

UDC: 664

PROSPECTS OF THE USE OF NON-TRADITIONAL VEGETABLE RAW MATERIALS IN THE PRODUCTION OF CONFECTIONERY PRODUCTS

<https://doi.org/10.15673/fst.v17i2.2600>

Correspondence:
A. Bozhko

E-mail: anastasiabozhko.26@gmail.com

Cite as Vancouver style citation

Usatiuk S, Bozhko A. Prospects of the use of non-traditional vegetable raw materials in the production of confectionery products. Food science and technology. 2023;17(2):60-70. <https://doi.org/10.15673/fst.v17i2.2600>

Цитування згідно ДСТУ 8302:2015

Usatiuk S., Bozhko A. Prospects of the use of non-traditional vegetable raw materials in the production of confectionery products // Food science and technology. 2023. Vol. 17, Issue 2. P. 60-70. <https://doi.org/10.15673/fst.v17i2.2600>

Copyright © 2015 by author and the journal "Food Science and Technology".

This work is licensed under the Creative Commons Attribution International License (CC BY). <http://creativecommons.org/licenses/by/4.0>



S. Usatiuk, PhD, Associate Professor

A. Bozhko, post-graduate

Department of Food Expertise

National University of Food Technology

Volodymyrska str., 68, Kyiv, Ukraine, 01601

Abstract. The article is devoted to the study of the state of the confectionery market in Ukraine and the prospects for the use of non-traditional plant raw materials during their production. Confectionery products occupy a significant share in the total volume of the food industry and are characterized by a wide range. The production volume of flour confectionery products is 58% of the total number of confectionery products, and their daily consumption per capita is up to 500 g. The largest share is produced by three Ukrainian confectionery corporations, which entered the annual world ranking of the top 100 Candy Industry in 2022 – the corporation «Roshen», «Millennium» factory, «Konti» company. Non-traditional plant raw materials are increasingly used to enrich food products with useful properties and flavor them in the form of powders, pastes, infusions, sauces. Every year, the assortment of wild fruits, berries and plants, which were not used in Ukraine before, expands significantly. The Google Trends program was used to analyze the popularity of the keyword «sugar-free sweets», comparing the dynamics of «carob» and «cocoa powder». It was established that over the past 5 years, on average, 45–55% of consumers prefer «sweets without sugar», and over the past year three times more often they show a desire to consume products with «carob» than «cocoa powder» in such regions as Kyiv, Lviv, Vinnytsia, Poltava, Dnipropetrovsk regions. The production technology of carob powder includes the following main stages: collecting carob pods, sorting, washing, drying, crushing, dividing into core (10%) and pulp (90%), roasting the pulp at different temperatures, grinding, sieving, packaging. Depending on the temperature conditions of roasting, carob powder is divided into light, medium, and dark types. The hierarchical structure of quality and safety indicators of carob powder consists of normative (organoleptic, physicochemical, microbiological indicators, toxic elements, radionuclides, mycotoxins, pesticides) and non-normative food indicators (proteins, fats, carbohydrates, minerals, vitamins). The analysis of domestic and foreign literary sources on the use of carob powder for the enrichment of confectionery products was carried out. Carob powder is often used as a substitute for cocoa powder, but it is more versatile than cocoa powder.

Key words: confectionery, market analysis, non-traditional vegetable raw materials, carob powder.

Introduction. Formulation of the problem

The events of recent years have had a strong impact on the food industry of Ukraine, which plays an important social and strategic role in the lives of Ukrainians, meeting the needs of the population in food products. The largest share of production falls on confectionery products, which is due to their high energy value, as they contain a significant amount of sucrose. Therefore, excessive consumption of sugar and saturated fats is noted in Ukraine, and as a result, obesity and diabetes.

It is urgent to develop the latest technologies of food products for health purposes or to improve traditional ones, which involve the use of ingredients

with high functional and technological properties, which allow to reduce the energy value, the content of light carbohydrates, and improve the nutritional and biological value of confectionery products.

Currently, the nutritional value of confectionery products is regulated by enriching them with additional vitamins, dietary fibers, organic acids and minerals, using non-traditional plant raw materials in the recipe.

Non-traditional botanicals: amaranth, chickpeas, sweet potatoes, matcha, quinoa, persimmon powder, tapioca, microgreens, peppermint, lemongrass, carob powder, seaweed, edible chestnuts and flowers, purslane, black cumin, chia seeds, which appeared on the market of Ukraine during the last decade, little

researched, but there is a possibility of its use in the production of food products in Ukraine.

One of the main trends in modern world technology is the use of wild fruits, berries, mushrooms, and medicinal plants in the form of powders, pastes, decoctions, infusions, mincemeat, sauce extracts, which provide an opportunity to enrich food products [1].

Non-traditional plant raw materials are used to flavor food products and expand the range of natural flavorings, namely: walnut leaves, pumpkin flowers, elder and linden flowers, blueberry shoots, lemon balm leaves, raspberries, strawberries, currants, flowers and leaves of thyme, calendula, viburnum [2].

Thus, the enrichment of confectionery products with useful substances of non-traditional raw materials is a promising direction of research.

The purpose and tasks of the research. The purpose of the study is to analyze the confectionery market of Ukraine and the prospects of using non-traditional plant raw materials in their production.

The task of the research is:

- to establish the demand for the use of carob powder in the production of flour confectionery;
- generalization of the production technology of carob powder and the development of a hierarchical structure for the standardization of quality and safety indicators in carob powder.

Analysis of recent research and publications

Confectionery market analysis. Despite the impact of the pandemic and military operations on the territory of Ukraine, the confectionery market remains one of the most developed in the food industry. In Fig. 1. the dynamics of confectionery production for the first half of 2022 is given.

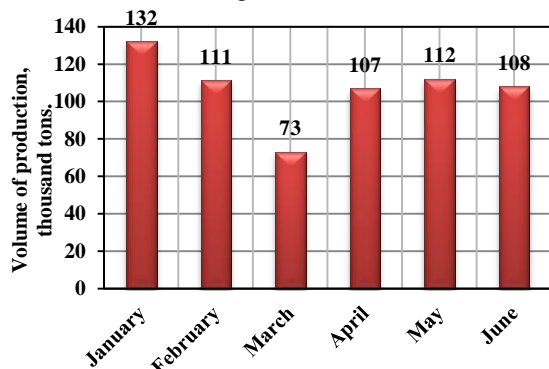


Fig. 1. Dynamics of confectionery production in the first half of 2022 [3]

According to the data, in relation to the volume of confectionery production, the following growth rate is observed: in February, the volume decreased by 16%; in March – by 34%; in April, the volume of production increased by 46%; in May – by 5%; in June, production decreased by 3%.

Export of confectionery products as of September 2022 is: flour products – \$14.3 million (+4.7%);

containing cocoa – 15.1 million dollars (+34.2%); sugar – 13.1 million dollars (+7.8%) [3].

