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Ziziphus Lotus and *Euphorbia bupleuroides* Algerian Honeys

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Abstract: Two Algerian honey types of semi-arid regions are characterized. Botanical origin is controlled by qualitative and quantitative melissopalynology. Based on dendrograms test, the 27 studied samples were classified into three homogeneous groups. The control analyzes showed that they are of good quality in agreement with the Codex Alimentarius. For discriminating between groups, physico-chemical parameters and phenolic and sugar composition were measured. But it is only the pH, free acidity, electrical conductivity and specific rotation that were powerful to differentiate unifloral Ziziphus Lotus group, *Euphorbia* and multiforal honeys containing *Ziziphus*.*Ziziphus lotus* honey presented specific characteristics, with high pH (4.96 ± 0.91), dextrogyrous specific rotation (-1.41 ± 7.55°) and high diastase activity (36.06 ± 10.06). While, *Euphorbia* honeys were within honey standards, with poor proline content (114.3 ± 30.3ppm) and low Diastase activity (14.6 ± 4.1Ush).The mineral fraction of ziziphus honey reveals the predominance of potassium, calcium and sodium with a constant presence of iron and magnesium. Finally, correlations analysis suggests the existence of a strong relationship between color and flavonoïd fraction, which is present in significant amounts (15-30 mg EQ/100g) compared to rates usually found in European monofloral honeys (1-6 mg EQ/100g), which is remarquable.

Key words: Algeria · Honey · Characterization · Quality · Arid Resources

INTRODUCTION

Arid and semi-arid zones represent nearly two-thirds of Tellian part of Algeria. The immensity of these territories and the absence of systematic studies of steppic bee flora, make honeys from these regions poorly studied and poorly understood. Louveaux and Abed [1] report some information on pollen profile of 59 honey samples from Algeria, in which steppic honeys were under-represented (3 samples) but characterized by their limited number of taxa and the existence of many unidentified pollen species.

Today, advances in Mediterranean bee flora studies, allowed the identification of many species of arid regions, "textbook of Mediterranean melissopalinology" [2] refers to the following genera for North Africa (Morocco, Algeria and Tunisia): Artemisia spp., Thymus spp., Rosmarinus spp., Pistacia spp., Lygeum spp., Stipa spp., Peganumspp., Dactylis spp., Trifolium spp., Hedysarum spp., Onobrychis spp., Medicago spp., Crucifereae spp., Phoenix spp., Pimpinella spp., Ceratonia spp., Erica spp., Eryngium spp., Ononis spp., Retama spp., Carthamus spp.and Lotus spp. etc.. This is not an exhaustive list and the contribution of these species in honey, still unknown, in some cases.

Ziziphus lotus L. (Z. lotus) is a Rhamnaceae called "Sedra, N'beg, or Azar Djerdjer" in our regions [3] and *Euphobia bupleuroides L.* (*E. bupleuroides*), called" Lebayna, Helayba, Halib el Diba, or tanahout", words derived from" Laban = milk" because of the white milky poisonous and corrosive juice, they secrete; Recent inventory of native plants in Algeria identify over than 51 species of Euphorbiaceae, *E. bupleuroides* is the main species used by beekeepers [4, 5].

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Both species grow everywhere in Algeria, even in Tellian coastal areas. Their distribution ranges from central Sahara to Western south [6]. They are very melliferous but give unifloral honeys only in steppic regions, where they are sufficiently and exclusively represented. Chakir *et al.* [7], studies some physico-chemical characteristic of some Moroccan honeys, they spoke about *Ziziphus lotus, Euphorbia resinifera* and *Euphorbia echinus* as endemic species used in traditional medicine in Morocco.

Like many species, these plants are part of popular traditional feeding and medical practices of Maghrebin people, but their use as beekeeping resource is relatively recent. The emergence of a new generation of professional beekeepers and generalization of transhumance led to the exploration of new territories, to discover new species and therefore production of new honeys.

This study focuses on the characterization of *Z. lotus* and *E. bupleuorides* honeys from arid Algerian zones and aim to establish their pollen spectrum and their physicochemical properties; this will help control authorities and professional beekeepers on their identification and labeling.

