UDC 641/642 DOI: http://doi.org/10.31617/k.knute.2020-06-01.65

M. M. Trusova, PhD;
ORCID: 0000-0001-8137-3869
A. V. Paulava,
PhD of Technical Sciences,
ORCID: 0000-0003-3216-9989
Scientific and practical centre for foodstuffs of the National academy of Sciences of Belarus Yanka Kupala State University of Grodno
Minsk, Belarus

APPLICATION OF CHITOSAN IN THE FOOD INDUSTRY

The article describes the main methods of using chitosan in the food industry as a thickener, sorbent, astringent, taste improver for the production of dietary products. The main focus of the review is on exploring the possibilities of using chitosan for processing beverages.

Keywords: *chitosan, sorbent, stabilizer, thickener, food industry.*

Relevance of the research topic. Chitosan is a water soluble biocompatible and biodegradable polymer. It was obtained as a derivative of chitin in 1859. Chitosan has been used purposefully in food production in recent years. Depending on the nature of the applied tasks, chitosan is introduced into the composition of products or used as an external technological factor. The use of chitosan in food technology is determined by the functional properties and its almost complete compliance with the requirements for food additives.

Formulation of the problem. The main problem is the introduction of chitosan in the food industry. The emphasis is on safety, environmental friendliness and economy of food production.

Analysis of recent research and publications. Analysis of recent research and publications. He studied and analyzed the scientific literature on modern technologies for the use of chitosan in the food industry.

Presenting main material. Chitosan is a natural polysaccharide polymer of nature, which is one of the most common organic compounds in nature. The raw material for its production is chitin - a structural polysaccharide of the crustacean epidermis, cuticle of insects and the cell wall of fungi. The most common sources of its production are mollusk shells (crabs, shrimp, etc.)

Chitosan has such properties as high sorption capacity, non-toxicity, ability to heal wounds, anticoagulant, bacteriostatic and antitumor activity. It is also a good flocculant, emulsifier, thickener. The wide possibilities of using chemical transformations of chitin and chitosan to obtain materials of various structures and properties make these polymers one of the most interesting types of raw materials. Currently, more than 100 uses of chitosan are known, the main of which are presented below.

A lot of research has been done on the use of chitosan to preserve the freshness of raw meat. To do this, a film of chitosan was applied to the product in a composition with other substances (starch or gelatin) to prevent moisture loss. The fact is that a decrease in the activity of water on the surface of the product increases its shelf life. In addition, the chitosan film reduces the spread of microbes in raw meat and inhibits the appearance of bacteria Staphylococcus aureus. A biodegradable film may cover the surface of food products such as molded minced products (meatballs, sausages) from fish, poultry and minced meat. Biodegradable film protects the surface of molded food products from harmful factors, extends its shelf life and can be used in food products together with the product, since it has the properties of biologically active additives. Food biodegradable film using chitosan is a replacement for modern hard-to-decompose packaging materials.

A food supplement for meat products has also been developed, including food blood, vegetable protein, milk protein, bone food fat, water, starch, gelatin and chitosan. The additive has high emulsifying and gel-forming abilities, which allows obtaining a meat product with high functional and technological indicators. In the technology of molded meat products, chitosan can also be used as a structure-forming agent that increases the rheological characteristics of food masses. It has the property of combining fragments of materials of different moisture content into an ordered structure.

Use chitosan to preserve the freshness of fruits and vegetables. Main post-harvest fruit is loss due to fungal infection, physiological disorders and physical injuries. One possible approach to increasing the safety of these perishable products is the use of ediblecoatings followed by cold storage. Edible coatingscan be used as a protective barrier to reduce respiratory rate and transpiration through the surface of the fetus, slowing the growth of microbes and discolorationand improved texture of fruits.

Such a property of chitosan as the ability to suppress mold, has found its application in the development of formulations of moldless shells for cheeses. Chitosan films can help maintain moisture and, conversely, protect against moisture. Edible films can be produced from chitosan for food packaging, as well as biodegradable packaging, for example, for field nutrition of soldiers.

