SPECIFIC REQUIREMENTS FOR WATER USED IN THE FOOD INDUSTRY

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Abstract. The authors considered the contemporary state of the issue of water treatment in food and beverages production. The article presents regulated water quality parameters for drinking and bottled water, for dairy industry, beer and soft drinks production, as well as for production of vodka, vodka for export, and baby food. The article shows that water from central utility and drinking water supply needs additional treatment to produce food and beverages. It should be cleaned from hardness salts, iron, manganese, mineral salts, organic compounds and microbial contamination. Besides, many companies use groundwater sources (from wells). That makes water treatment procedure even more complicated. The authors considered such treatment methods as ion exchange, magnetic water treatment, catalyzed oxidation, deferrization using sorption-filtering materials from mineral raw materials, aeration, reverse osmosis, electrodialysis, activated carbon adsorption. The authors show the treatment mechanisms, their advantages and disadvantages. The article indicates which materials and equipment can be used to apply these methods in water treatment practice. It describes new techniques for effective water treatment such as radiolysis, cavitation and advanced oxidation treatment techniques.

Keywords: water, hardness salts, iron, manganese, mineral salts, organic compounds, specific requirements

Executive summary Water is a major input in food, from primary production through all stages in the food value chain to consumption. Water can contact food directly or indirectly and is used in maintenance of hygiene and sanitation throughout the food chain. Water is a diminishing resource globally and not all food primary producers and processors have access to safe water sources. Water needs to be used conservatively and it is possible to reuse water if it does not present a health risk for consumers [1]. At its 48th session in November 2016, the Codex Committee on Food Hygiene (CCFH) noted the importance of water quality in food production and requested the Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO) to provide guidance for those scenarios where the use of “clean water” was indicated in Codex texts – in particular, for irrigation water and clean seawater – and on the safe reuse of processing water. In addition, guidance was sought on where it is appropriate to use “clean water” [2-7]. The first meeting of Experts was held in Bilthoven, The Netherlands, in 2017, to address this request. The Experts concluded that future work should focus on the following: • development of a fit-for-purpose concept, taking into consideration the context of water uses along the food chain; • focus on the priority sectors – fresh produce, fishery products and reuse of water in food operations – chosen based on their significance in health protection and global trade; • review of existing guidance materials in food and water safety in consultation with experts with relevant expertise to exploit synergies between these areas and to ensure relevance for the food industry; • practical guidance provided through the use of decision support system (DSS) tools, such as a decision tree (DT), incorporating assessment of risks and use of monitoring to ensure safe quality of the water; • other end products, such as communication tools for end users. A second meeting of Experts was held at FAO in Rome, Italy, in 2018, to address the work recommended. Working groups were formed for the three priorities for water use and safety – i.e. fresh produce sector, fishery sector and water reuse in establishments [8-15].

Water supplied to feed the population belongs to the strategic category. It should be supplied around the clock, in sufficient quantity and quality. This food resource has an important social and sanitary-epidemiological significance. Water is one of the most important factors in protecting the health of citizens, their physical potential, working capacity and life expectancy.

The functionality of water is versatile. On the one hand, water is not actually a nutrient, does not have nutritional and energy value. However, its physiological effect on the body is very significant. Given the fact that a person consists on average of 60% of water, 34% of organic substances, 6% of inorganic (for different ages, the ratios given change), in oda takes part in almost all vital metabolic processes: promotes digestion, serves as a solvent for inorganic and organic compounds, removes harmful metabolic products from the body, regulates the salt content in tissues and fluids, participates in many other metabolic reactions [16].

The mineral composition available in the water can serve as a source of food nutrients necessary in the diet. But the excess of individual macro- and micronutrients in water, organic and mineral impurities have a toxic effect on the human body. These indicators are regulated by sanitary rules and norms SanPiN 2.1.4.1074-01. Drinking water. (WHO, EU, USEPA).

In Russia, catering and food industries in the production of food products mainly uses water from the system of domestic and drinking water supply. In the production of certain types of food products, general requirements for water are not enough. Water must be of a high degree of purification or enriched with certain minerals. Such water has additional requirements related to the characteristics of technology, quality and purpose of products, storage time, specifics of use [17].

The quality of food products depends on the components of the recipe, the technological process, the qualification of personnel, the industrialization of the technological process, compliance with the principles of HACCP. The most important and fundamental in this chain is water. It must have a qualitative and quantitative composition of chemical components determined for each type of product, which is consistent with the technology used and the ingredient composition specific to the specific technological process of the food industry. In case of imbalance, for example, the possibility of intoxication of consumers of products, if water with an increased concentration of chemical components is used. A synergistic effect is also possible with the combination of chemical interaction of substances in water and the main components of food products. There salting food product will be of reduced quality and safety and. It should be noted another important factor. Excessive mineralization of water will affect organoleptic indicators. Finished products may have unconventional taste data that differ from the requirements for quality, traditional perception and consumer preferences. Changed organoleptic indicators of manufactured products can also affect the course of technological processes, supplies of raw materials, storage.