MATERIALS AND METHODS

Sampling and Identification of Floral Origin: This study involved 27 honey samples from Laghouat, Djelfa, Medea and El Bayadh, including 18 alleged ziziphus honeys (*Z. lotus L.)* and 9 supposed Euphorbia honeys (*E. bupleuroides L.*). Information regarding the harvesting date, the region and the floral origin were recorded and shown in Table 1. Sampling took place over 5 years (2005/2010) and honeys were stored at 4°C in airtight jars until analysis.

Table 1: Sample identification and pollinic information.

				Mellissopalynologic information					
Code	Region	Harvested on	Supposed origin	Dominant pollen	%	First accompaniment pollen	%	Taxa number	Class
Z1	Laghouat	July 2007	Ziz.	Ziz	50,0	Peg.	28,2	14	II
Z2	Djelfa	July 2007	Ziz.	Ziz	56,2	Peg.	22,9	8	I
Z3	Djelfa	July 2007	Ziz.	Ziz	75,0	-	-	7	I
Z4	Djelfa	June 2005	Ziz.	Ziz	56,0	Peg.	22,6	8	I
Z5	Ain safra	July 2008	Ziz.	Ziz	73,4	-	-	7	I
Z6	NI	July 2008	Ziz.	Ziz	73.2	-	-	16	I
Z7	NI	July 2009	Ziz.	MF	-	ziz	30,0	15	I
Z8	Médéa	2005	Ziz.	MF	-	ziz	43,6	19	I
Z9	Laghouat	July 2007	Ziz.	MF	-	ziz	42,4	16	I
Z10	NI	NI	Ziz.	Peg.	52,2	Euc.	18,2	09	I
Z11	NI	NI	Ziz.	Ono.	70,4	Omb.	14,8	14	II
Z12	Djelfa	2008	Ziz.	Cha.	71,3	-	-	14	I
Z13	Laghouat	June 2007	Ziz.	Peg.	46,9	Ziz.	21,4	8	I
Z14	Djelfa	June 2007	Ziz.	MF	-	Astera.	37,7	8	I
Z15	Djelfa/Laghouat	June 2007	Ziz.	MF	-	Euc.	32,3	12	I
Z16	Laghouat	June 2007	Ziz.	MF	-	Ziz.	29,1	7	I
Z17	el bayadh	Sum. 2010	Ziz.	Ziz.	70.0	-	-	6	I
Z18	el bayadh	July 2010	Ziz.	Ziz.	48.0	Euph.	20	6	I
E1	el bayadh	sum 2010	Euph.	Euph.	54.4	Ziz.	16,3	19	I
E2	el bayadh	Sum. 2010	Euph.	Euph.	69.7	-	-	17	I
E3	el bayadh	Sum. 2010	Euph.	Euph.	75.9	-	-	12	I
E4	el bayadh	Sum. 2010	Euph.	Euph.	55.5	Ziz.	15,2	13	II
E5	el bayadh	Sum. 2010	Euph.	Euph.	77.3	-	-	14	I
E6	el bayadh	Sum. 2010	Euph.	Euph.	64.0	Ziz.	13,6	15	I
E7	el bayadh	Sum. 2010	Euph.	Euph.	70.3	-	-	12	I
E8	el bayadh	Sum. 2010	Euph.	Ziz.	42.0	Euph.	34.7	8	II
E9	el bayadh	Sum.2010	Euph.	Euph.	57.8	Ziz.	26,8	6	II

Euph.: *Euphorbia* spp., Euc.: *Eucalyptus* spp., Ziz.: *Ziziphus* lotus, Peg.: *Peganum harmala*, Aster.: astreraceae, Omb.: ombelliferae, Cha.: *chardon*, Ono.: *Ononis*, MF: multiflorl, NI: non identified, sum: summer

Methods: The confirmation of botanical origin was performed according to the harmonized methods of mellissopalynologie [8], pollen spectra and the class to which each sample belongs was established. The pollen residue isolated from 10g of honey is mounted between glass lame and slide, the identification is done using Mediterranean pollinic atlas CD, the total number of *fungi imperfecti* is used for quantification.