In the highly developed countries of the world, the production of confectionery products per capita in England is 25 kg, in Germany – 19 kg, in the USA – 16 kg per year, the products are of high quality and a very wide range.

The distribution structure of the confectionery production market in Ukraine is shown in Fig. 2.

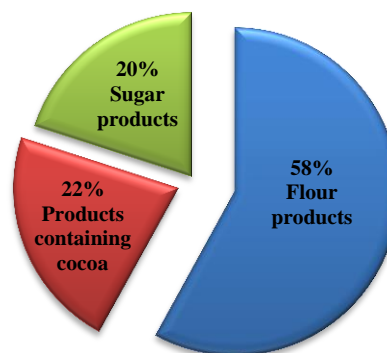


Fig. 2. The distribution structure of the confectionery market of Ukraine in 2022 [3]

Flour products account for the largest share of confectionery production due to their high nutritional value and affordability for consumers in the price segment. The consumption of flour confectionery products in Ukraine is 15 kg per capita per year, and the average daily consumption is up to 500 g per capita.

In 2022, three Ukrainian confectionery corporations were included in the annual world ranking of the top 100 Candy Industry in 2022 – «Roshen» Confectionery Corporation (28th place with a turnover of \$800 million, 10,000 employees and 8 production sites), Chocolate Factory «Millennium» (75th place with a turnover of \$225 million, 3,000 employees and 2 factories) and «Konti» JSC (93rd place with a turnover of \$160 million, 8,097 employees and 5 factories) [4].

On a global scale, Ukraine is in 4th place among the most dynamically growing markets in the category «flour confectionery» (Fig. 3) [5].

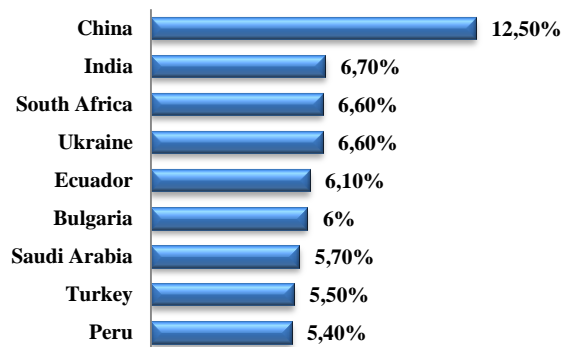


Fig. 3. Volume of flour confectionery production in the countries of the world, % [5]

Factors affecting the state of the market in 2022:

- population migration to safe areas/countries;
- «personnel hunger»;
- decrease in the purchasing power of the population;
- threat to production safety, partial or complete destruction of capacity;
- work in conditions of an energy crisis and air attacks from the aggressor country;
- disruption of logistics chains between market participants;
- increase in cost of logistics;
- rising prices for raw materials and energy resources [3].

Scientists of the Kherson National University, working on enriching the shortbread recipe, suggested replacing part of the flour with persimmon powder. Analyzing the organoleptic evaluation of quality, it was established that it is advisable to replace 10% of flour with persimmon powder. The nutritional value of the product increases due to an increase in the content of mineral substances, a decrease in the content of mono- and disaccharides (17%). Persimmon powder does not change the taste or structural parameters of cookies, but allows to increase its biological value [6].

Algae and their extracts are used in the production of flour confectionery and bakery products, as additives to enrich the formulation with organic and mineral substances. Aqueous extract of chlorella microalgae in the amount of 0.3–0.5% is first subjected to alcohol (concentration 30–50%) and then thermal (50–70°C) treatment to remove sediment and is used in the production of biscuit.

Research was conducted on the use of a sweet kelp product for caramel filling. Algae product, which was mixed with fruit puree in a ratio of 1:1, had attractive organoleptic indicators [7].

Ya. Bachynska suggests enriching the semi-finished product with pumpkin seed meal and a mixture of dietary fibers from pumpkin seeds, amaranth and wheat germ, as these vegetable additives do not disrupt the technological process of making cookies and do not affect the main consumer properties of the finished product. As a result of research into the chemical composition of the products, it was found that these additives make it possible to enrich the finished product with vitamins (A, E, PP and group B), minerals (potassium, magnesium, phosphorus) and dietary fibers, which are necessary for the human body [8].

Analysis of the demand for the use of carob powder. The majority of consumers pay attention to confectionery products with a functional purpose, about 70% of consumers prefer products with a low sugar content (or without sugar) and study information about the nutritional value of products. Consumers are

changing their diet to improve immunity and overall well-being.

According to the research organization FMCG Gurus, about 60% of global consumers consider the statements of confectionery market operators regarding the ecological trend to be important and are ready to pay more for products made from environmentally friendly ingredients [9].

Sugar production in Ukraine in 2022 is 1.8 million tons, 1.21 million tons are allocated to supply the domestic market (based on consumption of 28.9 kg/year per person). About ¾ of all sugar is used for the production of confectionery and soft drinks [10].

«Useful» sweets are confectionery products, the consumption of which not only increases the level of glucose and insulin in the body, but also contains useful fiber, vitamins, minerals, and does not contain chemical impurities or harmful preservatives. One of the types of such confectionery products is sweets without sugar.

To study consumer demand for «healthy» sweets, the Google Trends program was used, with the help of which the dynamics of the popularity of keywords can be detected.

In Fig. 4. the results of Google Trends for the search term «sweets without sugar» in the period from December 2017 to December 2022 are given.

According to the obtained analysis, it was established that the demand for sugar-free sweets has various fluctuations, but remains at a level above 40%. In most cases, an increase in search queries is observed with the beginning of the cold season and decreases with the onset of the warm season.

Carob powder is used as a substitute for cocoa powder because it has a similar taste, color and mineral composition, but does not contain fromanin, caffeine, theobromine and phenylethylamine [11]. In Fig. 5. Google Trends comparison results for the search terms: «carob» and «cocoa powder» in the period from December 2021 to December 2022 are given.

According to the results of the comparison, it can be concluded that the search term «carob» is a more popular search word than «cocoa powder». Functionality of Google Trends allows you to estimate the frequency of requests for selected search words according to the territorial location. In Fig. 6. the popularity of the search term «carob» by region of Ukraine is given.

According to the results, the most popular search word «carob» on the Internet of Ukraine is among users of the following regions: Kyiv city (100% level of interest), Kyiv region (92%), Lviv region. (92%), Vinnytsia region. (86%), Poltava region. (81%), Dnipropetrovsk region. (80%), Zaporizhzhia region. (67%), Odesa region. (62%), Kharkiv region. (45%) [12].

