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PHYSICOCHEMICAL CHARACTERISTICS AND POLLEN SPECTRUM OF SOME NORTH-EAST ALGERIAN HONEYS

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ABSTRACT

The qualities of seventeen honey samples harvested from the North-East areas of Algeria were evaluated by determining the pollen spectrum, pollen number quantity and physicochemical attributes. Pollen analysis can therefore be useful to determine the geographical and botanical origin of honeys. The following determinations were carried out: pH, density, acidity (free, lactone and total), moisture, electrical conductivity, hydroxymethylfurfural, diastase activity, apparent sucrose, and proteins. The results obtained in the present study show the variability of chemical composition of the honey samples. It proved that nine natural honeys are of blossoming origin; suitable for consumption and that one (T5 conferred Bougous) can be used with fine dietetics, it is very rich in pollen which is regarded as protein source. The remainder, eight honeys, were not in conformity with the International Regulatory Standards, their sugar contents (Sucrose) and hydroxymethylfurfural exceeded the International Regulatory Standards Review by the International Honey Commission, this was probably due to use of syrup for the over-feeding the bees during the spring. The sample Bouhachana (G1) had high water content (more than 20%), low density and electrical conductivity higher than 5 µS/cm, which makes it likely to undergo fermentation and degradation. Honeys of Guerguour (T1), Boutheldja (T2) and Bouhadjar (T3) had pH lower than the European standards concerning the quality control of the foodstuffs (exp. honey). These samples are fragile; so we cannot preserve them for a long period. The palynological analysis (qualitative and quantitative) of the harvested samples in the area, showed the absence of a honey obtained from only one melliferous plant. All honeys are polyfloral exits of the several plant species visited by the worker bees during their blossoming periods. Three families are the most represented in the groups of pollen of accompaniment (the secondary pollen ranged between 16-45%) and the pollen considered as rare (minor pollen 3-15%) in the counted total number of the pollen grains in 10 grams of honey. These forager honey families are: Myrtaceae presented by the Eucalyptus, Papilionaceae presented by *Hedysarum coronarium* which is a forager plant characterized by a very vast surface of development, and Rosaceae represented by orchard and forest species.The pollen grain number counted in honeys is very significant (between 80 000 and 24 832 000pollen grain), what makes it possible to classify the samples analyzed among the categories rich in pollen.

Key words: melissopalynology, physicochemical analyses, sucrose, hydroxymethylfurfural

INTRODUCTION

Honey is natural complex food product produced by bees from nectar of plants and also from honeydew. It is a unique sweetening agent that can be used by humans without processing. Honey of honeybees has significant nutritional and medicinal benefits. It is a rich source of readily available sugars, organic acids, various amino acids and in addition source of many biologically active compounds [1].

The quality and biochemical properties of honey are related to honey maturity, production methods, climatic conditions, processing and storage conditions, as well as the nectar source of the honey [2-6].

However, quality and composition of honey are negatively affected by the other factors such as overfeeding with sucrose and other sucrose variants, harvesting prior to maturity, unhealthy storage conditions and overused veterinary drugs [7-9].

Considering the dietetic importance of this product and its scarcity on the market, it is exposed to fraud. For that, the European and International Commissions proposed methods of analyses followed by standards bodies such as Codex Alimentarius [10, 11] or European Standards for honey quality control.

In Algeria, bee-keeping is practised in many areas, characterized by a remarkable richness of honey plants. The Algerian East is one of the zones of the most significant bee-keeping in the country. During the last years, a progression in the honey production has been observed. Therefore, the present study was undertaken to characterise the physicochemical properties and the botanical origin (blossom and/or honey-dew honeys) of the Northeast Algerian honey.

MATERIAL AND METHODS

Honey samples

Seventeen honey samples produced in various regions of North-East of Algeria (Fig. 1) were collected from beekeepers between July 2001 and September 2001. The samples were stored in a refrigerator at 4-6°C in airtight plastic containers until analysis. The regions from which the honey samples were collected are indicated in Table 1. The botanical origin of the honey samples was based on the pollen spectrum (45% and above), which is the ratio of the frequency of each pollen type in the honey [12].

