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HONEY SENSORY QUALITY

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Abstract

Honey, represent a natural product made by bees from the nectar of flowers, with a lot of health benefits and a good nutritional value. Honey quality is assigned to sensorial, physicochemical and microbiological parameters in relation with purity, authenticity and environmental influences. The aim of this study is to evaluate the sensory attributes of most-favorable honey types (acacia, lime, rapeseed and sunflower honey), to select honey with the best sensorial overall and the highest consumer acceptance. The sensory analysis was conducted with a questionnaire survey, in total 30 consumers participated. The results showed that the majority of participants consume honey only occasionally, and according to sensory analysis the most appreciated type of honey was rapeseed, followed by acacia, sunflower and lime types.

Key words: honey, sensory quality, consumer perception

According to the Codex Alimentarius and 110/2001 EU Regulation, honey is the natural sweet substance, produced by *Apis mellifera* 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 honeycombs to ripen and mature.

Romania holds an important position among European honey producers, contributing significantly to the apiculture sector. However, in 2024, honey production in Romania experienced a dramatic decline of approximately 40–45%, driven by extreme weather conditions that severely impacted floral sources such as rapeseed, acacia, linden, and sunflower (1,2).

This environmental vulnerability raises pressing concerns about the sustainability of apiculture under accelerating climate change.

Quality standards established at international and national levels assess key parameters such as moisture content, electrical conductivity, sugar composition (notably fructose and glucose), enzymatic activity (e.g., diastase, invertase), proline levels, and hydroxymethyl furfural (HMF). Beside these, sensory analyses of honey have different goals: to describe and communicate sensory properties, to assess the

variety typicity, to determine the popularity among consumers, or to identify faults (1,2,5)

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Sensory analysis is the examination of a product through the evaluation of the attributes perceptible by the five sense organs (organoleptic attributes), such as color, odor, taste, touch, texture and noise (5).

Until the 1960s, sensory analysis techniques basically relied on the personal experience of expert assessors, being simple and low cost. In the second half of the twentieth century, new and improved sensory evaluation methods were developed using panels of assessors, well defined and controlled experimental protocols and statistical techniques for processing the results. (10)

Honey is a supersaturated sugar solution, but also contains many secondary substances. The ingredients of the honey have an effect on the sensory properties.

The appearance of honey includes transparency, opacity and degree of crystallization.

Colour: the color of the honey correlates with its content of phenolic compounds, pollen

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and mineral substances. It changes during the storage of the product

The colour can vary from very light shades, such as yellowish-white or pale yellow, to darker tones, such as amber or brown (6). Natural pigments in honey, such as carotenoids and flavonoids, play an essential role in determining the color. In general, honey with a darker color has a higher content of phenolic compounds and minerals, having a higher antioxidant activity (11).

Crystallization is a natural phenomenon that depends on the ratio of glucose to fructose. A honey with a high glucose content will crystallize faster, while one with a higher fructose content will remain liquid for a longer period of time.

The flavor (aroma) of honey is influenced by the volatile compounds present, which are derived from the nectar of flowers, as well as by the enzymatic processes that occur during honey maturation. The main classes of volatile compounds include alcohols, aldehydes, ketones, esters and hydrocarbons, which contribute to the distinct aromatic profile of each type of honey (8).

Taste: the carbohydrate content of honey is 80 to 85%. The greater part of this is accounted for by the two monosaccharides fructose (27 to 44%) and glucose (22 to 40%). However, the disaccharides maltose (3 to 16%) and sucrose (0 to 8%) or the trisaccharide melicitose also occur in honey. Approx. 20 different carbohydrates have been found in honey. In blossom honeys the sugar ratio is typical for the relevant plant species, with the emphasis on fructose and glucose, but in different ratios. As fructose tastes sweeter than glucose, not every honey is equally sweet.

Texture: due to the melicitose content, forest honey often has a firmer consistency. The crystallization also depends on the sugar spectrum.

The objective of our study was to see the consumer behaviour and sensory perception in four types of honey: acacia, lime, rapeseed and sunflower.

MATERIAL AND METHOD

To easily observe the sensory characteristics of the honey varieties, we chose for this work a questionnaire with 20 questions, which we applied to 30 respondents, 15 men and 15 women, aged between 25 and 65, some consuming honey daily, others occasionally, and others very rarely.

