

ANTIBIOTICS IN HONEY- ANTIMICROBIAL RESISTANCE RISK

Manjola KULIÇI¹, Sonila ÇOÇOLI², Arbenita HASANI^{3*}

¹Department of Food and Biotechnology, Faculty of Biotechnology and Food, Agricultural University of Tirana, Tirana, Albania

²Public Health Department, Faculty of Veterinary Medicine, Agriculture University of Tirana

³University Hasan Prishtina, Faculty of Agriculture and Veterinary, Food Technology and Biotechnology

*Corresponding author email: arbenita.hasani@uni-pr.edu

Abstract

The use of antibiotics is among the most frequently cited factors in pollinator population decline, and their use poses a risk to bees and consumers. Much research shows that residues of antibiotics in honey originate from improper beekeeping practices than the environment. In this context, this paper aims to assess the beekeeping practices regarding antibiotics, specifically the knowledge of the risk posed by antibiotics. A structured online questionnaire was developed with beekeepers having bee-stabilized parks distributed in a wide geographical area in Albania. The results showed that many beekeepers (56.6%) use antibiotics for bee treatment. The majority of beekeepers (69.7%) are not aware of drug-resistant infections that may come from the consumption of honey obtained from hives treated with antibiotics. The results also showed that 37.4% of beekeepers use antibiotics without following the labeled instructions. About 40% of beekeepers obtained information on the Internet or other uncontrolled sources regarding the source of information on antibiotics use. These findings suggest a lack of knowledge of antibiotics among beekeepers in Albania. Also, the potential antimicrobial resistance risk among consumers. This is an important food safety issue that needs to be tackled by Albania's food safety and quality policy.

Keywords: Honey, antibiotics, antimicrobial resistance, Albania, food safety

1. Introduction

Honey is one of the beekeeping products that is produced in an environment polluted by different sources of contamination where antibiotic residues in it have recently become a major consumer concern. This study aimed to evaluate the level of knowledge and awareness that Albanian beekeepers have on antibiotics use inside the hives because consumption of honey without source and safety information can adversely impact public health. Sources of honey contamination can be divided into environmental (indirect pollution) and apicultural (direct pollution) contaminations. An indirect way of contamination (environmental contamination) reflects the transport of toxic substances to the hive during the collection of nectar, water, pollen, propolis, or the theft of honey from other contaminated hives. Antibiotic residues originating from agricultural use should be carefully monitored as they can be allergenic and carcinogenic factors, and may contribute to bacterial resistance^{1,2}. The direct way of contamination (apicultural contamination) which is the most important, is related to the contamination of bee products from the use of antibiotics and pesticides from beekeeping practice. The residues of antibiotics in honey originate mostly from improper beekeeping practices.

The term antibiotic initially refers to any agent with biological activity against living organisms. Antibiotics are medicines - therapeutically used to protect the health and welfare of humans and animals, it inhibits or abolishes the growth of microorganisms such as bacteria, fungi, or protozoa³. Antibiotics are worldwide used in apicultural practices for the control of honeybee diseases, particularly American and European foulbrood⁴ and nosemosis, a parasitic disease affecting adult bees. Beekeepers use antibiotics at relatively high doses to treat infections, or at low doses as "growth promoters". Maximum residue limits (MRLs) have been established for most foods produced by animals treated with sulfonamides and tetracyclines. However, there are no MRLs

for bee products such as honey⁵. The use of antibiotics in beekeeping is illegal in some EU countries. However, there are no MRLs established for antibiotics in honey according to European Community regulations, which means that honey containing antibiotic residues are not permitted to be sold^{6,9}. The extensive use of antibiotics leads to an accumulation of antibiotic residues in honey, thereby leading to decreased quality and difficulty in marketing⁷.

The use of antibiotics is among the most frequently cited attributors to pollinator population decline. In Albania, many chemicals aimed at controlling colony parasites or pests have been shown to have negative effects on the health of honey bees¹¹. But antibiotics used in animal foods pose a risk not only for bees but also for consumers because honey with antibiotic residues can produce resistance in the bacterial population which can evolve into more powerful organisms in the consumers⁵ and can affect public health. These bacteria might then cause difficult-to-treat human infections. Many cases of infant botulisms have been attributed to contaminated honey⁵. Some drugs have the potential to produce toxic reactions in consumers directly while others can produce allergic or hypersensitivity reactions¹⁰. The latter requires an extremely long treatment. According to European Union regulations, honey as a natural product must be free of chemicals⁸. Currently, in Albania, there are no exact data about the amount of antibiotic residue in produced honey, so we suggest further studies to monitor the presence of antibiotics in honey.

