

Ministry of Education and Science of Ukraine
**ODESSA NATIONAL ACADEMY OF
FOOD TECHNOLOGIES**

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**BLACK SEA
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Odessa National Academy of Food Technologies

International Competition of Student Scientific Works

BLACK SEA SCIENCE 2020

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1. FOOD SCIENCE AND TECHNOLOGIES

TECHNOLOGY OF EDIBLE BIODEGRADABLE COATING FOR CONFECTIONERY PRODUCTS

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Abstract. *The confectionery market in Ukraine has changed significantly in recent years, it was caused by negative and positive factors. Negative factors include a decrease in the purchasing power of the population, an increase in the price of goods. Positive factors include a introduction of the modern technologies and the use of new equipment have contributed to this, which contributes to the great demand of domestic products both among the population of Ukraine and beyond.*

An important aspect that characterizes the quality of confectionery products is the preservation of their freshness during storage. The use of polymer materials partially contributes to the solution of this problem, however, the current environmental situation requires reducing the use of polymer packaging.

The relevance of the work is to replace traditional types of packaging made of polymeric materials with a new one – edible biodegradable packaging from renewable raw materials, which will allow to maintain high quality products during storage.

The purpose of the work is the development of an edible biodegradable coating for confectionery products in order to prevent their staling (marshmallows and cookies) and to slow down the oxidation of fat (cookies).

The objective of the scientific work is the selection of film-forming substances for the development of an edible coating that protects confectionery products from stale and oxidation of fat.

Research methods – analytical, standard organoleptic, physico-chemical and structural-mechanical.

Key words: *biodegradable coatings, edible coating, confectionery products, marshmallows, cookies, starch, gelatin, plasticizer.*

I. INTRODUCTION

The development of edible packaging for food products is a relatively new achievement, contributing to the reliable protection of the food product from the course of oxidative and microbiological processes. Preservation of quantitative and qualitative indicators of food quality due to the absence of an air layer between the food product and the film makes the packaging technology more rational and modern.

In modern conditions relevant is the creation of a covering which is formed on the food product in the form of a sheath or film, to remove that before using is not necessary. The main advantage of such packaging is the use of eco-friendly and safe substances based on natural renewable raw materials, among which the most promising is using of starch.

Through the use of edible coatings enriched composition of a possible extension of the range of daily consumer products, in particular confectionery, because this coating is able to retain biologically active substances, and, accordingly, enrich the foods with the necessary nutrients [1].

The object of research is technology biodegradable edible coatings; properties of the developed coatings based on natural polymers; modification of the organoleptic and physico-chemical properties of marshmallows and butter biscuit coated with edible film during storage.

The subject of research – biodegradable edible coatings based on natural polymers for marshmallows and butter cookies.

The work purpose – development of manufacturing technology biodegradable edible coatings for confectionery, to prevent their hardening and slowing the oxidation of fat. The work provides for the investigation of physicochemical regularities and development of chemical and analytical support of processes of creation of new materials.

II. ANALYTICAL REVIEW OF THE LITERATURE

The confectionery industry is one of the leading branches of food industry of Ukraine is more than 16 % of the gross output accounted for its share. During storage of confectionery products there is the shrinkage and hardening, but these slow the process and increases the duration of their storage.

One of the main factors determining the competitiveness of confectionery products is the increase in shelf life of finished products. Packing is the most economical event prolongation of maintaining their freshness, reducing losses from shrinkage, improvement of sanitary conditions of storage and transportation. For confectionery packaging, use paper, cardboard boxes and various polymeric compositions. To extend the shelf life of confectionery products with a high content of fat in their composition contribute antioxidants and synergists of antioxidants [2].

Marshmallow is a sugar confectionery obtained by whipping fruit and berry puree with sugar and egg white, are added into this mixture of any of the formative (tagliatelli) fillers. As additives in the production of marshmallows used food acids, essences, dyes and ect. Due to the content of carbohydrates, marshmallows, in limited quantities, promotes mental activity and dietary fiber help digestion, the method of preparation allows to preserve most of the nutrients intact [3].

In terms of production of cookies and wafers in second place (19,6 %) after bakery products (70,9 %) [4]. Slowing oxidation of fats to prolong shelf life and avoid reducing the quality of flour confectionery products [2].

A promising direction in the food industry is the use of edible coatings (film), with the aim of preserving the nutritional value of foods. Back in the old days, in Ancient China in the XII century used food packaging (wax) to maintain moisture and elasticity of the product. In the XV century in Europe, this technology has received a special name – lang (covering fruits and vegetables with a layer of wax or fat that operational shrinkage of food products). In Japan they used film, which was called Yuba – received by boiling soy milk to improve the appearance and preserve the quality of food. The first patent on a food packaging was published in the USA in the XIX century, when it was suggested to wrap meat products in a gelatin shell [5].

Each film biodegradable material contains the following components:

1. Primary: film-forming substance (polymer) that forms a matrix; the solvent (water, alcohols, acetone, gasoline etc.); plasticizer (glycerin, sorbitol, sucrose etc.).
2. Additional: stabilizers; fillers (mineral powders); inhibitors, retarders ect.

Edible film among the various types biodegrading packaging are subject to relatively new areas of research. This kind of biodegrading film has an alternative natural mechanism baronceanca – under the influence of intracellular, endo - and ectoenzymes contained in the stomach and human intestines, a polymeric material subjected to chemical reactions, which is oxidation and hydrolysis [6].

Nutritional value of edible coatings conventionally are divided into digestible (based on proteins, fats, carbohydrates) and not absorbed (based on waxes, paraffins, water-soluble natural and synthetic gums, water soluble cellulose derivatives, polyvinyl alcohol, polyvinylpyrrolidone, etc.) [7].