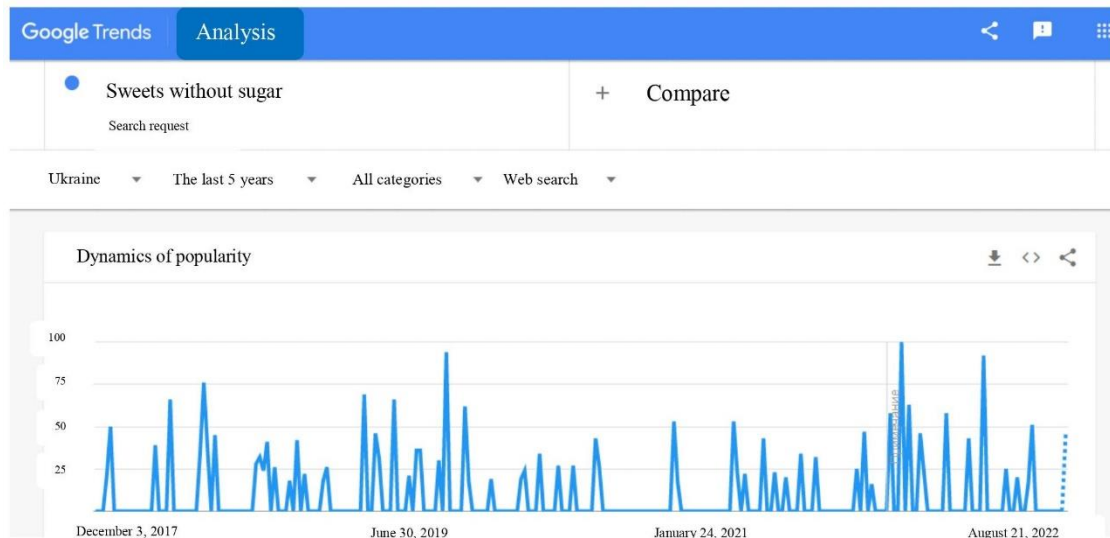


Fig. 4. Google Trends results for the search term «sweets without sugar» [12]

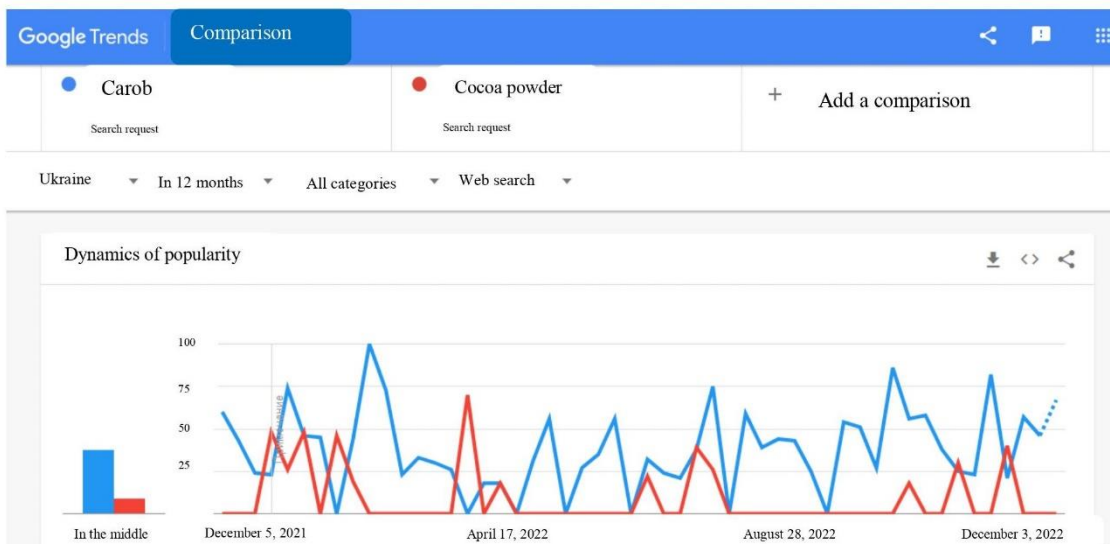


Fig. 5. Results of Google Trends comparison of search terms [12]

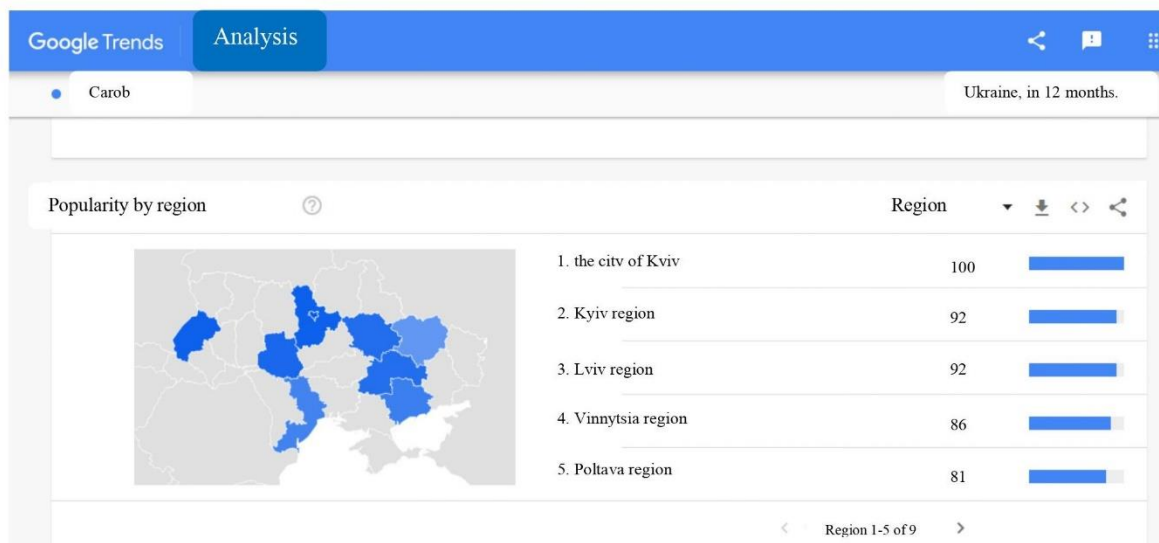


Fig. 6. Popularity of the «carob» request according to territorial units [12]

Production technology of carob powder. Carob powder is a sweet powder made from the pulp of the pods of the evergreen carob tree *Ceratonia siligua* Leguminosae, which is native to the Mediterranean countries (Cyprus, Spain, Italy and others). As a food raw material, carob pods have not been studied much, but recently they have attracted attention due to the presence of functional ingredients in its composition that show preventive properties [11].

The technological flow diagram for the production of carob powder is shown in fig. 7. Carob pods are sorted, washed with water to remove dirt and soil, dried. Crushing of the pods takes place in a mechanical crusher in order to separate them into two main components – the core (10%) and the pulp (90%). During the peeling of the endosperm, the kernels separate the embryo, which contains 50% of proteins, and carob gum is extracted – a food additive (E 410), which is used in the food industry as a thickener and stabilizer.

