Sensory and physic-chemical properties of wheat bread prepared with apple pomace

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Abstract. The influence of secondary apple raw materials (frozen apple pomace) on organoleptic and physicochemical indicators of the quality of wheat bread has been studied. The traditional recipe of wheat bread was taken as a basis. In this recipe for the sample of bread No. 1, a part of the premium wheat flour was replaced with 25% rice flour and 10% frozen apple pomace. In the sample of bread No. 2, a part of the premium wheat flour was replaced with 12.5% rice flour and 10% fresh frozen apple pomace. For the organoleptic assessment, a five-point scale for assessing the quality of bread was developed, in which the maximum number of points up to5 was assigned to each indicator. According to the results of the study of the organoleptic indicators of the quality of the developed samples of bread using a point scale, it was found that they exceeded the control sample. The best was the sample with fresh frozen apple pomace10% and rice flour in the amount of 12.5%. In terms of physical and chemical indicators, the developed samples of wheat bread enriched with apple raw materials meet the regulatory requirements.

1 Introduction

There was a general trend recently toward increasing the nutritional value of bakery products like bakery products strengthening fiber, as the bakery products are consumed widely in the international food markets [1].

Bread is a staple diet that is consumed daily, and its quality and sensory attributes are highly considered by consumers [2].

It can act as an excellent source of energy. Bread is a carrier of folate, copper, thiamine, zinc, iron, phytic acid, minerals [3].

Bread can also be a good carrier of phenolic antioxidants and fiber polysaccharides in high concentrations [4], which are very rich in apple raw materials.

Apple is an important nutritional crop that is mostly consumed as fresh fruit; however, a small proportion of apples are processed into cooked slices, juices and jellies [5]. This produces a huge amount of pomace, which is a waste of juice production.

Apple pomace is mainly composed of skin and flesh with a low proportion of seeds and stems [6].

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Apple pomace is used as animal food as it is a good source of digestible fiber, pectin and phenolic compounds while its use as compost is not environmentally friendly. The phenolic profile of apple pomace includes hydroxycinnamic acids, flavan-3-ols, anthocyanins, flavonols and dihydrochalcones [7].

Apple pomace is a rich source of natural (PPs) with remarkable antioxidant properties. Excellent reviews are devoted to the health related effects of PPs in human nutrition [8-10].

Meanwhile, apple pomace is a rich source of biologically active substances - vitamins C, P, E, β-carotene, triterpene compounds, vitamins of group B, mineral elements (after squeezing the juice, almost half of the total amount of essential mineral elements remains in the pomace), dietary fiber , including pectin substances [11]. Dietary fibers from various sources are used to replace wheat flour in the preparation of bakery products.

2 Materials and methods

2.1 Materials

Baking wheat flour of the highest grade produced by Ryazanochka (Russia), rice flour produced by Kudesnitsa (Russia).

Fresh pressed yeast, salt and corn oil were purchased from the local market.

Apple pomace is obtained as a waste in the production of apple juice and is subject to shock freezing.

2.2 Determination of the biochemical activity of yeast

The biochemical activity of yeast is of great technological importance in the production of bread. The structure of the dough, the volume and shape of the finished products depend on the properties of the yeast [12-14].

To study the biochemical activity of yeast, a nutrient mixture was prepared. Water at a temperature of 35°C was poured over thawed apple pomace and stirred to ensure a more complete extraction of soluble substances. Then yeast was added to the mixture and the mixture was kept at 33–35 °C for 30 min. The lifting force of the yeast improved from 12 minutes (no activation) to 7 minutes. Studies have shown that increasing the dose of raw apple pomace is impractical [15].

To determine the effect of the supplement on the condition and activity of the yeast, a number of studies have been carried out. The lifting force of the yeast was determined by the accelerated method. Counting the number of cells of microorganisms under a microscope was carried out using a Tom-Goryaev camera.

2.3 Bread making technology and recipe

Apple pomace was previously thawed and soaked in a mixture of vegetable oil and warm water (water temperature 28–30 ° C). The mixture was constantly stirred until it became a homogeneous consistency. Then it was allowed to stand for 15–20 minutes. The remaining ingredients (flour, salt, yeast) were mixed at the same time. After that, the mixture with pomace was added to the dough.

