Research on the Production of Functional Bakery Products Using Some Plant Additives

G.V. Hajiyeva[1*], H.K. Fataliev[2]

[1]Azerbaijan State University of Economics (UNEC), Baku, Azerbaijan
[2]Azerbaijan State Agricultural University, Ganja, Azerbaijan
Hajiyeva.Gunay.Valeh@unec.edu.az

Abstract. Rose hips are a plant belonging to the rose family. Its fruits are famous for being rich in vitamin C. About 300 species of rose hips are known. 42 of them grow in Azerbaijan and 36 of them grow wild. Its leaves, flowers and fruits are characterized by various therapeutic effects. Two species are more important for industry. These are the wrinkled and brown rose hips.
Wrinkled rose hips can be used as an additional product in flour products. The aim of this research is to obtain a new taste and vitamin product by adding rose hips to flour products. Rose hips in powder form, made from dried and ground fruits, are added to flour products. The study highlights that rose hips can make a significant contribution to the diversification and competitiveness of the product in global markets. r. Sustainable practices and controlled fermentation processes are also proposed to preserve its original character.

Keywords: bakery products; rose hips; rose hip powder

1 Introduction

The wild rose plant is a native wild plant that has been part of the flora of Azerbaijan since ancient times. It has existed in Azerbaijan since ancient times and has been used in folk medicine and as food for hundreds of years. This plant does not have a complete history of discovery, and the first scientific descriptions were given by botanists studying the flora of the Caucasus in the 19th century. It is a widespread, hardy plant and can grow in a wide variety of climatic conditions [1-3].
The use of various rich plant additives in bakery products is gaining relevance on our agenda. If we look at rose hips as a cheap and useful product, then the advantages of this plant come to the fore. Rose hips are both very easy to find in natural conditions and are very rich in terms of health. Therefore, adding them to everyday products such as bread is both economically and nutritionally beneficial. Vitamin C, antioxidants, fiber and minerals make bread more nutritious, and because it is fibrous, it creates satiety and improves intestinal function. Antioxidants protect blood vessels and support blood circulation [4-7]. Our research shows that it is possible to create high quality even with cheap products.

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Despite its high results in “Bakery Technology”, scientific research on the application of rose hips to bakery products remains limited. Comprehensive studies are needed to fully characterize the potential of rose hips. Rose hips bread is particularly beneficial for patients, as it has both high nutritional value and supports immunity and body regeneration. With its easy collection and cheap raw material, it has economic advantages, multifunctional use, and high potential in biotechnological research. This is a strong basis for investigating the contribution of this research to the identity and economic development of the Azerbaijani baking sector [8-10].

Rose hips are a plant belonging to the rose family. Its fruits are famous for being rich in vitamin C. About 300 species of rose hips are known. 42 of them grow in Azerbaijan and 36 of them grow wild [9-10]. Its leaves, flowers and fruits are characterized by various therapeutic effects. Two species are more important for industry. These are the wrinkled and brown rose hips. Wrinkled rose hips can be used as an additional product in flour products. The aim of this research is to obtain a new taste and vitamin product by adding rose hips to flour products. Rose hips in powder form, made from dried and ground fruits, are added to flour products. The study highlights that rose hips can make a significant contribution to the diversification and competitiveness of the product in global markets. r. Sustainable practices and controlled fermentation processes are also proposed to preserve its original character.

2 Experimental Section

The origin of the name “Itburnu” (Rose hips) is directly related to its appearance and characteristics among the people. The word “It” (in azerbaijanian) is used here in the sense of “wild”, that is, it means a natural wild plant that is not cultivated at home. “Burnu” (in azerbaijanian too) refers to the fact that the tip of the fruit of the plant protrudes like a nose. That is, the word “itburnu” means “wild nose-shaped fruit”. This name has been used since ancient times in both Azerbaijani and other Turkic languages and arose due to the characteristic shape of the plant.

