Some Properties of Algerian Honey

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Short title: Algerian honeys

Abstract

An analytical investigation was carried out on 66 honey samples produced in different regions of Algeria, in order to evaluate their quality, verify their compliance with international standards and study their melissopalynological characteristics. The results show that the professional level of beekeepers often does not achieve the production of high quality honey for the market in the country: only 62% of the samples were estimated as wholly compliant, while about 38% of them showed minor or major defects, mainly depending on production and/or storage practices. The pollen analysis showed the main botanical species for honey production to be *Eucalyptus* spp., Umbelliferae (above all *Pimpinella*), *Hedysarum*, Compositae (mainly *Carduus*), *Trifolium* spp., *Echium*, *Rubus*, Cruciferae and *Citrus*. A preliminary picture of the pollen spectrum typical of the Algerian honey is given. A better knowledge about Algerian honey and bee flora is important to improve beekeeping practices and the production of valuable unifloral honeys. Moreover it would provide scientific support for the control of marketed honey and the protection of the consumer.

Key words: honey, physicochemical analysis, melissopalynology, Algeria.

Introduction

In Algeria honey is used both for nutritional and therapeutic purposes, and its price attains quite high levels, while the knowledge of the product is still poor, and the quality control of local and imported honey is completely inadequate. This situation does not allow a sufficient protection of the consumer and facilitates possible frauds. Indeed, at the scientific level, only a few data are available: a research carried out on 11 honey samples [1], and a University thesis carried out on 15 samples [2].

To contribute more to the knowledge of Algerian honey, in the present research we further investigated the subject, developing a previous University thesis [3], with the aim of evaluating, on a larger number of samples, the quality of Algerian honey, verifying their compliance with international standards [4, 5], and examining their melissopalynological characteristics.

Material and methods

Sixty-six honey samples produced in different regions of Algeria (West, Centre, Est), were collected, partly from beekeepers and partly from the market, during a 3 years period (2003- 2005). All samples were kept refrigerated until analysis. On all the samples the following physicochemical parameters were measured, according to the analytical methods harmonized by the European Honey Commission [6]: water content, sugars (HPLC with pulsed amperometric detection), electrical conductivity, pH and free acidity (equivalence point titration), HMF (Winkler method), diastase (Phadebas method) and invertase activity. Colour was also measured, according to Aubert and Gonnet [7]. The melissopalynological characteristics, both qualitative and quantitative, were studied following Louveaux *et al*. [8].

Results and discussion

Physicochemical analyses and conformity to the international standards.

Results of physicochemical analyses are reported in table I.

Table 1. Results of physicochemical analyses on 66 Algerian honey samples. (n.d.= not detectable)

Parameter	Mean value ± St. dev.	Min – Max values	Limits of international standards	Samples exceeding limits of international standards
Water (g/100g)	16.5 ± 1.6	13.9 – 20.2	not more than 20 g/100g	1 sample (11 samples between 18 and 20 g/100g)
Fructose (g/100g)	41.8 ± 3.4	34.0 – 49.1	no fixed limit	
Glucose (g/100g)	29.1 ± 2.9	21.2 – 35.2	no fixed limit	
Fructose+Glucose (g/100g)	70.9 ± 4.8	55.2 – 79.8	Nectar honey: not less than 60 g/100g Honeydew honey: not less than 45 g/100g	2 samples
Sucrose (g/100g)	1.14 ± 0.96	n.d. – 4.31	not more than 5 g/100g	
Fructose/Glucose ratio	1.45 ± 0.17	1.11 – 2.00	no fixed limit	
Glucose/Water ratio	1.78 ± 0.25	1.30 – 2.34	no fixed limit	
El. Conductivity (mS/cm)	0.65 ± 0.21	0.21 – 1.24	Nectar honey: not more than 0.8 mS/cm Honeydew honey: not less than 0.8 mS/cm	18 samples
pH	3.94 ± 0.40	3.40 – 6.23	no fixed limit	
Free acidity (meq/kg)	10.9 ± 3.7	3.0 – 22.5	not more than 50 meq/kg	
HMF (mg/kg)	18.5 ± 20.3	0.5 – 124.0	not more than 40 mg/kg	4 sample (43 samples between 10 and 40 mg/kg)
Diastase (DN)	17.4 ± 9.0	4.0 – 40.0	not less than 8 Schade units	6 samples
Invertase (IN)	8.1 ± 5.0	n.d. – 20.0	no fixed limit	
Colour (mm Pfund)	74.8 ± 23.1	18.0 – 119.0	no fixed limit	