The pulp is roasted at three different temperatures, which makes it possible to obtain cherub powder of different colors and tastes. In order to prevent spoilage of carob powder during transportation and storage, it is packaged in containers made of moisture-proof materials [11,13].

According to different degrees of temperature treatment, carob powder is divided into types, the characteristics of which are given in the Table 1.

Table 1 – Characteristics of carob powder types

Name	Type of roasting	Humidity, %	Color	Taste
Carob dry	Dried	8–10	Light beige	Sweet, different from chocolate
Carob light	Light	6–7	Light brown	Light caramel
Carob medium	Medium	5–6	Dark brown	Caramel with acidity
Carob dark	Dark	3–4	Dark chocolate color	Chocolate with inherent bitterness

Dried carob contains a total amount of sugar of 48–56% (sucrose: 32–38%; glucose: 5–6%; fructose: 5–7%). As the temperature treatment parameters increase, the sugar content in carob powder decreases [14].

In fig. 8. shows the hierarchical structure of normative and non-normative indicators of quality and safety of carob powder. Organoleptic, physico-chemical, microbiological parameters, toxic elements, radionuclides, mycotoxins, pesticides belong to normative ones [15], and the content of proteins, fats, carbohydrates, minerals, vitamins to non-normative ones [16].

Analysis of publications. In work [17] it was established that the moisture content of carob powder decreases by 47% with an increase in the degree of roasting (the moisture content of light – 6.91%, medium – 6.04%, dark – 3.66%), which is due to a greater

allocation of physical condensed moisture during prolonged thermal exposure. As the degree of temperature treatment increases, the ability of carob powder to retain fat and moisture decreases.

Boruk S.D. conducted a study on the determination of the antioxidant capacity of carob powder (low, medium and high heat treatment) and cocoa powder, their effect on the organoleptic characteristics of shortbread cookies. The antioxidant activity of substances was determined by their ability to absorb free radicals. The antioxidant capacity of cocoa powder in an aqueous solution without centrifugation is 53.3%, and carob is 71.6–72.5%, i.e. 18.3–19.2% more, the content of polyphenols in cocoa powder is 180–170 mg/g is less than that of carob powder. Such a dependence is observed when alcohol and water with or without sediment are used as extractants. Heat treatment of carob powder leads to an increase in the proportion of polyphenols that can be extracted from the solid phase. It was established that the antioxidant capacity of the investigated additives in the composition of shortbread decreases during its baking, and in carob powder – by 10–12%, and in cocoa powder – by two times. Organoleptic indicators of shortbread cookies with the content of cocoa powder and carob powder – shape, surface, color of the crumb, taste and smell, appearance when broken, condition of the crumb, consistency meet the requirements established in DSTU 3781:2014 «Biscuits. General technical conditions», which makes it possible to recommend it for use in the production of confectionery products [18].

In order to expand the assortment of flour confectionery products with the use of raw materials of increased nutritional value – carob powder, a method of production of baked biscuit semi-finished product «Zoryany» with «Zdorovya» flour and carob powder is proposed [19]. According to the developed method, 100% replacement of cocoa powder with carob powder is provided, which is mixed with «Health» flour and added to the rest of the ingredients. The obtained biscuit semi-finished product is characterized by pleasant organoleptic properties and a sweet taste. The chemical composition of the semi-finished product is significantly enriched with mineral substances. This method of semi-finished biscuit production needs to be adjusted, as it has a large amount of sugar (30% of all raw materials), and the sweetness of carob powder makes it possible to exclude sugar from the recipe.

Scientists at the University of Valladolid in Spain conducted a study on replacing rice flour (15%) with carob powder with three different degrees of roasting (low, medium and high) during the production of gluten-free flour confectionery. Adding carob powder when making muffins increases the viscosity of the dough and adds elasticity to the cookie dough. Addition of powder with a low degree of roasting does not affect the specific volume and hardness of the dough, but reduces the staleness of cakes [20].

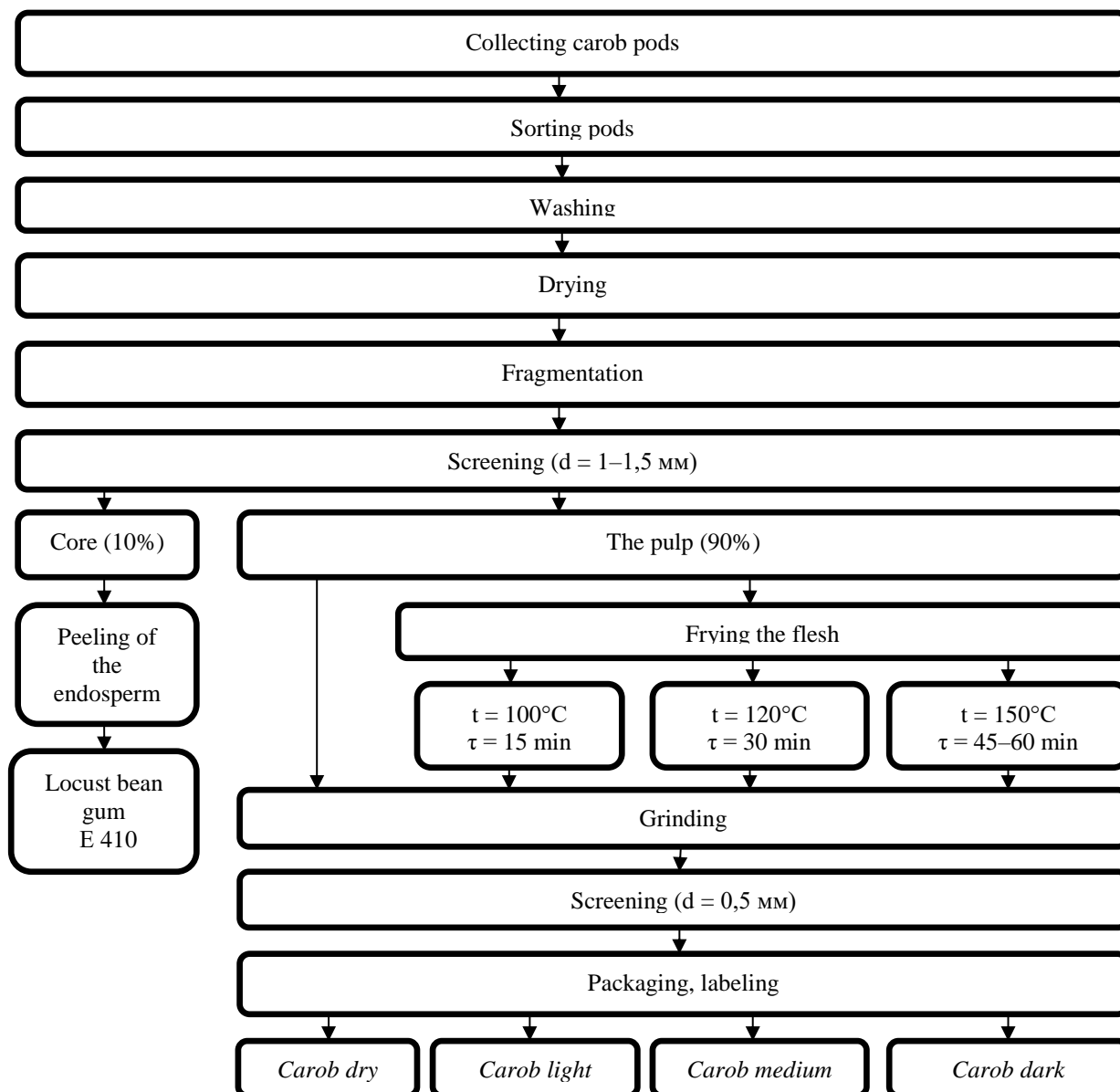


Fig. 7. Diagram of technological flows of carob powder production
 Source: formed by the authors according to [11,13,14,18]