The analysis was based on the principle that microscopic elements were concentrated by centrifuging the honey dissolved in water, examining the sediments and evaluating them under the microscope after acetolysis. The method followed for pollen analysis was described by Louveaux *et al.* [12]. Briefly, a sub-sample of honey (10g) was dissolved in 20 ml of warm distilled water (around 40 °C) and centrifuged twice (2000 rpm) for 10 min. The dry sediment was mounted on a slide with glycerine/gelatine slightly stained with an alcoholic solution of fuschin. Slides were

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microscopically observed and compared with the reference for identification. The following terms were used for frequency classes: predominant pollen (more than 45% of pollen grains counted), secondary pollen (16–45%), important minor pollen (3–15%) and minor pollen (less than 3%).

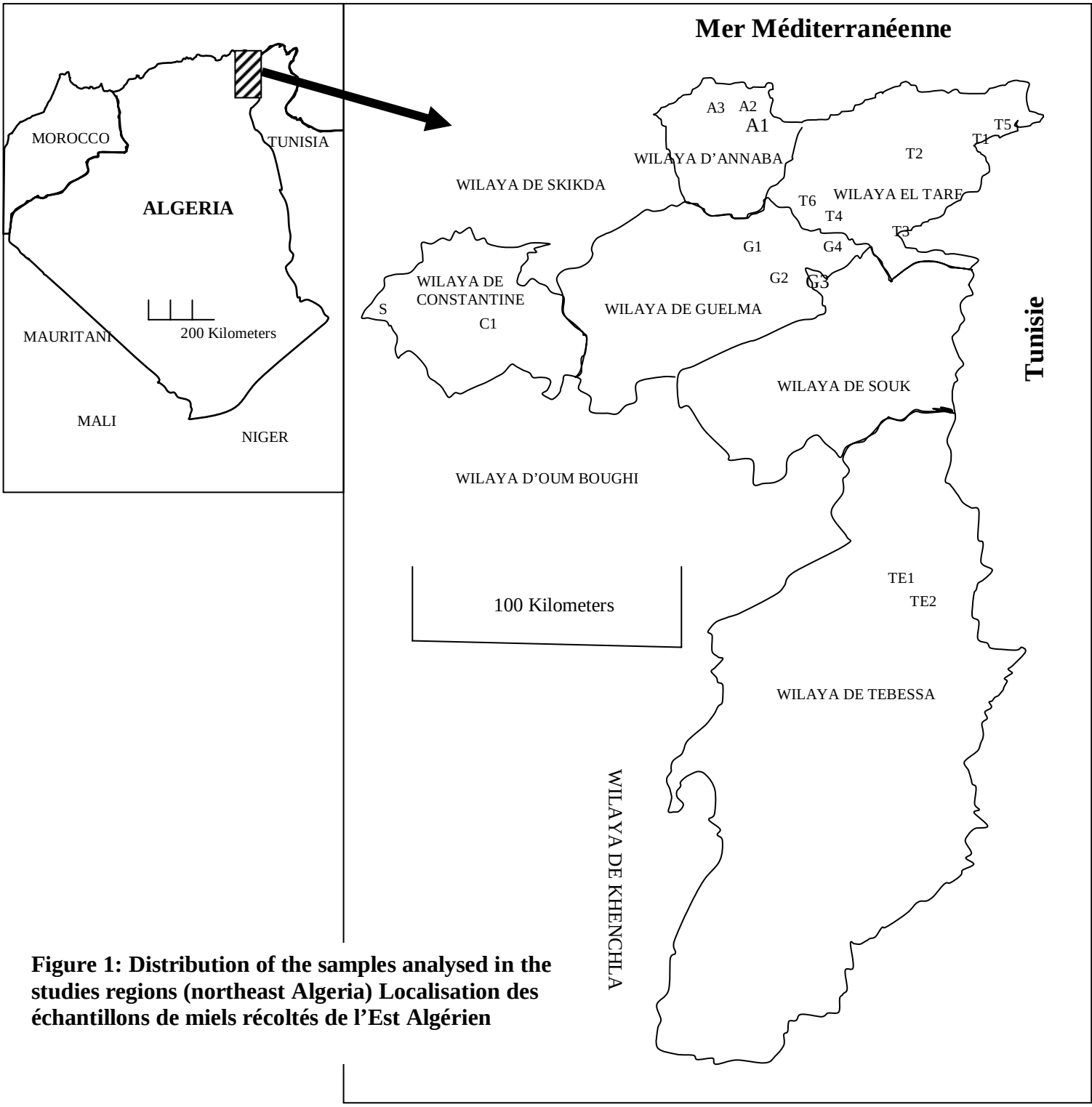

Figure 1: Distribution of the samples analysed in the studies regions (northeast Algeria) Localisation des échantillons de miels récoltés de l'Est Algérien

Honey properties

The samples of honey were analysed according to the European Honey Commission methods [13-16, 10, 11]. The specific gravity of honey (density) was determined by dividing the weight of specific gravity bottle (50 ml) filled with honey by the weight of the same bottle, filled with water [17]. Moisture was determined by refractometry method [18]. Electrical conductivity was measured in a 20% (w/v) solution of honey in deionised water using Leibohld model conductimeter. The pH was assessed in a 10% (w/v) solution of honey in distilled water [18].

Lactone and total acidity were determined by the titrimetric method as follows: Sample was titrated to pH 8.5 using 0.05N NaOH (free acidity). Excess 0.05N NaOH (10ml) was, immediately added and without delay back-titrated with 0.05N HCL to pH 8.3 (lactone acidity) [18, 19]. Total acidity was obtained from the sum of free and lactone acidities [19]. Results were expressed as meq/kg.

Apparent sucrose was determined by the methods described in the French Official Journal [18].