Water content (H), Electrical Conductivity (CE), pH and free acidity (FA), HMF, Proline, specific rotatory power (ROT), Diastase number (DN), were performed according to the harmonized methods of the international honey commission IHC [9].

Ash was prepared by incinerating honey at 600°C, HCl diluted mineral solution is submitted to SAA analyses, minerals are expressed in ppm. Color value (COLOR) was determined using Lovibond comparator; values were converted into mmPfund units.

Folin-Ciocalteu method is used to determine total phenolic content (POLY), a 10% solution is prepared and filtered and treated with Meda *et al.* method [10]. Blue color measured at 760nm. A calibration curve with Gallic acid is established. Flavonoids (FLAVO) are revealed at 510nm with quercitin calibration curve.

A 4° brix honey solution is prepared for DPPH Anti-radicalar activity, then 1ml is mixed with 1.5ml of 0.02mg/ml DPPH (2,2-diphenil-1-picrylhydrazyl) solution. Measurements are done at 517nm, the radical scavenging activity (ARA) is expressed in % inhibition comparing to blank essay [11].

For Sucre separation profile the AOAC method is used [12], 10µl of each clarified solution is injected into a Shimadzu HPLC with refractive index detector. Sugars are expressed in % of total sugars.

Statistical Analysis: Statistical analyses were performed with specific software (Statistical Package for Social Science, SPSS 17.0). Cluster analysis based on pollinic characteristic is used to regroups data. The samples are grouped such that similar objects fall into the same class; it has the advantage of not demanding a prior knowledge of cluster number. Descriptive statistics of honey physico-chemical properties were calculated and represented by box plots. Then pair wise correlations between variables were calculated and the most important variables having discriminator power related to botanical origins found.

RESULTS AND DISCUSSION

Melissopalynology Analyzes: The identification of the studied samples and the results of the qualitative and quantitative pollen analysis are listed in Table 1.

The classification by dendrograms method (Fig. 1 left, Ward's method) has identified, based on pollen analysis, two distinct groups, represented by honey samples containing more than 42% of *Z. lotus* pollen for the first, with relatively simple spectra (less than 10 taxa). The second group is characterized by a richer pollen profile (more than 12 taxa) where *Z. lotus* is present like

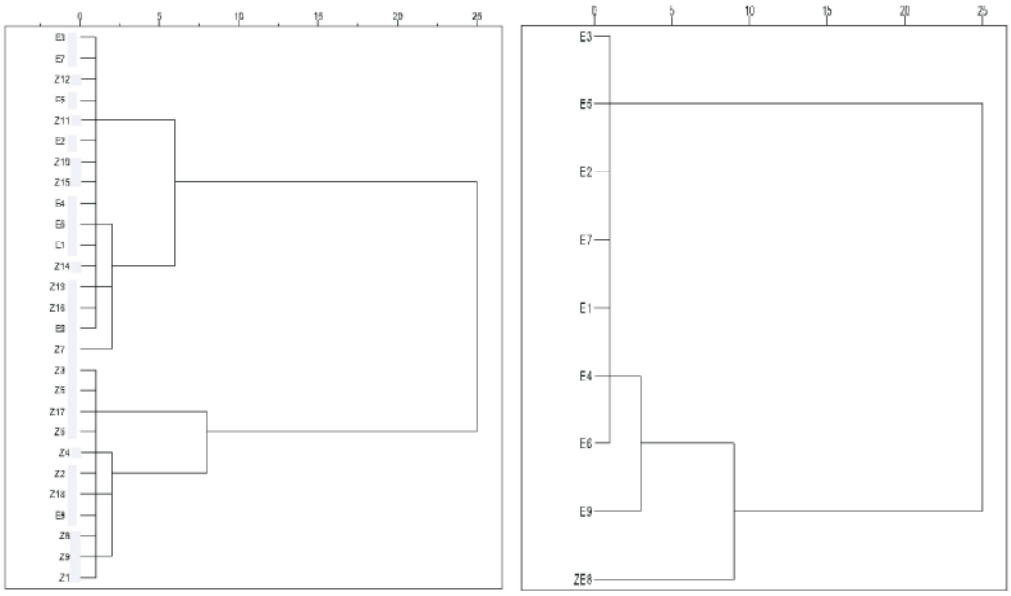

Fig. 1: Dendrogram sample classification (all samples/left, supposed *Euphorbia* spp samples./right)

