EFFECT OF APPLE POMACE POWDER ADDITION ON RICE FLOUR BASED BISCUITS QUALITY

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Abstract

Apple pomace is the primary by-product generated during the production of apple juice. This study investigates the effect of apple pomace powder (APP) on baking quality of rise-flour based biscuits. Water activity, moisture content was measured; sensory evaluation, colour investigation, total polyphenol content and texture profile analysis were performed.

By increasing the concentration of apple pomace, the hardness, fracturability, polyphenol content and antioxidant capacity increased, while their brightness, moisture content, water activity and overall popularity decreased. Apple pomace flour addition also increased the sweet taste intensity of cookies suggesting that in bakery products APF evolve a flavor enhancer role. Based on the sensory and compositional attributes, it was concluded that good quality biscuits can be prepared through using 5% and 7.5 % apple pomace powder with rice flour. APP proved to be a promising alternative ingredient in case of biscuits.

Introduction

During processing of apples 25% of the apple mass (eg, skin, stem, seeds, and pulp) being discarded as by-product, what is referred to as apple pomace [1; 2].

Currently, apple pomace has a lot of utilization possibility, as a livestock feed ingredient, for specific nutrient (dietary fiber, polyphenol, etc) extraction for dietary supplements, and as a food ingredient substitute [3]. Apple pomace should be considered for use as a food ingredient for human consumption (pomace in jams and in sauces, confectionery products such as pomace powder for toffees, using pomace powder in bakery products [4, 5, 6]. Dried apple pomace powder (APP) contains high level of the fiber [7]. it can be used in bakery products to enhance dietary fiber and bioactive compounds in the products [8; 9]. This study is aimed to investigate the effect of apple pomace powder on baking quality of rise flour based biscuits.

Experimental

Non enzymatic treated wet apple pomace was obtained from a hungarian juice maker company (Agrana Juice Ltd.). 200g of the pomace were spread in a drying tray with a depth of 0.5 cm, the drying temperature was 80°C and samples were dried in the dryer until reached 4 % moisture content using atmospehric drying equipment (LP 232/1, Hungary). Dried samples were ground into flour using a “PRINCESS” multi chopper and grinder and after it were vacuum packaged. Basic ingredients needed for the preparation of biscuits were all commercially available: rice flour, icing sugar, butter, margarine, vanilla sugar and egg.

Preparation of bakery products

The ingredients were mixed, and after this the biscuits were rounded in shape with diameter of 40 mm and thickness of 6-8 mm and baked in an electric oven at 170 °C for 7 min. The ingredients are shown in Table 1.

Table 1. Ingredients of the biscuits

	RF 0%	RF 5%	RF 7.5%	RF 10%
Rice flour	48.08g	45.67g	44.47g	43.27g
Apple	0 g	2.40g	3.61g	4.81g
Margarine	32.05g	32.05g	32.05g	32.05g
Sugar	16.03g	16.03g	16.03g	16.03g
Egg yolk	2.56g	2.56g	2.56g	2.56g
Vanilla	1.28g	1.28g	1.28g	1.28g

Determination of baking loss values

After cooling to room temperature, biscuits were weighed and baking loss (Bl) was determined using the following equation: $Bl = ((w_1-w_2)/w_1)\times 100$, where w_1 is the weight of biscuit prior to baking, w_2 is the weight of biscuit after baking.

Determination of dry material content and water activity

Determination of dry material content of the biscuits was performed by using a MAC-50 rapid moisture analyzer (Radwag Waagen GMBH, Hilden, Germany). To determine the water activity, Novasina, LabMaster-aw equipment was used.

Colour measurements

Colour is a determining factor in the definition of the quality of any food. The colour of the surface of three biscuit samples were also measured with 9 parallels (3 biscuits/3 places) using a Konica Minolta CR400 chromameter. Results were expressed as L*, a*, and b* values. L* is a measure of the brightness from black (0) to white (100), while a* describes the redgreen color (a*> 0 indicates redness, a* < 0 indicates greenness), and b* describes yellow-blue color (b*> 0 indicates yellowness, b* < 0 indicates blueness). To determine the total color difference between two samples using all the three coordinates, the following formula was used: $\Delta E^* = \sqrt{(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2}$

Texture analyis

Texture analysis of the biscuits was performed using a Stable Micro System TA.XT2 with 2mm Cylinder Probe (P/2). Three biscuit were selected, and the measurement was performed on their center and two side points. The data were recorded, and the analysis of the texture profile was performed by using Texture Expert software. The test parameters were the follows: trigger force: 5g, test speed 0.5 mm s^{-1}, distance reached by the test piece in the sample: 2 mm. Based on the texture profile load (g) in function of time (s), two parameters were chosen as texture indicators: hardness (g) (maximum deformation force during the first mastication cycle), and fracturability (g) [10].