For the water content, most of the samples show quite low values (average value 16.5), and only 1 sample exceeds the limit of 20 g/100g established by the international norms; however another 11 samples (16.7%) have values higher than 18 g/100g (Fig. 1), that might be a cause of fermentation and, more generally, of a shorter shelf life [9]. These high values could be accounted for by a premature honey harvesting or by inadequate storage conditions.

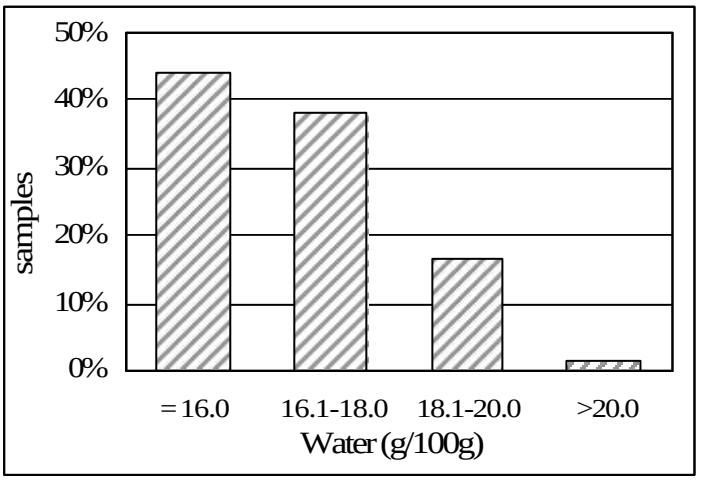


Figure 1. Distribution of the 66 honey samples according to the water content.

Sugar content is quite in agreement with Bogdanov *et al*. [10] and with the international standards: only 2 samples show a fructose+glucose content lower than 60 g/100g, probably due to the presence of some honeydew component; for the sucrose no samples exceed the value of 5 g/100g.

The electrical conductivity of the 66 honeys examined is quite elevated, with an average value of 0.65 ± 0.21; most of the samples (41 = 62.1%) fall in the range 0.4-0.8 mS/cm, and 18 samples (27.2%) show values higher than 0.8 (Fig. 2). For this parameter the international standards prescribe a maximum limit of 0.8 mS/cm for most nectar honeys [4, 5, 10], with several exceptions, among which is *Eucalyptus* honey: actually, 7 of the 18 samples exceeding 0.8 mS/cm have *Eucalyptus* as the predominant pollen, but for the other samples there is no evidence of any specific nectar or honeydew components that could explain these high values. Almost all of them are characterized by a dark colour, but the sugar spectrum and pH values do not indicate a significant amount of honeydew.

