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IMPROVING THE CONSUMER PROPERTIES OF FOOD PRODUCTS: MODERN STRATEGIES, TECHNOLOGIES, AND EVALUATION METHODS

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Abstract

This article presents a comprehensive analysis of modern approaches to improving the consumer properties of food products. Three key areas are considered: the use of edible coatings to preserve the quality of fruit and vegetable products, the use of secondary food industry resources to enrich traditional products, and the implementation of innovative quality management methods (QFD, qualimetric forecasting). Particular attention is paid to methods for assessing sensory characteristics and studying consumer preferences. This work is based on an analysis of relevant scientific publications (2019–2026) and contains practical recommendations for food manufacturers.

Keywords: Consumer properties; edible coatings; functional foods; sensory analysis; quality management; food additives.

Introduction

In the current context of the food industry's development, the issue of improving the consumer properties of food products is becoming particularly relevant. Consumers are increasingly demanding the quality of food products, expecting not only the satisfaction of basic taste needs but also additional health benefits, ease of use, and ethical production [4:5].

Consumer properties of food products represent a set of characteristics that determine their suitability to satisfy a variety of human needs. Traditionally, several groups of consumer properties are distinguished: organoleptic

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(appearance, taste, aroma, texture), functional (nutritional and biological value), ergonomic (ease of preparation and consumption), and properties related to safety and shelf life [7].

Current trends in improving the consumer properties of food products include:

1. Development of "clean label" products, which involves minimizing the use of synthetic additives [9];
2. Creation of functional products enriched with biologically active components [8;10];
3. Using innovative processing and storage technologies to maximize the preservation of the native properties of raw materials [1; 5];
4. Using a systems approach to quality management based on a study of consumer expectations [2; 6].

The purpose of this work is to systematize modern scientific approaches to improving the consumer properties of food products and analyze their practical implementation using various product categories as examples.

Theoretical Foundations for the Formation of Consumer Properties

1. Classification of Quality Attributes

According to modern concepts, food quality is a multidimensional category formed by various groups of attributes. A review published in European Food Research and Technology (2023) identifies three main categories of attributes influencing consumer choice [3]:

Intrinsic attributes are properties inextricably linked to the physical essence of the product: taste/aroma, texture, appearance, color, smell. According to numerous studies, these characteristics are the most significant in influencing repeat purchases [3]. Taste and aroma are key drivers of consumer acceptance, while texture (tenderness, juiciness, firmness) determines the tactile sensations during consumption.

Extrinsic attributes include price, origin of raw materials, production methodology, and certification. This group also includes information about production methods that ensure safety and quality [3].

Credential attributes are characteristics that consumers cannot independently verify even after consuming the product (nutrient content, environmentally

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friendly production, compliance with animal welfare standards). Interest in natural products with quality certification is steadily growing [3; 4].

2. Factors Determining Consumer Preferences

Consumer perception of quality is mediated by a number of individual factors. Women and individuals with higher levels of education have been found to be more aware of the relationship between nutrition and health. Older consumers also show greater concern about product quality [3].

Importantly, the process of forming consumer satisfaction begins long before the purchase and does not necessarily end after consumption [3]. Expectations formed based on previous experience, information from the manufacturer, and social environment significantly influence the final quality assessment.

Modern Technologies for Preservation and Quality Improvement

1. Edible Coatings for Fruit and Vegetable Produce. One of the most promising areas for improving the consumer properties of perishable products is the use of edible coatings. As noted in a review published in the journal Food Systems (2025), edible coatings are becoming an increasingly popular alternative to traditional plastic packaging [1]. Edible coatings are a thin protective layer applied to the surface of a product that helps extend its shelf life after harvesting, processing, transportation, and storage. Due to their barrier properties, these coatings prevent spoilage and dehydration of products, preserving their quality and organoleptic characteristics [1].

A significant advantage of edible coatings is the ability to modify their composition by introducing various active substances that are subsequently consumed with the product. Current research in this area is aimed at developing coatings with antimicrobial and antioxidant properties.

