

THE AUTHENCITY OF HONEY IN RELATION TO QUALITY PARAMETERS

N. Dugalić-Vrndić¹, J. Kečkeš^{1,2}, M. Mladenović²

¹Institute of Veterinary Medicine of Serbia, Autoput 3, 11000 Belgrade, Republic of Serbia

²Faculty of Agriculture, Nemanjina 6, 11080, Belgrade, Republic of Serbia

Corresponding authors: ndugalic@gmail.com

Original scientific paper

In the Serbian market can be found significant quantity of honey which authenticity can be doubt. Honey is changed sensory, as well as in certain chemical quality parameters. Sometimes it happens that honey is in accordance to quality requirements but that doesn't mean that it's natural and authentic honey. Many analysts who are engage in testing the quality of honey have experience to recognize the honey that isn't from honey bees but the work of skilled producers. The question is how to solve the problem - how to recognize forgery honey from natural although it is in accordance to quality requirements prescribed by the legislation? The most important is that this honey isn't selling to consumers as a natural honey. Analysts here are becoming helpless because the law is rigid and based on the quality parameters that we cannot with certainty tell if the honey is forgery or not. In this article we reviewed the results of examination of quality of honey from the market of Serbia, where the sensory evaluation demonstrated that it is a honey in which authenticity can be doubted. The results were: 1. honey that has sensory changed with good quality parameters and 2. honey that has sensory changed with quality parameters which isn't in accordance with Book of Regulation. The conclusion is that a larger number of samples that have been sensory changed did not satisfy the chemical quality parameters, and in one part of the samples were present residues of antibiotics and sulfonamides.

Key words: honey, authenticity, chemical quality parameters, sensory evaluation

Introduction

Honey is a food of animal origin and in our region is a product of the honey bee - *Apis mellifera carnica*. Honey is a unique food that contains all the necessary elements for growth and development of organisms (amino acids, carbohydrates, vitamins, organic acids, minerals, pollen, essential oils, proteins, enzymes, etc.). The quality of honey depends on the geographical origin and presence of the plant species on the site. In Serbia, the most common are acacia and meadows - flower honey, and lime and sunflower honey. Other types of honey

appear in small numbers. Honey is used by all groups, but it is recommended to children, athletes, convalescent and elderly people because of the rich content of vitamins, minerals, enzymes, amino acids and others. The crisis in society leads to a crisis of morality, so in the market can be find a certain amount of honey that are not authentic - natural (Dugalić-Vrndić et al., 2005, 2006). Based on the Book of Regulations for quality and other requirements for honey, bee products, honey based preparations and other bee products (*Official Gazette of Serbia and Monte Negro, no. 45/03*), honey has to have intrinsic color, aroma and taste, and may be liquid or pureed consistency, partially or completely crystallized. Sensory analysis is a science method that measures and evaluates the characteristics of the product (color - appearance, consistency, odor and taste) with one or more senses and as such is one of the most important parameters in defining the overall quality of honey (Popov-Raljić et al., 2005, 2006, 2007). Based on sensory analysis, a number of honey samples did not in accordance to the Book of Regulations. Therefore, we can doubt the authenticity of these samples. However, these samples of honey are impossible to declare a forgery on the basis of quality parameters prescribed by legislation. Some natural components of honey can be find on the market in the synthetic form (e.g. diastase, HMF) and when examining the standard methods cannot be determined the origin of these components, and this creates a problem to analysts recognize forgeries, and it cannot prove the prescribed test methods. On the other hand, the use of antibiotics and sulfonamides in the treatment of bees that use unskilled persons leads to the presence of residues of antibiotics and sulfonamides in honey. The aim of this paper is to highlight the problem that is increasingly present in the Serbian beekeeping and that is the appearance of honey that is not natural but on the market is declared as natural and authentic. Such honey is not a safe food for consumption. In addition, the authors propose that the legislation have to include some other quality parameters that would prevent counterfeiting and to thereby bring order to the honey market and protect human health and the honey produced by beekeepers conscientious.