Table 2: Descriptive Statistics for honey quality criteria, classified by botanical origin

	Z. lotus (n=8)				*Multiflal with Z. lotus* (n=7)				*E. bupleuroides* (n=8)				
	Min	Max	Moy	SD	Min	Max	Moy	SD	Min	Max	Moy	SD	*Codex alimentarius limit*
H	13.4	15.5	14.63	0.70	12.8	16.8	15.19	1.38	13.7	15.2	14.76	0.51	< 18%
HMF	0.0	6.0	2.91	2.04	0.0	18.7	3.92	6.58	1.98	5.3	2.81	1.03	< 40 mg/kg
Proline	150	647	382.50	184.01	198	723	453.0	178.82	89	167	114.25	30.25	> 180 ppm
DN	24.4	52.0	36.06	10.06	25	55	32.43	10.31	9.2	20.5	14.63	4.05	> 8 USh
G+F	60.8	75.1	70.31	4.09	71.1	75.1	73.93	1.93	73.8	75	74.4	0.64	> 65%
G/H	1.5	2.1	1.96	0.26	1.5	2.6	1.83	0.44	2.0	2.3	2.15	0.16	-
F/G	1.29	2.28	1.44	0.35	1.22	2.28	1.85	0.54	1.27	1.39	1.33	0.06	-

H: water content in %, HMF: hydroxyméthylfurfural in mg/kg, proline in ppm, DN: diastase number in Ush, G: glucose in %, F: fructose in %.

largely isolated or isolated pollen (average 11.83%), those are either multiforal containing *Z. lotus* or monofloral honeys of other species. *Z. lotus* accompaniment pollens differ by region and year of harvest; it could be find Peganum harmala, Cirsium spp., Compositeae or Euphobia spp pollens. Largely isolated or isolated pollen belongs, in most cases, to Ombelliferae, Brassicaceae, Asteraceae, Leguminosae and Compositeae families.

However Euphorbia honeys (Figure 1, right), all from the same region (El Bayadh), have a pollen spectrum dominated by Euphorbia spp. grains (> 54%) with greater than 12 taxa. the major accompaniment pollen was *Z. lotus* indicating a juxtaposition of flowering periods of both species with a temporal priority of Euphorbia spp. (late spring / early summer). The other pollen families are almost (in order of importance): Asteraceae, Compositeae, Bracicaceae, Ombelliferae, Tiliaceae, Ericaceae.

The constant presence of tertiary contamination and anemophilous pollen (*Stippa tenassissima, Phoenix dactilifera*) is observed in both cases, probably due to transhumance and wind transported grains (Rutaceae, Myrtaceae, Oleaceae, Cistaceae). No honeydew indicators were observed.

The quantitative pollen analysis shows that both types of honey (*Z. lotus* and *E. bupleuroides*) are unifloral underrepresented honeys classed (I) (pollen <20 000 grain / 10 g of honey).

Pollen analysis and statistical classification test allowed us to keep these three homogeneous groups: monofloral ziziphus group (n = 8), monofloral Euphorbia group (n = 8) and multiforal containing ziziphus (n = 7), the other samples were excluded in physico-chemical statistical analysis.

Physico-Chemical Quality: To market good quality honeys, International regulations -Codex Alimentarius [13] adopted by Algeria- have set limits for the most important criteria (Table 2, column a). Table 2 summarizes these quality criteria for our samples (H, HMF, proline, DN, G+F, G/H and F/G).

Studied honeys have, relatively, low moisture levels ranging from 14.63 to 15.19; eliminating fermentation risk and giving them good skills in conservation [14].

