which was 100 mm in diameter. Test speed was 1 mm/s with 5 s between two compressions. Hardness, cohesiveness, springiness and chewiness values were obtained.
- *Specific volume ($cm^3.g^{-1}$)*: Three replicates of each honey bread were weighed, and their volume was measured using rapeseed displacement. The specific volume was defined as the ratio between the volume and the weight of the honey breads (AACC, 2000).
- *Colour*: Colour analysis was performed in a ColorFlex 45/0 Spectrophotometer (Hunterlab, Reston, USA) with illuminant D65 and a 10° observer. Three replicates of the crust and dough of each honey bread were analysed, and luminosity (L*), a* (opposition of colours green and red), b* (opposition of colours blue and yellow), chroma (C*) and hue (h) values were obtained (Clydesdale, 1984). The total colour difference (ΔE) was calculated using the following equation: $\Delta E = (\Delta L^2 + \Delta a^2 + \Delta b^2)^{1/2}$, where $\Delta L = L_{std} - L_{sample}$, $\Delta a = a_{std} - a_{sample}$, $\Delta b = b_{std} - b_{sample}$ and formulation with wheat flour was used as a reference (standard) colour.

*2.6 Statistical analyses*

Difference-from-control test means were compared through analysis of variance followed by Dunnett's test, and the means of sensory acceptability were compared through analysis of variance followed by Tukey's test (all analyses were considered significant when $p \leq 0.05$). Pearson's correlation was applied between the average difference intensity and average sensory acceptability. Correlation was considered fairly strong when the correlation coefficient was above 0.70 or below −0.70 (Leighton *et al.*, 2010) and significant when $p \leq 0.05$. All of these analyses were performed using the PASW Statistics 18 software (SPSS Inc., Chicago, USA).

A non-parametric statistical method was applied to the average chemical composition values and average physical property values due to the low sample size ($n < 30$). All means were compared using Kruskal–Wallis followed by Dunn's test at a significance level of 0.05 using the PASW Statistics 18 software (SPSS Inc., Chicago, USA).

The principal component analysis was applied to describe the honey breads in terms of their chemical composition and physical properties. The raw data of each chemical and physical parameter of the honey breads were placed into the columns (variables), while the formulations were placed in the rows (cases). The data were standardized in the columns and analysed using the correlation matrix without factor rotation. A percentage of explanation above 70 per cent for the two first principal components indicates a strong correlation among the variables, and also indicates that principal component analysis is an appropriate multivariate analysis for these data (Mardia *et al.*, 1979). The analysis was performed using the Statistica 10.0 software (StatSoft Inc., Oklahoma, USA).

## 3. Results and discussion

*3.1 Sensory differences and acceptability of honey breads*

All honey breads formulated with passion fruit peel flour were different to the standard honey bread (Table II), and the difference was enhanced as the quantity of wheat flour substitution increased (from 10 to 50 per cent substitution). In addition, the acceptability scores given to honey breads with 10 and 20 per cent passion fruit peel flour were equal to the acceptability scores given to standard formulations in all attributes and also

| Formulation* | Difference intensity | Acceptability | | | | |
|---|---|---|---|---|---|---|
| | | Appearance | Aroma | Texture | Flavour | Overall |
| Standard | 0.8 ± 0.9 | 7.6 ± 1.2$^{a}$ | 6.9 ± 1.7$^{a}$ | 7.4 ± 1.3$^{a}$ | 7.0 ± 1.7$^{a}$ | 7.2 ± 1.5$^{a}$ |
| 10% | 2.5 ± 1.4** | 7.5 ± 1.1$^{a}$ | 6.3 ± 1.5$^{ab}$ | 7.1 ± 1.3$^{ab}$ | 6.5 ± 1.5$^{a}$ | 6.6 ± 1.2$^{ab}$ |
| 20% | 3.5 ± 1.6** | 7.0 ± 1.3$^{a}$ | 6.2 ± 1.5$^{ab}$ | 6.8 ± 1.5$^{ab}$ | 6.5 ± 1.5$^{a}$ | 6.6 ± 1.3$^{ab}$ |
| 30% | 4.4 ± 1.9** | 5.9 ± 1.8$^{b}$ | 6.0 ± 1.5$^{b}$ | 6.4 ± 1.6$^{b}$ | 6.1 ± 1.7$^{a}$ | 6.2 ± 1.5$^{b}$ |
| 40% | 6.4 ± 1.7** | 4.6 ± 2.0$^{c}$ | 5.5 ± 1.8$^{bc}$ | 4.7 ± 2.0$^{c}$ | 5.1 ± 2.1$^{b}$ | 4.9 ± 1.9$^{c}$ |
| 50% | 7.1 ± 1.4** | 4.2 ± 1.9$^{c}$ | 5.0 ± 2.0$^{c}$ | 4.1 ± 2.2$^{c}$ | 4.2 ± 2.2$^{b}$ | 4.2 ± 2.0$^{c}$ |

