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# COMPARATIVE STUDY OF THE QUALITY OF TRADITIONAL HONEY AND INDUSTRIAL HONEY

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***Abstract***

*Along with the special nutritional properties, honey also has therapeutical properties, finding its place in many applications of modern medicine. The main objective of the research consisted in the qualitative testing of eight honey types, four of traditional type and four of industrial type, both organoleptic and physico-chemical and microbiological: lime honey, acacia honey, sunflower honey and polyfloral honey. The organoleptic determinations allowed us to classify all types of honey in the high quality category. In the case of microbial contamination, it was found that no honey sample developed microbial colonies. The pH determinations revealed that all commercial honey showed slightly high value than the traditional ones. In the case of viscosity, the largest differences were observed. It has been found that the traditional sunflower honey has the highest viscosity, respectively 8860cP, and the commercial sunflower honey the lowest viscosity, 200cP. The determination of reducing sugars by the Schoorl method showed that industrial sunflower honey has the highest content, 92.5%, and traditional lime honey, the lowest, 74.3%.*

***Key words****: honey, sugars.*

## INTRODUCTION

Bee honey is one of the most biologically complex products, in which compositions, apart from directly assimilable sugars, have been found very important substances for the human body. This fact increases the importance of honey to humans, compared to any other food (Bogdanov et al., 2008).

Besides the nutritional qualities, honey is in the first place among the medicines that nature offers us through flowers and herbs (Miguel et al., 2017).

The chemical and biological composition of honey makes it, in addition to excellent food, an important pharmaceutical means (Bogdanov et al., 2008). Vitamins in honey play the role of catalysts, glucose and fructose help regulate nerve activity, dilate blood vessels, have hemostatic action (stop bleeding) (Bogdanov et al., 2004). As it decreases the acidity of the gastric juice, honey is recommended in duodenal ulcer and hyperacidity (Sultan et al., 2017).

In the therapeutic field, honey can be used both orally and by local application. The most common diseases for which the honey bee is beneficial are: digestive disorders, hepato-biliary disorders, cardiovascular disorders and nervous system disorders (Miguel et al., 2017).

Honey is very nutritious, with promising properties of antioxidant, anti-inflammatory, antibacterial, as well as cough reduction and wound healing (Jaafar et al, 2017). The main concern in the use of honey-based medicines in modern medicine is the variation of the composition and the lack of clinical studies. Therefore, honey bee is recommended as a valuable dietary supplement.

The limited availability and the high price of honey offered a greater interest for falsifying or altering its quality. Honey quality and identity parameters are considered useful for detecting these possible distortions and also for confirming the hygiene conditions for handling and storing honey (Khaliq et al., 2013).

The main objective of this research consisted in the qualitative testing of eight honey types, four of traditional type and four of industrial type, both organoleptic and physico-chemical and microbiological: lime honey, acacia honey, sunflower honey and polyfloral honey.

## MATERIALS AND METHODS

The examination of honey was carried out in order to assess its quality and purity, in order to establish the state of degradation or alteration, through a series of physico-chemical and microbiological determinations (Szasz-Zima et al., 2016).

In order to carry out the experiments, 8 honey bee samples were analyzed:

1) Traditional honey (purchased from small manufacturers):

- P1 - lime honey;
- P2 - acacia honey;
- P3 - sunflower honey;
- P4 - polyfloral honey.

2) Industrial honey (purchased from commerce):

- PI - lime honey;
- PII - acacia honey;
- PIII - sunflower honey;
- PIV - polyfloral honey.

The following parameters were analyzed: organoleptic parameters (appearance, color, odor, taste, consistency), pH, total acidity, reducing sugars, refractive index, viscosity, microbiological contamination.

***Organoleptic analysis*** consists of examining a product by evaluating the perceptible attributes of the five sense organs (organoleptic attributes), such as: color, smell, taste, touch, texture. Sensory evaluation allows us to distinguish the botanical origin of honey, to identify and quantify certain defects (fermentation, impurities and flavors).