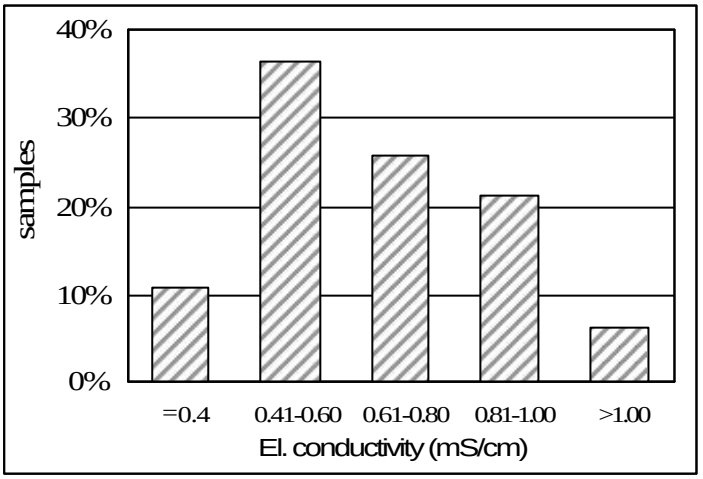


Figure 2. Distribution of the 66 honey samples according to the electrical conductivity values.

All acidity values fall under the prescribed limit of 50 meq/kg.

The measure of HMF content and enzyme activities (diastase and invertase) are used to evaluate honey freshness. The international standards establish a limit of not more than 40 mg/kg for HMF and not less than 8 Schade units for diastase (not less than 3 for honeys with low enzyme content, if HMF content is below 15 mg/kg). For invertase (more sensitive to heating than diastase) no limits are fixed by the norms; however Persano Oddo *et al.*, [11] report that fresh honeys most fall into the range 5-20 IN (lower values are found in honey types with a low enzyme content), while Bogdanov *et al*. [10] suggest 10 IN as minimum value for fresh honeys (4 for honeys with low enzyme content). It is to be noted that the use of enzyme activities as indicators of honey freshness is often criticised, since the initial enzyme activity may be very different in the various honey types [11, 12, 13, 14].

In the 66 samples analyzed, the HMF content is quite elevated (18.5 mg/kg on average): 4 samples exceed the limit of 40 mg/kg, and only 19 samples (28.8%) show values lower than 10 mg/kg (Fig. 3), which are typical of fresh unheated honeys, according to the current quality criteria [15]. As far as enzyme activities are concerned, 6 samples have a diastase value lower than 8 Schade units, and 22 samples have an invertase value lower than 5 IN, but some of them (with a

prevalence of *Citrus* or *Vicia*), showing a low HMF content, may be classed as honeys with low enzyme content.

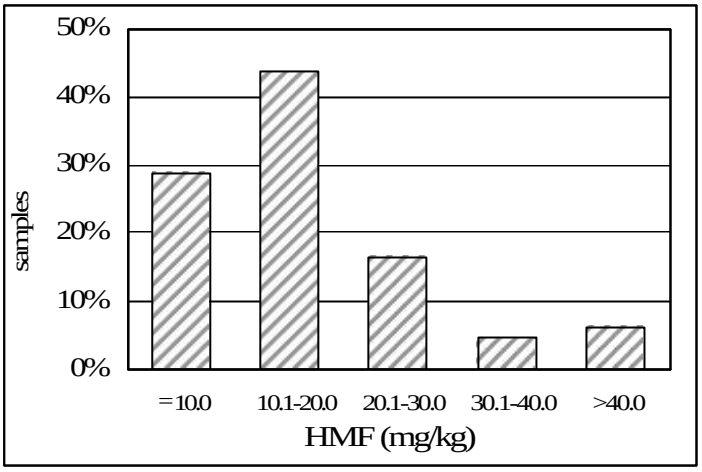
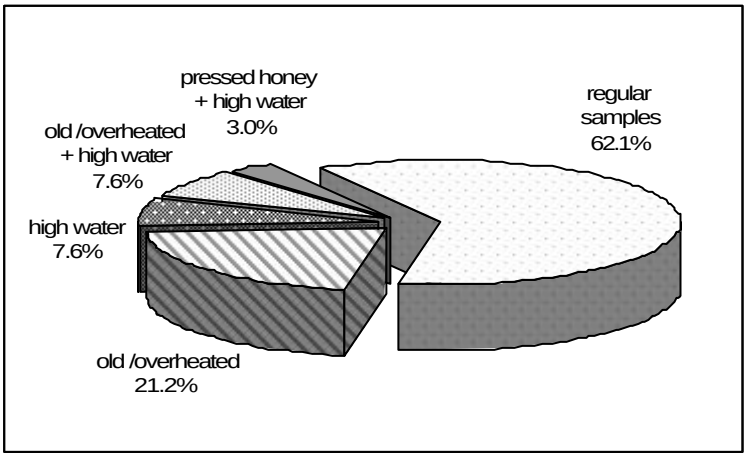


Figure 3. Distribution of the 66 honey samples according to the HMF content.