**Notes:** *Standard = honey bread only with wheat flour; from 10 to 50% = honey breads containing increasing percentages of passion fruit peel flour as a wheat flour substitute; **indication that the average formulation differs statistically from the average standard honey bread ($p \leq 0.05$); same letters in the same column indicate significantly equal means ($p > 0.05$)

**Table II.** Difference intensity ($n = 47$) between each honey bread with passion fruit peel flour in relation to the standard honey bread, as well as sensory acceptability ($n = 57$) of each formulation (mean ± standard deviation)

overall (Table II). However, the substitution of wheat flour with more than 30 per cent passion fruit peel flour resulted in a lower acceptability score for honey breads.

Considering the flavour acceptability as an example to relations between the difference intensity and sensory acceptability scores, as the quantity of passion fruit peel flour in the honey breads increased, difference intensity increased and sensory acceptability decreased. Moreover, the difference intensity was negatively correlated with the acceptability score; the coefficient of correlation ranged from $-0.95$ ($p \leq 0.05$) for flavour to $-0.98$ ($p \leq 0.05$) for aroma. These behaviours indicate the dependence of sensory characteristics of honey breads on the quantity of passion fruit peel flour added to the formulations.

A literature review performed by Ktenioudaki and Gallagher (2012) found that sensory acceptability can be affected by the addition of fibre to baked goods, especially in terms of appearance, texture and flavour, when fibre addition varies between 5 and 15 per cent. Moreover, the effects of fibres on baked products include decrease on volume, increase of hardness of crumb, loss of crispiness and change on taste and appearance (colour, surface properties, density), reasons that may have reduced the sensory acceptability for honey breads with more than 30 per cent of passion fruit peel flour. However, other studies, also described by Ktenioudaki and Gallagher (2012), reported that fibre-enriched flours can replace wheat flour at levels of up to 40 per cent without negatively affecting sensory acceptability. In the current study, the honey breads with 10 and 20 per cent passion fruit peel flour differed the least to standard honey bread and received the same acceptability scores. Therefore, all three honey breads were characterized in terms of their chemical compositions and physical properties.

### *3.2 Chemical composition and physical properties of honey breads*

The honey breads containing passion fruit peel flour did not differ in terms of any nutrients or fibre contents (Table III). However, the honey bread with 10 per cent passion fruit peel flour was found to have higher moisture and lipid contents than the standard honey bread, while the honey bread with 20 per cent passion fruit peel flour was found to have higher ash and fibre contents and less protein than the standard honey bread. Passion fruit peel flour is rich in fibres and minerals, which explains the observed results for honey bread with 20 per cent of this ingredient (Cazarin *et al.*, 2014).

**Table III.** Chemical composition ($n = 3$; mean ± SD) of the standard honey bread (S) and of honey breads containing 10 and 20% passion fruit peel flour as a wheat flour substitute

| g/100 g | S | 10% | 20% |
|---|---|---|---|
| Moisture | $21.9 \pm 0.01^{a}$ | $26.5 \pm 0.01^{b}$ | $26.0 \pm 0.03^{ab}$ |
| Protein | $6.0 \pm 0.12^{a}$ | $5.3 \pm 0.12^{ab}$ | $5.0 \pm 0.07^{b}$ |
| Lipid | $1.7 \pm 0.03^{a}$ | $3.3 \pm 0.06^{b}$ | $3.0 \pm 0.06^{ab}$ |
| Ash | $1.2 \pm 0.01^{a}$ | $1.2 \pm 0.03^{ab}$ | $1.4 \pm 0.03^{b}$ |
| Total dietary fibre* | 1.1 | 2.6 | 4.0 |
| Insoluble fibre | $0.7 \pm 0.05^{a}$ | $1.7 \pm 0.09^{ab}$ | $2.7 \pm 0.16^{b}$ |
| Soluble fibre | $0.4 \pm 0.02^{a}$ | $0.9 \pm 0.06^{ab}$ | $1.3 \pm 0.07^{b}$ |
| Available carbohydrates** | 68.1 | 61.1 | 60.6 |

**Notes:** *Result from the sum of insoluble and soluble fibres; **result from 100 − (the sum of moisture, protein, lipid, ash and total dietary fibre contents); different letters in the same line indicate significantly different means ($p \leq 0.05$)