Reducing sugars rate is, for all samples, above 65% and proline rate greater than 180 ppm which indicates a good maturity. *E. bulpeuroides* honeys group is differentiated by low proline content with an average of 114.25 ± 04.05 ppm, lower than the American Honeys limit, set at 150 ppm [15].

According to Tabouret [16] moisture below 14% or greater than 20% allows the honey to remain perfectly liquid for periods exceeding 13 months of conservation, the ratios G/H and F/G are not sufficient to explain this complex phenomenon. Ziziphus honeys remained liquid and showed no sign of crystallization (G/H = 1.92 ± 0.26 and F/G = 1.44 ± 0.35), these results are consistent with the values of F/G, given for Sidir Asser and Sidir Albaha (Rhamnaceae From Saudi Arabia), of 1.56 and 1.47 [17], indicating a general character of this honey family.

The Euphorbia honeys were about small and fast crystallization (G/H = 2.15 ± 0.16 and F/G =1.33 ± 0.06). The multiforal group containing ziziphus had intermediate crystallization. These trends are explained only by the richness in glucose of Euphorbia honey, because its moisture and fructose levels were comparable.

Z. lotus honey DN contains an average of 36.06 and 32.43 Ush respectively, values much higher than those quoted by Al Khalifa *et al*. [17] for *Z. spina christi* (L.) and Chakir *et al*. [7] for *Z. lotus* of Morocco that fall between 4.00 and 9.3 Ush in the first case and 15.63 in the second.

The DN is only of 14.63 Ush for Euphorbia honeys, comparable to data on *E. resinifera* and *E. echinus* of Morocco [7] with an average of 13.89 Ush.

Table 3: Descriptive statistics of characterization criteria of honeys, sorted by botanical origin

	Z. lotus (n=8)				*Multifleurs with Z. lotus* (n=7)				*E. bupleuroides* (n=8)			
	Min	Max	Moy	SD	Min	Max	Moy	SD	Min	Max	Moy	SD
pH	3.5	6.1	4.96	0.91	3.8	5.3	4.34	0.48	3.5	4.0	3.83	0.15
FA	10	27	14.75	5.95	12	23	17.71	4.54	13	18	15.13	1.73
EC	328	714	478.25	125.24	293	588	418.29	109.19	251	275	258.13	7.38
$[á]^{D}_{20}$	-12.1	+7.9	-1.41	+7.55	-12.7	+19.0	-2.97	+10.63	-27.1	-14.6	-20.05	+3.90
Color	88	119	100.88	11.34	77	119.00	101.57	15.84	119	130	124.50	5.88
Poly	33.3	76.2	54.51	16.19	33.3	70.2	56.34	13.81	43	66.7	51.01	7.54
Flav	8.6	22.6	15.60	4.15	8.6	24.1	16.49	4.56	13.3	30.3	20.45	5.70
Flavo/poly	23.7	32.6	28.94	3.15	24.8	52.4	30.11	10.03	25.7	49.1	40.25	9.45
ARA	4.7	9.3	6.33	1.56	4.0	9.3	5.73	1.86	5.2	6.6	5.81	0.55
F	36.2	52.2	41.13	4.68	40.1	52.2	47.16	6.30	42.0	42.9	42.45	0.48
G	22.9	31.0	29.20	3.37	22.9	33.8	26.77	4.92	30.9	33.0	31.95	1.12
S	0.0	2.6	1.30	0.69	1.3	2.6	2.21	0.63	0.9	1.5	1.15	0.19

FA: free acidity in meq/kg; EC: electric conductivity in µS Cm^{-1}; HMF: hydroxymethyl-2-furaldehyde; $[á]^{D}_{20}$: specific rotatory power in° ml/g.dm; n: number of samples; SD: standard deviation, ARA: antiradicalar activity in %,, G: glucose in %, F: fructose in %, S: sucrose in %, color in mm pfund, Poly: polyphenols in mg EAG/100g, Flav: flavonoids in mg EQ/100g, Flav/poly: ratio in %.