Table 1 presents the main types of materials used to create edible coatings and their functional characteristics.

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Table 1. Materials for the production of edible coatings and their properties

Material type	Examples	Main functions	Additional features
Polysaccharides	Starch, cellulose, chitosan, pectin, gums	Barrier to gases (O_2, CO_2), slowing down breathing	Antimicrobial properties (chitosan)
Proteins	Gelatin, whey proteins, zein	Formation of strong films, high mechanical strength	Improving nutritional value
Lipids	Waxes, stearic acid, oils	Moisture barrier (hydrophobic properties)	Adding shine to the surface
Composites	Combination of polysaccharides + lipids	Combined barrier (gases + moisture)	Optimization of properties for product type

Source: Posokina N.E., Zakharova A.I., 2025

Research shows that edible coatings can be effectively applied to a wide range of fruit and vegetable products, including apples, persimmons, tomatoes, cucumbers, and leafy greens. Of particular interest is the use of nanotechnology to improve the functional properties of coatings [1].

2. Using secondary resources to create functional products. The modern paradigm of sustainable development in the food industry assumes the fullest possible utilization of raw materials, including secondary processed products. A significant amount of research is devoted to the possibility of using by-products from the oil and fat, flour, and fruit and vegetable industries to enrich traditional foods.

A study by Wirkijowska et al. (2020), published in the journal LWT - Food Science and Technology, demonstrated the possibility of using flaxseed flour and cake (by-products of the oil extraction industry) to produce functional bread [8]. Flaxseed is an important source of dietary fiber (approximately 30 g/100 g), protein (22 g/100 g), and lignans—compounds with proven antioxidant activity. It has been established that the addition of 10% flaxseed meal produces bread with high nutritional properties and acceptable sensory characteristics [8].

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The study results showed that the addition of flaxseed components:
• increases bread yield (by 146-148% compared to the control);
• increases dietary fiber content (both soluble and insoluble fractions);
• reduces the caloric content of the finished product;
• modifies textural characteristics (hardness, elasticity, chewiness) [8].
However, the negative impact of flaxseed components on the specific volume and porosity of bread was not statistically significant at an addition level of up to 10%.
A similar approach was implemented in the development of meat products. A study on the creation of functional mortadella (2025) examined the effect of partially replacing cassava starch with Peruvian maca flour (Lepidium meyenii) [9].
Peruvian maca is characterized by high carbohydrate (54-60 g/100 g), protein (23-38 g/100 g), and dietary fiber (8-9 g/100 g) content. It also contains unique bioactive compounds—macamides and glucosinolates—which have antioxidant activity [9].
The optimal formulation involved replacing 75% of the cassava starch with maca flour. The resulting product was characterized by:
• stable pH (6.43) and water-holding capacity (90.7%) over 90 days of storage;
• low lipid peroxidation (1.38 mg malondialdehyde/kg);
• high sensory acceptability (scores above 7.0 on a 9-point scale) [9].

3. Enrichment of products with biologically active components. The trend toward creating products with improved functional properties is reflected in the development of fortified dairy and confectionery products.
Dunchenko and Yankovskaya (2022) presented a new approach to creating functional yogurts using sea buckthorn and cryopreserved rye powder. The developed product was characterized by high levels of vitamin C, potassium, and β-carotene, and also received high scores in sensory evaluation.
The authors proposed a systems approach to quality engineering, including:
1. Identification of product quality requirements and production processes;
2. Analysis of nonconformities at various stages of production;
3. Prediction of the impact of quality-determining factors;
4. Development of universal solutions to ensure the required properties.

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Methods for Assessing and Managing Consumer Properties

1. Sensory analysis as a quality control tool. Sensory analysis remains one of the most informative methods for assessing the consumer properties of food products. As noted in the review by Guerrero et al. (2023), the arsenal of sensory analysis methods is constantly expanding, including both classical descriptor methods and modern quantitative and qualitative techniques [3].