Materials and Methods

Sixty five honey samples were collected and examined in this study. Honey used in this study came from three sources:

1. Honey purchased in supermarkets (25 samples) of different owners, different types of honey (mountain, meadow, flower, forest, etc.)
2. Honey samples (25 samples) taken from the famous beekeepers on-site production
3. Honey from the laboratory of the Institute, which is encrypted arrived for examination (15 visually altered samples).

All of honey samples were placed in jars made of glass or plastic. In all the samples the first was carried out sensory evaluation. Color - appearance, odor, taste and consistency were tested by sensory evaluation without use any operating tools.

Color - appearance of honey was examined in the following way: approximately 40 g of honey were measured in a transparent glass balloon (160 ml) at a temperature of 18°C to 25°C and colors and hue were evaluated. Determination of odor - olfactory technique: about 40 g of sample was measured in a glass balloon of 160 ml at room temperature. Honey sample is taken with plastic spoon and placed in front of nose and intensity of flavor and aroma are estimated by inhaling volatile compounds. Sensory evaluation of taste: 1-2 g of honey is weighed at room temperature then tasted and evaluated. Consistency/texture of honey is determined based on mechanical, geometric and surface properties which can be observed mechanical, tactile and where is possible, with visual and auditive receptor.

After sensory evaluation six quality parameters were determinate: reducing sugars, sucrose (HPLC/RI), moisture (refractometry), acidity (volumetry), diastase activity (UV/Vis spectrophotometry) and HMF (HPLC/UV) were determined using standard methods of the International Honey Commission (IHC) and the presence of residues of antibiotics and sulfonamides. Examination of residues of antibiotics and sulfonamides was done in parallel using two microbiological methods - Premi® test and Four plate methods.

Results and Discussion

Based on the sensory evaluations of 65 honey samples with the methods used human senses (visual, olfactory, tactile and auditory receptors) (*Popovic-Raljić et al., 2005, 2006, 2007.*) Results are obtained, where 40 (61,5 %) of honey samples does not correspond to sensory specifications given in ISO standard. Table 1 and 2 shows the results of sensory evaluation.

Table 1. Sensory evaluation of honey quality (source *Popović-Raljić et al. 2005* modified by the authors)

Honey origin	Number of samples	Description of the sensory characteristics			
		Color - appearance	Odor	Taste	Consistency
Source 1	25	inconsistent, inappropriate	inappropriate, unpleasant, atypical note	inappropriate	liquid, viscous and Granulated in 2 - 3 layers
Source 2	25	color intensity, hue, saturation and purity consistent and appropriate	odor intensity highly strong that can be identified	highly inherent basic taste that lasts longer than 5 minutes	creamy inherent (fine crystals)
Source 3	15	inconsistent, inappropriate	inappropriate, unpleasant, atypical note	inappropriate	liquid, viscous and Granulated in 2 - 3 layers

Table 2. Results of sensory evaluation

Honey origin	Number of samples	Results of sensory evaluation		
		In acc.*	Not in acc.**	Evaluation
Source 1	25	-	25	0
Source 2	25	25	-	3
Source 3	15	-	15	0
Total %	65 100 %	25 38.5 %	40 61.5 %	

Table 3. Results of laboratory examination of honey samples I

Honey origin/ Parameters	Source 1		Source 2		Source 3	
	In acc. *	Not in acc. **	In acc. *	Not in acc. **	In acc. *	Not in acc. **
Reducing sugars MRL min. 60 %		+	+			+
Sucrose MRL max. 5 %	+		+		+	
Moisture MRL max. 20 %	+		+		+	
Acidity MRL max. 40 mmol/kg	+		+		+	
Diastase activity MRL min. 8 DN		+	+			+
HMF MRL max. 40 mg/kg		+	+			+
Residues of antibiotics and sulfonamides		+		+		