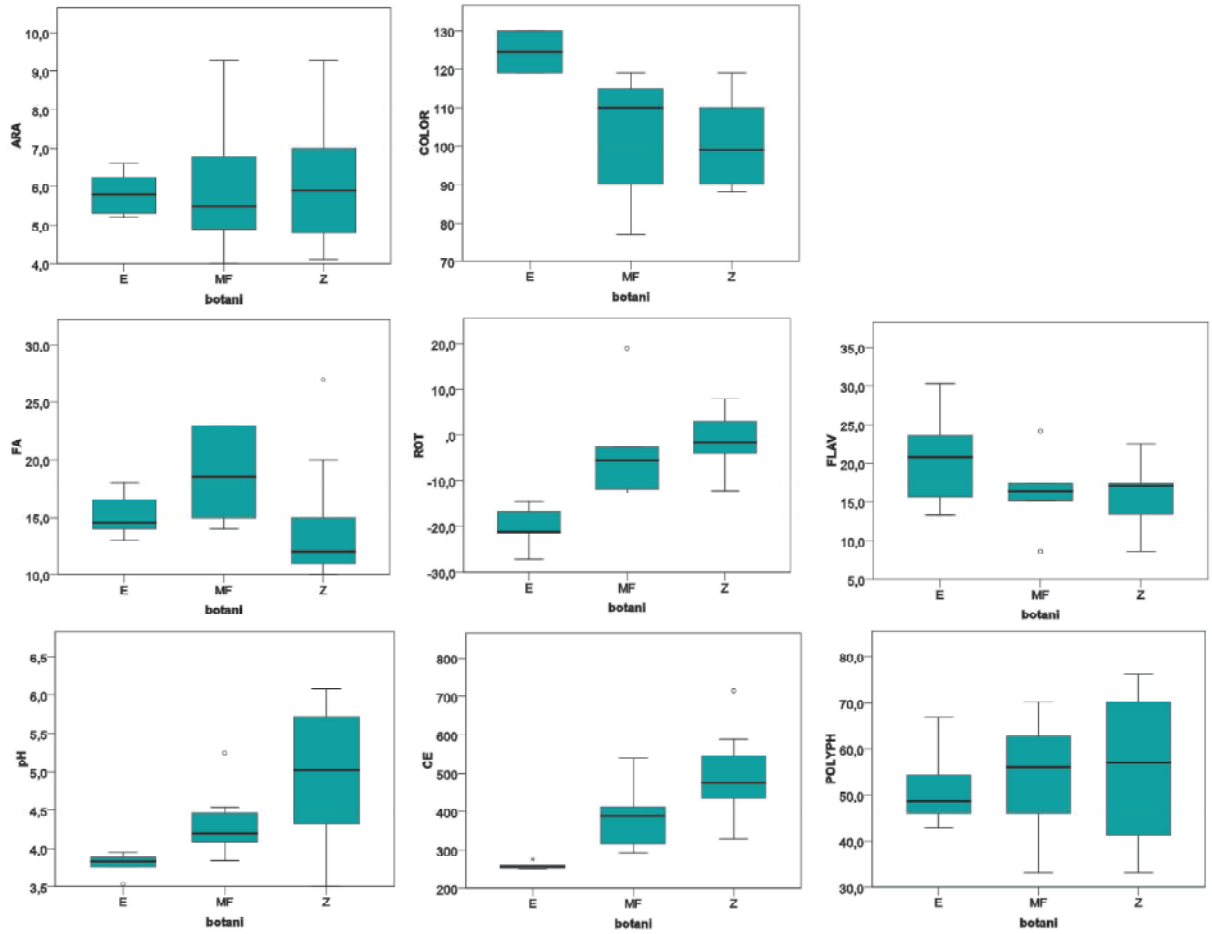

Fig. 2: Representation in box plots of studied honeys characterizing parameters.
MF: multifloral containing ziziphus.
Botani: botanical origin
Z: Ziziphus lotus
E: Euphorbia bupleuroides

Babacan *et al*. [18] provide an optimum pH range (5.3-5.6) favoring the activity of diastase, this may explain the high DN value in the first two groups compared to the third (Euphorbia).