The protein content was determined by the method of Azeredo *et al.* [20]. Briefly, protein extract (honey sample 50% w/v) (0.1ml) was added to 5 ml of Coomassie Brillant Blue. After 2 min of incubation, the quantity of proteins was determined at 595 nm and compared to bovine serum albumin standard curve [21].

Hydroxymethyl furfural (HMF) was determined after dilution with distilled water and addition of p-toluidine solution according to Official Methods of Analysis of AOAC International [22] and Saudi Arabian Standard Organization [23]. Absorbance was determined at 550 nm using a 1 cm cell in a Biochrom Spectrometer. Results were expressed in mg/kg.

Diastase activity was measured with Phadebas unit, according to the Harmonized Methods of the European Honey Commission [16]. The unit of Diastase Activity, the Gothe unit, is defined as that amount of enzyme which will convert 0.01 gram of starch to the prescribed end-point in one hour at 40 °C under the conditions of test. Results are expressed in Gothe units (or Schade units) per gram of honey [22, 24, 25].

RESULTS

Pollen analysis

The absolute numbers of pollen grains indicate the richness of the samples in sediments [26]. The number of pollen grains in 10 g of honey ranged between 8 000 and 2 424 000.pollen grains (Table 2).

According to the total number of plant elements, the honey samples were distributed into four classes [27]:

Class I: include A1 with low pollen grains (8 000 PG/10g).

Class II: Four samples (T6, G4, TE1 and S1) with a number ranging between 21 000 and 100 000.

Class IV: Three samples were included (T3, G2 and C1) with a pollen number ranging between 240 000 and 646 000.

The remainders of the samples are classified in class V with a pollen number higher than one thousand.

The results from the pollen analysis (pollen spectrum) summarised in Table 3, show that all honeys were polyfloral, because any pollen type had been access 45 percent of the total pollen grain number found in honey samples.

More than 20 pollen types are found in honey sample of Setif (S1), collected in the western part of the studies region, 12 in samples of Guergour (T1), Constantine (C1), 11 in two samples (TE2, G4), and 10-6 in others.