The questionnaire was completed 4 times by each person, for each type of honey taken into analysis; we selected the types of honey so that there were no variations (of taste, color, olfactory perception, etc.) that could mislead consumers. The honey that we subjected to sensory analysis was of the best quality, either from established local producers or certified organic honey.

Through the questionnaire applied, we monitored the consumer's behavior regarding the analyzed products, as well as the degree to which they correctly identify the sensory properties of honey.

The questionnaire includes 5 sections, in addition to the one dedicated to the participants data, each of them monitoring a specific parameter: the visual appearance of the honey, the olfactory perception, the taste, texture and sensations in the oral cavity and finally, the degree of general acceptability.

The results were compared with other sensorial studies (table 1, 2, 3, and 4).

Table 1

Acacia honey sensory characteristics (Persano Oddo, et. al 2004)

Visual assessment	Colour intensity: very light	
	Colour tone: normal color of honey	
Olfactory assessment	Odour intensity: weak	
	Odour description: floral – fresh, fruit	
Taste assessment	Sweetness: medium to strong	Acidity: weak
	Bitterness: absent	Aroma intensity: weak
	Aroma description: floral – fresh-fruit, warm	
	Persistence/after taste: short	
	Other mouth perceptions: -	
Physical characteristics	Crystallization rate: very late – more than a year	

Table 2

Lime honey sensory characteristics (Persano Oddo, et. al 2004)

Visual assessment	Colour intensity: light to medium	
	Colour tone: normal color of honey with bright tone (yellow)	
Olfactory assessment	Odour intensity: strong	
	Odour description: woody, chemical and fresh	
Taste assessment	Sweetness: medium	Acidity: weak
	Bitterness: absent to medium	Aroma intensity: strong
	Aroma description: woody, chemical and fresh	
	Persistence/after taste: long	
	Other mouth perceptions: - astringent	
Physical characteristics	Crystallization rate: moderate	

Table 3

Table 3 Rapeseed honey sensory characteristics (Persano Oddo, et. al 2004)

Visual assessment	Colour intensity: light	
	Colour tone: normal color of honey	
Olfactory assessment	Odour intensity: medium	
	Odour description: spoiled and vegetal	
Taste assessment	Sweetness: medium	Acidity: weak
	Bitterness: absent	Aroma intensity: medium
	Aroma description: floral – fresh fruit (fruity), warm, spoiled and vegetal	
	Persistence/after taste: short; aftertaste sometimes present (blackcurrant)	
	Other mouth perceptions: -when crystallized in very small crystals, refreshing (like “fondant”)	
Physical characteristics	Crystallization rate: quick; this honey is often in crystallized form with very small crystals; in this case, the color appears whitish or dull ivory	

Table 4

Sunflower honey sensory characteristics (Persano Oddo, et. al 2004)

Visual assessment	Colour intensity: medium	
	Colour tone: bright yellow	
Olfactory assessment	Odour intensity: weak	
	Odour description: floral – fresh fruit (fruity), warm and vegetal	
Taste assessment	Sweetness: medium	Acidity: strong
	Bitterness: absent	Aroma intensity: weak to medium
	Aroma description: floral – fresh fruit (fruity), warm and vegetal	
	Persistence/after taste: short	
	Other mouth perceptions: -when crystallized with very small crystals, refreshing (like “fondant”)	
Physical characteristics	Crystallization rate: quick, crystallization with hard crystals (hardly soluble) is frequent	

RESULTS AND DISCUSSION

The aim of these study is to describe and communicate sensory properties, to assess the variety typicity, to determine the popularity of four types of honey among consumers.

Among the consumers, 20% are occasional consumers, 40% (once a month), and 40% weekly honey consumers. The results achieved in *general appearance* of honey reveals that the respondents accurately identified the clarity of the honey (lime honey had a beginning

of crystallization at the bottom of the jar) that is why there was a variation in the answers.

Acacia honey was predominantly perceived as slightly cloudy (70%), but still clear compared to rapeseed or sunflower honey; the colour varied between very light (10%), light amber (50%) and medium amber (40%), specific to the characteristic appearance of this variety. Lime honey stood out for its medium clarity, and the color was darker, dominated by shades such as

dark amber (50%), medium amber (30%) and even brown (20%), which indicates a floral source with more intense pigments. Sunflower honey was perceived as opaque by all respondents, with a predominantly light amber color (70%) and a smaller percentage very light (30%).