The ***pH*** **determination** was performed by potentiometric method (Romanian Pharmacopoeia, X$^{th}$ Edition, 1993). Honey contains a number of acids which include amino acids and organic acids.

The ***total acidity*** was determined by titration with 0.1N sodium hydroxide solution (Romanian Pharmacopoeia, X$^{th}$ Edition, 1993). Increased acidity of honey is an indicator for a fermentation process and transformation of alcohol into organic acid

The determination of the ***reducing sugars*** was done by the Schoorl method (Jurcoane et al., 2010).

Refractometric determination of the ***water content*** The refractive index of honey varies almost linearly, depending on the water content (Cano et al., 2001). It is considered that moisture content less than 18% will prevent the fermentation.

The ***viscosity*** was determined with the Brookfield DVII+Pro viscometer. The water content greatly influences the viscosity of honey. The more water a honey contains, the more fluid it is. Also, the presence of dextrins increases the viscosity of honey and gives it a glossy, unpleasant appearance.

***Determination of impurities***. The impurities were determined by weighing the resulting residue after filtration and drying of 10 g honey diluted to 50 ml with water. The impurities found in the honey samples represent an important parameter that provides information on the precision of the honey processing process.

***Diastatic index*** The determination of the *diastatic index* was performed by the Goethe method (Persano et al., 1990). The diastatic index is expressed by the amount of starch (1%) hydrolyzed in 1 hour of 1 gram of honey. *diastatic index* is a measure of freshness, correct processing and a guarantee of its authenticity.

The ***microbiological analysis*** wanted to highlight the presence of possible microorganisms (bacteria and fungi) in the tested samples (Romanian Pharmacopoeia, X$^{th}$ Edition, 1993).

## RESULTS AND DISCUSSIONS

***Organoleptic examination*** performed on the honey assortments allowed us to classify them in the good quality category (Table 1).

Table 1. Organoleptic characteristics of the analyzed honey samples

| Honey sample | Organoleptic characteristics |
|---|---|
| P1 | Clean, homogeneous appearance; fluid; light yellow; sweet taste; strong lime aroma |
| P2 | Clean, homogeneous appearance; fluid; light yellow; sweet taste; pleasant aroma |
| P3 | Clean, homogeneous appearance; fluid; viscous; dark yellow; pleasant, sweet, specific taste. |
| P4 | Clean, homogeneous appearance; fluid; light yellow; sweet taste, very aromatic |
| PI | Homogeneous appearance; fluid; yellow-orange, sweet taste, strong lime aroma |
| PII | Clean, homogeneous appearance; fluid; light yellow; sweet taste, pleasant aroma |
| PIII | Clean, homogeneous appearance; fluid; golden yellow; sweet taste; pleasant aroma |
| PIV | Clean, homogeneous appearance; fluid; light yellow; sweet taste, very aromatic |

***The pH of honey***. Honey contains a number of acids which include amino acids and organic acids, which gives honey an acid character.
The pH values were between 3.5 for industrial sunflower honey and 4.2 for industrial lime honey. The average pH of honey is 3.9, with a typical range of 3.4 to 6.1. A lower pH value suggests a possible alteration of the honey by fermentation, The pH value tests revealed that all honey samples fall within the normal limits of the admitted pH values (Figure 1).

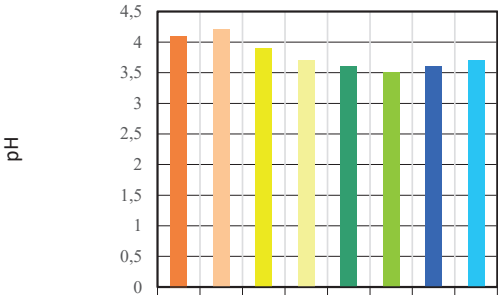


Figure 1. The pH value of of honey samples

***Determination of total acidity.*** This parameter allows to appreciate the freshness of honey. The acidity can be exceeded in case of fermentative alteration. In the case of falsification with invert sugar syrup, the reaction can be strongly acidic, if the acid used has not been neutralized, or neutral to alkaline in case of excessive neutralization.
All the analyzed samples were within the permissible limits, according to Table 2, the highest value being found in samples P4 (traditional polyfloral honey) 2.8, and the smallest value in sample I (industrial honey of lime), 1.4.

