

USE OF SECONDARY PRODUCTS OF PERSIMMON PROCESSING AS A BIOLOGICALLY ACTIVE ADDITIVE

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Abstract. *The article presents the results of a study on the application of dried persimmon peel powder in bakery products as an element of a zero-waste fruit processing technology. An experimental study was conducted on bread formulated with 70 g of persimmon peel powder per 930 g of wheat flour. The physicochemical properties of the dough, technological characteristics of the bread, organoleptic indicators, and functional value were investigated. It was found that the addition of persimmon peel does not impair crumb structure, preserves porosity, and increases the content of dietary fiber and phenolic compounds by more than twofold. The results demonstrate the feasibility of introducing zero-waste persimmon processing in breadmaking and expanding the range of functional food products.*

Keywords: *persimmon, peel, zero-waste technologies, breadmaking, functional foods, dried peel powder, rational use of raw materials.*

Аннотация. *В статье представлены результаты исследования применения порошка сушеной кожуры хурмы в хлебопекарной продукции как элемента безотходной технологии переработки плодов. Проведено экспериментальное исследование хлеба, включающего 70 г порошка кожуры на 930 г пшеничной муки. Изучены физико – химические свойства теста, технологические характеристики хлеба, органолептические показатели и функциональная ценность. Установлено, что добавка кожуры не ухудшает структуру мякиша, сохраняет пористость, повышает содержание клетчатки и фенольных соединений более чем в два раза. Результаты демонстрируют возможность внедрения и безотходной переработки хурмы в хлебопечении и расширения ассортимента функциональных продуктов.*

Ключевые слова: *хурма, кожура, безотходные технологии, хлебопечении, функциональные продукты, порошок сушеной кожуры, рациональное использование сырья.*

Introduction. Modern fruit processing faces the problem of generating significant amounts of waste such as peels, seeds, cores, and pits, which reduces the economic efficiency and environmental sustainability of production. In the conditions of the Republic of Uzbekistan, annual production reaches large volumes, and the rational use of all parts of fruits is an urgent task.

Waste-free processing technologies ensure the comprehensive utilization of fruits and make it possible to obtain food products with enhanced functional value. Persimmon peel contains dietary fiber, pectins, phenolic compounds, trace elements, and vitamins, which makes it a valuable raw material for food enrichment.

A review of the literature shows that the addition of fruit and vegetable powders to bread increases its nutritional value and functional properties, improves organoleptic characteristics, and contributes to reducing production waste (1). However, the use of persimmon peel specifically in bread-making has been scarcely studied.

The objectives of the study were to determine the effect of persimmon powder addition on the physicochemical properties of dough and bread; to evaluate the organoleptic characteristics of the bread; to determine the content of dietary fiber and phenolic compounds, as well as the functional value of the product; and to compare the results with control bread without additives and with literature data.

Materials and Methods: The peel powder was obtained by drying at 55–60°C to a residual moisture content of 8–10% and then grinding to a powdery state. Wheat flour – 930 g.

Additives: dry yeast – 15 g, sugar – 15 g, salt – 20 g, vegetable oil – 15 g. Peel powder – 70 g.

Bread-Making Technology: Mix the flour and peel powder. Dissolve the yeast in water with the addition of sugar, salt, and oil. Knead the dough until a homogeneous consistency is achieved, and ferment for 1.5–2 hours at 28–30 °C. Shape the dough and allow secondary fermentation for 20–30 minutes. Bake at 200–220 °C for 25–30 minutes.

Parameters Studied: Physicochemical, organoleptic, and technological characteristics.

Methods of Analysis: Moisture content was determined according to GOST 9404-88 “Flour and Bran. Method for Determining Moisture.”

Bread porosity and volume were assessed visually.

Phenolic compounds were determined using a spectrophotometric method. Organoleptic evaluation was carried out using a 5-point scale.

Research Results:

Physicochemical Parameters



Table 1

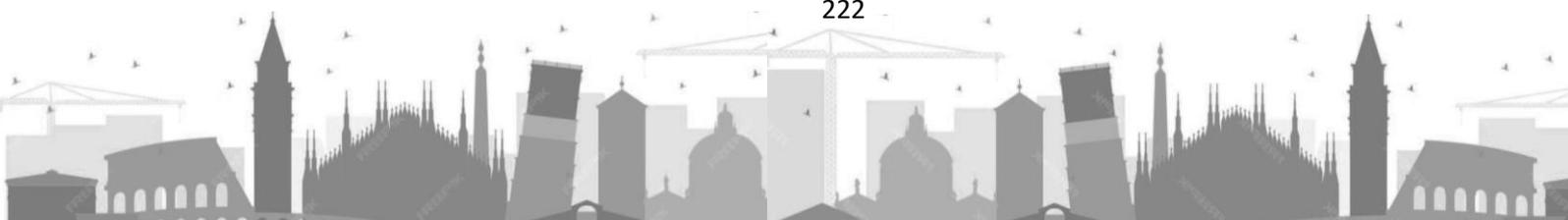
Parameter	Control	With Persimmon Powder Addition
Moisture , %	39,5	38,8
Acidity, °T	0,18	0,22
pH	5,6	5,4
Dietary Fiber.%	2,1	4,8
Phenols, mg /100г	12,5	28,7

The addition of peel powder increased the content of dietary fiber and phenolic compounds more than twofold, without adversely affecting moisture or acidity.

Organoleptic Evaluation of Bread

Table 2

Parameter	Control	Score	With Persimmon Powder Addition	Score
Внешний вид	Правильная форма, равномерная поверхность	5	Форма правильная , корка более темная	4
Цвет мякиша	Светло кремовая	5	Оранжево коричневый, равномерно окрашенный	5
Аромат	Характерный для хлеба	5	С легким ароматом хурмы	5
Вкус	Нейтральный	4	Легкая сладость	5
Консистенция мякиша	эластичная	5	Упругая структура	4
Пористость	72-75 %	5	65-68%	3
Структура корки	тонкая	4	Более плотная	5
Влажность мякиша	41-42%	5	38-39%	4
Общее	Стандартный	5	Хлеб с	5



впечатление	хлеб		повышенной пищевой ценностью	
		4,78		4,56

Despite a slight decrease in porosity and a denser structure, bread with peel powder showed a high overall score of 4.56, confirming its potential for industrial implementation.

Thus, a product with the addition of persimmon peel powder can be recommended as a promising functional bakery product. Technological Indicators: Bread volume decreased slightly by 3–5%, which is acceptable. The dough consistency became denser, but kneading and fermentation were not adversely affected.

Discussion of Results: The addition of persimmon powder not only allows for the rational use of fruit processing waste but also enriches bread with dietary fiber and antioxidants, enhancing its functional properties.

Comparison with the control bread showed that the crumb structure and porosity remained practically unchanged, while the organoleptic characteristics remained at a high level. Thus, the proposed method introduces waste-free persimmon processing technologies into traditional bread-making.

Conclusions: Dried persimmon peel powder is well incorporated into bread production, maintaining crumb porosity and elasticity while enriching the nutritional value of the bread. Bread volume and structure remain unchanged. This method implements waste-free fruit processing, reducing production losses. The results can be applied in bread-making, confectionery production, and other sectors of the food industry to create functional products.

REFERENCES

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