After kneading, the dough was fermented for 5–7 minutes. In this case, the dough temperature rose to 30°C. Then the kneading was carried out, after which the fermentation process continued for another 5–7 minutes.

To increase the acidity of bread and reduce the fermentation process, apple raw materials are introduced into the recipe. This made it possible to shorten the fermentation

process. Then they were poured into molds. The bread for proofing was placed in a special chamber for 20 minutes. The proofing process was carried out at a temperature of 34–35 °C. As a result, the dough increased in volume. Bread was baked at a temperature of 195–205 °C. The baking time was 20 minutes. The baked bread was gradually cooled at room temperature.

Bread recipes are presented in table 1.

Table1. Breadrecipe.

Raw material composition	Controlsample	Sample №1	Sample №2
High-grade baking wheat flour, g	160	120	140
Riceflour, g	-	40	20
Pressedyeast, g	5,5	5,5	5,5
Drinkingwater, ml	110	110	110
Vegetableoil, ml	10	10	10
Applepomace, g	-	30	30
Tablesalt, g	2,5	2,5	2,5
Granulated sugar, g	2,5	-	-

2.4 Physicalpropertiesofbread

The bread weight (g) was determined after cooling for 60 minutes. according to the techniques described in AOAC (2000) [16].

Moisture content and acidity were determined on the day of baking according to the method described in AOAC (2000).

The content of iron in food was determined using a spectrophotometer, based on measuring the colour intensity of a solution of a complex compound of ferrous iron with orthophenanthroline.

To determine phosphorus in bread, the method of dry or wet mineralisation was used.

2.5 Sensory characteristics of bread

Evaluation of the sensory properties of the bread was carried out using expert and organoleptic methods. The expert method is based on the fact that an expert assigns a certain point to each of the criteria [17]. The sensory properties of bread were assessed according to the developed five-point scale: 5 - excellent quality; 4 - good quality; 3 - not very good quality; 2 - poor quality.

The scale is presented in Table 2.

Table 2. Scale scoring the quality of bread

Indicators	Points			
	5	4	3	2
Form	Rounded, oval or oblong-oval, not undefined, without imprints	Rounded, oval or oblong-oval, not undefined, with small imprints.	Rounded, oval or oblong-oval, slightly undefined, with imprints	Does not match the bread shape, undefined, with a fallen crust
Surface	Free from large cracks or tears, smooth or rough. Allowed: mealy for hearth bread	Smooth or rough, with small cracks and breaks, Allowed: mealy	Rough, glossless surface, with cracks and dents.Allowed: mealyfallencrust	Rough, glossless surface, with large cracks and explosions.Peeling of crust from crumb
Colour	Light yellow to dark brown with even distribution of supplements	Light brown to dark brown with slightly uneven distribution of supplements	Pale brown to dark brown with uneven distribution of supplements, burnt	Pale grey or brown-grey to black with uneven distribution of supplements
Bakedgoods	Baked, not damp to the touch.Elastic, after light pressure with your fingers, the crumb should return to its original shape	Not damp to the touch.After light pressure with your fingers, the crumb does not return to its original shape	Wet to the touch.After light pressure with your fingers, the crumb does not return to its original shape	Not baked, moist to the touch.Not elastic, after light pressure with fingers, the crumb does not return to its original shape
Mixture	No lumps and traces of impurities.	Small lumps are observed, without traces of impurities	Small lumps and traces of impurities are observed	Lumpyandpoorly mixed
Porosity	Developed, without holes and compaction.	Developed, without holes and compaction.	With a lot of holes, with little compaction at the crust	Undeveloped, with large holes and / or severe crust compaction
Taste	Characteristic of this type of product, without any strange taste.	Weakly expressed taste of this product, without strange aftertaste	Poorly expressed taste of this product with an added additive, with a strange taste	Uncharacteristic of this type of product with a pronounced extraneous taste not typical of additionally introduced raw materials
Smell	Specific to this type of product, without any strange smell	Weak smell of this product, no strange smell	Poor smell of this product, with a strange smell	Uncharacteristic for this type of product, with a strange , musty and mouldy smell

3 Results and discussion

Using a point scale (Table 2), each taster completed the card. The obtained results were processed and based on them a test report was drawn up. Description and average values of organoleptic indicators of the quality of bread samples are given in table 3.