Most confectionery products, example, candy require the application of edible coatings to prevent adhesion, absorption of moisture, and for chocolate and other confectionery products lipidosteric – loss of oil. Candy is often covered with confectionery glaze, shellac or wax. Candy, covered with a coating based on corn starch and plasticizer remain dry even in conditions that cause surface stickiness [8].

To improve water resistance and mechanical properties of edible packaging are administered in various non-toxic additives, mostly plasticizers, conduct processing of film and coatings «stitching» components that increase strength for reduce water vapor permeability in the composition of the film added fatty acids. It reduce the water vapor permeability and some reduction in the solubility of film in water [9].

Known technology for the production of cake, which is covered by a thin layer of cling film (based on potato starch, sugar and apple juice), to protect from contact with the environment, the preservation of biologically valuable substances and impart gloss. The disadvantage of this design is the high sugar content in the film [10].

Developed biodegradable film containing the film-former, plasticizer, water and optionally a biologically active additive for increasing the biological value of confectionery products. The disadvantage of this coating composition is that biological additive in the composition of the film will prevent oxidation of fats, which are found in confectionery in large quantities (up to 20%) [11].

The application of edible coatings based on inulin, gelatin, whey and glycerol with addition of probiotic *Lactobacillus casei Shirota (LBC)* for the cracker significantly increased moisture content, reduced resistance to rupture. It is established that the coating consisting of: inulin 4 %, glycerol 3,5 % and 2 % *LBC* – preserve the quality of the cracker and will lead to better to improvement of the functioning of the digestive system due to the composition of the probiotic [12].

N. C. Brake and O. R. Fennema have developed an edible coating containing high-methoxyl pectin, acacia gum, corn syrup, to inhibit lipid migration for confectionery [13]. The best moisture retention effect on crumb moisture during storage was established using polymyxane and xanthan films [14].

A promising direction is the use of the film-forming solution basis of which are natural polymers – polysaccharides. Polysaccharide-based films protect the food product from weight loss and create a barrier to the penetration of oxygen and other substances from the outside. We have developed a technology of edible biodegradable coating for confectionery products, which contains vitamin E, which prevents fat oxidation in confectionery products during long-term storage.

The main advantages of edible packaging coatings include: simplicity of technological solutions of application of the product; the possibility of increasing the nutritional value of the product; environmental friendliness; the relatively low cost and availability of raw materials; reducing product losses [15].

The disadvantages include: increased humidity of the film-forming solution; high vapor permeability; lower mechanical, protective and barrier properties than traditional packaging materials.

III. OBJECT, SUBJECT AND METHODS OF RESEARCH

III.I. Object and subject of study

The subject of the study is an edible biodegradable coating based on natural polymers for marshmallows and cookies.

Raw materials used in the production of edible coating: corn and potato starch; gelatin; glycerin (E 422); sorbitol (E 420); sucrose; fruit powders; Vitamin E; water.

In the experimental studies used marshmallows «Shkolyarik» TM «Jaco» without packaging (control sample 1) and in polymeric packaging (control sample 2), marshmallows with developed edible coating without additives and with fruit powders: lemon, strawberries and blueberries. A cookies made according to DSTU 3781: 2014: without packaging – sample 1, in a plastic bag – sample 2 and with a developed edible coating with vitamin E (sample 3) were studied. The samples were stored at room temperature (18-20 °C) and relative humidity not higher than 75%.

Object of study – technology of edible coating; properties of the developed coating based on natural polymers; changes of organoleptic and physicochemical properties of marshmallows and cookies with edible film during storage.

The technology of edible film is shown on fig.3.1.