Determination of total polyphenol content

Total phenolics were determined using the Folin–Ciocalteu colorimetric method as described by Singleton and Rossi (1965) [11]. The results were expressed in gallic acid equivalents (GAE, μg ml^{-1} biscuit exract).

Sensory evaluation

During the sensory evaluation, the judges had to score the biscuits on a 100-point scale. The sensory attributes were given different scores. Colour and texture were 20 points, smell 10 points and taste 40 points.

Statistical analysis

For the statistical analysis the mean values were compared by 2-way analysis of variance (ANOVA) when evaluating the sensory attributes of the products ($\alpha = 0.05$). Pair comparison was performed by Tukey HSD post hoc test. The statistical analysis was carried out using SPSS ver.No.23.

Results and discussion

In general, geometry is an important parameter in baking quality of biscuits. Increased volume of baking products is associated with their improved quality [12; 13]. Baking loss refers to the moisture loss during baking: The higher water binding capacity of dough is related to lower baking loss. The baking loss values of the biscuits were the follows: RF 0%: 5.71%; RF 5%: 5.31%; RF 10%: 4.67% and RF10%: 5.42%.

The moisture content of the biscuits were ranged from 5.59-6.52 % RF10 biscuits showed higher a_w values (6.52%), which may result from the water holding capacity of apple pomace [13]. In case of water activity, there was no differences between the values (0,32-0,36). The water activity values of biscuits are below 0.6, what means a microbiological stability, but it can only be stated that these foods are stable with the knowledge of appropriate microbiological tests.

Color is an important parameter in determination of baking quality. During the color measurement, L* and ΔE* values were considered as these properties show the difference between the biscuits the most (Fig. 1). According to the literature the addition of apple pomace decreases the L* value of the samples and increases the color difference [14]. In case of the biscuits, significant differences were observed at 5% significance level. Between RF5 and RL7.5, there is significant difference, but for the other pairings, significant differences are observed, so that RF0 and RF10 biscuits are significantly different from RF5 and RF 7.5, and also from each other ($p<0.000$). Color difference (ΔE*) between control and APP added biscuits was higher, than 6.0, so it indicate huge differences. According to Wenzl-Gerőfy (2014) [15], the critical values are the follows: $\Delta E^* < 1.5$: not perceptible; $1.5 < \Delta E^* < 3.0$: perceptible; $3.0 < \Delta E^* < 6.0$: well perceptible; $6.0 < \Delta E^*$: huge difference.

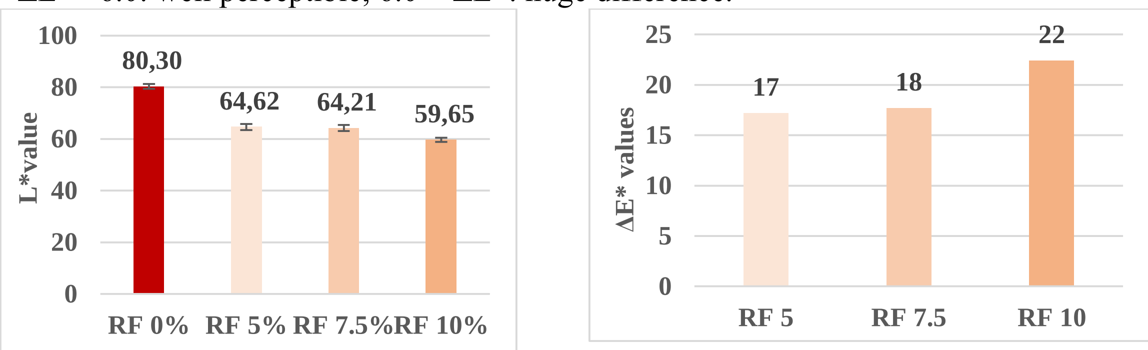

Figure 1. L* and ΔE* values

The decreasing tendency of L* and the color difference between the samples can be caused by the brown color of the pomace and the behavior of polyphenols as substrates, which can lead to enzymatic browning [6]. Melanoids and reaction products formed during the Maillard reaction cause browning in fried products [16; 17].
By the texture measurements, hardness and fracturability were determined (Fig.2.) using the texture profile. Analysis of variance analysis showed that for RL biscuits there is a significant difference between different concentrations. To investigate this further, Tukey's pairwise comparison was performed, which showed the significant difference between each samples. RF 10% samples differ significantly in hardness from each concentration.