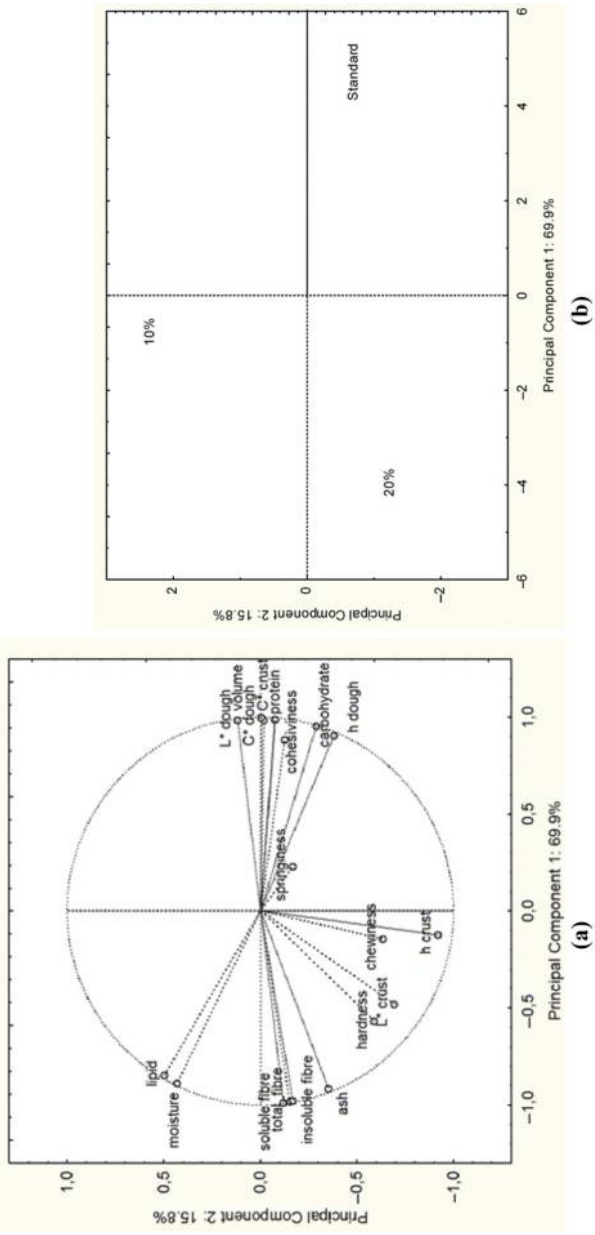
The honey bread with 20 per cent passion fruit peel flour was harder than the other formulations, while all of the honey breads with passion fruit peel flour were less cohesive than but as elastic as the standard formulation (Table IV). Less cohesiveness means that the honey bread is extended less before it ruptures (Szczesniak, 2002). Moreover, honey bread with 20 per cent passion fruit peel flour was found to have a lower specific volume than the standard formulation. Changes in the physical properties of the honey breads can be attributed to the fibre content in the passion fruit peel flour. The addition of fibres to baked products can cause the dilution of gluten proteins, a process which affects water absorption in the dough and complicates gluten development, thus resulting in harder products (Collar *et al.*, 2007; Angioloni and Collar, 2009). Moreover, the interaction between fibres and gluten prevents dough expansion due to gas loss during the heating process and thus reduces the volume of the final product (Wang *et al.*, 2002; Gomez *et al.*, 2003). Similar results regarding the addition of fibres to baked goods were found in other studies (O'Brien *et al.*, 2003; Ronda *et al.*, 2005; Moscatto *et al.*, 2006; Volpini-Rapina *et al.*, 2012).

When the colour was evaluated, the honey bread with 10 per cent passion fruit peel flour was found to have luminosity (L*), chroma (C*) and hue (h) values which were equal to those of the standard formulation in both the crust and the dough, besides intensities of red (a*) and yellow (b*); while the honey bread with 20 per cent passion fruit peel flour was also compared to the standard recipe and was found to have lower values of red, yellow and chroma in the crust and the dough, along with a lower

