

STUDY CONCERNING THE IDENTIFICATION OF ADULTERATED HONEY MARKETED IN THE SOUTH OF THE COUNTRY

STUDIU PRIVIND IDENTIFICAREA UNOR FALSIFICARI ALE MIERII DE ALBINE COMERCIALIZATE ÎN ZONA DE SUD A ȚĂRII

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ABSTRACT | REZUMAT

Honey is a semi-liquid substance, with a sweet taste and a pleasant aroma, rich in carbohydrates and vitamins, produced by bees from the nectar of flowers, but also from the sweet secretions of the trees, which they secrete and release outside, due to the bites made by the aphids. Sanitary and hygiene-wise, honey is defined as natural product extracted from honeycombs when they were covered with beeswax on at least 3/4 of their area. In terms of food safety, honey should be free of chemical, toxic and carcinogenic contaminants, including pesticides and antibiotics. The limited availability and high price of honey have increased the interest in adulterating this product. The study was conducted in a specialized unit in the South of the country that has its own laboratory. In this paper, the aim was to identify the quality of honey marketed in the Southern area of Romania, both by the study unit and by individual producers. On one hand, we followed the ways of the processing units to verify quality parameters of the honey raw material, received from beekeepers, while on the other hand, we followed the quality parameters of the honey marketed directly by sanitary-veterinary authorized beekeepers. The value of hydroxymethylfurfural (HMF), industrial glucose, tetracycline residue level and pollen index were analysed. Following the analyses of the honey samples received in the study unit, it can be seen that the value of the HMF accepted by the legislation in force for some samples, is exceeded. Adulterated samples by the addition of industrial glucose were found, correlating with the presence of an increased amount of HMF in the composition. There is also evidence of exceeding the accepted level of tetracycline residues. Regarding honey purchased directly from beekeepers authorized for marketing, it was found that in some samples, the value of HMF was exceeded, this being correlated with the addition of industrial glucose. Following the results of the ELISA test, in order to determine the tetracycline residues from the honey samples purchased from authorized beekeepers, the value of 2 ppb was not excee-

Mierea este o substanță semilichidă, cu gust dulce și cu aromă plăcută, bogată în zaharuri și vitamine, produsă de albine din nectarul florilor, dar și din secrețiile dulci ale pomilor și copacilor pe care aceștia le secretează și le scot în exterior în urma înțepăturilor ce le sunt făcute de către aphide. Din punct de vedere alimentar și igienico-sanitar, prin miere se înțelege alimentul natural extras din faguri când aceștia au fost căpăciți de albine pe cel puțin 3/4 din aria lor. În ceea ce privește siguranța alimentelor, mierea trebuie să fie lipsită de contaminanți chimici, toxici și cancerigeni, incluzând pesticide și antibiotice. Disponibilitatea limitată și prețul ridicat al mierii au făcut să crească interesul în ceea ce privește falsificarea acestui produs. Studiul s-a efectuat într-o unitate specializată din sudul țării care deține laborator propriu. În prezenta lucrare s-a urmărit identificarea calității mierii de albine comercializată în zona de sud a României, atât de către unitatea de studiu, cât și de către producători individuali. Pe de o parte s-au urmărit modalitățile unităților procesatoare de a verifica parametri de calitate ai mierii de albine materie primă, recepționată de la apicultori, iar pe de altă parte s-au urmărit parametri de calitate ai mierii de albine comercializată direct de apicultori autorizați sanitar veterinar. S-au analizat: valoarea hidroximetilfurfuralului, glucoza industrială, nivelul reziduurilor de tetraciclină și indicele polenic. În urma analizelor probelor de miere recepționate în unitatea de studiu se poate constata depășirea valorii HMF-ului acceptată de legislația în vigoare pentru unele probe. S-au depistat probe falsificate prin adăugare de glucoză industrială, acestea corelându-se cu prezența unei cantități crescute de HMF în compoziție. Se constată la unele probe și depășirea nivelului acceptat de reziduuri de tetraciclină. În ceea ce privește mierea achiziționată direct de la apicultori autorizați pentru comercializare s-a constatat că în unele probe s-a depășit valoarea HMF, aceasta fiind corelată cu adaosul glucozei industriale. În urma rezultatelor testului ELISA, în vederea determinării reziduurilor de tetraciclină din probele de miere achiziționate de la apicultori autorizați, nu a fost depășită valoarea de 2 ppb, dovedind astfel respectarea cerințelor legale. Determinarea sortului de miere, pe baza identificării microscopice a polenului dominant