2. Materials and methods

The research was conducted from January to February 2022. Household surveys, field observations, and quantitative structured survey¹³ collected through the beekeeping associations in Albania were used as the main tool for data collection. One hundred fifty beekeepers with large bee-stabilized parks (most of which are registered) have participated in this study. The majority of the respondents were males and well distributed in all considered group ages. The questionnaire is composed of two sections: in the first one, the demographic characteristics of the beekeepers are collected. The second section collects data about the knowledge of the risk posed by antibiotics.

3. Results and discussion

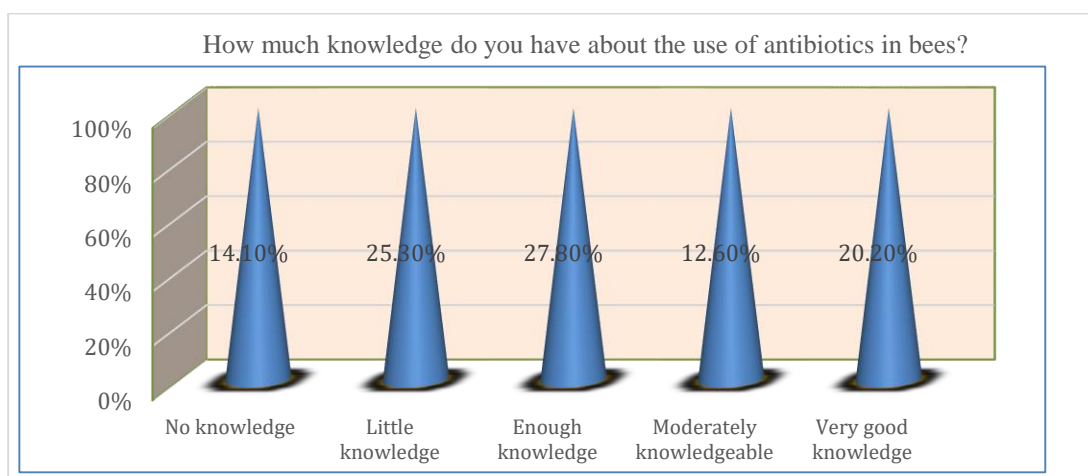
The benefits of using an online survey were evident in the number of responses received (150 beekeeper responses). The results show (Table 1) that the average beekeeper included in this study is 38.5 years of age and the majority of the respondents are males with experience of 1-5 years. This result is evaluative and shows that despite the different professions and maybe not enough knowledge in the field of beekeeping, people are also dealing with beekeeping. These beekeepers (36.3%) keep honeybees as a hobby. Most honey produced by hobbyists is consumed at home, given to friends and relatives, or distributed through local outlets. On the other side, 30.1% of beekeepers included in this study operate beekeeping primarily for profit and production efficiency, and some of them are specialized in the production of queens and other bee productions. These full-time beekeepers can be divided into two groups: migratory and non-migratory beekeepers. Most full-time beekeepers relocate their bee colonies several times during the year to provide pollination services, to reach more sources of nectar, or to escape from adverse climatic conditions or pesticides from agricultural use. The non-migratory beekeepers move their colonies over significant distances but most of the time their colonies are normally left in the same location.

Table 1. Socio-demographic variables of the sample and population.

	Category	Albania %
Age Average= 38.5	18-24 years old	6.2
	25-34 years old	26.7
	35-44 years old	17.1
	45-54 years old	30.1
	More than 55 years old	19.9
Gender	Male	89
	Female	11
Experience	0-5 years	36.3
	6-10 years	16.4
	11-20year	17.1
	Over 20 years	30.1
Number of hives	1-10	16.4
	11-20	17.1
	21-50	30.1
	Over 50	36.3