| Physical properties | S | 10% | 20% |
|---|---|---|---|
| *Texture* | | | |
| Hardness (N) | $1.18 \pm 0.14^{a}$ | $1.22 \pm 0.14^{a}$ | $1.58 \pm 0.33^{b}$ |
| Cohesiveness | $0.67 \pm 0.03^{a}$ | $0.60 \pm 0.02^{b}$ | $0.58 \pm 0.03^{b}$ |
| Springiness | $0.80 \pm 0.03^{a}$ | $0.78 \pm 0.09^{a}$ | $0.76 \pm 0.08^{a}$ |
| Chewiness (N)** | $0.64 \pm 0.09$ | $0.58 \pm 0.10$ | $0.70 \pm 0.21$ |
| Specific volume ($cm^3.g^{-1}$) | $3.3 \pm 0.3^{a}$ | $2.6 \pm 0.2^{ab}$ | $2.1 \pm 0.2^{b}$ |
| *Crust colour* | | | |
| L* | $26.4 \pm 1.6^{a}$ | $25.9 \pm 0.02^{a}$ | $27.5 \pm 0.3^{a}$ |
| a* | $13.3 \pm 1.1^{a}$ | $10.0 \pm 0.6^{ab}$ | $7.7 \pm 0.2^{b}$ |
| b* | $14.6 \pm 1.4^{a}$ | $10.0 \pm 0.9^{ab}$ | $8.7 \pm 0.2^{b}$ |
| C* | $19.7 \pm 1.8^{a}$ | $14.2 \pm 1.1^{ab}$ | $11.6 \pm 0.3^{b}$ |
| h | $47.7 \pm 0.6^{ab}$ | $45.1 \pm 0.6^{b}$ | $48.6 \pm 0.4^{a}$ |
| ΔE | – | 15.6 | 33.4 |
| *Dough colour* | | | |
| L* | $36.8 \pm 0.8^{a}$ | $33.6 \pm 0.4^{ab}$ | $30.5 \pm 1.0^{b}$ |
| a* | $15.5 \pm 0.3^{a}$ | $12.7 \pm 0.03^{ab}$ | $10.4 \pm 0.2^{b}$ |
| b* | $26.9 \pm 0.5^{a}$ | $20.3 \pm 0.2^{ab}$ | $16.7 \pm 0.2^{b}$ |
| C* | $31.1 \pm 0.5^{a}$ | $23.9 \pm 0.1^{ab}$ | $19.6 \pm 0.3^{b}$ |
| h | $60.0 \pm 0.4^{a}$ | $58.0 \pm 0.2^{a}$ | $58.1 \pm 0.3^{a}$ |
| ΔE | – | 5.2 | 19.9 |

**Notes:** **Result from the multiplication of hardness, cohesiveness and springiness; different letters in the same line indicate significantly different means ($p \leq 0.05$)

**Table IV.** Texture profile analysis ($n = 10$), specific volume ($n = 3$) and colour ($n = 3$) of the standard honey bread (S) and of honey breads containing 10 and 20% passion fruit peel flour as wheat flour substitute (mean ± SD)




**Notes:** (a) Projection of the variables; (b) projection of the samples)

**Figure 1.**
Principal component analysis of chemical composition and physical properties of honey breads

luminosity value in the dough. Moreover, the difference colour (ΔE) from standard honey bread was more expressive to honey bread with 20 per cent fruit peel flour (Table IV). Passion fruit peel flour contains more fibre and lower quantities of carbohydrates and proteins than wheat flour, and the 20 per cent substitution of wheat flour with passion fruit peel flour may have limited the Maillard reaction (Oliver *et al.*, 2006), resulting in honey bread with a less intense colour.

The principal component analysis explained 85.7 per cent of the total variation data (Figure 1). The first principal component explained 69.9 per cent of the variation data and was explained by protein and carbohydrate content, dough colour, crust chroma (C*), volume and cohesiveness (variables with factorial charges higher than +0.70), as well as by fibre, ash, lipid and moisture contents (variables with factorial charges lower than −0.70) [Figure 1(a). The variables of the former group themselves are positively correlated, while are negatively correlated with variables of the second group. Thus, the standard honey bread was described by higher intensities of dough colour and crust chroma, besides protein, carbohydrate, cohesiveness and volume, while honey bread with 20 per cent passion fruit peel flour was described by high fibre and ash contents [Figure 1(b)]. The second principal component explained 15.8 per cent of the variation data and was explained only by crust hue and luminosity [Figure 1(a)), but these characteristics did not describe any sample. Similarly, honey bread with 10 per cent passion fruit peel flour was not described by any chemical or physical characteristic [Figure 1(b)]. These results show that, although the honey breads have different chemical and physical characterizations, all of them received equal sensory acceptability scores from the panellists (Table II).

## 4. Conclusions

The addition of passion fruit peel flour as a substitute for wheat flour leads to changes in the characteristics of honey breads. The honey breads containing 10 and 20 per cent passion fruit peel flour are as acceptable by consumers as honey bread only with wheat flour, and they differ less from honey bread with wheat flour than do the honey breads with 30 to 50 per cent passion fruit peel flour. The honey breads with 10 and 20 per cent passion fruit peel flour are similar in terms of their chemical compositions and physical properties; however, honey bread with 20 per cent passion fruit peel flour possesses higher fibre and ash contents, a higher hardness value, a lower specific volume and different colours when compared to honey bread only with wheat flour. Although honey breads with and without wheat flour substitution differ in their chemical compositions and physical properties, their sensory acceptability scores are the same. This similarity shows that the substitution of wheat flour with passion fruit peel flour is feasible in honey bread production.

Conflict of Interest: The authors declare that there is no conflict of interest.

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