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ded, thus proving compliance with the legal requirements. The determination of the type of honey, based on the microscopic identification of the dominant pollen, showed that out of five honey samples purchased from authorized beekeepers, only one sample complies with the legal requirements, while the other 4 samples did not have results consistent with parameters written on the label. The monitoring of honey composition is crucial in order to have a fair competitive market. Thus, an alarm signal is drawn regarding the local beekeepers, as they have to check honey more rigorously, because the consumer has the right to be informed correctly about the products they purchase.

Keywords: adulterated of honey, antibiotic residues, hydroxymethylfurfural, pollen index

Honey is the sweet natural substance produced by *Apis mellifera* bees from the nectar of plants, from secretions of living sections of plants or from the excretions of insects that are fed through suction from plants and which the bees collect and transform, combining them with their own specific substances, store, dehydrate, collect and leave them in honeycombs to macerate and mature (1, 11, 17, 36, 39, 42, 44). This is a natural product, consumed as food from ancient times (38). According to provenance, honey is classified in single-flower honey, poly floral honey and forest honey (3, 9, 13, 40).

Sanitary and hygiene-wise, honey is defined as natural product extracted from honeycombs when they were covered with beeswax on at least 3/4 of their area, in such a manner as to avoid the penetration of larvae, bees bodies, wax fragments or other impurities (5). Due to the fact that honey is a very valuable food, it is susceptible to adulterating by adding corn syrup, sugar cane syrup or other sweet substances (14). On one hand, adulterated honey affects the consumers who are looking for products with nutritional and therapeutic value, and on the other hand, it makes the market unfair to the high-quality honey producers. Therefore, identifying hazards for food safety and monitoring honey composition is crucial for a fair competitive market, for both conventional and organic products (7, 8, 10, 25, 30, 43, 45, 46).

Honey has therapeutic and medicinal properties and is considered a healthy food with high nutritional value (12, 16, 19, 29, 33, 41). Honey can be used as it is, or as a sweetener in the manufacture of pastry products, along with other products obtained from plants (20, 23, 34, 49).

In terms of food safety, honey should be free of chemical, toxic and carcinogenic contaminants, including pesticides and antibiotics (6, 21, 47, 50). Exposure of bees to these compounds causes a different acute to-

a evidențiat faptul că din 5 probe de miere de albine achiziționate de la apicultori autorizați, doar o probă respectă cerințele legale, celelalte 4 probe neavând rezultate conforme cu ceea ce era înscris pe etichetă. Monitorizarea compoziției mierii de albine este crucială pentru a exista o piață competitivă corectă. Se trage astfel un semnal de alarmă referitor la apicultorii locali, mierea acestora trebuind verificată mai riguros, deoarece consumatorul are dreptul de a fi informat corect cu privire la produsele pe care le achiziționează.

Cuvinte cheie: falsificarea mierii de albine, reziduuri de antibiotice, hidroximetilfurfural, indice polenic

xic effect, which results in short-term mortality, as well as honey contamination and health consequences for consumers (22, 26, 27, 28). Thus, the quality parameters of honey are useful for detecting possible frauds (4, 37). Improving the quality of food and ensuring its safety must be the main objectives of food business operators (24, 32).

Honey is among the top ten foods with the highest adulterating rate in the European Union (18). The authenticity of honey is an issue of international interest because honey has frequently been subjected to fraudulent practices, such as mislabelling in relation to botanical and geographical origin, mixing it with sugar syrups or with honey of lower quality (15, 31).

The purpose of this research is represented by the verification of the honey received by the study unit from beekeepers and by its monitoring throughout the processing procedure. Due to the fact that some apiculture products are marketed directly from beekeepers, another purpose of this study is to highlight the quality of these products.

MATERIALS AND METHODS

In this paper, the aim was to identify the quality of honey marketed in the Southern area of the country, as well as the modalities of the processing units to verify honey quality parameters.

The study took place in a profile unit located in the South of Romania and is based on the grouping of working samples, within three studies.