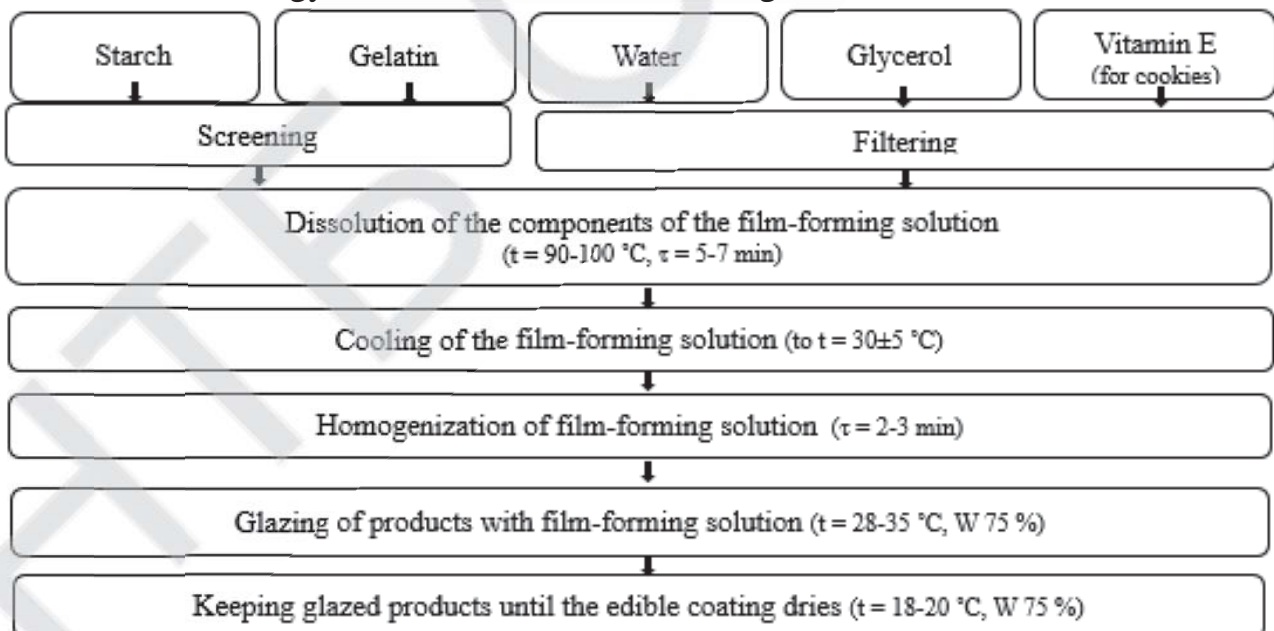


Fig. 3.1. Technology of edible coating

III. II. Research Methods

III. II. I. Methods of film study

A 5-point scale was developed to evaluate the organoleptic quality of edible film (Table 3.1) [15].

Table 3.1. – Score of the quality of edible films

Metric name	Point				
	«5»	«4»	«3»	«2»	«1»
Taste (0,5)	Neutral, sweet taste allowed	Sweet taste that does not spoil	The taste is not peculiar, bitter	Foreign taste	Not typical
Scent (0,2)	The inherent odor of raw materials used	Neutral	Abrupt	Hardly a foreign smell	Foreign smell
Surface (0,1)	Smooth, glossy or matte	Smooth	Minor roughness	Rough	Very rough
Color (0,1)	Colorless	Colorless with grayish tint	Gray, white	White	Very white
Transparency (0,1)	Transparent	Transparent	Transparent with little opacity	It's cloudy	Very cloudy

The weight coefficients adopted in the studies for the calculation of the complex film quality index are presented in the Table 3.2 [16].

The determination of the elongation and tensile strength of the tear film was performed according on the F-1000 tensile machine at a temperature (23 ± 2) °C and relative humidity (50 ± 2)%.

The viscosity characteristics of the prescription coating mixtures were determined on a Rototest-2 rotational viscometer.

III. II. II. Methods for the study of the quality of edible marshmallows

Organoleptic quality of marshmallows was investigated according to DSTU GOST 6441-2003; physicochemical parameters (mass fraction of moisture) by refractometric method according to DSTU 4910:2008; as well as the change in weight of the food during storage, by weighing the samples during the month [17, 18].

To evaluate of the organoleptic properties of edible coated marshmallows, a 5-point scale was developed and the weighting coefficients of each indicator were determined using the ranking method (Table 3.2) [19].

Table 3.2. – Score quality of marshmallows with edible coating

Indicator	Weighting factor	Point	Characteristic
Appearance: Form	0,1	5	The correct product is not minted for this product
		4	Proper with lightweight clamps
		3	Slightly primate and vague
		2	Blurry, with lateral effusions
		1	Irregularly shaped, blurry, trashy
Surface	0,1	5	Without rough curing on the side faces, smooth or slightly rough
		4	Smooth, rough
		3	Smooth with slight wrinkling
		2	Wrinkled, noticeable hardening on the edges
		1	Very firm on the side faces
Color	0,1	5	Uniform, white with a rudder
		4	Completely white
		3	Uneven color with steering tint
		2	Uneven color with steering tint
		1	Uneven color with a grayish tinge

Continuation of table 3.2.

Indicator	Weighting factor	Point	Characteristic
Structure	0,1	5	Uniform, elastic, non-sticky, fine-porous
		4	Uniform, elastic, finely porous
		3	Uniform, inelastic, finely porous
		2	Uniform, with large pores
		1	Uniform, inelastic, slightly sticky to the touch
Taste and smell	0,2	5	Characteristic marshmallows, well expressed
		4	A pronounced, characteristic marshmallow
		3	Not pronounced, characteristic marshmallows
		2	Unspoken
		1	Not peculiar, unpleasant, extraneous
Consistence	0,1	5	Soft, easy to break
		4	Slightly protracted, breakable
		3	Slightly protracted, barely susceptible to breaking
		2	Soft when breaking the middle of the product is wet
		1	Too soft, middle when wet
Chewiness	0,3	5	Well chewed
		4	Chews with little effort
		3	Tough when chewed
		2	Hard
		1	Hard to chew

III. II. III. Methods of research of quality of cookie with edible coating

Organoleptic indicators of cookie quality were investigated according to DSTU 3781:2014. To evaluate the organoleptic properties of a cookie with edible coating, we developed a 5-point scale. The ranking method determined the weight coefficients of each indicator in the overall organoleptic evaluation, which is shown in Table 3.3.

Table 3.3. – Score of quality of cookies with edible coating

Indicator	Weighting factor	Point	Characteristic
Appearance: Form	0,1	5	The product, inherent in this type of product, is correct, even edges
		4	Correct, with slight dents
		3	Uneven, edges curved
		2	Cracks and fractures
		1	Irregularly shaped, deformed
Surface	0,15	5	Not burnt, without swellings, bursting bubbles and crumbs
		4	Not burned, without tears and splashes
		3	Not burned, the presence of crumbs
		2	The presence of burns
		1	The burned surface
Color	0,15	5	Uniform, light yellow, bright
		4	Uniform, light yellow
		3	Less pronounced
		2	Slightly pronounced
		1	Uneven, dull

Continuation of table 3.3.