Table 2. Total acidity of honey samples

| Honey sample | Total acidity ($cm^3$ NaOH solution 0.1 N/100 g honey) |
|---|---|
| Limit | max. 4.0 |
| P1 | **1.4** |
| PI | 1.6 |
| P2 | 1.8 |
| PII | 2.2 |
| P3 | 2.6 |
| PIII | 2.6 |
| P4 | **2.8** |
| PIV | 2.4 |

Since none of the samples exceeded the maximum allowed value, we can conclude that the honey tested did not suffer any alteration or falsification and shows stability for fermentation.
***Determination of reducing sugars.*** Sugars are the main constituent and they give honey the main characteristic, the sweet taste: glucose, fructose, and sucrose. In general, the sugar composition of honey is affected by botanical origin (types of flowers), geographical origin, climate, processing and storage time (da Silva et al., 2016)
The average content of honey in reducing sugars is around 76%. A low content indicates poor quality of honey, which makes it susceptible to fermentation, while a too high content can mean artificial intervention on its composition.
From the results presented in Figure 2 it can be observed that the values regarding the content in reducing sugars corresponds, in almost all samples, to the data mentioned in the literature. Exceptions and extremes were the samples PIII (commercial sunflower honey), 74.8% and P3 (traditional sunflower honey), 86.4%.
Comparing traditional honey samples with the industrial ones we can observe that the first ones, due to their higher sugar content, are more qualitative.
In the case of P3, due to the very high content, 86.4%, we can assume that it was counterfeit by the addition of sugar. However, if we correlate this result with those obtained for the water content and the viscosity of the sample, this increased content sugars can be justified.

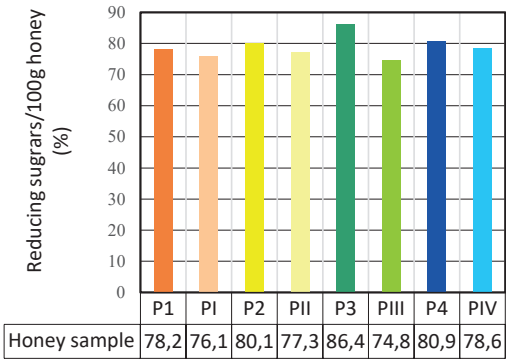


Figure 2. Content in reducing sugars of honey samples

***Determination of water content***. The higher moisture-in-honey content, the greater is the

possibility that the yeasts will ferment and change the flavor.The values of the refractive index varied between 1.4870-1.5044, all these data being presented in Table 3. The excess water content (max. 18%) reduces the value of honey and predisposes it to fermentation.
The low water content of P3 (traditional sunflower honey) is also supported by the following determination, of the viscosity, which could not be achieved under the same conditions as the other samples.

Table 3. Corelation between water content and refractive index of the honey samples

| Honey sample | Refractive index (nD) | Water content (%) |
|---|---|---|
| Limit | 1.4915 to 1.4993 | 20.8-15.0 |
| P1 | 1.4937 | 17.1 |
| PI | 1.4915 | 18.0 |
| P2 | 1.4987 | 15.2 |
| PII | 1.4920 | 17.8 |
| P3 | **1.5044** | **13.0** |
| PIII | **1.4870** | **19.8** |
| P4 | 1.4956 | 16.4 |
| PIV | 1.4930 | 17.4 |

***Determination of viscosity***. As can be seen in Table 4, the viscosity of the honey samples varied very widely. The determinations made at 22ºC, for 5 min, 8 RPM, with 06 rod, the values obtained varied between 240 cP, for PIII and 800 cP, for P2. Due to the high viscosity of sample P3, the determination was made with the 07 rod, without disk, the value obtained being 1200 cP.