Related to the use of antibiotics the results showed that a high degree of beekeepers (56.6%) use antibiotics for bee treatment. This is a worrying result as beekeepers have not yet understood the consequences of using these antibiotics on bees and this may have been one of the main reasons for the large losses that beekeepers have had in Albania during the winter of the last year¹¹. These effects of antibiotics on bees have been studied by various researchers. According to Yarira Ortiz-Alvarado (2020), 12 antibiotic treatments affect the number of lipids and rate of behavioral development of honey bees. Also, the timing of antibiotic treatment had distinct effects on the age of onset of behaviors, starting with cleaning, then nursing, and lastly foraging. However, this high rate of antibiotic use may come from a lack of information on the part of beekeepers or from the fact that antibiotics are relatively cheap and easy to take for use in various treatments. Most of these respondents (43.4%) indicated that they either did not use antibiotics in their beekeeping or that it was illegal to use them. After analyzing the obtained results, we identified that for the question how much knowledge do you have about the use of antibiotics in bees? (using the Likert scale = 1 No knowledge 5 =Very good knowledge), 14.1% of beekeepers indicated “no knowledge”, 25.3% indicated “little knowledge”, 27.8% indicated “enough knowledge”, 12.6% indicated “moderately knowledgeable” and 20.2% indicated “very good knowledge”.

Graph 1. Likert scale: How much knowledge do you have about the use of antibiotics in bees?



As seems that 39.4% of beekeepers have very poor knowledge about antibiotics and their use. Such results pose a threat to the hive because antibiotics may have been misused for the appropriate disease, or used altogether against the wrong disease, or may not have been used at the right time and in the right dosage and this may lead to the onset of new infections or may increase the frequency of treatment failures. Such results also pose a threat to consumer food safety. Long-term effects of exposure to antibiotic residues consumed with honey include microbiological hazards, carcinogenicity, reproductive effects, and teratogenicity⁵. Microbiological effects are one of the major health problems in human beings. Certain drugs like nitrofurans and nitroimidazoles can cause cancer in human beings, similarly, some drugs can produce reproductive and teratogenic effects at very low doses⁵. The use of antibiotics due to the treatment of bee diseases dominates (30.8%) in the results obtained for the question if they used antibiotics, for what reason did they use them? They use them mostly to control European foulbrood (EFB), American foulbrood (AFB), and Nosemosis. 20.7% of beekeepers who participated in this study said that they used antibiotics to prevent diseases and 4.5% said they used them to control bacterial infections.

About 40% of beekeepers obtained information on the Internet or other uncontrolled sources regarding the source of information on antibiotics use. 48.9% of beekeepers obtained information from a veterinary pharmacy and supervising veterinarian and 11.1% from other beekeepers and beekeeping associations. Also by asking the beekeepers: How often do you think beekeepers use antibiotics without following the labeled instructions, from 1 to 5, Albanian beekeepers reported that 37.4% of them use antibiotics without following the labeled instructions. It is, therefore, a critical issue that beekeepers aren't properly informed about the risks incurred by antibiotic issues and they lack knowledge about antibiotics. That is not much to say that one source of information is less accurate than another, as many veterinarians lack knowledge and expertise about the beekeeping industry¹³. However, we suggest getting information from trained professionals and also suggest training beekeepers for antimicrobial interventions.

As we mention above, antibiotic residues consumed along with food and honey can produce resistance in bacterial populations. The majority of beekeepers included in this study (69.7%) are not aware of drug-resistant infections that may come from the consumption of honey obtained from hives treated with antibiotics and 30.3% appeared more aware of drug-resistant infections. Antibiotic resistance is a global public health concern. In this way, if policymakers do not interfere with training and information policies for beekeepers, the number of bacteria resistant to antibiotics consumed with honey may increase, and many bacterial infections may become resistant to the most common antibiotic treatments. To the question: Do you know that honey/honeycombs obtained from antibiotic-treated hives should not be consumed? 81.8% of 3 beekeepers answered that they were aware and 18.2% of them were not aware. As we see most beekeepers reported that

recently treated hive products should not be consumed, but are not aware that antibiotic waste in the hive takes time to eliminate, this was evident from the results of the above questions.

4. Conclusions

These findings suggest a lack of knowledge of antibiotics among the beekeepers in Albania and a potential antimicrobial resistance risk among bees and consumers. This is an important food safety issue that needs to be tackled by Albania's food safety and quality policy. We suggest the extent of this study on identifying antibiotics residue among different kinds of honey or the extent of this study on the health impact of honey contaminated with antibiotics. Also, we suggest policymakers apply training politics to beekeepers to ensure in-depth awareness and understanding of antibiotic applications.

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