Rapeseed honey, it was also perceived as opaque and very light in 70%, which corresponds to its characteristics known from the literature. Crystallization was absent in acacia honey, while lime honey presented fine crystals, the rest being still fluid.

Sunflower and rapeseed honey were completely crystallized, which corresponds to their natural behavior of forming crystals quickly due to the ratio of glucose to fructose. The appearance of acacia and lime honey was described as “slightly uneven”, in contrast to sunflower and rapeseed honey, which were perceived as “very uniform”, as a result of complete crystallization.

According to *olfactory perception*, acacia honey was perceived for its delicate aroma, being described as light (50%) or very light (30%), with floral and fruity notes. Lime stood out for its more intense aroma, with 70% of consumers indicating a strong aroma, dominated by floral, spicy and woody notes – a rich and distinctive aromatic profile. Sunflower honey had a more restrained aroma, light (60%) or very light (40%), characterized by floral, vegetal and slightly fruity notes. Rapeseed honey was perceived as having a weak to moderate intensity, with caramelized, fermented aroma (although the honey did not present fermentation processes, 2 of the respondents perceived its aroma as altered, smelly) and vegetal, sometimes difficult to accept by the most sensitive consumers.

Acacia honey was considered the sweetest, with 80% of respondents perceiving it as strongly or very strongly sweet, consistent with its fructose-rich composition. Lime honey, on the other hand, was rated as less sweet, with 50% of consumers indicating a weak or slight sweetness. Sunflower honey was considered weak in this parameter, while rapeseed honey was rated as slightly sweet – 60%. Acidic or sour notes were almost absent in all types, except for acacia honey where 20% reported a very weak presence. Bitter notes were reported only in linden honey, by some respondents (moderately perceptible bitter notes), which may influence the overall perception of quality.

The *consistency* of acacia honey was described as “slightly fluid”, while lime honey was “very fluid”, characteristics reflecting a high water content. Sunflower honey, on the other

hand, was “very dense”, and rapeseed honey “thick and viscous”, in line with the high degree of crystallization. The *texture* in acacia and lime honey was perceived as very fine, in contrast to sunflower (very rough) and rapeseed (slightly grainy). The mouthfeel ranged from “pleasant and sticky” to “rough or sandy” in the case of crystallized honey.

The *aroma* of acacia honey was considered too sweet, while lime honey was perceived as too bitter; in contrast, sunflower and rapeseed honey were appreciated for a “pleasant and balanced” taste. The persistence of the taste was notable only for acacia honey (persistent sweetness) and lime (persistent bitter notes), as the other two varieties did not leave a prolonged sensation in the oral cavity. The taste of honey is one of the most relevant parameters in sensory evaluation, directly influencing consumer preferences.

The four types of honey present distinct taste profiles, according to floral origin and chemical composition.

Acacia honey was perceived with a floral and fruity taste, classic features for this variety; the light and refined taste makes acacia honey one of the most appreciated by consumers, being ideal for those who prefer milder flavors. Lime honey was distinguished by a complex and robust taste profile, including fermented, woody and spicy notes. The presence of these notes can be attributed to the essential oils and volatile compounds specific to linden flowers, and the more intense taste, with bitter accents, is characteristic of it and may be less appreciated by sensitive consumers to strong flavors. At the same time, the slightly fermentative taste reported may indicate a higher level of enzymatic activity. Sunflower honey presented a combination of floral, fruity and woody notes, suggesting a relatively balanced and pleasant taste. The woody taste could come from certain phenolic compounds, while the slightly sweetness contributes to a more accessible and easily tolerated sensory profile than in other types of honey. Rapeseed honey was evaluated as having caramelized, vegetal and woody notes. The vegetal notes are specific in these type, often associated with a strong taste, sometimes considered unpleasant by consumers, the caramelized note is a natural feature of rapeseed flowers, and the woodiness, also present here, in combination with the vegetal taste can determine a less refined perception.

The overall sensory quality was assessed differently: acacia honey received ratings ranging from “acceptable” to “very good”, lime honey

was perceived as having poor to good quality, and sunflower and rapeseed honey were generally well-appreciated, with mentions of “very good” and “excellent” in the case of the latter. Based on the sensory characteristics, the majority of respondents would purchase the honey they tasted, with the exception of linden honey, which 60% of consumers would not purchase due to persistent bitter notes, and rapeseed honey, which 20% of consumers perceived olfactory as fermented, spoiled.

