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Standards of Honey Quality in Serbian Legislation

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Abstract:

According to the European Union Legislation and the *Codex Alimentarius*, honey is defined as natural sweet substance produced by honey bees from the plants nectar or from secretions of plants living parts or excretions of plant sucking insects on the living parts of plants, which the bees collect, transform by combining with specific substances of their own, deposit, dehydrate, store and leave in the honeycomb to ripen and mature. The quality of honey and bee products depends on its geographical and botanical origin, with high aspect of environment condition. Active components in plants depend on various factors and climatic conditions in different geographical locations, botanical origin etc. *Codex Alimentarius* presented that chemical characteristic and element concentration of honey must meet the criteria of honey quality, according to national and international legislation. Also, in some counties issued national legislation, decisions and guidelines which correlate with European and International standards. In Serbia honey and other honey bee products must meet criteria according to Official Gazette RS: Rulebook on quality of honey and other bee products, No. 101/2015. Official Gazette RS defined the physicochemical parameters of natural honeys, such as moisture, reducing sugars, sucrose, hydroxymethylfurfural (HMF), free acidity, diastase activity, water-insoluble content and electrical conductivity, and constitute the quality indicators which characterize individual honey varieties. In this paper, we discuss the rules governing regulation of honey in national provisions of different countries taking into account suggestion of the EU.

Keywords: honey; legislation, Codex, EU standards, quality.

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1. Introduction

Codex Alimentarius (2001) define honey as *natural sweet substance produced by honey bees from the nectar of plants or from secretions of living parts of plants or excretions of plant sucking insects on the living parts of plants, which the bees collect, transform by combining with specific substances of their own, deposit, dehydrate, store and leave in the honey comb to*

ripen and mature. Different studies show that honey have a high nutritional and biological effects (Oryan et al., 2016; Tsavea et al., 2022; Ávila et al., 2022; Graikou et al., 2022). The honey is an excellent source of energy, 100 g honey supplies about 306 kcal. Similar, 20 g of honey is the usual quantity per serving or tablespoon that provides about 61.2 kcal, which represents more or less 3% of the energy necessary per day (Bogdanov et al., 2008). The main constituents of honey are the simple carbohydrates that are used for human body energy requirements after being rapidly absorbed into the blood without previous digestion (Ajibola et al., 2012).

According to chemical composition honey content a difference sugars, predominantly fructose and glucose as well as other substances such as organic acids, enzymes, vitamins, proteins, volatile compounds, several bioactive substances (phenols and flavonoids) and micro and macroelements. The mainly sugars are carbohydrates (60–85%), predominantly fructose and glucose (Machado De-Melo et al., 2018). The water content of honey is related to different factors such as the botanical and geographical origin of nectar, season of harvesting, intensity of nectar flux, degree of maturation, manipulation by beekeepers during period of harvest, as well as extraction, processing and storage conditions (Estupinan et al. 1998; Gonzalez, 2002; Ojeda de Rodrıguez et al 2004; Pontara et al., 2012; Sabatini, 2007; Sainz-Laın and Gomez-Ferreras, 2000; Ciric et al. 2018; Ćirić et al., 2020; Ćirić et al., 2020). The physicochemical characteristics and quality are defined in different national and EU regulation. In this review paper, we discuss the different regulation of honey worldwide, primary Serbian, compere to Council directive 2001/110 EU with revised Codex Alimentarius (2001). The mail objective is to show some differences in honey quality among this regulation in order to increase their efficiency in the different countries.

2. Official Gazette RS: Rulebook on quality of honey and other bee products, No. 101/2015

Official Gazette RS (2015) (https://www.pravno-informacionisistem.rs/SlGlasnikPortal/eli/rep/sgrs/ministarstva/pravilnik/2015/101/2) defined the physicochemical parameters of natural honeys, such as moisture, reducing sugars, sucrose, hydroxymethylfurfural (HMF), free acidity, diastase activity, water-insoluble content and electrical conductivity, and constitute the quality indicators which characterize individual honey varieties. According to origin, honey is classified as:

1) flower or nectar (obtained from the nectar of plants), namely:

(1) monofloral honey,

(2) multifloral/polyfloral honey;

2) honey house;

3) baker's honey.

Monofloral honey is a product produced by honey bees from the nectar of the flowers of honey plants of a certain species. Honey with the name of a specific type of honey plant should have the taste, smell and color characteristic of that plant, with the number of pollen grains of that type of plant predominating. Monofloral honey can be labeled according to a certain plant

species, if it contains at least 45% of the pollen grains of that plant species in the insoluble part (Official Gazette RS, 101/2015). Table 1 shows the minimum percentage of pollen grains in the insoluble part for certain plant species. Similar, Greece has their national legislation regarding to chemical composition of monofloral honey (AXS, 2004). Also, German (Leitatze, 2011), Croatia (Croatia Ministry of Agricultural, 2009), Italy and Turkey (Turkish Food Codex 2012) provide a chemical parameter of different type of monofloral honey. In the most case, chemical characteristics are correlate with pollen analyses (melissopalynology).