These three studies took place at different times of the year. Study 1 has been carried out during the summer months, when the bees harvest intensely, for which the unit received large quantities of honey from various beekeepers in the country, the assessed samples being numerous. Study 2 has been conducted in November on honey samples received from beekeepers.

pers for which there is no history, and which the study unit intended to include in the list of accepted suppliers. Study 3 was also conducted in November 2019, on honey samples purchased in Bucharest from a local sanitary-veterinary authorized beekeeper, following the concordance between the results obtained from the analyses and the inscriptions on the label.

The processing unit sells honey from both its own apiary and from beekeepers in the country. The unit purchases honey only if it complies with the following four conditions: **hydroxymethylfurfural** value of maximum 1g/100g honey; absence of **industrial glucose**; maximum 2 ppb **antibiotic residues**: tetracycline; **pollen index** value according to SR 784-3:2009 (52).

In study 1, in July, August, September 2019, 156 samples received in the study unit were analysed and the HMF value (by Winkler method), industrial glucose (by reaction with alcohol) and tetracycline residues (by ELISA method) were determined.

In study 2, in November 2019, 12 honey samples received in the study unit were analysed from beekeepers who provided honey for the first time, as follows: 6 polyfloral honey samples, 4 lime tree honey samples, 1 acacia honey sample, 1 rapeseed honey sample. The HMF value (by Winkler method), as well as industrial glucose (by reaction with alcohol) and tetracycline residues (by ELISA method) were determined for these.

For the third study, also in November 2019 were analysed 5 samples of honey purchased from the commercial network, respectively from Bucharest, from a local sanitary-veterinary authorized beekeeper (1 sample of coriander honey, 1 sample of mint honey, 1 sample of *Rhus spp.* honey, 1 sample of raspberry honey, 1 sample of acacia honey) and determined: HMF value (by Winkler method), industrial glucose (by reaction with alcohol), tetracycline residues (by ELISA method) and pollen index (according to SR 784-3:2009).

Determination of HMF value

The Winkler method was used to determine the HMF value. Hydroxymethylfurfural (HMF) occurs in honey when glucose decomposes within a warm and acidic environment in furfural products. HMF forms a red coloured complex with butyric acid in the presence of p-toluidine. The colour intensity is proportional to the HMF content (52). The HMF value admitted according to SR 784-3:2009 is maximum 1.5 mg/100g honey, but the value accepted by the study unit is more restrictive, this being maximum 1 mg/100g honey.

Identification of industrial glucose

For this analysis, the method used was the reaction with alcohol. Industrial glucose has a relatively high

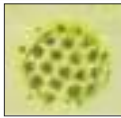
content of maltodextrins which is evidenced by alcohol precipitation. To eliminate protein interference, the reaction is performed on the deproteinized honey solution. If honey contains maltodextrins, turbid liquid of different intensities appears (opalescent, milky, flocculent). The solution remains clear, perfectly transparent in floral honey (negative reaction). In honey with industrial glucose addition, the liquid becomes turbid, milky, and flocculent (52).

Determination of tetracycline residues

For this parameter, the ELISA method was used, which is based on the reaction between the antigen and the antibody. The wells in the kit are lined with a tetracycline protein conjugate. After adding standards and samples, anti-tetracycline antibodies are added. The free and immobile tetracycline compete for binding sites of anti-tetracycline antibodies. The limit on tetracycline residues according to SR 784-3:2009 is maximum 2 ppb (52).

Table 1

The morphology of pollen granules according to the botanical origin of honey

Botanical origin of honey	The appearance of pollen granules
Lime tree (<i>Tilia spp.</i>)	
Acacia (<i>Robinia pseudoacacia L.</i>)	
Sunflower (<i>Helianthus annuus</i>)	
Rapeseed (<i>Brassica napus oleifera</i> and <i>Brassica rapa oleifera</i>)	
Corn (<i>Zea mays</i>)	
Coriander (<i>Coriandrum sativum</i>)	

Determination of pollen index

In order to determine the number of specific pollen granules, the microscopic examination of the sedi-

ment obtained after centrifugation was performed. Their percentage representation is determined by the ratio between the number of pollen grains of the same kind and the total number of pollen granules found in the same microscopic fields. We count approximately 1000 pollen granules (half for each drop), noting separately the number of granules belonging to the investigated species and separately from the other species. Depending on the botanical origin of honey, the pollen granules have a different appearance (Table 1).

RESULTS AND DISCUSSIONS

The quality of honey purchased from beekeepers influences most of the finished products quality. For this reason, the unit in which the study was conducted accepts only honey that meets the criteria established and specified previously.

