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IMPORTANCE OF CONTROLLING THE HYGIENIC CORRECTNESS OF HONEY AND OTHER BEE PRODUCTS IN MONTENEGRO

SUMMARY

With global environmental pollution caused by industry, traffic, agriculture, etc. the risk of contamination of honey and other bee products also increases. Environmental pollution has also increased in Montenegro, which poses a danger to the health safety of honey. That is why is very important to control the hygienic correctness of bee products. This implies monitoring the entire process of honey production, from the apiary to the end consumer. Contaminants in honey most often occur as a result of unprofessional application of agrotechnical measures, industrial production, inadequate waste disposal, application of artificial fertilizers containing cadmium and other toxic substances, pesticides containing mercury, arsenic, improperly implemented good beekeeping practices, etc. The biggest dangers for honey contamination are pesticides and means used to protect bees from varroa. In Montenegro, legal regulations set the maximum allowed concentrations of contaminants in honey (heavy metals - lead), residues of pesticides and veterinary drugs, microbiological criteria. Honey control monitoring is carried out in Montenegro every year. The results of honey monitoring in 2019 and 2020 showed that there were no non-compliant samples in terms of honey's healthiness. However, considering the mentioned factors, one should be very careful and work on increasing the number of tested samples on an annual basis.

Keywords: honey, health, safety, contamination, monitoring, Montenegro

INTRODUCTION

Montenegro has a very long tradition of beekeeping. The warm climate, relief, very rich flora enable the development of beekeeping and the production of special quality honey (Anon., 2016, Anon., 2019a). Honey is a completely natural product, a sweet substance produced by honey bees (*Apis mellifera L.*) by processing the nectar of plants, of juices from living parts of plants or by

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collecting the excreta of insects that suck juices from living parts of plants. It is a very complex mixture of more than 70 different components. The most abundant ingredients are carbohydrates, of which simple sugars - fructose and glucose and water together make up more than 99% of the composition of honey (Anon., 1981, Milošević *et al.,* 2013, Batinić and Palinić, 2014, Anon., 2014, Jovanović, 2015, Lazarević, 2016, Tanković *et al.,* 2017). Honey is used as food and medicine and its contamination can bring serious health hazards. Nutrition with honey of unknown origin and composition can have serious consequences. Insufficiently developed awareness of the dangers that occur due to improper use of chemical agents leads to large losses in beekeeping and to the fact that honey becomes a threat to human health. Harmful substances that can be found in honey originate from the environment, due to the application of agrotechnical procedures or due to poor implementation of beekeeping practices (Mahmoudi *et al.,* 2016). Increased industrialization, the development of agriculture, traffic, inappropriate waste removal, an increase in the number of illegal landfills, the burning of fossil fuels, and the development of tourism have increased the degree of environmental pollution in Montenegro as well, and thus the risk of contamination of honey and other bee products (Anon., 2017a, Bojanić Rašović, 2020b, 2020c, 2020d, 2020e, 2020f, 2020g, 2021a, 2021c). That is why is very important to control the hygienic correctness of bee products and establish traceability. This implies monitoring the entire process of honey production, from the bee farm to the final consumer.

Contaminants in honey

Food contaminants are substances that are not added to food intentionally, but are found in it as a result of environmental pollution or as a result of inadequate production, processing, packaging, transportation of food, etc. The main environmental contaminants of honey and bee products are: heavy metals (lead, cadmium, mercury), radioactive isotopes, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), pesticides (insecticides, fungicides, herbicides and bactericides), pathogenic bacteria, genetically modified organisms. The main contaminants of honey that occur as a result of inadequate beekeeping practices are: acaricides (lipophilic synthetic compounds and non-toxic compounds such as organic acids and components of essential oils), antibiotics if they are used illegally to control bee brood diseases (tetracyclines, streptomycin, sulfonamides, chloramphenicol), paradichlorobenzene, which is used to control the wax moth, chemical repellents (Bogdanov, 2006, Al-Waili *et al.,* 2012, Jovetić, 2018).