Indicator	Weighting factor	Point	Characteristic
Taste and smell	0,2	5	Even
		4	Yellow-brown
		3	Not typical
		2	Dark brown
		1	White
The view in the fault	0,1	5	Well-baked, with no trace of non-tampering, easily broken
		4	Roasted, without traces of non-tampering, crumble
		3	With traces of non-mining, it crumbles heavily
		2	Signs of worming, badly broken
		1	A stale product that does not break
Chewiness	0,3	5	Easy, well chewed
		4	Moderate
		3	The complexity of the bite
		2	It's cruel
		1	Does not chew

Physico-chemical indicators of quality of cookies (mass fraction of moisture) were determined by drying according to DSTU 4910: 2008, the ability to get wet according to DSTU 5023:2008. The change in mass of the test specimens during storage was determined by weighing them during the month.

IV. RESULTS OF WORK

IV. I. Investigation of new types of edible materials based on natural polymers for marshmallows

IV. I. I. Determination of the influence of different types of starch on film quality

Organoleptic quality assessment of edible films based on different types of starch (potato and corn) was determined by the complex quality index in conventional units from 0 to 1. It was found that films based on corn starch had the highest complex quality index.

The physico-mechanical properties of starch-based films depend on the ratio of its amorphous and crystalline structure. Factors such as the content of amylose in starch, the type of starch, the content of mineral additives, the pH of the solution, and the temperature of the crystallization influence the nature of the rheological curves [20]. The results of changing the viscosity of the solution depending on the type of film-forming agent are shown in Fig. 4.1.

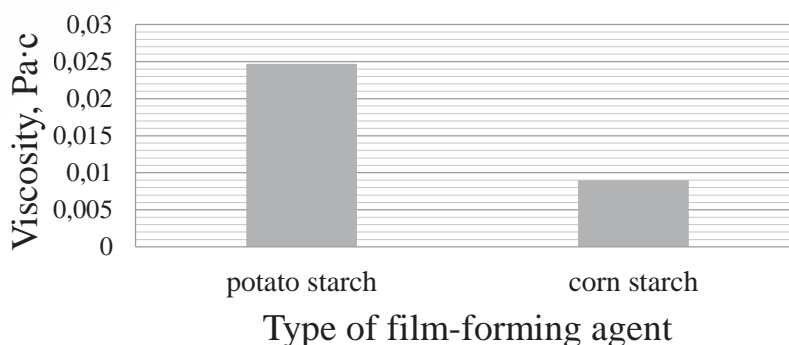


Fig. 4.1. Change in viscosity of starch-gelatin-glycerol solution

The highest viscosity has a film solution with potato starch, which is quite reasonable, since the starch contains a large amount of amylopectin 77 %, whereas in corn starch, its content is within 72 % [21].

The characteristics of the physical-mechanical properties of films with different film-forming agents are shown in Fig. 4.2.

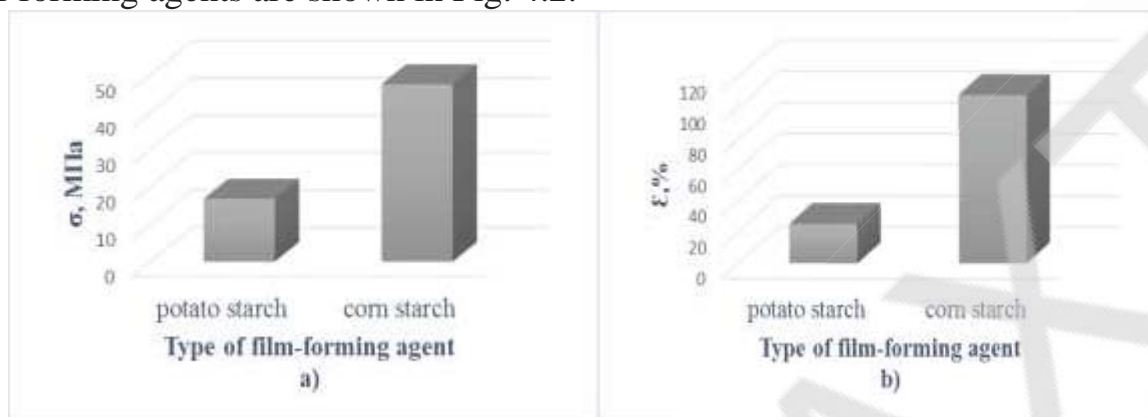


Fig. 4.2. Effect of film-forming agent on: a) film strength (σ) and b) elongation (ϵ)

Corn starch films have better strength (47,6 MPa) and elongation (108,1 %). The integrity of the coating must not be compromised during consumption, storage and transportation. According to organoleptic and structural-mechanical parameters, corn starch is selected as the optimal film-forming agent.

IV. I. II. Determination of the effect of gelatin on film quality

Gelatin is a powder that swells in water and dissolves when heated above 50°C, forming a viscous liquid. During cooling, the gelatin forms jewels and, when heated, returns to the liquid state. The determination of the effect of different concentrations of gelatin on physico-mechanical quality of film is given in Table 4.1.

Table 4.1. – Physico-mechanical properties of gelatin films

№	Ingredients, g / 100 g of solution			Physico-mechanical indicators		
	Corn starch	Gelatin	Glycerol	Thickness μm	Strength MPa	Lengthening %
1	1	1,0	0,5	0,03	2,5	34
2	3	3,0	1,5	0,13	10,7	44
3	3	6,0	3,0	0,11	17,6	80
4	5	3,5	2,5	0,23	13,2	60
5	3	-	2	0,17	9,4	64
6	5	-	2	0,12	10,4	24

Increasing the content of the ingredients (sample № 4) leads to a thickness of the film by 0,23 μm , whereas with their smaller content (sample № 1). The thinnest film is formed with a thickness of 0,03 μm . The elongation rate of the films varies depending on the concentration of the glycerol plasticizer in it: min concentration – 34 % (sample № 1), max concentration – 80 % (sample № 3). The concentration of starch and glycerol does not affect on the thickness of the films. Two samples without gelatin (№ 5 and № 6) were investigated to confirm the effect of the gelatin fraction in the film composition. It is established that gelatin in the composition of the film increases its

strength: the sample of film without gelatin (sample № 5) has a strength 9,4 MPa, and the sample № 3 of the same composition, but with gelatin – 17,6 MPa. Sample № 6 has a strength of 10,4 MPa, while sample № 4 with gelatin is 13,2 MPa.