Scientists [21] investigated the effect of carob powder on the organoleptic properties of semi-finished sand. Carob powder was introduced into the recipe of semi-finished sand in the amount of 5, 10, 15% of the mass of flour, taking into account the sugar content of carob powder. The results of studies of the organoleptic parameters of the obtained samples showed that products with the addition of carob in amounts of 5 and 10% have a fine-porous structure, a compacted consistency, which is explained by the moisture-retaining property of carob powder. Cookies acquire a chocolate color, taste and smell. Products with the addition of 15% carob have a dense consistency, become too fragile, their taste deteriorates – a noticeable bitter aftertaste, dark brown color appears. Therefore, it is recommended to use

carob powder in shortbread technology in the amount of 10% to the mass of flour with a decrease in the proportion of sugar in the recipe.

The patent [22] describes the composition of the fat filling for the Lvivyanka waffle cake, which contains confectionery fat, fructose, ascorbic acid and additional non-traditional raw materials: carob powder, rosemary and blueberry powder, red lentil flour. The peculiarity of the composition is that it is not subjected to heat treatment, that is, all biologically valuable substances of the raw material composition remain in their natural form and do not undergo destruction. The optimal dosage of ingredients allows you to get a waffle cake with increased nutritional and biological value, which has preventive properties and an extended shelf life.

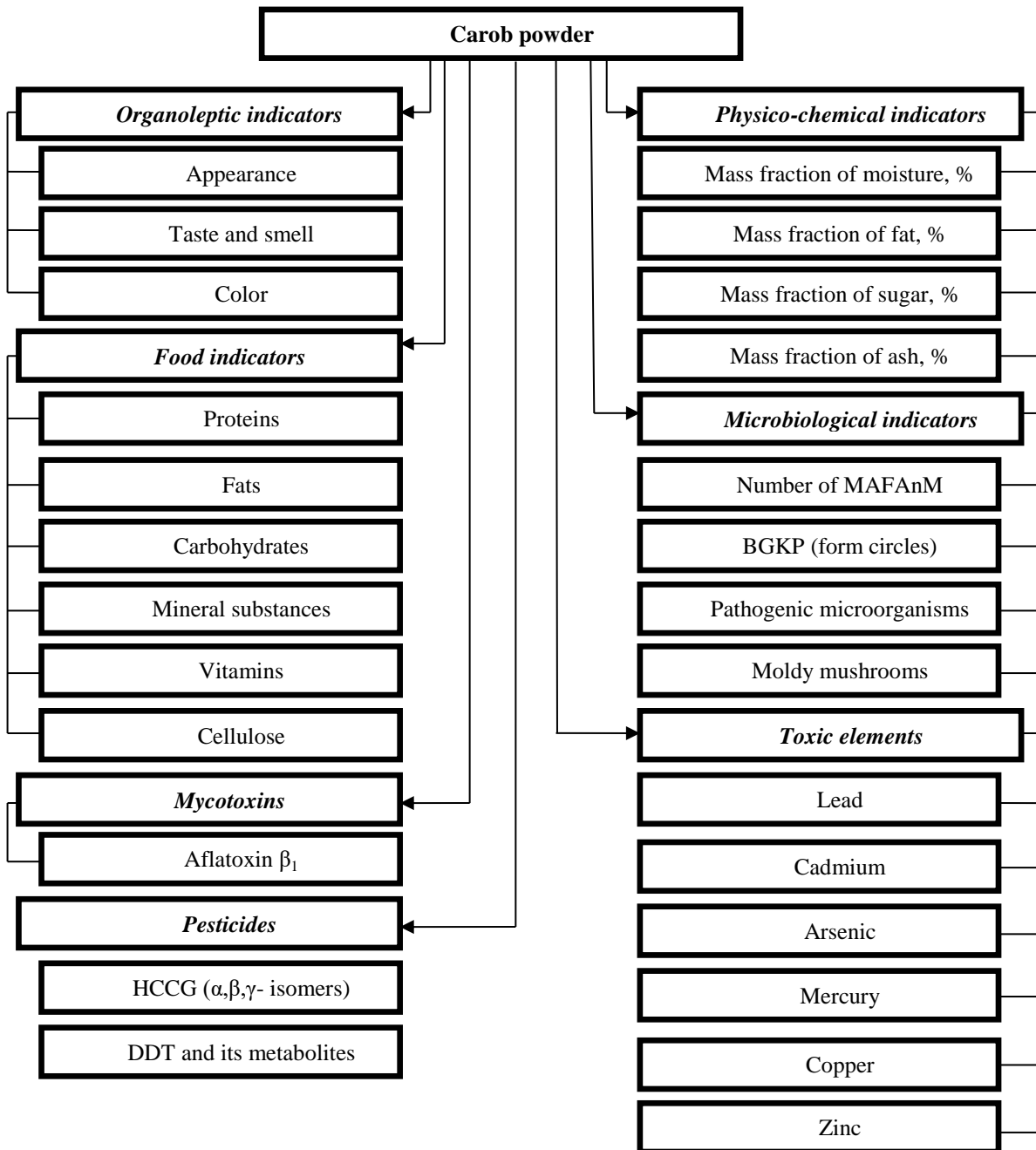


Fig. 8. Hierarchical structure of indicators of quality and safety of carob powder
 Source: created by the authors according to [11, 15, 16]

Scientists [23] developed a method for the production of gluten-free muffins based on buckwheat flour with cherub powder. Carob powder goes well with buckwheat flour in terms of color, masks the specific taste of buckwheat in muffins, gives products a chocolate taste and aroma. A comparison of the moisture-retaining capacity of potato and corn starch, buckwheat flour, carob powder was made and it was established that this indicator is 192% for potato starch, 162% for corn

starch, 312% for buckwheat flour, and 178% for carob powder. The use of carob powder to enrich buckwheat flour cakes is advisable, because the energy value of the products decreases and the cakes are enriched with dietary fibers, vitamins, essential amino acids, phosphorus, calcium, and magnesium.