Table 4. Results of laboratory examination of honey samples II

Honey origin	Number of samples	Quality (chemical parameters)		Residues of antibiotics and sulfonamides	
		In acc.*	Not in acc.**	Present	Not present
Source 1	25	7	18	5	20
Source 2	25	25	-	3	22
Source 3	15	5	10	-	15
Total %	65 100 %	37 56.9 %	28 43.1 %	8 12.3 %	57 87.7 %

*in accordance with the Book of Regulations/per samples

**not in accordance with the Book of Regulations/per samples

Based on the results of testing of 65 honey samples, 40 samples are not in accordance to the sensory evaluation, 28 samples are not in accordance to chemical parameters of quality and in 8 samples we found the presence of residues of antibiotics and sulfonamides (tables 2 and 4). Probably it might be higher presence of residues of antibiotics and sulfonamides probably if we had more authentic honey samples than the honey of doubtful origin.

Source 1: according to sensory evaluation of 25 honey samples taken from the market, it was found to be inadequate due to changed sensory characteristics (appearance, taste, odor, color and consistency). In the same group (source) 18 samples of honey were not in accordance with the legislation, while the other 7 were in accordance. The presence of antibiotics and sulfonamides was found in 5 samples. The results are similar to research *Dugalić-Vrندیć et al. (2005, 2006)*, where they established the presence of residues of antibiotics and sulfonamides in honey purchased in supermarkets in the low percentage of the total number of examined samples (2 %). Uncontrolled use of antibiotics has resulted in their retaining in honey and other bee products, and studies have found that oxytetracycline retains after 40 to 46 days in the weak and medium bees colonies, while in the strong bee colonies they decompose after 25 days. (*Plavska et al., 2005*). Compared to other countries in the EU, where the presence of antibiotics have been found in up to one third of honey that are on the market (*Bogdanov et al, 2007*), honey purchased in supermarkets in Serbia is much less contaminated, as can be seen from the results of this research

Source 2: honey sampled on the place of production of known beekeepers, without notice, gave good results in tests of sensory evaluation and chemical parameters, however in a certain number of honey we found the presence of residues of antibiotics and sulfonamides (3 honey samples). Results are similar to the results of *Dugalić-Vrندیć et al., 2005*, they are found residues of antibiotics and sulfonamides in 18% of examined samples. Similar results related to the chemical quality parameters gave research *Matović et al. (2009)*, where 11.48 % of honey samples found to not in compliance with legislation.

Source 3: Honey visually changed, arrived at the Institute for examination (15 samples). All 15 samples were not suitable sensory (appearance, taste, odour, color and consistency), in 5 samples were not found HMF (hydroxymethyl furfural) and these samples are the exception in laboratory practice. Hydroxymethyl furfural is the cyclic aldehyde resulting from dehydration of fructose and glucose in acidic conditions (*Tosi et al., 2004; Dugalić-Vrندیć et al., 2010*) and continues to be broken down into formic acid and levulinic acid. Speed of decomposition is higher at elevated temperatures and increase in speed of decomposition is proportional to the temperature rise. In between HMF occurs naturally, its content is low in fresh honey and ranges from 0.6 to 2 mg/kg. Honey that was examined came in the winter when the honey had the lowest age and in such of samples HMF expected to attend in a certain amount. The remaining 10 samples with altered sensory and

visual properties had satisfactory quality parameters. Here is a problem: How to honey in which authenticity we suspect declare as a forgery based only on sensory analysis and quality parameters which are in accordance to Book of Regulation? Based on analysis scientists know that this honey is not natural, but what to do when the parameters prescribed by the Book of Regulations have a value within the allowable limits? No doubt legislation must be applied, but this gives the possibility to forged honey gets on the market as genuine - natural honey.

Conclusion

Based on the research can be concluded:

- 61.5% of honey samples have been changed sensory
- With 43.1% of values honey samples of chemical quality parameters (HMF, reducing sugars, diastase) were not in accordance with legislation prescribed MRL
- 12.3 % of samples were contaminated with antibiotics and sulfonamides

Comparing the percentages of samples that did not in accordance to sensory and quality regulations, the number of samples that had been changed sensory greater than the number that did not correspond to chemical quality parameters although it was expected that this number be equal.