IV. I. III. Effect of different plasticizers on the quality of films

Starch-based films have low mechanical properties [22], so plasticizers are added to the solution for improving the flexibility, elongation, strength, and resistance of film breakage [23, 24]. The plasticizer should be compatible with the polymer, well soluble in the solvent and close to the polymer structure [25].

We have selected the most common plasticizers: glycerol (E 422) and sorbitol (E 420) for corn starch films. It is advisable to perform a comparative analysis to determine the optimum of the most common and inexpensive plasticizers. The films studied by us on organoleptic indicators are colorless, transparent and odorless. For plasticizer film The integrated quality index for plasticizer film was 1.

The results of change of strength and elongation of films depending on the type of plasticizer are shown in Fig. 4.3.

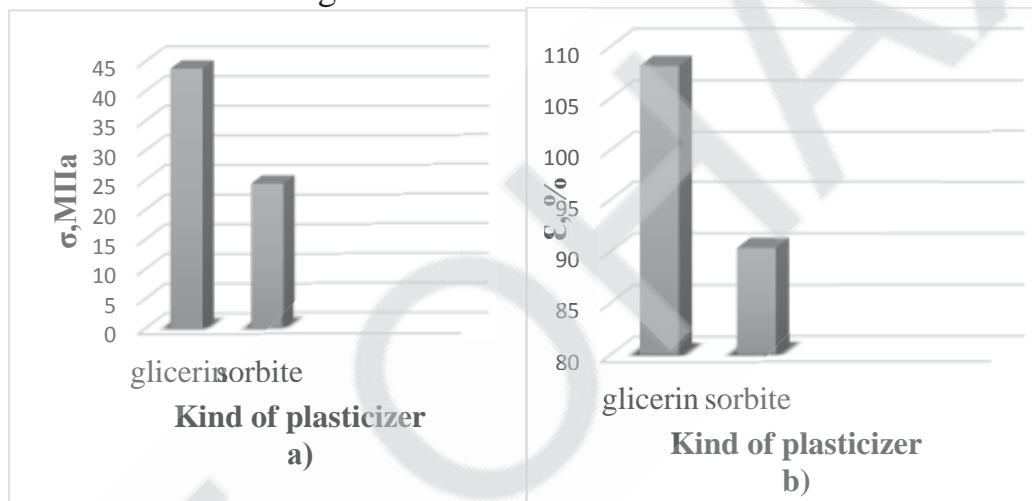


Fig. 4.3. Physico-mechanical characteristics of films with different plasticizers: a – tensile strength; b – elongation

The values for the sucrose plasticizer are not shown on the graph because the films were fragile. The films with the plasticizer glycerin (43,7 MPa) have the highest strength and the sorbitol (24,3 MPa) have the lowest strength. The highest elongation was observed for films with glycerol (108,1 %) and the lowest for sorbitol (90,3 %). Thereby, glycerol was chosen as the optimal plasticizer.

IV. II. Effect of edible biodegradable coating on marshmallow quality

An edible coating consisting of starch, gelatin and glycerol has been developed. The gelatin in the coating retains better moisture than starch, which is able to undergo retrogradation. The combination of gelatin and starch in the recipe composition of the edible coating, due to the fact that gelatin during cooling forms jelly, which makes it impossible to further apply such coating on confectionery. All selected components of the food coating are accessible and safe.

Edible coating should not alter the organoleptic characteristics of marshmallows. The results of the summary tasting assessments and the calculation of the total quality of edible coatings are given in Table 4.2.

Table 4.2. – Tasting assessments of organoleptic evaluation of marshmallows

Sample	Fomn	Surface	Color	Structure	Taste and smell	Consistence	Chewiness	Generalized Quality Score
	Weighting factor							
	0,1	0,1	0,1	0,1	0,2	0,1	0,3	
The sample in the package	4,8±0,1	4,8±0,1	4,9± 0,1	5,0±0,2	5,0±0,2	4,8±0,1	4,8±0,1	4,87
Sample without powder	4,8±0,1	4,8±0,1	4,9± 0,1	5,0±0,2	5,0±0,2	4,8±0,1	4,9±0,1	4,90
Sample 1	4,8±0,1	4,9±0,1	5,0± 0,1	5,0±0,2	5,0±0,2	4,8±0,1	4,9±0,1	4,92
Sample 2	4,8±0,1	4,9±0,1	4,9± 0,1	5,0±0,2	5,0±0,2	4,8±0,2	4,9±0,1	4,91
Sample 3	4,8±0,1	4,8±0,1	5,0± 0,1	5,0±0,2	5,0±0,2	4,8±0,2	4,9±0,1	4,91

Note: Sample 1 – marshmallow with blueberry powder, Sample 2 – marshmallow with strawberry powder, Sample 3 – marshmallows with lemon powder

The edible coating developed has a neutral taste, transparency and chewiness. An organoleptic evaluation of the quality of the marshmallow samples tested showed that the edible coating developed did not alter the organoleptic characteristics.