The international patent [24] describes the recipe composition of functional food bars containing carob powder (6–15%), rice milk (2–30%), palm oil (15–37%), cranberries (2–20%), goji berries (2–20%),

raisins (2–20%), cashew nuts (2–20%). Light cherub powder is used, as it has a less pronounced bitterness and a more pleasant taste. The resulting product does not contain sugar, gluten, lactose and soy. A food bar with the use of carob powder is a product of high benefit for consumers, as it has functional properties for the body.

Carob powder is used for the production of confectionery products – wafers [25], which are subject to further freezing. The recipe includes flour (whole wheat, organic or sprouted), sweeteners, olive oil, carob powder, cinnamon, vanilla and water. You can use molasses, honey or date syrup as a sweetener. Waffles are baked at a temperature of 180°C for 25 minutes. This type of wafer is used with such confectionery products as ice cream sandwich, sherbet, custard, confectionery glaze, as they have a less fragile structure and absorb slowly. Waffles can be consumed by people who do not like chocolate or cannot eat cocoa products at all.

The use of dark-roasted carob powder is promising in the production of chocolate, as it has the inherent bitterness of chocolate. Yanchyk M.V., Kiyko V.V. and Mazur M.V. developed chocolate based on cherub with the addition of peanuts and sesame seeds [26]. The glycemic index of chocolate determines the degree of influence of its consumption on the level of glucose in the blood. The glycemic index of chocolate with a content of 60% cocoa products is 25.78 units, carob-based chocolate without additives is 10.08 units, with the addition of peanuts and sesame – 7.7 units. Carob-based chocolate with the addition of peanuts and sesame seeds have a glycemic index three times lower, which allows them to be consumed by people with diabetes.

Scientists [27], while studying the replacement of cocoa powder with carob powder in the production of milk and dark chocolate, developed five chocolate samples containing the following amounts of carob powder: 20, 40, 60, 80, and 100%. The developed chocolate samples were compared with the control sample. As a result of the research, it was found that chocolate formulations with a lower content of carob powder showed better quality in terms of color, average particle size and hardness (values close to the control ones). The addition of carob powder led to a decrease in the melting point of dark chocolate. The results proved the feasibility of using carob powder to replace cocoa powder in chocolate production, in order to improve the nutritional value (increase fiber and decrease calories) and pleasant sensory properties.

When comparing the rheological and sensory properties of the glaze with cocoa powder and carob powder [28], the Ostvald-de-Waele method was used to determine that the glazes have the same rheological properties. A sensory evaluation of appearance, color, aroma, taste, consistency, sweetness, aftertaste, and general perception was performed. The resulting

glaze can be used as a mass for glazing various cookies, such as muffins, cakes, pastes, croissants, etc. It can also be used as fillings and confectionery creams.

Scientists [29] developed gluten-free cookies using carob powder and dried apple pomace. The development of the recipe for these cookies was based on varying the amount of water for the mixture of rice flour and carob powder, adding apple pomace prepared with and without microwave blanching. Apple pomace combined with rice flour and carob powder improves the physicochemical, textural and sensory characteristics of the biscuits. The resulting gluten-free biscuits with carob powder have increased nutritional value and are a source of dietary fiber.

Carob powder is transported to Ukraine from the Mediterranean countries, so it is necessary to ensure its traceability. A checklist has been developed depicting the detailed movement of carob powder from carob pods to flour confectionery with the necessary documents for traceability according to the GS1 Global Traceability Standard (Fig. 9) [30]. This checklist is convenient to use for all confectionery market operators. Applying a unique bar code to the labeling of carob powder and ready-made confectionery products will ensure quick identification and obtaining information about the product.

In the production of confectionery products, there are losses at all stages of the technological process - from the supply of raw materials to the transportation of finished products, therefore it is urgent to replace cocoa powder with carob powder, which has half the cost.

So, carob powder is a promising multifunctional food product and requires further study of the features of its use in the composition of flour confectionery products.

Conclusion

The production of confectionery products in Ukraine is widely developed, especially the production of flour confectionery products by volume ranks 4th in the world. Every year, Ukrainian market operators enter the «Top 100 Candy Industry».

In 2022, many new factors have affected the state of the market, such as population migration to safe areas/countries; «personnel hunger»; threat to production safety, partial or complete destruction of capacity; work in conditions of an energy crisis and air attacks from the aggressor country; rising prices for raw materials.

Google Trends analyzed the trend for «sugar-free sweets» between December 2017 and December 2022, and compared the dynamics of demand for «carob» and «cocoa powder» over the past year. The demand for the use of carob powder is increasing along with the trend for functional food products.