In terms of micronutrient profile, rosehip powder provides antioxidant and enzymatic activity with vitamin C (ascorbic acid), which can affect the pH and yeast activity in dough; vitamin A (carotenoids) is resistant to baking temperatures and can give bread a deep orange color; vitamin E (tocopherol) delays lipid oxidation, extending the shelf life of bread; and B vitamins (niacin, riboflavin, thiamine) support fermentation in dough.

I used high-gluten flour for the study. This is the most suitable flour for rosehip powder, as rosehip powder tends to dilute the gluten, and strong flour balances this effect. We optimally took 10–15 g of rosehip powder for 100 g of flour, this ratio made the bread orange in color, the taste remained balanced, the volume did not decrease, the texture became soft, and the bioactive substances increased;

When 20 g was added, the color darkened, the taste became fruity and sour, and the volume decreased slightly as the dough became heavier, and this amount was proportional for functional breads;

When 30–40 g was used, the bread became very dark and dense, the taste became sharp, the gluten became diluted, and such a high addition is recommended only for special dietary and functional products, therefore the most successful amount is 10–15 g.

When rose hip powder (dried rose hip fruit) is added to bread dough, the chemical structure of the bread remains largely the same, but several new molecules and chemical interactions are formed in the dough. The original structure is replaced by plant-derived bioactive substances.

The changes are shown below:

1. When rosehip powder is added to bread, the carbohydrate structure changes because new sugars – fructose, glucose, sucrose, and pectin-linked galacturonic acid polymers – are added, and these sugars can enhance fermentation as an additional food source for yeast.

2. Rosehip powder is rich in pectin, and pectin is a partially methylated polysaccharide ($(C_6H_8O_6)n$) and swells with water in the dough, making the dough more gel-like, strengthening the matrix together with starch and keeping the inside of the bread softer and moist. That is, a new "composite matrix" is created, which includes pectin + starch + gluten in the chemical structure.

3. Rose hips are high in antioxidants, especially vitamin C (ascorbic acid, $C_6H_8O_6$), which can strengthen the gluten network in dough, as ascorbic acid is oxidized in bread to dehydroascorbic acid; also, phenolic compounds – catechins, flavonoids and tannins – can darken the color of bread by affecting the Maillard reaction and act as antioxidants, reducing the oxidation of fats.

4. Rosehip powder contains carotenoids (lycopene, beta-carotene) and volatile aromatics, which give the bread an orange-red color, a fruity taste, and a more aromatic crust.

5. Rose hips add minerals such as calcium, magnesium, potassium, iron, and zinc to bread, creating partial ionic bridges in the dough, and these minerals can interact weakly with pectin and starch.

6. When rose hips are added to bread, the additional fructose and glucose increase fermentation, causing the dough to rise more quickly, and the sugars in the rose hips also enter into a Maillard reaction with amino acids, creating a darker color and stronger aroma in the bread crust.

Although rosehip powder does not completely change the chemical structure of bread, it introduces new bioactive substances into the dough - pectin polysaccharides, vitamin C, phenolic compounds, carotenoids, additional monosaccharides and mineral salts - and these substances interact with the starch-gluten-water matrix in the dough, increasing the structure, color, softness and biological value of the bread. Below is a simplified spatial representation of the main components of dough and their interactions.

1. Standard bread dough matrix (starch + gluten + water)

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[Q]~~~~[Q]~~~~[Q] ← Gluten protein network
          \   |   /
        [N] [N] [N] ← Starch granules
      |    |    |
(Water)(Water)(Water) ← Matrix of water molecules
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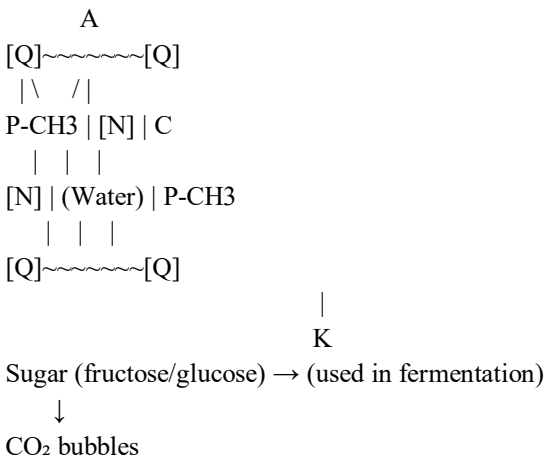
2. When rose hips powder is added, new components are introduced