Table 3. Average values of organoleptic indicators of the quality of bread samples

Nameofsamples	Controlsample	SampleNo.1	SampleNo.2
Appearance Form	product of the correct shape;there are lateral explosions (4.2 points)	product of regular shape, with a slightly convex upper crust (4.9 points)	product of the correct shape, with a convex upper crust (4.8 points)
Surface	rough, withexplosions (3.8 points)	rough, without cracks and explosions (4.8 points)	rough, without cracks and explosions (4.6 points)
Colour	light brown, with slight burnt;crumb color white (3.6 points)	light brown;white crumb with a grayish tint (4.9 points)	light brown;white crumb with a slight grayish tint (4.8 point)
The crumbs: Baked goods	baked, not wet to the touch, elastic; after light pressure with your fingers, the crumb takes on its original shape (5 points)	baked, not wet to the touch, elastic; after light pressure with your fingers, the crumb takes on its original shape (5 points)	baked, not wet to the touch, elastic; after light pressure with your fingers, the crumb takes on its original shape (5 points)
Mixture	without lumps and traces of impurities (5 points)	without lumps and traces of impurities (5 points)	without lumps and traces of impurities (5 points)
Porosity	developed, the presence of large (4.0 points)	developed, fewholes (4.6 points)	developed, withoutholes (5 points)
Taste	pleasant, typical of wheat bread (5 points)	characteristic of this type of product, slightly sweetish (5 points)	characteristic of this type of product, slightly sweetish (5 points)
Smell	characteristic of wheat bread, without strange smells (4.6 points)	characteristic of the added flavourings, without strange smells (4.2 points)	characteristic of the added flavourings, without strange smells (4.9 points)
Total points	35.2	37.5	39.1

Figure 1 shows bread samples.

During the study, it was found that all samples are of sufficient quality. At the same time samples No. 1 and No. 2 had high organoleptic characteristics. The products had a regular shape, with a slightly convex upper crust for sample no. 1 and more convex for sample no. 2. Samples no 1 and no 2 have pleasant taste and smell. The crumb is baked, not wet to the touch, elastic. Only sample No. 1 had a small amount of holes and the crumb is slightly darker than that of sample No. 2. Due to the active work of rice flour enzymes, the dough is very sticky, and the crumb has a dark colour with uneven porosity.

Soaking the apple pomace in corn oil before making the dough made it possible to obtain bread with developed porosity and good volume. Moisture loss is slower. Therefore, the bread remains fresh after 72 hours and does not go stale.

Fig. 1. Bread samples

The use of rice flour in the amount of 10% -50% increases the autolytic activity of wheat flour. The higher autolytic activity of wheat flour indicates an increased activity of enzymes, in particular α-amylase. This further negatively affects the quality of the baked product [18].

When more than 20% of rice flour is added to the dough recipe, there is a deterioration in the elasticity of the dough and darkening of the crumb. Cracks and tears appear on the surface of the product. An increase in the dosage of rice flour leads to a deterioration in the rheological and biochemical parameters of the dough. To obtain bread of satisfactory quality with a dosage of rice flour more than 20%, it is necessary to use special acidifying natural additives.

As a result of carrying out physical and chemical tests for baked bread samples using recycled apple raw materials, the data presented in table 4 were obtained.

Table 4. Results of physical and chemical tests for the developed loaves

Name of the indicator	Control sample	Sample No.1	Sample No.2
The humidity of the crumb, %	42.2	43.6	43.6
The acidity of the crumb, 5%, no more	3.2	3.4	3.4
Porosity, %, noless	69.25	73.30	73.30

In terms of physical and chemical parameters, bread samples meet the regulatory requirements. The developed bread samples have high porosity and optimum moisture content. These indicators make bread easier to digest.

The degree of acidity increase is determined by the dosage of the introduced product and the acid content in it. In the process of fermentation of the dough, acid accumulation is not intensified, which should be taken into account when developing a technology for the use of apple products in baking.