Chemical contaminants of honey

Heavy metals are significant contaminants of honey. Their importance lies in the fact that they accumulate in living organisms, are highly cytotoxic, carcinogenic, organisms do not have the ability to detoxify and thus circulate in the environment. The environment is often polluted with lead, zinc, cadmium,

chromium, copper, manganese, iron, molybdenum, arsenic, mercury. Their main source are the metal production and processing industry, traffic, remains of paint, coatings, thermal energy plants, combustion of fossil fuels, residues pesticides, mineral fertilizers, etc. Lead enters the nectar or honeydew directly from the air. Cadmium in nectar and honeydew is transported from the soil to the plant, and through the plant to the bee. An increased concentration of heavy metals, especially mercury and chromium, was also found in the pollen (Jovetić, 2015, Tanković *et al.*, 2017). *Polycyclic aromatic hydrocarbons* (PAHs) are liposoluble organic compounds that have two or more condensed aromatic rings in their structure. They are created during pyrolytic processes, especially incomplete combustion of organic matter, processing of coal and crude oil, combustion of natural gas, heating, incineration of waste, traffic, smoking. These compounds exert mutagenic and carcinogenic effect. The most toxic is benzopyrene, which is most often used as an indicator of the presence of these compounds in the environment. PAHs reach honey through air, water, soil, as well as during the process of fumigation of bees in the hive and honey processing (Sofilić, 2014). Elevated levels of PAHs was determined in samples of honey and other bee products from urban and industrial areas. Residues of polycyclic aromatic compounds were found in honey produced near oil factories. The content of PAHs in pollen samples is significantly higher than in honey samples, because the average proportion of lipids in pollen is even and up to 22.4%. A special group of pollutants is the organochlorine group compounds, the so-called *persistent - long-term pollutants* (Persistent Organic Pollutions, POPs). These compounds are poorly soluble in water, and they dissolve very well in fats, which results in their bioaccumulation in the fatty tissues of living organisms. They are toxic to living organisms. They are transported over long distances by water and air, which is why they are widely distributed even where they have never been used. They are carcinogenic. The most widespread from this group are: polychlorinated biphenyls (PCB), dioxins (polychlorinated dibenzo-p-dioxins–PCDD), furans (polychlorinated dibenzofurans–PCDF) and organochlorine pesticides (OCP). Polychlorinated biphenyls (PCBs) are organic chemicals that originate from transformer and motor oils, coolants etc. They were produced until 1980, but they are still present in the environment and endanger bees and their products. Their content in wax is higher than in honey. One of the most dangerous environmental pollutants that represent a particular problem are dioxins. They are created as a result of inadequate incineration of municipal and medical waste and as by-products of the chemical industry. The air serves as a medium for the transfer of dioxin molecules and particles, which then fall to the ground, and in this way the bees bring them into the hives via pollen. If dioxins are found in honey, honey is not allowed for consumption (Jovetić, 2015).

The control of honey for the presence of *radioactive substances* is also very important. The main radioactive isotopes found in honey are 40 K and 137 Cs - the first is of natural origin, and the second is from the Chernobyl nuclear power plant in 1986. According to literature data, in the early sixties of the last

century and during the accident in Chernobyl in 1986, the area of the Republic of Croatia was contaminated by the processes of dry and wet deposition from the atmosphere, as well as by the radioactive isotope cesium 137 Cs. Deposited cesium is absorbed on soil particles over time, and partly penetrates into deeper layers and reaches the zone of the root system of plants. Like other biogenic elements, cesium is incorporated into plants through the root system. More than fifteen years after the Chernobyl accident, 137 Cs was still found in some types of honey, such as coniferous honeydew and chestnut honey (Barišić *et al.*, 2005).