On the basis of the research and scientific and professional knowledge, the authors recommend the implementation of new methods, i.e. quality parameters: pollen and isotopic analysis of honey (testing the authenticity and geographical origin). Honey pollen analysis is a method, supported by chemical analysis, which allows identification of forged honey. Pollen grains in honey are a significant indicator of origin of honey - pollen of plant species is a fingerprint and in addition can also be determined the geographical origin of honey. While measurement of stable isotopic composition allows evaluation of food adulteration of natural sweeteners with high fructose corn syrup.

Artificial honey and a presence of residues of antibiotics and sulfonamides is becoming a problem in Serbia and in its resolving must be team-work (the authorities of the legal and criminal policy, professional and scientific workers in finding research methodology) in order to protect human health and production of high quality foods such as honey.

Acknowledgment

The work is based on research funded by the Ministry of Science and Technology. Project No. 46009, subproject 46009/III, "Improvement of technological processes in the production of bees, honey, wax and pollen".

Autentičnost meda u odnosu na parametre kvaliteta

N. Dugalić-Vrندیć, J. Kečkeš, M. Mladenović

Rezime

Na tržištu u Srbiji se može naći veća količina meda u čiju se autentičnost sumnja. Med je promenjen senzorno, kao i u određenim hemijskim parametrima kvaliteta. Dešava se da med ispunjava uslove kvaliteta, a da ipak nije prirodan i autentičan. Mnogi analitičari koji se bave ispitivanjem kvaliteta imaju iskustva da prepoznaju med koji ne potiče od medonosnih pčela, već je delo umešnih proizvođača falsifikovanog meda. Tu nastaje problem – kako med koji jeste falsifikat a ispunjava sve uslove kvaliteta propisane zakonskom regulativom proglasiti falsifikatom? Od primarnog je značaja da se takav med ne dospe na tržište kao prirodan med. Analitičari tu postaju bespomoćni jer je zakon rigidan i na osnovu parametara kvaliteta koji su njim propisani ne može se sa sigurnošću tvrditi da je med falsifikat ili ne. U ovom radu dat je pregled rezultata ispitivanja kvaliteta jednog broja uzoraka meda sa tržišta Republike Srbije, gde su senzorne ocene pokazale da je u pitanju med u čiju se autentičnost može sumnjati. Dobijeni su sledeći rezultati: 1. med koji je senzorno promenjen sa dobrim parametrima kvaliteta i 2. med koji je senzorno promenjen sa parametrima kvaliteta koji ne odgovaraju Pravilniku. Zaključak je da je kod većeg broja uzoraka med koji je senzorno promenjen nije zadovoljavao hemijske parametre kvaliteta, a kod jednog dela uzoraka koji nisu ispunjavali zahteve propisane zakonom su bile prisutne i rezidue antibiotika i sulfonamida.

References

- BOGDANOV S. (2007): Be products and health. Zbornik plenarnih i naučnih radova XV naučno savetovanje sa međunarodnim učešćem." Proizvodnja i promocija meda i pčela"10-11 februar, Poljoprivredni fakultet Beograd, 95-108.
- DUGALIĆ-VRNDIĆ N., MLADENOVIĆ M., NEDIĆ N. (2005): Rezidue antibiotika i sulfonamida u medu sa beogradskog tržišta. Zbornik plenarnih i naučnih radova XIII naučno savetovanje sa međunarodnim učešćem." Proizvodnja i promocija meda i pčela"12-13 februar,2005 Poljoprivredni fakultet Beograd, 53-56.
- DUGALIĆ-VRNDIĆ N., NEDIĆ N., MLADENOVIĆ M. (2006): Ispitivanje parametara kvaliteta meda u prometu. Zbornik plenarnih i naučnih radova XIII naučno savetovanje sa međunarodnim učešćem. "Zaštita i proizvodnja domaće pčele i meda. Poljoprivredni fakultet u Zemunu, 11-12 februara, 2006. godine.