Unlike most polysaccharides of beer, wine, and other fermentation products, such as starch, dextrins, chitosan has a powerful positive charge that allows it to bind to negatively charged surfaces, including phenolic substances, polysaccharides, fats, and microorganism cells, which is especially important for further development of fermentation technology, including brewing. The absorption capacity of chitosan is used in brewing to remove sediment. The so-called opacities in the drink are formed due to the components of the raw materials and auxiliary materials in the form of proteins, carbohydrates, living cells and oxalates. To remove living cells, chitosan is used in the clarification phase of the product.

In the process of wort fermentation, the colloidal system of future beer is enriched with biopolymers of autolizing yeast: glucan and mannoprotein of the cell walls, products of incomplete protein breakdown. These components are involved in the formation of colloidal turbidity along with biopolymers of wort and hops. Given the ability of chitosan to bind glucans and mannoproteins, it is advisable to use chitosan for the prevention of colloidal opacities of beer.

Studies by Japanese scientists have shown that the use of chitosan in the brewing industry as a food additive improves the taste and foaming ability of beer. According to the authors, this is due to the binding of proteins using chitosan and the formation of new colloidal structures that impede the destruction of the foam.

Unique results show chitosan as an enterosorbent. Chitosan absorbs fat and cholesterol in the digestive tract. A positively charged chitosan is attracted to a negatively charged fat, removing fat from the body 10-12 times its molecular weight. In addition, chitosan has a general cleansing effect on the body: it adsorbs toxic substances, products of incomplete digestion from the contents of the intestines and blood, stops the manifestation of allergic reactions, and improves the function of the intestines, liver and kidneys. Thus, food enriched in chitosan can be used in dietary nutrition.

The immobilization of enzymes on biomaterials based on chitosan is an important application of chitosan in the food sciences. When immobilized on chitosan carriers, enzymes become more stable and more resistant to environmental changes. The heterogeneity of the immobilized enzyme systems also provides easier recovery, repeated reuse, faster termination of reactions, and many other benefits. Chitosan-based bio-substitutes in various geometric configurations have been studied for enzyme immobilization applications, including powders, flakes, balls, films and membranes. Chitosan biomaterials immobilized by the enzyme have also beendeveloped in the form of various biosensors for their new applications in the food industry, for example, glucose, choline, as well as a kit for the detection of polyphenols.

Another use of chitosan is wastewater treatment in the food industry. Recently, this has attracted great scientific and industrial interest, since water pollution is one of the most serious environmental problems that adversely affect the quality of life. The cleaning process involves many stages, such as removing heavy metal ions, dyes and phenolic compounds, conditioning the precipitate, and so on. Water industry typically uses polyelectrolyte polymers for wastewater treatment and the production of drinking water. Due to the many amino groups, chitosan is a very effective adsorbent for removing water impurities and is mainly applied in the form of hydrogel beads and microspheres. It has also been extensively investigated for its role in bioconversion of phenolic compounds, removal dyes and Cu^{2+} and Zn^{2+}. To increase the effectiveness of chitosan as water purifier have been applied various modifications such as functionalized chitosan membrane with carbon nanotubes, chitosan balls impregnated with ion imprinting to remove metals, water-soluble chitosan for clay flocculation and conjugated chitosan to remove phenols. Besides the use of wastewater, chitosan is currentlytime is being examined for its ability to improve the quality of drinking water bytrace elements, defluorination and microtoxins removal.

Chitosan in the food industry is also used for coagulation of whey proteins in the dairy industry, for the production of iodized food products based on the creation of iodine-chitosan complexes, and for other purposes.

Conclusions. Based on the analyzed literature, we have studied the main areas of use of chitokhan in the food industry. Relevant is the clarification of the relationship between the chemical structure and biological activity of chitosan, the creation of new products based on it with new useful qualities.

REFERENCES

1. Evdokimov I. A., Alieva L. R., Varlamov V. P., Kharitonov V. D., T. V. Butkevich, V. P. Kurchenko*Usage of chitosan in dairy products production* // *Foods and Raw materials*. 2015. № 2.

2. Gutiérrez, T. J. (2017). Chitosan applications for the food industry. *Chitosan: derivatives, compositesandapplications. Wiley-ScrivenerPublisher*, 185–232.

3. Roghieh, T. H., Shahin, Z., Alireza, T., &Sepideh, K. J. (2019). Effects of chitosan coating enriched with thyme essential oil and packaging methods on a postharvest quality of Persian walnut under cold storage. *Foodsand Rawmaterials*, *7*(1).