The specifics of the food industry sectors have also affected the requirements for water. So, for water used in dairy production, the requirements are set according to SanPiN 2.1.4.1074-01 "Drinking water. Hygienic requirements for the water quality of centralized drinking water supply systems". This water is subject to control indicators with restrictions on the total mineralization, the content of iron, manganese, hardness salts, phenol, and organohalogen compounds. The issue of water hardness is particularly acute.

The concentration of salts in water affects the organoleptic parameters and solubility of dry substances, the pH value determines the rate of chemical reactions, affects the smell, taste and its appearance. An increase in water hardness helps to reduce the rate of dissolution of dry dairy products, and in the restored milk processing product - to reduce the stability of the protein phase with an increased risk of premature coagulation, as well as the heat resistance of the restored products. These processes can be prevented by softening water [18, 19]. Features are also noted in the production of sugar. Only water of a low degree of mineralization is suitable here, since the high salt content makes it difficult to cook and the subsequent process of sugar crystallization. In the production process, the presence of rotting substances is completely excluded due to the fact that the latter are the cause of fermentation of the reaction mass in the diffusers, which is absolutely unacceptable, leads to marriage [20].

In the beverage industry, special requirements are imposed on water. The usual concentration of ions in natural waters has a significant impact on the quality of drinks. The usual concentration of ions in natural waters has a significant impact on the quality of drinks. For example, bicarbonate ions bind acids that provide a regulated taste of beverages. The content of magnesium, iron, and calcium ions can lead to the formation of sediment and opalescence [21].

Certain specific requirements are noted in the distillery production. Here, the water should not contain calcium and magnesium chlorides, which affect the vital activity of yeast. In accordance with the current regulatory document, the presence of calcium sulfate in the water used for brewing is limited, which prevents the fermentation of malt [20].

For the production of alcohol-containing products, the water that is part of the drink should not contain hardness salts and be moderately mineralized [20]. It is shown in [22] that the methods of water treatment introduced at distilleries do not provide softened water with good technological qualities. An analysis of the available publications on this issue shows that in the process of water treatment using existing technologies, the total salt content does not decrease, but only their qualitative composition changes; organic substances that negatively affect the taste and smell of water, and then the vodka produced on it, are not removed. Due to the fact that the qualitative and quantitative composition of mineral impurities in natural waters varies greatly in the sources, in order to obtain good vodka indicators, it needs to be adjusted, and every time when using water from another system or artesian [22]. In the current economic conditions, it is more expedient to completely demineralize the source water, purify it from organic substances and then give it drinking qualities with salts in a certain proportion. The alcoholic beverage obtained on the water prepared in this way will meet the established quality.

Water treatment in the manufacture of meat products remains an important factor. An increase in water hardness affects the ability of muscle proteins to retain free water during processing (cooking), reduces consumer properties and product yield. Products are severely dehydrated, excessive shrinkage occurs, leading to weight loss, deformation of products and other defects. According to other indicators, the water used in the meat industry must meet the requirements of the SanPiN 2.1.4.1074-01.

The production of bakery products also imposes special requirements on the quality of water. It affects the intensity of fermentation and the organoleptic properties of the dough and finished products. In order to improve the structural and mechanical properties of semi-finished products and finished products, increase the mass of finished bread by increasing the moisture content of the dough and improving the safety of bread, the water used, which is introduced into the technological process of manufacturing products from the domestic drinking water supply system, must be additionally purified from iron, hardness salts, organochlorine compounds and other impurities present in the water, depending on the region of its content [23, 24].

In accordance with the requirements set out in this message, it is necessary to systematize specific additional values and functional features and develop modern methods of water conditioning in relation to the type of manufactured products. The aspect of using unified methods of water treatment is very important.

Currently, ion exchange methods of water purification from undesirable impurities, usually on synthetic high-polymer ionites, are widely used in the food industry due to the high efficiency and simplicity of organization. The existing variety of hardware and technological design allows you to effectively carry out the stages of water purification, both from organic and mineral impurities. There are opportunities to create low-waste technological processes. One of the directions may be ion exchange technologies for water purification, which is its ecological aspect and rational organization of technology. To ensure water quality, various methods of water treatment are used: coagulation, Na-cation, demineralization, distillation, electrodialysis, reverse osmosis, according to approved regulatory and technical documentation. Depending on the composition of the source water, its clarification, de-ironing, softening, demineralization, desilinization are carried out at distilleries. [24]. At the enterprises of the baking industry, its air conditioning is carried out.

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