- DUGALIĆ-VRNDIĆ N., RIZNIĆ Lj., NEDIĆ N. (2005): Kvalitet meda i prisustvo rezidua meda u prometu. Zbornik radova sa naučnog skupa pogorički dani meda, 2005, 38-41, Podgorica, oktobar 2005.
- DUGALIĆ-VRNDIĆ N., KEČKEŠ J., MLADENOVIĆ M., NEDIĆ N. (2010): Starost pčelinjeg meda i kvalitet. XV Savetovanje o Biotehnologiji-Zbornik radova, vol.15.(17), 2010.Čačak, 26-27 mart 2010. god. 865-860.
- MATOVIĆ K., VUKAŠINOVIĆ M., KALJEVIĆ V., NENADIĆ D., ŽARKOVIĆ A., POPOVIĆ P.,VIDANOVIĆ D., RAIČEVIĆ Z. (2009): Kvalitet meda i prisustvo rezidua bakra u medu, na području dela centralne ,zapadne i jugozapadne Srbije. Zbornik plenarnih i naučnih radova XVII naučno savetovanje sa međunarodnim učešćem.Kvalitet meda i selekcija medonosne pčele , 7 februar 2009.godine. Zemun.136-143.
- PLAVŠA N., ĐURIČIĆ B., BALTIĆ M., MLADENOVIĆ M. (2005): Primena antibiotika u suzbijanju oboljenja pčela i njihove posledice na kvalitet meda. Zbornik plenarnih i naučnih radova XIII naučno savetovanje sa međunarodnim učešćem.” Proizvodnja i promocija meda i pčela”12-13 februar 2005 Poljoprivredni fakultet Beograd, 53-56.
- POPOV-RALJIĆ J., GORJANOVIĆ R.,LALIČIĆ J., SIMIKIĆ V. (2006): Uslovi objektivizacije senzornog vrednovanja meda. Zbornik plenarnih i naučnih radova. XIV Naučno savetovanje sa međunarodnim učešćem.” Zaštita i proizvodnja domaće pčele i meda”. Poljoprivredni fakultet Beograd, pregledni rad 64-70.
- POPOV-RALJIĆ J., GRUJIĆ S., SIMIKIĆ V., LALIČIĆ J., GORJANOVIĆ R. (2007): Opšti zahtevi, termini i metodologija senzornog vrednovanja konzistencije meda. Zbornik plenarnih i naučnih radova. XV Naučno savetovanje sa međunarodnim učešćem.” Proizvodnja i promocija meda i pčela”.10-11 februar 2007. godine. 117-122.
- POPOVIĆ-RALJIĆ J., GORJANOVIĆ R., LALIČIĆ L., SIKIMIĆ L. (2005): Specifičnosti senzornog vrednovanja kvaliteta meda. Zbornik plenarnih i naučnih radova XIII naučno savetovanje sa međunarodnim učešćem.” Proizvodnja i promocija meda i pčela”12-13 februar,2005 Poljoprivredni fakultet Beograd, 32-36.
- Pravilnik o kvalitetu i drugi zahtevima za med i druge pčelinje proizvode, preparate na bazi meda i drugih pčelinjih proizvoda (Sl. List SiCG br. 4/2004).
- RAŠIĆ S., MLADENOVIĆ M., NEDIĆ N., KEČKEŠ S., PETROVIĆ J. (2007): Hidroksimetilfufural u medu. Zbornik plenarnih i naučnih radova XV naučno savetovanje sa međunarodnim učešćem.” Proizvodnja i promocija meda i pčela”10-11 februar, Poljoprivredni fakultet Beograd, 141-145.
- TOSI E.A.,LUCERO H., BULACIO I. (2004): Efectof honey high-temperature sshort-time heating on parameters related to quality crystallisation phenomena and fungal inhibition. LWT 37,669-678.