The main ingredents from rose hips: Pectin polysaccharides (methylated);Vitamin C; Phenolics (antioxidants); Carotenoids; Fructose / glucose; Minerals

I will mark these in the diagram like this: P = Pectin (methylated polysaccharide); CH_3 = methyl groups; C = Vitamin C; F^- / Ca^{2+} / Mg^{2+} = minerals (in simple terms); A = antioxidant phenolics; K = carotenoid

3. Chemical matrix of dough with added rose hips (scheme)



1. Pectin (P-CH_3) enters the gluten network: Methylated pectin binds water; Softens the matrix by intercalating between gluten chains; Increases dough viscoelasticity

2. Vitamin C strengthens gluten through oxidation: Ascorbyl → dehydroascorbyl; Increases disulfide bridges in gluten

3. Antioxidants (A) and carotenoids (K) enrich the matrix in terms of color and aroma: Modify the Maillard reaction of the crust; Darkens the color; Antioxidants reduce fat oxidation

4. Sugars enhance fermentation: Yeast breaks down additional fructose and glucose → more CO_2 is produced; Dough rises better

5. Minerals form weak ionic bridges with pectin • Ca^{2+} can "cross-link" pectin chains Structural stability increases As a result, the overall chemical structure of the dough is as follows: Starch + gluten base matrix; Pectin-enriched hydrogel structure; Complex blend stabilized with antioxidants and vitamins; System with high fermentation activity

In conclusion, the rose hip plant represents a valuable component of Azerbaijani baking technology. Combining traditional baking practices with modern analytical and technological approaches, the wrinkled rose hip variety can be elevated to a global symbol of authentic quality and cultural identity.

3 Result and Discussion

The technological, structural, and nutritional properties of bread were significantly influenced by the incorporation of rose hip powder. An optimal formulation was obtained with 10–15 g per 100 g of high-gluten flour, resulting in a stable loaf volume, soft crumb texture, balanced flavor, and an attractive orange color, while preserving adequate gluten strength. When the level was increased to 20 g, a darker crust, fruity-sour taste, and a slight decrease in volume were observed due to higher dough density, whereas the use of 30–40 g caused pronounced gluten dilution, a dense crumb structure, and a sharper flavor profile, making such concentrations more appropriate for specialized functional products. From a structural standpoint, a modified composite matrix was formed in the dough: pectin improved water retention and softness, vitamin C enhanced gluten development through oxidative disulfide bond formation, and additional sugars promoted yeast activity and CO_2 production. Crust color and aroma were intensified by phenolic compounds and carotenoids through Maillard reactions, while their antioxidant properties limited lipid oxidation, and minerals contributed to weak ionic cross-linking that increased structural stability. Thus, without fundamentally changing the starch–gluten base system, rose hip powder created a pectin-enriched, antioxidant-stabilized dough with enhanced fermentation activity and improved biological value.

4 Conclusion

This study shows that rose hip powder is a valuable functional ingredient for bakery products, as it enhances the nutritional value, color, aroma, and softness of bread due to its richness in vitamin C, antioxidants, pectin, natural sugars, and minerals. When used at an optimal level of 10–15% of flour weight, it maintains proper volume and texture while increasing bioactive compounds. Technologically, it strengthens and enriches the dough matrix: pectin improves moisture retention and crumb softness, vitamin C supports the gluten structure, natural sugars stimulate fermentation, and antioxidants help extend shelf life. Therefore, the use of rose hips provides nutritional, technological, and economic advantages and, as a locally available raw material in Azerbaijan, offers strong potential for the production of competitive, high-quality functional bakery products.

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