The determination of the floral origin of honey has been achieved by the analysis of the pollen present in honey. The different pollen types are described in the literature [26-34].

The results from the quality analysis are shown in Table 3. Sixty five pollen types had been identified from 28 families. Three families (Asteraceae, Rosaceae and Apiaceae) are best represented with a number of taxa which is respectively 8, 7 and 5 types. The anemophilus pollen grains observed in four samples (T6, G3, A2 and TE2).

The only type of pollen present in almost all the samples is the *Eucalyptus*. This species is a polliniferous plant which has a very broad surface of distribution.

Physicochemical parameters

Mean results for physicochemical analysis (moisture content, density, pH, total acidity, electric conductivity, sugar, diastase index, protein content) are summarised in Table 4.

Density: The density values ranged from 1.37 to 1.5.

Indeed, the samples G2, T3, T6 and A1 had values exceeding the average standard (1.39 to 1.44 at 20 °C) and did not exceed the maximum limit which is 1.5.They are very dense honeys. SampleA1 which had a very thick aspect, had the highest density.

The samples T1, G1 and A3 have density slightly lower than the standard, because they have a high water contents.

Moisture content: Water content, a parameter related to the maturity degree, is an indicator of the mode of extraction of honey and density. Analyzed honeys had values between 16.4-20.4%.

According to Gonnet [35], honeys having a water content higher than 18% are regarded as lower quality (preserves itself badly).

The water contents obtained for various honeys range from 16 to 20.4%. The honey having a value ranging between 16- 18% is regarded as the best honey with respect to the preservation and storage [5].
Only one honey sample (G1) was found to have moisture content (> 20%) higher than the maximum allowable content according to the International Honey Commission [2].

Electrical conductivity: All honeys conformed with the international standard (1 to 15 X10 $^{-4}$ S/cm). In this interval, honeys are classified in two groups: (Table 4)

- Fourteen honeys produced from nectar, with their electrical conductivities ranging between 1-5 X10 $^{-4}$ S/cm [36, 37].
- Honeys (G1, G2 and T6) were of the median values between 5 and 10 X10 $^{-4}$ S/cm.

These values indicate that the samples contain mixture compounds between honeydews and nectar blossom.

This parameter depends on the ash, organic acids, proteins, some complex sugars and polyols contents, and varies with botanical origin [38]. The conductivity measurement is easy. It is widely used for discrimination between honeydew and blossom honeys and also for the characterisation of unifloral honeys [5]. The honeydew honeys are characterised by their very dark colour and high values of pH, ash content and electrical conductivity [39, 40].

pH: According to the standards [19, 11], honeys whose pH is in the range 3.5 to 4.5 results mainly from the plant visited (blossom honey) by honeybees. It is the case of all the analyzed samples except the samples T1, T2 and T3. The pH values located between 4.5 and 5.5 indicate that it is about a honey of honeydew- [35]. Moreover, a honey with a low pH of about 3.5 is regarded as a fragile product for the preservation, whose great precautions must be taken.

Total acidity:
Total acidity of T1 was higher than the other honeys. This sample has a value out the international standard average; it had the highest free acid content (Table 4). The acidity of honey is due to the presence of organic acids, particularly the gluconic acid, in equilibrium with their lactones or esters and inorganic ions such as phosphate and chloride [41, 42]. The variation in acidity among different honey types may be attributed to variation in these constituents due to extraction season [43]. El-Sherbiny and Rizk [44] reported that total acidity was higher in cotton honey than in clover honey which indicates the influence of floral types in total acidity.

Sugar: Sucrose Content of eight samples (A1, A3, T1, T4, TE1, TE2, C1 and S1) did not on conformity with the international standard. A high content of this sugar means most of the time, an early harvest of the honey, that is, a product in which the sucrose has not been fully transformed into glucose and fructose by the action of invertase. Generally, the sucrose content does not exceed 5% for authentic honey samples [20].

This value indicates that the bee keepers use a sucrose syrup to over feeding the bees in the winter season.