Biological contaminants of honey

The presence of microorganisms in honey can affect its quality and health safety. Microorganisms found in honey and honeycomb are bacteria, molds and yeasts, and they come from bees, nectar or from external sources. Pollen, intestinal tract of bees, man, equipment, containers, wind, dust are possible sources of contamination by microorganisms. Moisture and temperature are of great importance for the growth of microorganisms in honey. Microorganisms that can be found in the intestines of bees are yeasts (1%), gram-positive bacteria (*Bacillus, Bacteridium, Streptococcus* and *Clostridium spp*.) 27% and gram-negative bacteria (*Achromobacter, Citrobacter, Enterobacter, Erwinia, Escherichia coli, Flavobacterium, Klebsiella, Proteus* and *Pseudomonas*) 70%. Most bacteria and other microorganisms can not grow or reproduce in honey. Honey has an antimicrobial effect and prevents the growth of many microorganisms. In addition, honey has a low water activity, which leads to the prevention of the reproduction and survival of bacteria. However, several types of pathogenic bacteria have been found in honey. The finding of a large number of vegetative forms of bacteria that can not reproduce in honey indicates fresh contamination. Different types of vegetative forms of bacteria in honey stored at 20°C decay within 8-24 days. However, spores of microorganisms can survive in honey at a low temperature. *Bacillus cereus, Clostridium perfringens* and *Clostridium botulinum* spores in honey stored at 25°C remain viable. Honey, as a substance with a high concentration of carbohydrates and a low pH value, adversely affects the development of bacterial spores. Bacterial spores and molds are brought to the hive by bees along with pollen and can be found in all bee products (Al-Waili et al. 2012). To destroy the spores, a temperature of 130 °C, increased pressure and a time period of three minutes are necessary. Honey is not subjected to these conditions (the exception is industrial honey), because this would damage the biological and physical-chemical properties of honey. There is a risk of botulism in infants if they consume contaminated honey. Honey that has not been tested and sterilized should not be used in the diet of infants or applied to wounds. Yeasts (genera *Candida, Saccharomyces*) and molds (genera *Penicillium, Aspergillus, Mucor*) can also be found in honey. *Mycotoxins* can be found in honey as a product of mold metabolism. Molds of the genus *Aspergillus* (*A. flavus* and *A. parasiticus*) produce aflatoxins, of which the most toxic is aflatoxin B1. Aflatoxins have a mutagenic and carcinogenic effect - they cause

liver cancer in humans. The source of mold contamination of honey is the intestinal content of bees, hives and pollen. Molds from the genus *Aspergillus* were also found in the gut of bee larvae. Pollen is considered to be the main source of microbial contamination of honey. Yeasts, toxicogenic molds, etc. were also found in it (Mahmoudi *et al.*, 2016). Honey produced from the flowers of some plants can cause intoxication and various symptoms such as dizziness, weakness, sweating, nausea, vomiting, hypotension, shock, and arrhythmia and death can occur. Some substances that are toxic to humans are not always toxic to bees. The nectar of certain plants contains poisonous substances. Consuming honey contaminated with the nectar of the *toxic rhododendron plant* leads to poisoning that can be life-threatening. In a mild form of poisoning, nausea, vomiting, excessive salivation and dizziness occur, and in a severe form, heart failure occurs. In addition to this plant, the toxic effect of honey obtained by collecting nectar from the flowers of plants such as *Andromeda polifolia* (wild rosemary), *Kalmia latifolia* (kalmia), plants of the genus *Melicope* in New Zealand, *Nerium oleander* (oleander) in the Mediterranean region, etc. is known (Dugasa *et al.*, 2019). In the United States and Canada, *genetically modified plants* are commonly grown and accepted by the public, while in the European Union there is strong opposition against the consumption of food containing genetically modified organisms (GMOs). In the European Union, labeling of food containing genetically modified organisms in an amount greater than 1% is mandatory. The PCR method makes it possible to detect the presence of only a few grains of pollen originating from a genetically modified plant. Bee pollen can be significantly contaminated, while honey, which contains less than 0.1% pollen, would not exceed this total GMO allowance of 1%. In countries where genetically modified oilseed rape and corn are grown, it can be a problem for beekeeping.

Residues in honey

Residues are the remains of intentionally used substances (pesticides and veterinary drugs) in the food production chain with the aim of improving production. *Pesticide residues* that can be found in honey can be acaricides, organic acids, insecticides, fungicides, herbicides and bactericides. Residues of pesticides and veterinary drugs lead to health problems such as malaise, eye pain, skin and respiratory system problems, gene mutations, cell damage, cancer, fetal malformation, chromosomal abnormalities and weakened immunity in humans. As a result of pesticide poisoning in humans, the cessation of the function of the vital centers, paralysis of the respiratory center, heart failure, pulmonary edema occur (Nzeh *et al.*, 2020., Jovanov *et al.*, 2015). Uncontrolled application of pesticides causes contamination of the environment, animals and people. Over 150 different pesticides were found in the hives. The most dangerous are organochlorine pesticides, which belong to persistent organic contaminants (POPs), because they break down slowly, accumulate, pollute soil, water, air, crops, and the living world. They have the ability to accumulate in the organisms