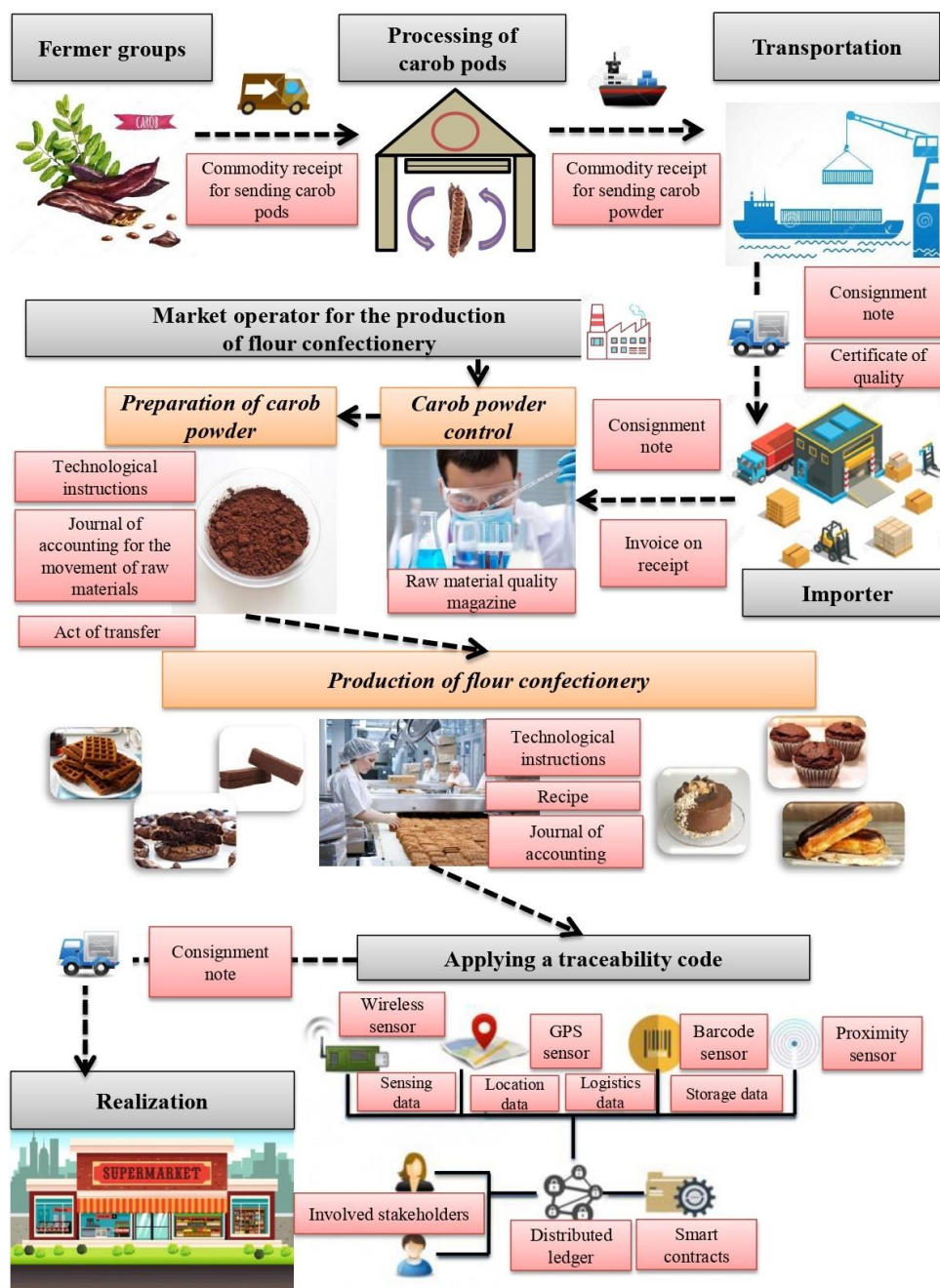


Fig. 9. Carob powder traceability checklist according to GS1 Global Traceability Standard [30]

The production technology of carob powder is described, the feature is the use of different temperature regimes for frying the pulp and obtaining three types of powder (light, medium, dark).

A checklist for the traceability of carob powder in the production of flour confectionery according to the GS1 Global Traceability Standard is indicated, which will help market operators to ensure the quick identification of the received carob powder and finished confectionery products.

Domestic and foreign literary sources on the use of carob powder in the production of confectionery were analyzed. It is promising to use carob powder for the production of sugar-free confectionery, such as biscuits, chocolate, cookies, waffles, snacks, muffins, nougat, pralines, bars.

Carob powder is a multifunctional raw material that improves the organoleptic and physico-chemical indicators of confectionery products and has a positive effect on the body of consumers.

References

1. Byshovets LH, Oliferchuk OH Netradytsiina syrovyna dlia innovatsiinykh tekhnologii produktiv kharchuvannia z ozdorovchymy vlastyvoistiamy. SH NTM «Novyi kurs». 2021;145-150.
2. Prybylskyi VL, Melnyk IV, Omelchuk SV Vykorystannia netradytsiinoi roslynnoi syrovyny v tekhnologiiakh fermentovanykh napoiv. Kharchova nauka i tekhnologia. 2014;3(28):47-51. <https://doi.org/10.1007/s40290-014-0045-7>
3. Analiz rynku. Pro-Consulting. URL: <https://pro-consulting.ua/ua> (Last accessed by December 01, 2022).
4. 2022 Global Top 100 candy companies. URL: <https://www.candyindustry.com/2022-Global-Top-100-candy-companies> (Last accessed by December 01, 2022).
5. Innova Market Sizing. URL: <https://www.innovamarketinsights.com/insight-solutions/market-sizing/> (Last accessed by December 01, 2022).
6. Dziundzia OV PISOCHNE PECHYVO Z VYKORYSTANNIAM POROSHKIV KHURMY. Modern Directions of Theoretical and Applied Researches. 2013 March: 15-23.
7. Hrebenuk SO, Kramarenko DP Analiz tekhnologii boroshnianykh kondyterskykh vyrobiv ta ozdoblivalnykh napivfabrykativ z vykorystanniam pidsolodzhuvachiv i produktiv pererobky morskykh vodorostei. Suchasni tekhnologii vyrobnytstva i profesiina osvita: tendentsii ta innovatsii. 2020, 16 Apr: 132-135.
8. Bachynska Ya Vykorystannia netradytsiinoi syrovyny pry vyrobnytstvi boroshnianykh kondyterskykh vyrobiv yak prohresyvnii napriamok stvorennia produktiv pidvyshchenoi biolohichnoi tsinnosti. International Electronic Scientific Journal. 2017;3(2):7.1-7.10.
9. The Sweets And Confectionery Sector In 2022. URL: <https://www.esmmagazine.com/features/the-sweets-and-confectionery-sector-in-2022-market-report-226894> (Last accessed by December 01, 2022).
10. Pyshna DS, Ostapenko RM Analiz rynku vyrobnytstva tsukru v Ukraini ta YeS. Stratehichni rozvytok Ukrainy: heneruvannia, implementatsiia, realizatsiia: tezy dopovidei Vseukr. nauk.-prakt. internet-konf. zdob. vyshch. osvity i molodykh vchenykh. April 2023: 210-213.
11. Bozhko AYU, Usatiuk SI Vykorystannia poroshku kerobu u vyrobnytstvi boroshnianykh kondyterskykh vyrobiv. Aktualni pytannia kharchovoi promyslovosti ta perspektyvy rozvytku haluzi. 2021: 22-26.
12. Google Trends. URL: <https://trends.google.com.ua/trends/explore?q=%D0%BA%D0%B5%D1%80%D0%BE%D0%B1&geo=UA> (Last accessed by December 01, 2022).
13. Eldeeb GS, Mosilhey SH Roasting temperature impact on bioactive compounds and PAHs in Carob powder (*Ceratonia siliqua* L.). Food Science and Technology. 2022;59:105-113. <https://doi.org/10.1007/s13197-021-04989-7>
14. Bozhko AYU, Usatiuk SI Vplyv temperaturnoi obrobky na tekhnolohichni vlastyvoisti poroshku kerobu pry vyrobnytstvi kondyterskykh vyrobiv. Zdobutky ta perspektyvy rozvytku kondyterskoi haluzi. 2022: 38-39.
15. Syed M, Nasar-Abbas et al. Carob Kibble: A Bioactive-Rich Food Ingredient, Comprehensive Reviews in Food Science and Food Safety. 2015;15(1):63-57. <https://doi.org/10.1111/1541-4337.12177>
16. Brassesco M, Brandão T, Silva C, Pintado M Carob bean (*Ceratonia siliqua* L.): A new perspective for functional food. Trends in Food Science & Technology. Aug 2021;114:310-322. <https://doi.org/10.1016/j.tifs.2021.05.037>
17. Samokhvalova O, Shydakova-Kamieniuka O, Labazov M Technological features of carob powder of different degrees of roasting. Prohresyvni tekhnika ta tekhnologii kharchovykh vyrobnytstv restorannoho hospodarstva i torhivli. 2021;1(33):167-176.
18. Boruk SD Antyoksydantna zdatsnist ta orhanoleptychni kharakterystyky kondyterskykh vyrobiv z dodavanniam kakao i kerobiv. Naukovi pratsi NUKhT. 2020;26(5):190-197. <https://doi.org/10.24263/2225-2924-2020-26-5-23>
19. Sposib vyrobnytstva vypechenoho biskvitnoho napivfabrykatu «Zorianyi» iz boroshnom «Zdorovia» i kerobom: pat. na korysnu model 92655 Ukraina, vlasnyky: Kravchenko MF, Romanovska OL, 2014.
20. Román L, González A, Espina T, Gómez M Degree of roasting of carob flour affecting the properties of gluten-free cakes and cookies. Journal of Food Science and Technology. 2017;54:2094-2103. <https://doi.org/10.1007/s13197-017-2649-x>
21. Rohova AL, Choni IV Vplyv kerobu na orhanoleptychni vlastyvoisti pISOCHNYKH vyrobiv. Resurso- ta enerhooshchadni tekhnologii vyrobnytstva i pakuvannia kharchovoi produktsii – osnovni zasady yii konkurentozdatnosti. 2020: 42-43.
22. Kompozytsiia zhyrovoi nachynky dlia vafelnogo torta «Lvivianka»: pat. na korysnu model 122574 Ukraina, vlasnyky Boidunyk RM, Syrokhan IV, 2018.
23. Stetsenko NO, Inozemtseva KV Rozroblennia sposobu vyrobnytstva bezghliutenovykh keksiv z kerobom. Experience of the past, practice of the future : proceedings of XXXXVIII International scientific conference. 2019:14-20.
24. Rotulo Montiani Emilia Rosario Food bar comprising carob powder. Patent EP3175716A1. URL: <https://worldwide.espacenet.com/patent/search/family/057485369/publication/EP3175716A1?q=pn%3DEP3175716A1>
25. Fagan Maureen Elizabeth. Wafer For Frozen Confections. Patent US2013309383A1. URL: <https://worldwide.espacenet.com/patent/search/family/049581504/publication/US2013309383A1?q=pn%3DUS2013309383A1>
26. Yanchyk MV, Kiiiko VV, Mazur MV Rozroblennia shokoladu na osnovi kerobu z dodavanniam arakhisu ta nasinnia sezamu. Visnyk Lvivskoho torhovelno-ekonomichnogo universytetu. Tekhnichni nauky. 2021;25:136-142.
27. Akdeniz E, Yakışık E, Pirouzian HR, Akkin S, Turan B, Tipigil E, Tokar OS & Ozcan O Carob powder as cocoa substitute in milk and dark compound chocolate formulation. Journal of Food Science and Technology. 11 January 2021;58:4558-4566. <https://doi.org/10.1007/s13197-020-04943-z>
28. Stankov S, Dzhivoderova-Zarcheva M, Dimitrova E, Damyanova-Bakardzhieva M, Fidan H Rheological and sensory properties of glazes prepared with carob and cocoa powders. Food Processing and Preservation. 20 July 2020;44(8):16-25. <https://doi.org/10.1111/jfpp.14580>
29. Skaltsi A, Marinopoulou A, Poriazi A, Petridis D, Papageorgiou M Development and optimization of gluten-free biscuits with carob flour and dry apple pomace, Food Processing and Preservation. September 2021;46(5):31-42. <https://doi.org/10.1111/jfpp.15938>
30. Bozhko A, Usatyuk S Implementation of the GS1 Global transibility standard by market operators for the production of flour confectionery products used use of carob powder. Věda a perspektivy. 2022;(13):303-316. [https://doi.org/10.52058/2695-1592-2022-6\(13\)-303-316](https://doi.org/10.52058/2695-1592-2022-6(13)-303-316)