By comparing the freshness indicators, 19 samples (28.8%) are judged not to correspond to fresh unheated honey. This can be accounted for by inadequate processing or storage conditions, but partly it could also be due to the climate of the production area (samples with the lowest invertase values come from the drier and hotter regions of Algeria).

Colour varies from 18 to 119 mm Pfund, with an average value of 74.8. Only 12 samples are light or extra light, while dark to very dark samples are predominant (51.5%). These latter include 12 of the 19 honeys judged as old or overheated on the basis of freshness indicators: for these samples the dark colour is probably the result of the inadequate processing or storage conditions.

Figure 4. Defects found in the 66 Algerian honey samples.



Considering altogether the results of these physicochemical analyses, we can observe that, as far as the quality is concerned, only 62% of the examined samples can be evaluated as wholly compliant, while about 38% of them present some quality defect (Fig. 4).

Melissopalynological analyses

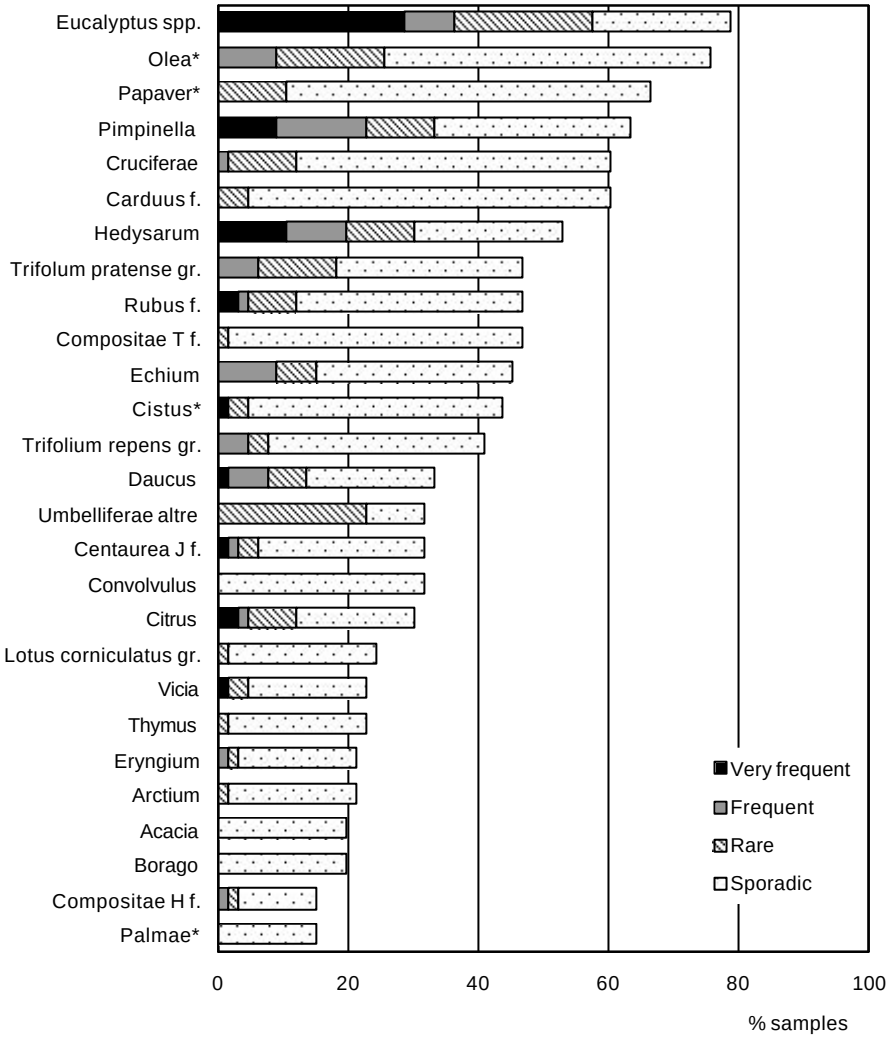


Figure 5. Main pollen types identified in the 66 Algerian honey samples. (= nectarless species)*

From the qualitative pollen analysis [3, 16], the main botanical species for honey production in Algeria are found to be *Eucalyptus* spp., Umbelliferae (above all *Pimpinella*), *Hedysarum*, Cruciferae, Compositae (mainly *Carduus*), *Trifolium* spp. and, to a lesser extent, *Echium*, *Rubus* and *Citrus* (Fig. 5).

Of the 66 samples, 18 presented very high percentages of *Eucalyptus* (over-represented species), and 14 of them were consistent with the characteristics of the unifloral honey, as described by Serra Bonvehí [17] and Persano Oddo *et al*. [13, 18, 19]; 7 samples had *Hedysarum* as the predominant pollen, but they did not fit with the characteristics described for the unifloral honey [18, 19], namely for the high values of colour and electrical conductivity, so they were classed as multifloral; in 6

samples *Pimpinella* was predominant, however the sensory and physicochemical characteristics of these samples were quite dissimilar from each other, so it was not possible to classify them in a definite way; 3 samples contained quite high percentage of *Citrus* (under-represented species), and 2 of them complied with the unifloral type [13, 18, 19, 20]; another 2 samples contained *Daucus* and *Vicia* as predominant pollen, but a description of these honey types is not available, so we have no criteria for classifying them as unifloral.