of plants and animals, so their long-term and uncontrolled use leads to a very harmful effect on the living world. Hexachlorocyclohexane (HCH) and its isomers are the most frequently found pesticides in honey, followed by dichloro-diphenyl-trichloroethylene (DDT) and its isomers (Dugasa *et al.*, 2019). Our country is a signatory to the Stockholm Convention on POPs (Anon., 2013b), which the use of organochlorine pesticides is prohibited due to their deposition in fatty tissue and a long half-life. The use of neonicotinoid pesticides is a risk for honeybees. There is a special risk from three types of neonicotinoids: clothianidin, imidacloprid and thiamethoxam. If the use of pesticides is carried out without control and in an inadequate way, to severe consequences - endangerment of bee colonies and contamination of their products. The most important pollutants of honey are substances that used to control bee diseases, primarily the causative agent of varroosis and american plague of bee brood. Synthetic acaricides are mostly fat soluble and stable in beeswax. After treatment, acaricides accumulate in wax and to a lesser extent in honey. Contamination of honey and other products with acaricides used to protect bees is, therefore, even more significant than contamination from the environment. They lead to direct contamination of the product. Honey is more often contaminated with pesticides than pollen, but the highest concentrations were found in pollen (Jovetić, 2018). The acaricide amitraz is rapidly degraded in the hive to metabolites, some of which are more toxic than amitraz to both humans and bees. In addition to honey, amitraz also contaminates wax, because it enters the structure of the wax as a liposoluble substance. Such contaminated wax leads to negative consequences after its use in medicine and cosmetics. Amitraz residues in honey are not allowed in some countries such as Italy, France, Japan and Germany (Ivanović *et al.*, 2021). Amitraz is according to the Regulation of the European Commission no. 775/2004 prohibited for use and circulation in the European Union. (Nzeh *et al.*, 2020, Bojanić Rašović, 2021b). The monitoring of pesticide residues in honey, wax and bees helps to assess the potential risks of these products to human health and provides data on the extent of pesticide treatment of agricultural crops in the vicinity of beehives. The main contamination risks for different bee products are: antibiotics for honey and royal jelly, lipophilic acaricides for beeswax and propolis, pesticides for pollen. *Residues of antibiotics* can occur due to treatment against american bee brood plague and european bee brood plague. Antibiotic residues have a relatively long half-life and can have direct toxic effects on consumers. They are also carcinogenic, cause reproductive disorders, and have a teratogenic effect. Long-term exposure to antibiotic residues leads to the appearance of resistance of pathogenic bacteria to antibiotics. The European Union as well as national regulations prohibit the use of antibiotics in the treatment of bee diseases. In most EU countries, no maximum allowed amounts of antibiotics are prescribed, which means that honey containing antibiotics is not allowed to be sold. However, some countries, such as Switzerland, Great Britain and Belgium have established maximum permitted amounts of between 0.01 to 0.05 mg/kg for each group of antibiotics (Vapa-Tankosić and Lekić, 2017).

Some beekeepers use *para-dichlorobenzene* (PDCB) to control the wax moth. This substance contaminates commercial beeswax and honey. An even more toxic substance is naphthalene, which is also used to control the wax moth and its residues have been found in honey. Means and paints for the protection of wood and beehives should not contain insecticides and fungicides, as this could lead to contamination of honey. Chemical repellents can also be a source of honey contamination. Remnants of phenol, a widely used repellent, were discovered in honey. Since it can also be found naturally in honey, the measured concentrations should be carefully analyzed.

Awareness of the severity of these dangers should motivate beekeepers and agricultural producers to create a joint pesticide management plan, in order to maximally avoid their negative impact on bees, but also on all living things and the environment. Introducing organic beekeeping is the best way to avoid the mentioned sources of contamination. To that end, beekeepers should be motivated and supported for practicing organic beekeeping. Organic beekeeping respects the laws of nature, does not disturb the natural balance and preserves the environment. It represents a return to tradition and healthy technologies, uses natural materials, which increases the bee's resistance. The priority of organic beekeeping is to achieve high quality and product safety. Organically produced honey, which is free of harmful chemical residues, has a beneficial effect on human health with its nutritional value and taste.