Changes in physico-chemical parameters have been investigated by determining the change in the mass fraction of moisture in marshmallows during storage. The results of changing the mass fraction of moisture of marshmallows during storage are shown in Fig. 4.4.

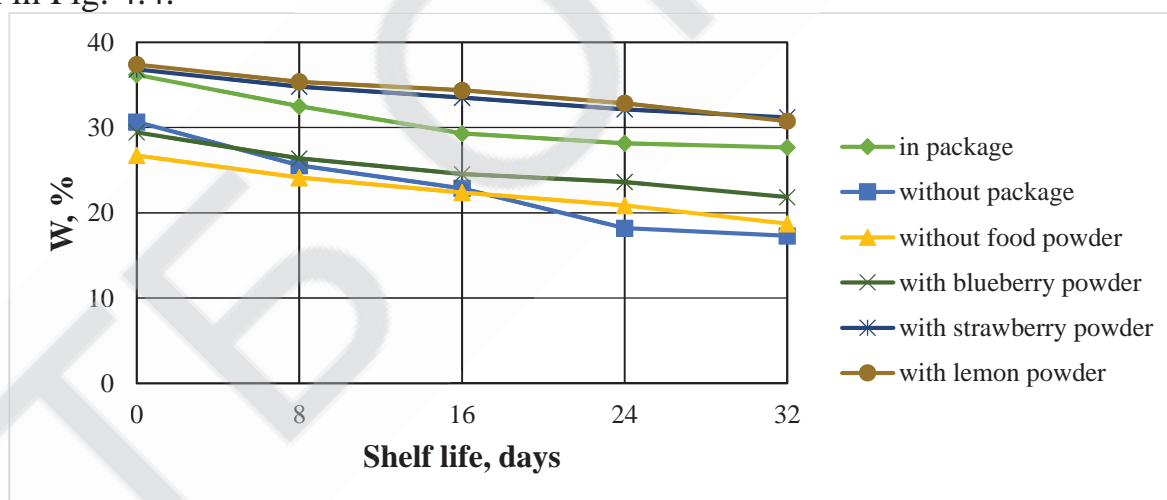


Fig. 4.4. Changing the mass fraction of moisture of marshmallows

According to Fig. 4.4 the moisture content of marshmallows in the packaging and edible coating is almost the same. After a month of sample storage, the moisture content of marshmallows without packaging decreased by 44 % and marshmallows with edible coating by 30 %. Therefore, the edible coating has barrier properties, which contributes to the longer conservation of marshmallows.

The change in mass of marshmallow samples during storage was investigated. The results are shown in Fig. 4. 5.

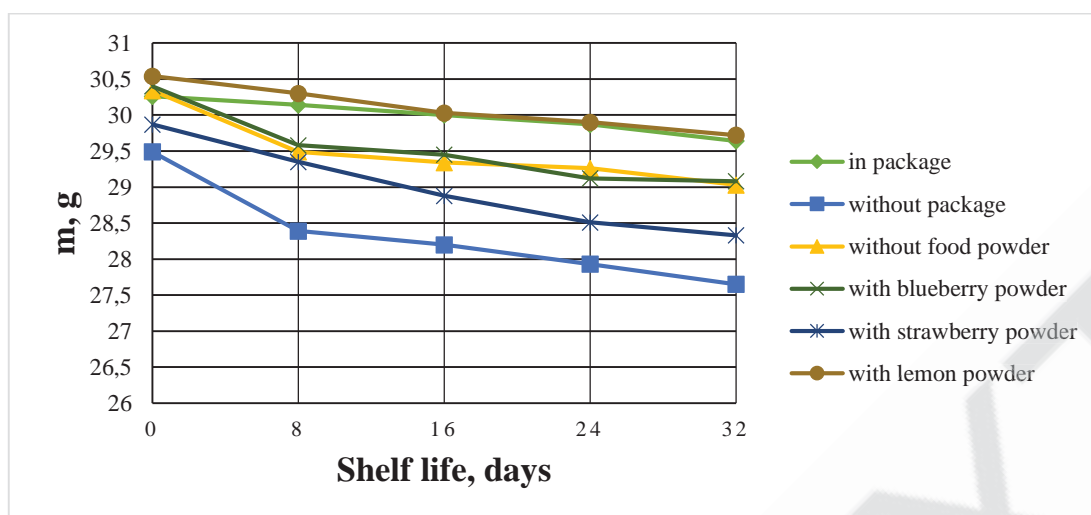


Fig. 4.5. Changing the mass of marshmallows during storage

It was found that during storage of marshmallows during the month, the weight of the product without packaging decreases by 6,3 %, the edible marshmallow reduced its weight by 4,3 %. The worst is that it retains its marshmallow properties without packaging, which is caused by the open access of the air to the foodstuff. The edible coating and storage of the product in the package are identical in value, and marshmallows with edible coating without the addition of powder and blueberry powder have similar results of mass deviations. However, marshmallows with strawberry powder did not provide conditions for long-term preservation of the food.

IV. III. The effect of edible film on the quality of the cookies

Edible coating should not alter the organoleptic characteristics of cookies. The results of the summary tasting assessments and the calculation of the total quality of edible coatings are given in Table 4.3.