Results and discussions regarding the determination of the hydroxymethylfurfural (HMF) value

Study 1 - determination of HMF from honey samples received in the study unit during July-September 2019

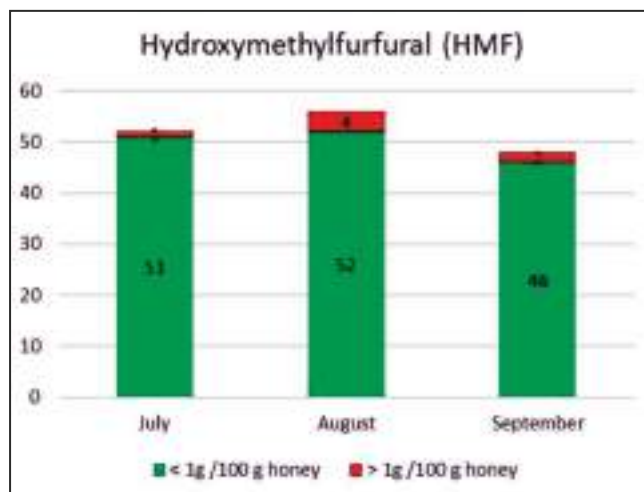


Fig. 1. Determination of HMF in honey samples received in the study unit during July-September 2019

Following the analysis of the 156 honey samples received in July, August, September 2019, 7 of the total

samples had a HMF value greater than 1 mg/100 g honey, which were rejected. The remaining 149 samples were accepted as honey raw material (Fig. 1).

Study 2 - determination of HMF from honey samples received in the study unit from beekeepers which deliver for the first time honey as raw material for the processor unit

In November 2019, 12 honey samples received by the study unit from beekeepers for which there was no history were analysed within the laboratory, being the first purchase. Thus, 6 polyfloral honey samples, 4 lime tree honey samples, 1 acacia honey sample and 1 rapeseed honey sample were collected. The values of the hydroxymethylfurfural obtained from the analysis by the Winkler method are presented in Table 2.

Table 2

HMF value of honey samples received in the study unit in November 2019

No.	Honey sort	HMF value (mg/100g)
1	Lime tree honey	1.52
2	Polyfloral honey	0.34
3	Polyfloral honey	0.69
4	Polyfloral honey	0.70
5	Polyfloral honey	0.76
6	Polyfloral honey	0.92
7	Lime tree honey	0.52
8	Lime tree honey	1.17
9	Lime tree honey	0.74
10	Polyfloral honey	0.51
11	Rapeseed honey	0.48
12	Acacia honey	0.63

Following the analysis of the 12 samples, sample 1 and sample 8 of lime honey exceed the admitted value of maximum 1 mg HMF/100g honey.

In the study conducted by Apriceno A. et al., in 2018 it was aimed to determine the HMF value of some samples of honey raw material of acacia, orange, chestnut, eucalypt, sunflower and lemon, the results obtained having higher values of HMF, these being between 0.2 mg HMF/100 g honey and up to 8.7 mg HMF/100 g honey (2).

Table 3

The HMF value (mg/100g honey) of the honey samples purchased from the commercial network

Honey sort	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
	Coriander honey	Mint honey	<i>Rhus</i> spp. honey	Raspberry honey	Acacia honey
HMF value	0.84	0.92	0.72	1.97	0.89

Study 3 - determination of HMF from honey samples purchased in November 2019, directly from beekeepers authorized for marketing

A number of 5 honey samples purchased from the commercial network were studied, of which: 1 sample of coriander honey, 1 sample of mint honey, 1 sample of *Rhus spp.* honey, 1 sample of raspberry honey and 1 sample of acacia honey. The results obtained from the determination of the hydroxymethylfurfural value are presented in Table 3. Regarding the determination of HMF for the samples of coriander, mint, *Rhus spp.* and acacia honey we find that the results correspond to SR 784-3:2009. Sample 4, respectively raspberry honey, exceeds the value admitted by HMF, registering 1.97 mg/100 g honey.