The importance of implementing good production and good hygiene practices in obtaining healthy honey in Montenegro

The lack of hygiene in production leads to a violation of the health safety of honey. Risks of dust contamination occur if containers with honey are kept open, if attachments are stored in unhygienic rooms, if a rusty and unclean tool is used to remove the lids, etc. Contamination of honey can also occur during processing, through equipment and tools. Storing honey in inappropriate containers can also lead to the appearance of undesirable heavy metal residues. Materials from which beekeeping equipment is made (aluminum, stainless steel, galvanized steel) can release contaminants such as aluminum, cadmium, cobalt, chromium, copper, iron, lead, nickel, zinc into the honey. Production equipment, as well as honey storage containers, must be made of materials specially intended for food. During the storage of honey, inorganic and organic components can diffuse from the inner surfaces of paraffinized, corrosive and painted containers and contaminate the honey (Bojanić Rašović 2020a, Bojanić Rašović 2020b, Bojanic Rasovic 2022). The carcinogenic compound semicarbazide was found in an amount of 0.003 up to 0.005 mg/kg honey and comes from lids for closing glass jars. Lids for jars are made of metal sheets, on which a sealing compound is applied or various washers are placed that ensure the tightness of the closed jar. One of the most commonly used lids is the so-called twist off (screw cap). EC Directive 2007/19/EC prohibits the use of azodicarbonamide in the manufacture of plastic materials and articles that come into contact with food. This compound

decomposes at high temperatures to semicarbazide. This information points to the importance of using proven, certified packaging intended for packing and storing food (Bogdanov, 2006). Should apply the HACCP system in order to ensure healthy honey and other bee products. It is based on the principle of hazard analysis and determination of critical control points for controlling and preventing the occurrence of these hazards. The basis for establishing this system is to consider all potential dangers and health risks from these dangers. The HACCP system - a system of hazard analysis and critical control points is useful for beekeepers, entities in the food business, veterinarians, and veterinary inspectors in the planning and implementation of controls. The bee pest control strategy should be based on eliminating the use of synthetic chemicals, so that the bees are healthy and the products are healthy. Non-toxic natural substances such as thymol and organic acids should be used. Given that it is soluble in fats, the remains of thymol occur in larger quantities in beeswax. Residues of thymol evaporate during wax storage. If thymol treatments are carried out throughout the season, its residues in honey can be in such a quantity that they can lead to a change in the taste of honey, which is not allowed according to international regulations on honey. That is why you should not exceed the limit of thymol content in honey of 1.1–1.5 mg/kg. Oxalic and formic acids are natural constituents of honey and are widely used in varroa control. They have the so-called GRAS status (generally recognized as safe) and maximum permitted amounts in honey are not prescribed for them. Single or repeated treatments with oxalic acid do not lead to the accumulation of residues in honey. It was shown that after treatment with formic acid, the concentrations of the residues of this acid in honey were within the limits of natural concentrations. Proper long-term use of formic acid does not lead to an increase in its concentration in honey, but if it is used unprofessionally, the content of its residues can be high and change the taste of honey (Bogdanov, 2006). The control of honey and bee products is very important in order to protect the health of consumers, but also to ensure healthy competition of producers on the market. Given that a prerequisite for honey production is an ecologically clean environment, the big challenge in the future for beekeepers will be how to get health-safe honey of good quality. For honey as a food with a special reputation, according to EU regulations, a zero level of pesticide residues is prescribed, which is a big problem for beekeepers in countries where control is rigorous, given that pesticides are widely used in the treatment of fruits, vegetables and other agricultural crops (Bogdanov, 2006).

Legal regulation in the field of health control of honey in Montenegro

Monitoring of residues and contaminants is of great importance for the safety of honey in Montenegro. It is carried out in accordance with the Rulebook on residue monitoring according to the annual Program of Food Safety Measures (Anon., 2017b, Anon, 2021). Samples are taken in any part of the honey production chain, in such a way that the origin of the honey can be determined. The number of samples that should be taken every year is at least 10 samples per