Among the most popular methods are:

Flash Profile – a rapid profiling method that allows for comparable results with significant time savings compared to traditional methods. In a study of functional mortadella, this method showed no significant differences in sensory characteristics between samples with and without synthetic antioxidants [9].

Hedonic scaling – a classic method for assessing consumer acceptability, using 9-point scales to evaluate appearance, taste, texture, and overall acceptability. Values above 7.0 are interpreted as high product acceptance [9].

The "ideal profile" method – involves comparing the evaluated sample with the consumer's perception of the ideal product, which helps identify areas for improvement.

2. Qualimetric Methods of Quality Management. Modern food quality management is impossible without the use of qualimetric methods, which allow for the formalization and quantification of consumer satisfaction.

Reznichenko et al. (2019), published in the IOP Conference Series: Earth and Environmental Science, demonstrated the effectiveness of the QFD (Quality Function Deployment) methodology in the development of a fortified flour confectionery product [2].

The QFD methodology allows for:

• establishing relationships between consumer expectations and the technical characteristics of a product;

• identifying priority physicochemical parameters that determine the functional focus of a product;

• identifying the most important criteria for consumers.

A similar approach was used by Mardar et al. (2022) in developing bread using deferred baking technology. The study demonstrated that when developing a new product with high consumer properties, it is necessary to ensure the product's

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naturalness through the use of natural additives and high-quality raw materials [6]. The development of the Quality House allowed us to:

• transform consumer requirements into quantitative technical product characteristics;

• rank consumer requirements and determine weighting factors;

• create a tree of quality indicators characterizing the level of consumer satisfaction [6].

The Impact of Processing on Finished Product Quality

An important aspect of improving consumer properties is understanding how different processing methods affect the organoleptic, physicochemical, and functional characteristics of products.

A special issue of the journal Foods (2025), dedicated to the impact of processing on food quality, contains a number of important findings [5].

Thermal processing of fruit and vegetable raw materials can both reduce the content of heat-labile biologically active compounds and increase the bioavailability of some of them by disrupting their cell walls. Optimizing heat treatment modes (e.g., steaming broccoli at 80-100°C for 4 minutes) minimizes isothiocyanate losses while reducing goitrogenic content [5].

Non-thermal processing technologies, such as ultrasonic treatment, allow for intensified drying processes with minimal deterioration in raw material quality. Ultrasonic pretreatment combined with infrared drying significantly reduces drying time, reduces moisture content, and improves sample quality [5].

3D food printing is an innovative technology that enables the creation of products with a specified shape and structure. A study examining the feasibility of using chokeberry gels for 3D printing showed that the optimal formulation includes the following ratio: chokeberry puree: methylcellulose: pea albumin: hyaluronic acid = 100:14:1:1.

Promising Research Areas

An analysis of current scientific literature identifies several promising areas for further research in improving the consumer properties of food products:

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1. The use of nanotechnology to create active packaging materials and coatings with controlled release of antimicrobial and antioxidant components [1].

2. The development of combined edible coatings that provide comprehensive protection against gases, moisture, and microbial contamination [1].

3. The use of by-products, including fruit and vegetable pulp, brewer's grains, bran, and other secondary resources, to create functional products [5; 8].

4. Improving sensory analysis methods, including the development of rapid methods and the introduction of instrumental methods (electronic nose, electronic tongue) to objectify the assessment [5].

5. The integration of qualimetric forecasting methods into the development of new products for the targeted development of consumer properties [10; 6].

Conclusion

Improving the consumer properties of food products is a complex task requiring a systems approach combining knowledge in food chemistry, production technology, sensory analysis, and marketing.

Current trends in this area are characterized by:

• a shift in emphasis toward the use of natural ingredients and minimally processed products ("clean label");

• the active use of secondary resources to create products with improved functional properties;

• the implementation of innovative quality management methods based on an in-depth study of consumer expectations;

• the development of new quality preservation technologies, including edible coatings and non-thermal processing methods.

An interdisciplinary approach, in which new product development is carried out while simultaneously considering technological capabilities, consumer preferences, and sustainable development requirements, is becoming especially relevant.

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