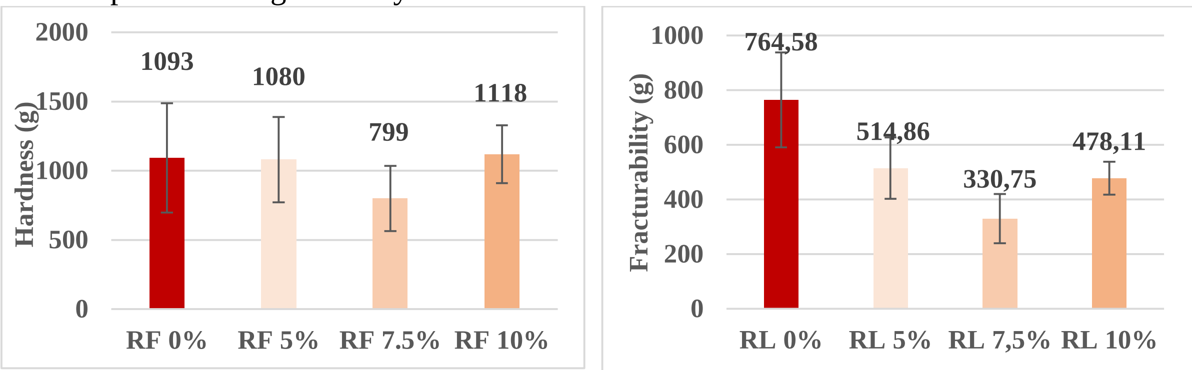

Figure 2. Hardness and fracturability values of the biscuits

As the apple pomace content of the samples decreased, the hardness is increased. Apple pomace has good water holding capacity, so it can soften the texture of the foods in which it is used [13]. Several studies report that the addition of fruit or pomace flour increases the hardness compared to the hardness of reference biscuits [18]. Apple pomace contains fructose, and it may have increased the hardness due to the crystallization of it [13]. The hardness of biscuits depends not only on the apple pomace, but also on the flours used in them (their grain size), the water, the sweetener, and fat, as well as the interactions between the ingredients [19].
Examining the total phenolic content of the samples, there was no significant difference between each sample (p>0000). The polyphenol content of the biscuits increased with increasing apple pomace. In case of the control sample TPC was 14 mg 100 g^{-1}; in case of RF 5 biscuit: 15 mg 100 g^{-1}; RF 7.5: 23 mg 100 g^{-1} and RF 10 biscuit: 24 mg 100 g^{-1} .
Effect of the added apple pomace powder on sensory attributes of biscuits was also investigated. Figure 3. shows the total point numbers of the biscuits in a bar graph. Critics preferred RF5% biscuits the most, but there was no sensory difference in the popularity of RF0% and RF7.5%. These results suggest that these type of biscuits can be fortified with up to 5%-7.5% apple pomace, as there is no sensory difference from biscuit-free biscuits.

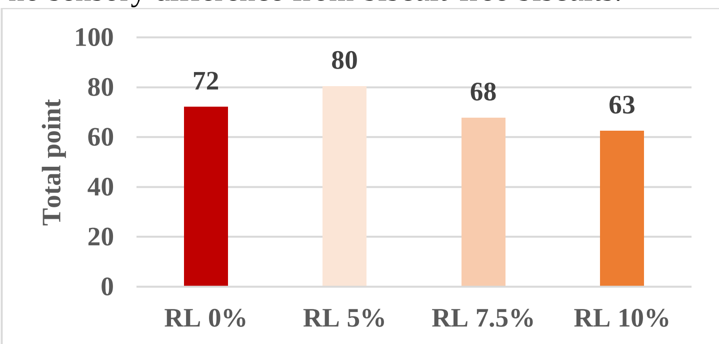

Figure 3. Total points of the sensory attributes

Conclusions

As the apple pomace concentration increased, the hardness and fracturability decreased, while their lightness, moisture content, polyphenol content and overall popularity increased. We can state that in the case of RL5 and RL7.5 biscuits, the biscuits enriched with 5% and 7.5% apple pomace flour proved to be the most suitable by the reviewers. Therefore, apple pomace can be regarded as a nutritional and functional ingredient in bakery products. Future studies are recommended to develop various types of functional baked foods with apple pomace as an ingredient.

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