Minerals are essential for many biological processes in the body, such as action of the nervous system, structural systems, other cellular processes and water balance [19]. The lack of intake of minerals has been correlated with mental impairment, increased disease conditions, and severe malnutrition [20, 21]).

Using a spectrophotometer, we determined the content of iron and phosphorus in the studied samples of bread. Based on the obtained calibration (Figures 2 and 3), the data presented in Table 5 was obtained.

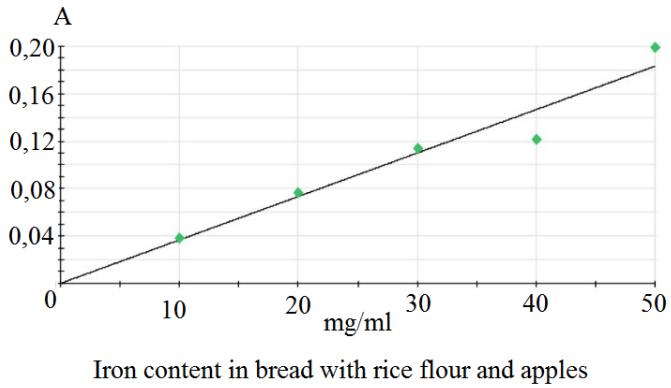

Fig. 2. Iron concentration in the studied samples of the raw materials used and in the obtained bread samples

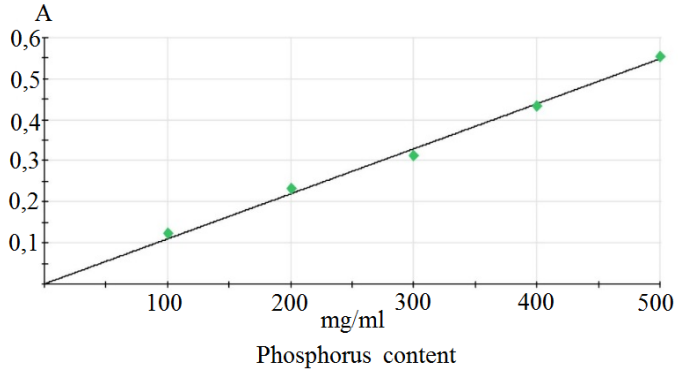

Fig. 3. Determination of the concentration of phosphorus in the test samples

Table 5. Content of iron and phosphorus in the test samples

Samples	Iron content, mg / 100g	Phosphorus content, mg / 100g
Riceflour	4.41	68.79
Wheat flour of the highest grade	6.20	72.86
Apple pomace	6.03	79.91
Control bread sample	3.36	47.82
Bread sample No.1	3.96	55.36
Bread sample No.2	4.43	56.40

Iron in combination with protein, vitamins, chlorophyll and silicic acid stimulates carbohydrate and protein metabolism, which is accompanied by an increase in the tone of the cardiovascular, respiratory and other body systems, contributes to an increase in the hemoglobin content in the blood and the number of erythrocytes [22, 23].

Analysis of the samples of bread and raw materials used for the content of iron and phosphorus showed that the highest content of this trace element is in sample No. 2. Sample No. 1 in terms of the content of these elements exceeded the control, but is inferior to sample No. 2. When analysing iron in raw materials, it was determined that its greatest amount is contained in wheat flour, the smallest amount in rice. Apple pomace in terms of iron content is close to wheat flour. The highest phosphorus content is observed in apple pomace, and the lowest in rice flour.

4 Conclusions

The results of this work showed that bread containing 10% apple pomace and 25% rice flour (sample No. 1), 10% apple pomace, 12.5% rice flour (sample No. 2), is superior in quality to bread made from 100% wheat flour. Sample no 2 was more palatable in taste, texture, aroma, colour and crumb. Sample No. 1 was no worse than sample No. 2 in terms of organoleptic characteristics. It only had holes in the structure.

The use of wheat flour and apple pomace in the manufacture of bread affects the increase in the content of iron and phosphorus in the finished product.

According to the data obtained as a result of this work, recipes containing apple pomace and wheat flour produce high quality bread.

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