Protein Contents:
The protein contents of analysed honey samples were between 0.22 - 0.96%. These results indicate that the colorimetric determination of the protein content of honey samples using the method of Bradford [20, 21, 22], was efficient and it allowed the detection of high values in the samples T1, T2 and T5. The results of this study were higher than those obtained by Azeredo *et al.* [20] for honeys of *Borreria verticillata* (0.223 %), whereas they were close to the results obtained by Ouchemoukh *et al.* [45] for some Algerian honeys. The samples T1, T2 and T5 have contents exceeding the standard [11]. This is explained by the strong content of pollen in these collected honeys [46, 47, 48].

Hydroxymethylfurfural (HMF): The results obtained (Table 4) showed that, in just one case, the content was higher than the maximum allowed, which is 40 mg/kg [49]. This one sample (A1) had been harvested after a relatively long time. The honey sample had been submitted to high temperatures, and its sucrose content was very higher (14.78%).

Diastase index (I.D.): Only one sample (A1) has a lower diastase index than the minimum standard value (superior than 8). This can be due to either, overheating at the time of the extraction, or to the natural poor levels of amylase in the sample. Diastase index and HMF content are the indicators of the freshness of honey [12, 15, 39, 50, 51].

DISCUSSION

The combination between the various physicochemical and palynological parameters used to characterize and control the quality of Algerian honeys allowed to raise the following points:
Four samples are in total agreement with the European standards [5, 7, 10, 11].These honeys (G2, G3 and G4) were collected from the same area of study under the same conditions. The hives are installed in sub humid zones just beside the forests and maquis.
Honey T5 (Bougous) was obtained by pressing. It is very rich in pollen and is of good quality, because it met the conditions of the Codex Alimentarius [10, 11].
The T6 sample obtained from an agricultural zone (Drean) contains a diastase activity lower than the standard [13-16, 18, 22-25] with a rate of HMF in the codex interval.
This value is due probably to nectar and pollen quality produced by honey plants, and determinate factors of foraging workers activity (the colony density and sanitary conditions).

Sample G1 of a forest area, obtained by pressing, had the highest water content (20.4%).This value makes this honey delicate if stored for a long period.

The honey T1 was characterized by significantly higher acidity (87.46meq acid/kg) compared to the other analyzed samples. This value is due to the low pH (3.29); water content (19.6%) and pollen grains number (6 220 000 PG/10g honey). The sucrose content of this sample (11.02%) is also beyond the standard suggested by the Codex Alimentarius [5, 7, 13-25, 52]. But the content of HMF was within the standards, because the honey was obtained by pressing without heating [4, 13-25, 52].

The honey of Boutheldja (T2) had a pH of 3.3 and diastase Index weak (3.55) with an average acidity (59.99 meq/kg). These results were due to the type of blossoming plant (polliniferous plants) visited by the workers. According to the pollen content (24 832 000PG/10g) found in honey, we can say that the area of Boutheldja is rich in polliniferous plants producing much more pollen than nectar [31, 52-54].

The Bouhdid honey (A1) is unsuitable for consumption by the citizens. It is rich in sucrose (14.78 %) and HMF (480 mg/kg) and very low diastase activity (2.83 Schade). This honey is of bad quality.

CONCLUSION

In conclusion, the physico-chemical characteristics of the seventeen honey samples analyzed in this study generally were not in agreement with the requirements of European Community Standards. An abnormal sucrose rate was detected in nine honey samples, with a very low pH for three samples.

The very high content of sucrose, with significant content on pollen number and very low pH shows that the beekeepers of these areas are not professional person.