Results and discussions regarding the identification of industrial glucose

Study 1 - determination of industrial glucose from honey samples received in the study unit during July-September 2019

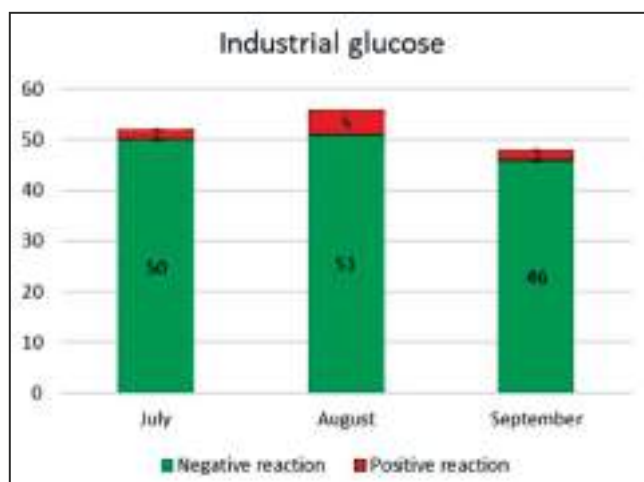


Fig. 2. Identification of industrial glucose from honey samples received in the study unit during July-September 2019

Following the analysis of the first study honey samples, it was observed that 9 samples showed a positive reaction regarding the determination of industrial glucose. Being susceptible to forgery, honey samples were rejected. The remaining 147 samples were accepted (Fig. 2).

Study 2 - determination of industrial glucose from honey samples from beekeepers who deliver honey for the first time to the processing unit

In November, the second study's honey samples were analysed in the laboratory. The results of the analysis are presented in Table 4. Positive results were obtained for samples 1 and 8 of lime tree honey, this honey being suspected of being adulterated by the addition of industrial glucose (Fig. 3), this fact can also be correlated with the presence of an increased amount of HMF in the composition.

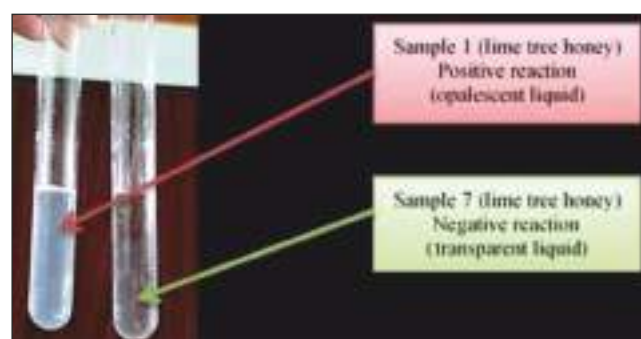


Fig. 3. Comparison between a positive and a negative sample regarding the identification of industrial glucose

Study 3 - Determination of industrial glucose from honey samples purchased from beekeepers authorized for direct marketing

The third study honey samples were analysed, and the results obtained regarding the identification of industrial glucose by reaction with alcohol, are presented in Table 5.

Table 4

Identification of industrial glucose by reaction with alcohol of honey samples from study 2

No.	Honey sort	Reaction result	Interpretation
1	Lime tree honey	Positive	Adulterated honey
2	Polyfloral honey	Negative	Natural honey
3	Polyfloral honey	Negative	Natural honey
4	Polyfloral honey	Negative	Natural honey
5	Polyfloral honey	Negative	Natural honey
6	Polyfloral honey	Negative	Natural honey
7	Lime tree honey	Negative	Natural honey
8	Lime tree honey	Positive	Adulterated honey
9	Lime tree honey	Negative	Natural honey
10	Polyfloral honey	Negative	Natural honey
11	Rapeseed honey	Negative	Natural honey
12	Acacia honey	Negative	Natural honey

Table 5

Results regarding the identification of industrial glucose by reaction with alcohol of honey samples from study 3

Honey sort	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
	Coriander honey	Mint honey	<i>Rhus spp.</i> honey	Raspberry honey	Acacia honey
Result	Negative	Negative	Negative	Positive	Negative
Interpretation	Natural honey	Natural honey	Natural honey	Falsified honey	Natural honey

Following the results of the analysis regarding the identification of industrial glucose, for sample 4 - raspberry honey, the result was a positive one, this honey being suspected of adulteration by the addition of industrial glucose.

Results and discussions regarding the detection of tetracycline residues

Study 1 - determination of tetracycline residues in honey samples received in the study unit during July-September 2019

Following the laboratory analysis, out of the 156 honey samples received in the study unit in July, August, September 2019, 10 samples had residues of more than 2 ppb tetracycline, which were rejected. The other 146 samples analysed were accepted, with compliant results (Fig. 4).