Table 4.3. – Organoleptic evaluation of the quality of the cookie samples

Sample	Form	Surface	Color	Taste and smell	Fracture view	Chewiness	Generalized Quality Score
	Weighting factor						
	0,1	0,15	0,15	0,2	0,1	0,3	
The sample is uncoated	4,8±0,1	4,8±0,1	4,9± 0,1	5,0±0,2	4,8±0,1	4,8±0,1	4,87
Sample in PE package	4,8±0,1	4,8±0,1	4,9± 0,1	5,0±0,2	4,8±0,1	4,9±0,1	4,90
The sample is film-coated	4,8±0,1	4,9±0,1	5,0± 0,1	5,0±0,2	4,8±0,1	4,9±0,1	4,92

The organoleptic evaluation of the quality of the cookies showed that the developed edible coating does not affect the taste properties and improves the appearance.

Changes in physico-chemical parameters have been investigated by determining the change in the mass fraction of moisture in a cookie during storage, since desorption processes are processes that lead to the release of moisture and cause a stale of cookies. The results of changing the moisture content of the cookie samples during storage are shown in Fig. 4.6.

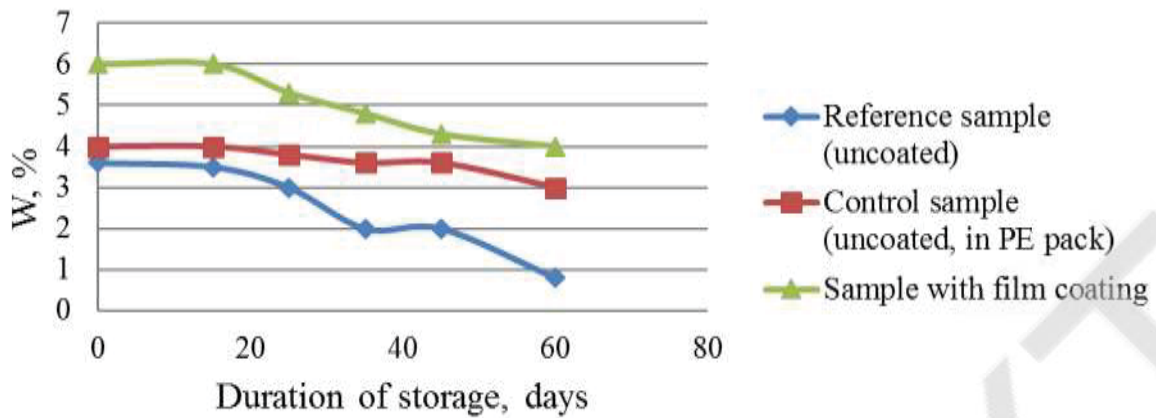


Fig. 4.6. Changing the moisture content of cookies during storage

Cookies are stored at a relative humidity of 70-75 %, under these conditions, moisture is absorbed and the cookie gradually loses its fragility. To prevent this, cookies should be packaged in a moisture-proof package [26]. According to the researches and the processed data the following results were obtained: in the cookies without packaging the mass fraction of moisture decreased by 78 %, in PE – 25 %, in the coating – 33 %. Therefore, the edible coating has barrier properties, which prevents moisture from being absorbed and the cookie fragility.

A change in the ability of cookies to get wet is shown in Fig. 4.7.

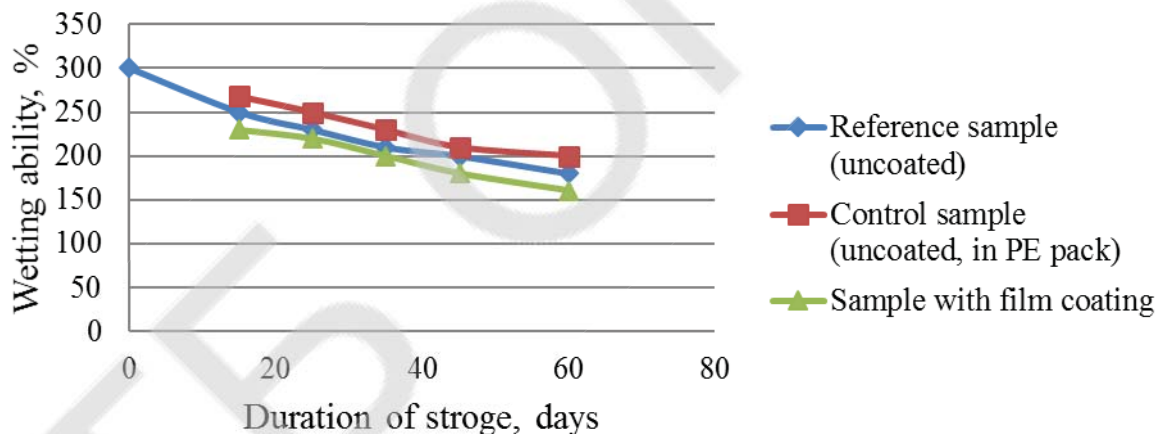


Fig. 4.7. A change in the ability of cookies to get wet

When conducting cookies on the ability to get wet, there is a dynamic decrease in performance in all three samples. The ability of cookies without packaging decreased by 40 %, in PE – 33 %, in the coating – 53 %. Therefore, the edible coating, due to the content of vitamin E, prevents the rapid oxidation of fat, strengthens the porosity of the structure and reduces the ability to get wet.

The change in the weight of the cookies during storage is shown in fig. 4.8.