Table 1: Sample of Algerian Nord east honeys and their botanical origin

Samples	location	Botanical origin	Harvested period	mode of extraction
T1	Guerguour	Eucalyptus	sept-01	centrifugation
T2	Boutheldja	Polyfloral	sept-01	pressing
T3	Bouhadjar	Polyfloral	jul-01	centrifugation
T4	Chihani	Polyfloral	sept-01	pressing
T5	Bougous	Polyfloral	sept-01	pressing
T6	Drean	Citrus	sept-01	centrifugation
G1	Bouhachana	Polyfloral	sept-01	centrifugation
G2	Hamam N'Bail	Polyfloral	sept-01	pressing
G3	Mekfel	Polyfloral	jul-01	pressing
G4	Megasmia	Polyfloral	jul-01	centrifugation
A1	Bouhdid	Polyfloral	jul-01	centrifugation
A2	Ain Barbar	Polyfloral	sept-01	pressing
A3	Oued El Aneb	Polyfloral	sept-01	pressage
TE1	El Hammamet	Polyfloral	sept-01	centrifugation
TE2	El Hammamet	Polyfloral	sept-01	pressing
C1	Station BenAbd Errahmane	Polyfloral	sept-01	centrifugation
S1	Setif	Polyfloral	sept-01	centrifugation

Table 2: Quantitative pollen analysis of honey samples [53]

Samples	location	pollen grain number (PG/g of honey)	Class
T1	Guerguour	6 220 000	V
T2	Boutheldja	24 832 000	V
T3	Bouhadjar	240 000	IV
T4	Chihani	3 774 000	V
T5	Bougous	7 300 000	V
T6	Drean	76 000	II
G1	Bouhachana	1 376 000	V
G2	Hamam N'Bail	646 000	IV
G3	Mekfel	6 190 000	V
G4	Megasmia	30 000	II
A1	Bouhdid	8 000	I
A2	Ain Barbar	1 200 000	V
A3	Oued El Aneb	5 800 000	V
TE1	El Hammamet	62 000	II
TE2	El Hammamet	2 424 000	V
C1	Station BenAbd Errahmane	638 000	IV
S1	Setif	96 000	II

Table 3: Qualitative analysis of pollen types in honey samples (in percentages)

Samples	Predominant Pollen (> 45%)	Secondary pollen (16 – 45%)	Minor pollen (3 – 15%)	Important minor Pollen (<3%)
T1	-	*Hedysarum coronarium* 24, *Eucalyptus spp* 22, Type Rosaceae 17	Apiaceae 15,*Thymus spp* 12 *Geranium* 7, Asteraceae 3	-
T2		*Eucalyptus* 33, *Daucus* 28, Urticaceae 16	*Eucalyptus* 10 *Trifolium spp* 7, *Rubus* 4	*Lavandula stoechas* 2
T3		*Hedysarum coronarium* 25 *Cistus spp* 20	*Rubus ulmifolius* 14, *Eucalyptus* 10, *Allium cepa* 8, *Ornithogalum* 10, *Asphodelus aestivus* 9	*Apium graveolens* 2 *Myrtus* 2
T4		*Eucalyptus* 34, *Cucurbita spp* 30	*Hedysarum coronarium* 12, *Trifolium spp* 8, *Allium spp* 6 , Iridaceae 4	*Myrtus communis* 2, *Potentilla spp* 2 *Taraxacum* 2
T5		*Eucalyptus* 37 *Pyrus /Malus* 29	Liliaceae 14 Euphorbiaceae 8, *Trifolium spp* 7, *Geranium* 3	*Anethum spp, Malva sylvestris*
T6		*Eucalyptus* 19	*Rubus* 15, *Daucus* 13, *Erica arborea* 13, *Foeniculum spp* 11, Liliaceae 10, *Citrus* 5, *Borago spp* 5, Euphorbiaceae 4	*Iris* 2, *Myrtus communis* 2, *Juniperus* 1
G1		*Hedysarum coronarium* 40 *Pyrus/Prunus* 25, *Trifolium spp* 18	*Anethum* 9, *Eucalyptus* 6	Liliaceae 2
G2		*Eucalyptus* 26, Apiaceae 22	*Trifolium spp* 13, *Myrtus* 12, *Genista* 9, *Rubus* 8, *Thymus vulgaris* 7, Asteraceae type *Centaurea* 3	
G3		*Eucalyptus* 35, *Hedysarum coronarium* 21, *Trifolium spp* 19	*Iris* 9, *Malva sylvestris* 7, *Prunus spp* 3	Chenopodiaceae 2 *Brassica* 2, *Euphorbia* 2
G4		*Prunus* 19, *Rubus* 16, Apiaceae 16 *Crataegus* 10	Liliaceae 14, *Cistus spp* 8, *Brassica nigra* 6, *Trifolium spp* 4, *Eucalyptus* 3, *Allium* 3	*Myrtus communis*
A1		Papilionaceae 40 *Eucalyptus* 27	*Anethum spp* 13, Campanulaceae 10, *Salix* 6, *Sinapis spp* 4	
A2		*Hedysarum coronarium* 32	*Inula viscosa* 13, *Eucalyptus* 11, *Echinops spinosus* 10, *Cichorium intybus*7, *Rubus* 6, *Malva* 5, *Cistus* 4, *Salix* 3, *Erica arborea* 3	Poaceae 1 *Allium spp* 2, *Cucurbita sp* *Beta vulgaris* 2
A3		*Echium* 23, *Brassica*	*Borago officinalis* 15, *Cistus* 12,	