300 tons of annual production for the first 3000 tons of production, and one sample for every additional 300 tons. The distribution of samples is done by testing 50% of the samples for the presence of antibacterial substances, including sulfonamides and quinolones (group B1) and carbamates and pyrethroids (group B2), while 40% of samples are tested for organochlorine compounds and polychlorinated biphenyls, organophosphorus compounds and chemical elements (group B3), while 10% of samples are distributed based on experience, with special attention addresses mycotoxins (Anon., 2017a). During monitoring, two samples of honey were examined in 2019, and three samples of honey were examined in 2020, with all nor were the samples harmonized according to legal regulations (Anon., 2019a, Anon., 2020). In relation to the information that honey production in Montenegro in 2017 was 390,000 kg, this means that the number of honey samples taken for monitoring should be higher (Anon., 2019d). Our Regulation on the Maximum Permitted Amounts of Contaminants in Food (Anon., 2019c) prescribes a maximum permitted amount of lead of 0.10 mg/kg of honey. In addition to lead, regulations in Serbia also define maximum permissible amounts for cadmium, arsenic, zinc, iron and copper (Anon., 2018b). Our regulations do not prescribed maximum permitted amounts of PAHs for honey and other bee products, which means that the tolerance for PAHs in these products is zero (Anon., 2019a, Ivanović *et al.*, 2021). The maximum permitted amounts of polycyclic aromatic hydrocarbons (PAHs) are in the European and domestic regulations defined only for foods containing fats and oils and where contamination may occur during the smoking or drying process. Maximum permitted amounts in food were determined for four PAHs: benzo[a] pyrene, benzo[a]anthracene, benzo[b]fluoranthene and chrysene. Our Rulebook does not specifically prescribe the maximum permitted amount of pesticides in honey, which means that honey must not contain more than 0.01 mg of pesticide/kg of honey (Anon., 2015). The Rulebook on Maximum Permitted Amounts of Residues of Pharmacologically Active Substances of Veterinary Medicines in Products of Animal Origin (Anon., 2018a) prescribes the maximum permitted amount of amitraz and its metabolites containing 2,4-DMA in honey, which is 200 μg/kg of honey. The maximum permitted amount of coumaphos in honey according to the same regulation is 100 μg/kg of honey. Antibiotic residue concentrations are not prescribed by the Rulebook (Anon., 2018a), which means the regulations of the European Union, as well as our regulations, do not determine the maximum allowed amount of antibiotics, which means that the level of antibiotics in honey must be zero and that honey containing antibiotics is not allowed for sale. The regulation on maximum permitted amounts of contaminants in food (Anon., 2016) does not prescribe maximum permitted amounts of mycotoxins in honey, which means that the tolerance dose for mycotoxins in honey is zero. According to our Law on Genetically Modified Organisms (Anon., 2008) and the Regulation on the conditions and manner of using genetically modified food or animal feed (Anon., 2019b) food containing more than 0.9% genetically modified organisms must be marked on the

declaration. According to the aforementioned regulation, the cultivation of GMOs in the open is prohibited, and for the cultivation of GMOs in closed conditions, special permits are required from the State and the National Council for GMOs. According to the Guide for Microbiological Criteria for Food Safety of Montenegro (Anon., 2013a), the recommended microorganisms for testing honey and other bee products, as well as honey-based products, are aerobic mesophilic bacteria, enterobacteria, sulfite-reducing clostridia, yeasts and molds. These microorganisms show the degree of hygiene in the process of production, packaging and storage of honey, they can lead to spoilage of honey, and some are pathogenic and can lead to diseases. These parameters refer only to production hygiene criteria. Of the five tested samples, it is acceptable that two samples can have a total number of aerobic mesophilic bacteria between 10^3-10^4 cfu/g, one sample can have a total number of enterobacteria of 10-10^2 cfu/g, and all five tested samples must have less than 10 cfu of clostridia in one gram of tested honey sample. Of the five samples tested, it is acceptable that one sample can have 10-10^2 cfu of yeasts and molds in one gram of honey sample. When it comes to other bee products and honey-based products, out of five tested samples, it is acceptable that two samples can have 10^4-10^5 cfu of aerobic mesophilic bacteria/g of honey, one sample 10^2-10^3 cfu of enterobacteria/g, one sample 10-10^2 cfu clostridia/g, one sample 10^2-10^3 cfu yeasts/g and one sample 10^3-10^4 cfu molds/g honey sample. These criteria, therefore, do not refer to finished products intended for the market, but to hygiene criteria during production. If these criteria are not met, the hygienic measures of production of honey and bee products must be improved (Anon., 2012, Anon., 2013a).

CONCLUSIONS

In Montenegro, there are good climatic conditions for the development of beekeeping and the production of high quality honey. However, due to increased environmental pollution from industrial production, traffic, agriculture, improper waste disposal, improper treatment of bees etc., there is a danger of contamination of honey and other bee products. This is why the role of primary production is crucial in food safety management and hazard analysis. It is very important to work on implementing good beekeeping practices and on the continuous control of honey production throughout the entire production chain. Annual monitorings are carried out regularly, which examine the honey for the presence of contaminants and residues of pesticides and antibiotics. The monitoring results in 2016 and 2017 showed that the tested samples were in compliance with the legal regulations in Montenegro. The number of samples covered by monitoring should be increased in accordance with legal regulations.

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