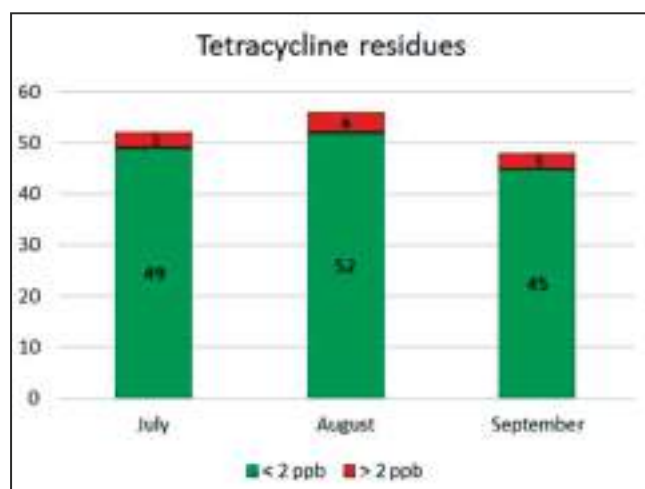


Fig. 4. Determination of tetracycline residues in honey samples received in the study unit from July to September 2019

Study 2 - determination of tetracycline residues from honey samples received from new suppliers of honey raw material

In November, the second study honey samples were analysed within the laboratory. Following the ELISA test (Fig. 5) for the determination of tetracycline residues, values between 1.21 ppb - 4.18 ppb (Table 6) were obtained.



Fig. 5. ELISA spectrophotometer and sample pipetting

Table 6

Results regarding the detection of tetracycline residues in study 2

No.	Honey sort	Final concentration (ppb)
1	Lime tree honey	1.95
2	Polyfloral honey	1.32
3	Polyfloral honey	1.41
4	Polyfloral honey	4.18
5	Polyfloral honey	1.77
6	Polyfloral honey	1.56
7	Lime tree honey	1.83
8	Lime tree honey	1.90
9	Lime tree honey	3.38
10	Polyfloral honey	1.48
11	Rapeseed honey	1.21
12	Acacia honey	1.32

Most of the samples recorded negative results (83.33%), excepting 2 samples (16.66%).

Similar results regarding antibiotic residues were observed in the study conducted by Vieriu M.C. in 2011 (48). Of the total honey samples, 17.92% were classified framed according to their content in the category of contamination suspected samples.

In another study conducted by Popa I.D. in 2013, values of tetracycline residues in the range of 1.25 ppb - 5.5 ppb were detected, with 19.56% of the total samples falling in the category of samples suspected of being contaminated with antibiotic residues (35).

Table 7

Results obtained after detecting tetracycline residues of honey samples from study 3

Honey sort	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
	Coriander honey	Mint honey	<i>Rhus spp.</i> honey	Raspberry honey	Acacia honey
Tetracycline concentration (ppb)	1.02	1.89	1.22	1.30	1.44

Study 3 - detection of tetracycline residues from honey samples purchased from authorized beekeepers for direct marketing

The honey samples for the third study were analysed and the results obtained, regarding the detection of tetracycline residues, are presented in Table 7. Following the results of the ELISA test, no positive results were found, with values not exceeding 2 ppb (52).

Results and discussions on determining the content of pollen granules and identifying the honey sort. Compliant results were obtained following the identification of the pollen spectrum, for all the samples analysed in studies 1 and 2.

Results and discussions regarding the determination of the pollen granules content and the identification of the honey sort of the samples analysed in the study 3.

In order to authenticate the honey sort, a number of 5 honey samples were analysed, purchased from beekeepers authorized for direct marketing to consumers in the commercial network, in November 2019, and the results are presented in Tables 8, 9, 10, 11 and 12.