Table 4. Viscosity of the honey samples

| Honey sample | Rod | Viscosity (cP) |
|---|---|---|
| P1 | 06 | 530 |
| PI | 06 | 440 |
| P2 | 06 | **800** |
| PII | 06 | 430 |
| P3 | 06 | 8860 |
| | **07** | **1200** |
| PIII | 06 | **240** |
| P4 | 06 | 610 |
| PIV | 06 | 490 |

***Determination of impurities***. Large impurities in honey are usually represented by dead bees or larvae or fragments thereof, by beeswax particles, pollen and sometimes by cellulose particles, all of which are insoluble in water. When the proportion of impurities exceeds 4% it proves negligence in extraction, purification or storage.

From the results presented in Figure 3 it can be observed that in case of 5 honey samples the content of impurities was exceeded.
The most important observation of this analysis is that all the traditional honey samples showed exceedances of the content of impurities, between 0.13-2.32%, which proves the negligence of the traditional producers regarding the processing and conditioning of honey.

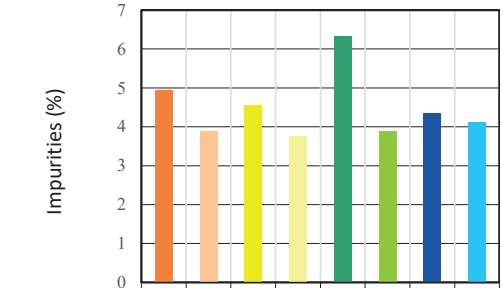


Figure 3. Content in reducing sugars of honey samples

What has caught our attention is that one of the industrial samples has slightly exceeded the content admitted for impurities.
***Determination of diastatic activity***. The presence of amylase in honey is a measure of freshness, correct processing (without heating exceeding 45 degrees Celsius) and a guarantee of its authenticity. The lack or small amount of diastase in honey may indicate a forgery. A diastatic index below 8 indicates a normal honey (Figure 4).

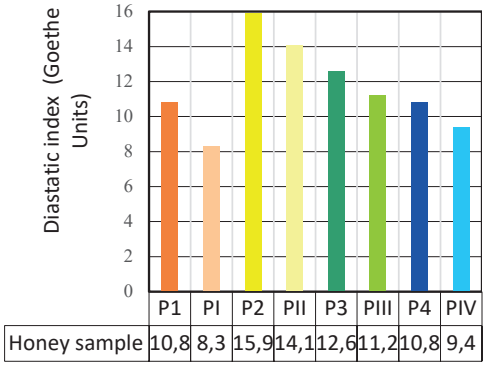


Figure 4. Diastatic index of honey samples

In honey degraded by energetic heat treatment and in the one treated with different substituents,

the activity of the diastase (amylase) will be diminished or completely null, so the value of the diastatic index will be below the normal limits, tending to zero.

The results obtained in case of determining the activity of diastasis have shown that honey, both traditional and industrial honey, are of high quality, presenting, in some cases, values much higher than the minimum allowed limit which proves the value and authenticity of the tested samples.

***Microbiological analysis*** of the samples after 2 days, in the case of bacteria and 7 days, in the case of fungi, showed that no analyzed sample shows contamination. Therefore, all assorted honey samples are safe for human consumption.

## CONCLUSIONS

Following the research conducted on honey samples it can be concluded that the tested honey samples are of good quality, observing very small differences in quality between industrial and traditional products, obtained by small producers.

The tests showed that all types of honey fall within the normal limits of the admitted values of pH, total acidity, reducing sugars, water content, viscosity, diastatic activity. Microbiological analysis demonstrated the absence of microorganisms (bacteria and fungi) from the tested samples.

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