		spp 16	*Pyrus* 8, *Lavandula stoechas* 12, *Erodium spp* 6 *Myrtus communis* 4, *Daucus carota* 4	
TE 1		Renonculaceae 16 *Hedysarum coronarium* 41	*Carduus* 11, *Cynoglossum* 7, *Eucalyptus* 7, *Scilla* 5, *Raphanus spp* 6, *Prunus amygdalus* 3, *Daucus* 3	*Malva sylvestris*
TE 2		*Hedysarum* 30, *Trifolium spp* 17	*Juniperus* 15, *Thymus spp* 8, *Brassica spp* 8, *Papaver rhoeas* 6, *Ferula* 6, *Galactites* 3	*Erica* 3, Poaceae 2, *Euphorbia* 2
C1		*Eucalyptus* 37	*Hedysarum coronarium* 14, *Ranunculus* 11, *Pyrus spp* 10, *Erica arborea* 7, *Daucus* 6, *Ecbalium elaterium* 5, *Mathiola* 4, *Myrtus* 3	Asteraceae, *Citrus*, *Erodium*
S1		*Eucalyptus* 20	*Ranunculus* 9, *Thymus spp* 8, *Asphodelus aestivus* 7, *Brassica napus* 7, *Oxalis* 6, *Daucus* 6, *Myrtus* 4, *Loranthus* 5, *Chenopodium* 3, *Cistus* 3, *Juniperus* 3, *Prunus spp* 3, *Ferula* 3	*Gladiolus* 2, *Polygonum*2, *Salix* 2, *Malva*, *Erica*, *Papaver rhoeas* 2, *Borago spp*2, *Ecbalium*, *Centaurea*

Table 4: Results of some physicochemical parameters of honey samples (mean±S.D.)