Table 1. The minimum percentage of pollen grains in the insoluble part for certain plant species (Official Gazette RS, 101/2015)

The name of the plant species	**Proportion of pollen grains in the insoluble part**
Castanea sativa Mill.	85%
Brassica napus L.	60%
Phacelia tanacetifolia Benth.	60%
Tilia spp.	25% (10%)*
Robinia pseudoacacia L.	20%
Mentha spp.	20%
Calluna vulgaris L.	20%
Satureja montana L.	20%
Taraxacum officinale Weber	20%
Rosmarinus officinalis L.	20%
Salvia officinalis L.	15% (10%)*
Arbutus unedo L.	10%
Citrus spp.	10% (5%)*
Lavandula spp.	10% (5%)*
Helianthus annuus L.	40%
Medicago sativa L.	30%

* with characteristic sensory properties of honey for a certain type of plant (smell, taste, color)

3. Composition criteria for honey

Physico-chemical parameters of honey according to Codex Alimentarius, Serbian legislation and Directive 2001/110 EU are indicated in Table 2. Some differences exist only for the baker honey. The main composition criteria defined moisture content (%), sum of fructose and glusoce (%), water- insoluble (%), electrical conductivity (mS/cm^{-1}), free acid (mEq/kg), diastase activity (Schade units)) and HMF. Water content is an important parameter in terms of

honey shelf life. The maximum allowed in Serbian honey is 20%, according to Serbian Regulations (101/15 Serbian Regulation, 2015). Electrical conductivity indicates the presence of nonorganic and organic ions in honey. The diastasis activity corresponds to the activity of the enzyme present in 1 g of honey, which can hydrolyze 0.01 g of starch in 1 h at 40 °C, expressed as the diastase number in Göthe (Schade units) (Ahmed et al. 2013; Bogdanov et al. 1997; Codex Alimentarius 2001). The current law stipulates a minimum value of 8.00 Schade units. However, honeys with naturally lower diastase activity tolerate a minimum of 3 Schade units if honeys have up to 15 mg kg^{-1} of HMF (da Silva et al., 2016; Council Directive 2001/110/EC 2002). Several factors have been reported to influence the levels of HMF, such as temperature and time of heating, storage conditions, pH, and floral source (Fallico et al., 2006). HMF levels in our Serbian honeys were below the maximum recommended by the European legislation (maximum of 40 mg/ kg).

Table 2. Compositional criteria of honey

Parameter/ Unit	**Official Gazette RS, 101/2015**	**Codex 2001**	**Directive 2001/110 EU**
Moisture- %	In general: Not more than 20%	In general: Not more than 20%	In general: Not more than 20%
Sum of fructose and glucose- %	Blossom honey 60 ≤ Honeydew honey, blends of honeydew honey with blossom honey 45% ≤	> 45	> 45
Sucrose- %	In general: Not more than 5%	In general: Not more than 5%	In general: Not more than 5%
Water- insoluble- %	In general: Not more than 0.1%	In general: Not more than 0.1%	In general: Not more than 0.1%
Electrical conductivity mS/cm^{-1}	In general: Not more than 0.8 mS/cm	> 0.8	> 0.8
Free acid- mEq/kg	In general: Not more than 50 meq/kg	In general: Not more than 50 meq/kg	In general: Not more than 50 meq/kg
Diastase activity	In general: Not less than 8	In general: Not less than 8	In general: Not less than 8
HMF- mg/kg^{-1}	In general: Not more than 40 mg/kg	In general: Not more than 40 mg/kg	In general: Not more than 40 mg/kg

The Serbian legislation (Official Gazette RS, 101/2015), Codex (2001) and Directive 2001/110 EU defined limits for moisture content no more than 20%, exceptions for *Calluna* honey and baker honey. The sum of fructose and glucose are defined to exceed 45 %. The Official Gazette RS (101/2015) required the sum of fructose and glucose content for blossom honey to exceed 60%. Codex, Serbian legislation (Official Gazette RS, 101/2015) and Directive 2001/110 EU required the sucrose content, in general no more than 5%. Persano and Piro (2004) found that honey from Eucalyptus generally content less than 4,2% sucrose. In the other hand, honey from dandelion may have more than 5% sucrose (Thrasyvoulou et al., 2018).

In general, water- insoluble content are limited no more than 0.1%, exception for pressed honey (< 0.5). According to Serbian legislation (Official Gazette RS, 101/2015), Codex (2001) and Directive 2001/110 EU the electrical conductivity of blossom must be lower than 0.8 mS/cm of EC, while electrical conductivity of honeydew honey and chestnut honey must be higher than 0.8 mS/cm. Exceptions are honeys from Arbutus, Banksia, Erica, Leptospermum, Melaleuca, Eucalyptus, Tilia and blends (Machado De-Melo et al., 2017). The Serbian legislation (Official Gazette RS, 101/2015), Codex (2001) and Directive 2001/110 EU defined limits for free acid no more than 50 meq/kg.

Diastase activity, so called diastase number, used for measuring enzyme is expressed as the amount of starch solution in ml of 1% that can be hydrolyzed by the enzyme in honey within one hour at 38-40 ºC (Türk, 2012). In the other hand HMF is very important quality criterion formed as a result of dehydration of hexose in honey in an acidic environment**.** Also, HMF and diastase activity used to detect adultered honey (Thrasyvoulou et al., 2018). According to Serbian legislation (Official Gazette RS, 101/2015) honey should not have HMF more than 40 mg/kg^{-1}. In the other hand, Czech Republic defined that honey should not have HMF more than 20 mg/kg^{-1}, as Slovakia. Some tropical country, as Kore and India defined that honey should not have HMF more than 80 mg/kg^{-1} (Bureau of Indian Standards, 2002).

5. Conclusion

In this review manuscript, we have indicated that there are differences in legislation and standards that regulate honey in different countries. Significant differences refer to the HMF and diastase activity content in honey.

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