ПЕРСПЕКТИВИ ВИКОРИСТАННЯ НЕТРАДИЦІЙНОЇ РОСЛИННОЇ СИРОВИНИ У ВИРОБНИЦТВІ КОНДИТЕРСЬКИХ ВИРОБІВ

С.І. Усатюк, кандидат технічних наук, доцент, *E-mail*: esmeraldo@ukr.net

А.Ю. Божко, аспірантка, *E-mail*: anastasiabozhko.26@gmail.com

Кафедра експертизи харчових продуктів
Національний університет харчових технологій
вул. Володимирська, 68, м. Київ, Україна, 01601

Анотація. Статтю присвячено вивченню стану ринку кондитерських виробів в Україні та перспективи використання нетрадиційної рослинної сировини під час їх виробництва. Кондитерські вироби займають значну частку в загальному обсязі харчової промисловості та характеризуються широким асортиментом. Обсяг виробництва борошняних кондитерських виробів становить 58 % від загальної кількості кондитерських виробів, а їх добове споживання на душу населення складає до 500 г. Найбільшу частку виробляють три українські кондитерські корпорації, які ввійшли до щорічного світового рейтингу топ-100 Candy Industry у 2022 році – корпорація «Roshen», фабрика «Millennium», товариство «ВО «Копі». Нетрадиційну рослинну сировину все частіше використовують для збагачення харчових продуктів корисними властивостями та їх ароматизації у вигляді порошків, паст, настоїв, соусів. Щорічно асортимент дикорослих плодів, ягід та рослин, які раніше не використовувалися в Україні, значно розширюється. Використано програму Google Trends для аналізу популярності ключового слова «солодощі без цукру», порівняння динаміки «кероб» та «какао-порошок». Встановлено, що за останні 5 років в середньому 45–55% споживачів надають перевагу «солодощам без цукру», а за останній рік втричі частіше виявляють бажання споживати вироби з «керобом», ніж «какао-порошком», в таких регіонах як Київська, Львівська, Вінницька, Полтавська, Дніпропетровська області. Технологія виробництва порошку керобу включає такі основні етапи: збирання стручків ріжкового дерева, сортування, миття, сушіння, дроблення, розділення на ядро (10%) та м'якоть (90%), смаження м'якоті за різних температурних режимів, подрібнення, просіювання, пакування. Залежно від температурних режимів обсмажування порошок керобу поділяють на типи light (світлий), medium (медіум), dark (темний). Ієрархічна структура показників якості та безпечності порошку керобу складається з нормативних (органолептичні, фізико-хімічні, мікробіологічні показники, токсичні елементи, радіонукліди, мікотоксини, пестициди) та ненормативних харчових показників (білки, жири, вуглеводи, мінеральні речовини, вітаміни). Проведено аналіз вітчизняних та зарубіжних літературних джерел щодо використання порошку керобу для збагачення кондитерських виробів. Найчастіше порошок керобу використовується для заміни какао-порошку, але він є більш поліфункціональним у порівнянні з какао-порошком.

Ключові слова: кондитерські вироби, аналіз ринку, нетрадиційна рослинна сировина, порошок керобу.