The most appreciated type of honey was rapeseed honey, closely followed by acacia; sunflower and lime honey being less appreciated by the consumers.

Honey is a product that can be stored for years. Ideally it should be stored in a dark room in odour-free vessels closed airtight at a temperature of max. 15 °C and an atmospheric humidity of max. 60%. Changes with sensory relevance can occur during storage.

Colour: in the course of storage the honey becomes darker due to Maillard reactions and the reaction of polyphenols. How quickly a honey darkens depends on the storage conditions. Higher temperatures promote darkening. If a honey crystallizes, it appears lighter. These colour changes can be recorded and quantified by sensory or instrumental analysis (7).

Texture: at low temperatures honeys with a low water content crystallize, with the glucose component developing a crystalline texture first. Blossom honeys that crystallize quickly are for example rape and sunflower honey.

Honeydew honey, sweet chestnut honey and robinia honey remain fluid for longer. Forest honey crystallizes much more slowly than blossom honey. Honeys that tend to crystallize quickly are mostly stirred to produce a creamy honey after centrifuging. It is possible to freeze honey. The honey then does not turn candy. Coarse crystals are considered to be a fault in honey.

Aroma: if the honey crystallizes, water that was previously bound to glucose is released. The water activity (*a_w*) and thus the risk of fermentation which become noticeable in a fermentative off-aroma – rises.

Heat also leaves detectable, undesirable traces in honey. When heated, hydroxymethylfurfural (HMF) results, which gives the honey a caramel-type aroma. The HMF-content of honey is thus a measurable quality parameter.

Honey can present sensory spoilage that affect its quality and consumer acceptability. These spoilages can affect aroma, taste, texture,

color, and visual appearance and can be related to processing steps, storage, microbial contamination, or adulteration.

One of the most common spoilage is the appearance and sour taste and odor, in fermented honey resulting from microbial activity, especially yeasts, when the moisture content exceeds 18%. This fermentation process leads to the formation of organic acids, such as acetic acid, which give honey an unpleasant and sour taste profile.

Honey may have smoky, medicinal or chemical tastes and odors, as a result of contamination from external sources, such as smoke from beekeeping treatments, residues from equipment or packaging materials. These foreign flavors negatively affect the natural profile of the honey and may indicate improper beekeeping or processing practices. When honey contains taste notes that are not associated with floral origin – such as plastic, metallic or solvent flavors – this suggests contamination or lack of quality control during extraction or storage. For example, the use of plastic containers or metal equipment can lead to the migration of compounds that alter the sensory profile of honey. Although crystallization is a natural process, a coarse crystallization can be perceived negatively. A grainy or sandy texture can occur as a result of rapid crystallization or storage at uncontrolled temperatures, which affects the enjoyment of the honey. Furthermore, if the honey is partially liquefied and then recrystallizes, it can have a layered or heterogeneous appearance.

Although color variation is natural and depends on the floral source, an abnormally dark honey may signal overheating, prolonged storage, or fermentation. Uniformity and clarity are important visual quality criteria, and turbidity or the presence of suspended particles may indicate impurities or microbial activity (9).

Odorless honey may be the result of excessive processing or long storage. This sensory absence suggests the loss of volatile compounds, essential for the aromatic complexity of quality honey (10).

An imbalance between sweetness and acidity or a persistent bitter or astringent taste, not specific to the floral source, may also be a sign of sensory defects. These may occur as a result of botanical abnormalities, excessive fermentation or contaminants and residues present in the product. These defects, either individually or in combination, can significantly reduce the acceptability of honey by consumers and compromise its authenticity and commercial value. Therefore, the detection and evaluation of these defects through structured sensory analysis

remains essential in the quality control and certification process.

CONCLUSIONS

1. The sensory evaluation, allowed the collection of qualitative data on the sensorial perception of honey.
2. Participants appreciated aspects such as appearance, clarity, colour, consistency, aroma intensity, taste and texture of the honey.

3. The consumers correctly identified each type of unifloral honey.
4. A positive appreciation was observed for acacia honey for its clarity and balanced sweetness, and rapeseed honey was noted for its special texture.
5. Sensorial evaluation indicated a good overall acceptability, with most consumers declaring that they would purchase the product based on the sensory characteristics.

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