Samples	Moisture (%)	Densité	pH	Free acid (meq/kg)	Lactone (meq/kg)	Total acidity (meq/kg)	Electrical conductibility (10-4S/cm)	Sucrose (%)	HMF (mg/kg)	Diastase Schade unit	Proteins (%)
T1	19.6 ± 0.00	1.37 ± 0.01	3.29 ± 0.01	63.5 ± 0.32	23.96 ± 0.22	87.46 ± 0.49	4.21 ± 0.2	11.02	4.416 ± 0.14	25.21 ± 0.02	0.92 ± 0.03
T2	18 ± 0.27	1.40 ± 0.011	3.3 ± 0.3	38.5 ± 0.29	21.49 ± 0.28	59.99 ± 0.55	3.55 ± 0.1	1.06	2.304 ± 0.04	3.55 ± 0.04	0.96 ± 0.06
T3	17 ± 0.29	1.46 ± 0.008	3.39 ± 0.01	27.25 ± 0.41	17.73 ± 0.28	44.98 ± 0.53	2.01 ± 0.2	2.28	6.72 ± 0.15	19.05 ± 0.35	0.72 ± 0. 01
T4	17.6 ± 0.51	1.41 ± 0.008	3.82 ± 0.04	11.5 ± 0.32	25.99 ± 0.3	37.49 ± 0.62	2.36 ± 0.0	9.14	14.016 ± 0.05	114 ± 0.69	0.87 ± 0.06
T5	17.8 ± 0.24	1.4 ± 0.009	3.71 ± 0.02	12.25 ± 0.38	22.73 ± 0.27	34.98 ± 0.63	2.96 ± 0.3	0	5.184 ± 0.053	22 ± 0.06	0.93 ± 0.03
T6	16.8 ± 0.44	1.48 ± 0.01	4.09 ± 0.01	13 ± 0.31	3.75 ± 0.21	16.75 ± 0.49	8.25 ± 0.6	2.92	14.97 ± 0.0	6.86 ± 0.32	0.63 ± 0.02
G1	20.4 ± 0.43	1.38 ± 0.009	3.8 ± 0.05	7.5 ± 0.28	39.98 ± 0.21	47.48 ± 0.45	9.22 ± 0.5	3.42	4.992 ± 0.061	34.17 ± 0.74	0.66 ± 0.01
G2	16 ± 0.25	1.48 ± 0.013	3.5 ± 0.04	26.25 ± 0.29	21.23 ± 0.21	47.48 ± 0.47	6.47 ± 0.7	3.3	1.728 ± 0.046	13.68 ± 0.31	0.79 ± 0.00
G3	18.1 ± 0.4	1.39 ± 0.007	4.05 ± 0.03	12 ± 0.29	15.49 ± 0.24	27.49 ± 0.53	3.1 ± 0.2	1.14	4.032 ± 0.01	22.01 ± 0.05	0.28 ± 0.01
G4	17.4 ± 0.51	1.44 ± 0.009	3.84 ± 0.01	12.5 ± 0.22	14.99 ± 0.12	27.49 ± 0.32	2.36 ± 0.3	0	5.952 ± 0.04	19.63 ± 0.053	0.22 ± 0. 01
A1	16 ± 0.32	1.5 ± 0.012	3.92 ± 0.03	15.75 ± 0.47	14.24 ± 0.23	29.99 ± 0.67	2.46 ± 0.3	14.78	480 ± 0 .00	2.84 ± 0	0.64 ± 0.06
A2	18.6 ± 0.46	1.39 ± 0.009	3.68 ± 0.03	29 ± 0.22	18.49 ± 0.1	47.49 ± 0.3	2.01 ± 0.2	2.28	5.568 ± 0.0	23.08 ± 0.7	0.53 ± 0.00
A3	18.8 ± 0.29	1.38 ± 0.007	3.86 ± 0.04	21.5 ± 0.38	19.24 ± 0.28	40.74 ± 0.66	2.49 ± 0.4	8.96	4.608 ± 0.016	25.21 ± 0.065	0.77 ± 0.03
TE1	17.4 ± 0.3	1.41 ± 0.012	3.7 ± 0.01	11.5 ± 0.31	18.49 ± 0.21	29.99 ± 0.49	4.28 ± 0.5	15.06	7.296 ± 0.031	33.94 ± 0.1	0.55 ± 0.02
TE2	17.4 ± 0.46	1.43 ± 0.013	3.82 ± 0.03	12.25 ± 0.31	20.24 ± 0.12	32.49 ± 0.43	2.69 ± 0.3	22.68	14.592 ±0.037	8.39 ± 0.03	0.72 ± 0.02
C1	17.8 ± 0.00	1.4 ± 0.011	3.49 ± 0.01	23.5 ± 0.41	21.47 ± 0.27	44.97 ± 0.67	3 ± 0.0	6.76	3.84 ± 0.01	14.54 ± 0.05	0.29 ± 0.05
S1	16 ± 0.45	1.49 ± 0.008	4.37 ± 0.04	7.25 ± 0.29	3 ± 0.13	10.25 ± 0.36	3.09 ± 0.5	8.15	11.32 ± 0.021	14.82 ± 0.097	0.57 ± 0.03

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