Our results are quite in agreement with Ouchemoukh *et al*. [1] and Belaid [2], as far as the main species are concerned, but these Authors report higher frequencies of pollen from fruit trees (*Prunus* and *Pyrus*) and *Erica*, which we found only in 9 and 5 samples respectively, almost always at a level of sporadic level.

From the results of quantitative pollen analysis, 22 samples belonged to the I class of representativity (under-represented honeys, with less than 20,000 pollen grains in 10 g honey, according to Louveaux *et al*. [8]), 27 to the II class (normal honeys, with 20,000 to 100,000 PG/10g) and 15 to the III class (over-represented honeys, 100,000 to 500,000 PG/10g); 2 samples, with more than 1,000,000 PG/10g, belonged to class V, pressed honey.

Even if the data are not sufficient for an accurate geographical characterization, we can draw a preliminary picture of the pollen spectrum of the Algerian honey (Fig. 5), where pollens representative of Mediterranean origin, as *Eucalyptus*, *Olea*, *Carduus*, *Cistus*, *Citrus*, are associated with species of cultivated areas (*Papaver*, Cruciferae, various Leguminosae) and some elements more typical of a dry-hot climate (*Acacia*, Palmae).

Conclusions

From the study of 66 Algerian honey samples, some consideration can be given to the professional level of beekeepers which often does not allow high quality honey production and marketing in the country: indeed, only 62% of the examined samples attain a good quality, while about 38% of them show one or more defects.

An increased and more effective extension service will be necessary to improve the beekeepers' knowledge about honey quality features and adequate production and storage technologies. On the other hand, better control of the marketed honey is needed for consumer protection.

The researches on Algerian honey should be further developed, in order to better understand the actual extent and interpretation of some of the analytical results obtained, which may be related to bee race, environment, climate, bee forage, etc., and to learn more about the local bee flora and the possibilities of increasing the production of valuable unifloral honey types. Moreover, the achievement of a good knowledge of the product would provide the scientific support for the introduction of a national norm for honey.

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