Table 8

Types of pollen granules identified in coriander honey (sample no. 1)

% examined pollen granules	
Acacia	3 %
Lime tree	1.5 %
Sunflower	75.3 %
Rapeseed	8.1 %
Corn	5.1 %
Coriander	2.1 %
Other types	4.9 %

Table 9

Types of pollen granules identified in mint honey (sample no. 2)

% examined pollen granules	
Acacia	26.5%
Lime tree	0.7 %
Mint	0 %
Sunflower	19.0 %
Rapeseed	40.7 %
Corn	3.1%
Other types	10.0 %

Table 10

Types of pollen granules identified in *Rhus spp.* honey (sample no. 3)

% examined pollen granules	
Acacia	3.5 %
Lime tree	2.1%
Sunflower	54.3%
Rapeseed	20.2 %
Corn	6.8 %
<i>Rhus spp.</i>	0 %
Other types	13.1 %

Table 11

Types of pollen granules identified in raspberry honey (sample no. 4)

% examined pollen granules	
Acacia	29.5 %
Lime tree	10.5 %
Sunflower	34.5%
Rapeseed	16.0%
Corn	6.0%
Raspberry	0%
Coriander	1.0%
Other types	2.5%

Table 12

Types of pollen granules identified in acacia honey (sample no. 5)

% examined pollen granules	
Acacia	35.2%
Lime tree	9.8%
Sunflower	30.2%
Rapeseed	9.2%
Corn	1.2%
Other types	14.4%

Sample no. 1: Coriander honey has a low content of coriander pollen granules, respectively 2.1% and a high content of sunflower pollen granules, respectively 75.3%. This percentage indicates the classification of honey in the sunflower honey sort. As a result, honey has been fraudulently mislabelled.

Sample no. 2: Mint honey does not contain mint pollen granules. It contains 26.5% acacia pollen, but additional pollen such as rapeseed and sunflower pollen have been also identified. According to STAS 784/

2009, the sample was framed as acacia honey of quality I. Thus, it was identified as fraudulent by mislabelling.

Sample no. 3: *Rhus spp.* honey does not contain *Rhus spp.* pollen granules, but a high percentage of sunflower pollen granules, more precisely 54.3%, compared to 40%, specified in the legal regulations for this type of honey.

Sample no. 4: Raspberry honey does not contain raspberry pollen granules. It contains 29.5% acacia pollen granules and lots of sunflower pollen granules. This honey is framed as acacia honey of quality I, being fraudulently mislabelled.

Sample no. 5: Acacia honey contains an increased percentage of acacia pollen granules, respectively 35.2%. The accompanying pollen consists of sunflower, rapeseed, lime tree and corn granules. The parameter determined is in accordance with the quality conditions provided by EU Directive 110/2001 for honey for human consumption and STAS 784-3:2009, respectively 30% (51, 52). Therefore, this is high quality acacia honey.

CONCLUSIONS

The quality of honey purchased from beekeepers largely influences the quality of the finished products, for this reason, monitoring the composition of honey is crucial in order to have a fair competitive market.

Of the 3 studies performed in this paper, the most non-compliant results were obtained in study 3, representing honey samples purchased from a local authorized beekeeper.

Regarding the value of the HMF determined for the samples of study 1, it was found that 4.49% of them exceeded the maximum level allowed by the study unit, being rejected, and 95.51% of the total analysed samples were accepted, while in the study 2, 16.66% of the samples were rejected, and the remaining 83.34 were accepted. In the third study, the value of HMF was exceeded for 1 sample out of the 5 analysed.

Following the identification of industrial glucose for the samples of study 1, it was found that 5.77% were falsified using industrial glucose. 16.66% of the samples from study 2 showed positive reactions, their falsification being acknowledged due to the addition of industrial glucose. In study 3, the same sample which presented exceeded values of HMF, registered also industrial glucose positive values.

The determination of the tetracycline residues detected in honey bees revealed that in study 1, 6.41% of the honey samples, exceeded the admitted level. In study 2, 16.66% of the samples were rejected due to the positive results for the same parameter. Concerning study 3, compliant results were obtained for all the analysed samples.

The determination of the content of pollen granules and the identification of the honey sort led to the highlighting of some compliant results for all the samples analysed in studies 1 and 2. Regarding the honey samples from study 3, purchased from local beekeepers, non-compliant results were obtained for four of the analysed samples, these being unable to meet the required percentage of pollen in order to be classified in the honey type labelled by the beekeeper.

The only sample with the corresponding pollen spectrum was the acacia honey sample. Coriander honey, mint honey, *Rhus spp.* honey and raspberry honey are fraudulently mislabelled, having not the required percentage of pollen granules specific to the sort labelled by the beekeeper.

Thus, an alarm signal is drawn regarding the local beekeepers. A more rigorous check of the authorized beekeepers and a warning of the consumers regarding the source of purchase of the bee products is recommended.

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