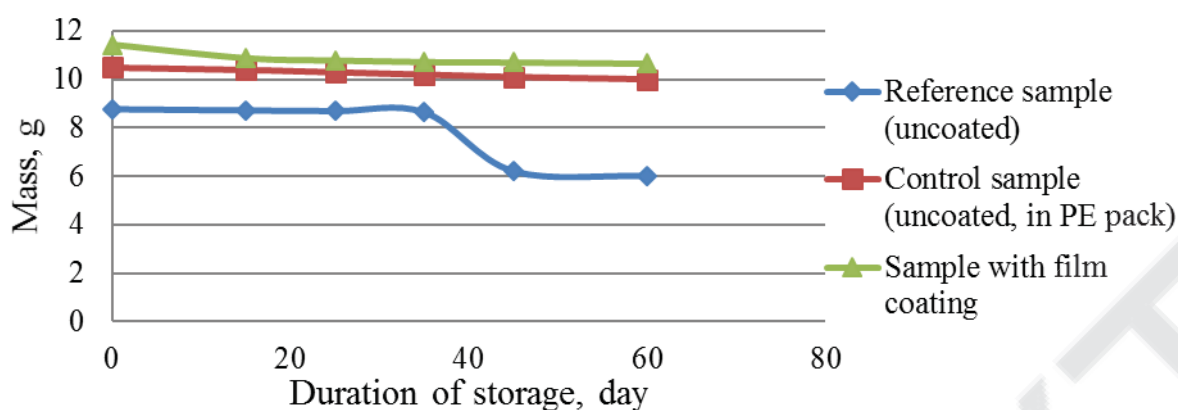


Fig. 4.8. Changing the weight of cookies during storage

It was found that during storage of cookies for 60 days, the weight of the product without packaging decreases by 31,7 %, in plastic packaging – 5 %, the cookies in the edible coating reduced its weight by 7 %. Worst of all, it retains its properties of cookies without packaging, which is caused by open air access to the food and oxidation of fat.

IV. IV. Marketing researches

As a tool for conducting marketing research, we used a developed questionnaire consisting of 9 questions. Consumers are less likely to buy pastry in paper based packaging than in PE. According to the ranking of respondents by various factors by importance, they can be divided as follows: taste preferences > appearance > packaging > brand > price. The survey showed that environmental and packaging safety were important factors for most respondents.

A large part of the population of different age categories is interested in new types of food packaging, which should meet the following requirements: not affect the taste properties of the product; not change its shape; high quality and safe; ergonomic; price. The competitiveness of cookie in edible packaging with respect to polyethylene has been proved based on the integral index [27, 28].

V. CONCLUSIONS

An analytical review of the literature shows that the use of edible films is a relatively new but promising packaging for confectionery, which not only extends shelf life, but also improves organoleptic characteristics (such as luster) and enhances their biological value through components films.

The technology of preparation of edible biodegradable coating was developed and the basic and additional raw materials for the manufacture of edible coatings, the method of determining the properties of the developed films and the change in the quality of marshmallows and cookie during storage were determined.

The organoleptic parameters of the quality of the edible film were determined according to the developed score scale, the elongation and the tensile strength of the film, the viscosity characteristics of the prescription coating mixtures.

A number of experiments were conducted, such as the study of organoleptic indicators of marshmallows and cookie using the developed score, determined changes in physicochemical parameters during the month shelf life.

The composition of the edible coating used allows the confectionery product to be stored for a certain period of storage without deterioration of organoleptic and

physico-chemical parameters.

In edible film-forming coatings, the most important properties are their microbiological stability, adhesion, cohesion, wettability, solubility, transparency, mechanical properties, permeability to water vapor and gases. It is established that the most appropriate edible coating to use for products where the determining factor for their storage are desorption processes.

Therefore, edible films and coatings used for food are effective materials for increasing the shelf life of products, while preserving their microbiological, organoleptic, physicochemical characteristics and consumption characteristics.

Thus, the developed edible coating for marshmallows and biscuits may have its segment in retail chains as an alternative to the replacement of synthetic packaging in the food industry.

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TABLE OF CONTENTS

1. FOOD SCIENCE AND TECHNOLOGIES.....	5
IMPROVEMENT OF FISH SNACKS TECHNOLOGIES WITH THE APPLICATION OF BIOTECHNOLOGICAL FAT REMOVAL Authors: German Sapozhnik, Yaroslav Kyslytsia Supervisors: Tatiana Manoli, Alina Menchynska.....	6
IMPROVEMENT OF THE TECHNOLOGY OF SUNFLOWER HALVA WITH THE USE GRAPE SEEDS POWDER Author: Viktoriia Bielikova Supervisor: Nataliia Hrevtseva.....	19
DEVELOPMENT OF COMPOSITIONS AND TECHNOLOGIES OF CULINARY CONFECTIONERY PRODUCTS WITH DETOX PROPERTIES FOR INTRODUCTION IN MODERN ESTABLISHMENTS OF THE RESTAURANT INDUSTRY Authors: Alina Dubyna, Anna Dubyna Supervisor: Nadya Dzyuba.....	33
PASTA OF NON-TRADITIONAL POLY-CEREAL RAW MATERIALS Author: Kyrmyzy Marat Supervisor: Aigul Timurbekova.....	46
TECHNOLOGY OF EDIBLE BIODEGRADABLE COATING FOR CONFECTIONERY PRODUCTS Authors: Anastasiia Robotko, Viktoriia Kalmazan Supervisor: Anastasiia Chorna.....	57
RESEARCH ON THE GOAT MILK YOGURT WITH FRUITS OBTAINING AND QUALITY INDEX CHARACTERISTICS OF IT Author: Valentina Rață Supervisor: Viorica Bulgaru.....	72
MAP OF DEFECTS AND DISEASES OF FRESH APPLES OF LATE MATURATION Author: Katsiaryna Maliauka-Kim Supervisor: Mariya Zenkova.....	87
SUBSTANTIATION OF WHOLE-GRAIN FLOUR PRODUCTION TECHNOLOGY Authors: Anhelina Batashchuk, Valeriia Pokarinina Supervisor: Olha Voloshenko.....	93