The HMF values are very low; they vary between 0.0 and 18.7 mg/kg, averaging no more than 4.0 mg/kg. These results are similar to those given by Al Khalifa *et al*. [17]. It is a good indication of the freshness of studied honey and their good quality (HMF <5 mg/kg) according to AFNOR [19].

Composition Parameters: This part of the study allows us to identify honeys characteristics related to their botanical origin as: pH, FA, EC, ROT, COLOR, POLY, FLAVO, ARA, F, G and finally S; are given in Table 3.

It appears from the representation in box plots (Figure 2), that *Z. lotus* and *E. bupleuroides* groups can be differentiated by several parameters, the most relevant are: pH, EC, ROT and COLOR.

The pH average of *Z. lotus* honey is around 5.0 in the range between 4.5-5.5, confirming the point made by Schweizer [20] on Rhamnaceae honey and emphasizes the exceptional nature of these floral honeys, pH of *E. bupleuroides* honey vary between 3.7 and 3.9 with a median around 3.8, while Multifloral group revolve around a pH of 4.2 (range 4.0-4.5). The same trend is observed for the EC, where *Z. lotus* honey average is much greater than those presented by the multifloral and *E. bupleuroides* groups. Those values are respectively 480, 400 and 260µS/cm. values two times lower than those given for *Z. lotus* and *E. resinifera* of Morocco [7].

The specific rotation ROT of *Z. lotus* honey is situated around 0°, followed by multifloral goup with mean values of -5° and in the last group (Euphorbia) typical values of -20°. These results are not explained by glucose, fructose or sucrose rates, but by other complex sugars present in their composition. Here, *Z. lotus* honey shows a behavior similar to honeydews [21]. *Z. lotus* honey are less dark, with mean values of 99 mm pfund, followed by multiflora group with 110 mm, Euphorbia honey are the darkest group with values of 125mm. studied Honeys are generally darker than the same honeys from Morocco cited by Chakir *et al*. [7].

Overall Phenolic Composition: The phenolic fraction is responsible of a great part of honeys non-peroxide antimicrobial, anti-radicalar and anti-oxidant activities, where phenolic acids and flavonoids are the most active families [22]. These compounds are often considered as botanical markers of honey origin [23].

In this study, a preliminary quantification of total polyphenols rate, flavonoids and anti-radical activity is performed (Table 3). The total polyphenols rate for ho *Z. lotus* honeys was 54.51 ± 16.19 mg EAG/100g honey, values lower than those quoted by Al Mamary *et al*. [24] for *Z. Spinas christi L.* The flavonoids rate is about 15.60 ± 4.15 mg EQ/100g, representing almost a third of total polyphenols. And finally The ARA is 6.33 ± 1.56%. The *E. bupleuroides* honeys contain comparable amounts of total polyphenols (51.01 ± 7.54 mg EAG/100g) and slightly more flavonoids (20.45 ± 5.70 mg EQ/100g) representing an average of 40% of the total phenolic fraction. The ARA is 5.81 ± 0.55%. Our samples contain modest amounts of polyphenols compared to values reported by Meda *et al*. [10] for multiforal honeys with an average of 74.38 mg EAG/100g, but they are richer in flavonoids, exceeding largely the maximum value of 8.35 mg EQ/100g given by the same author. Compared to European unifloral [25-27], these observations remain correct. This phenomenon is related to plants sunshine exposure in our regions, which promotes the synthesis of flavonoids as electron carrier during photosynthesis [28]. These molecules are important in human nutrition because they represent micronutrients that play protective antioxidants roles [29].

Mineral Composition of *Z. lotus* Honeys: In this section the mineral fraction is recovered and analyzed only for *Z. lotus* honeys or honeys containing ziziphus pollen. The mineral concentration is shown in Table 4. It shows in percent, the global composition for both groups. Two facts are noteworthy: that in *Z. lotus* honeys the most dominant minerals are K, Ca and Na; Fe and Mg are present in constant amount (1%), other minerals are in traces. while studied multiforal containing ziziphus, show a single mineral profile with a prevalence of Ca, Na followed by K.

Al Khalifa *et al*.[17] give largest values of K and Na but comparable values for other minerals for Saudi Arabia species of ziziphus spp., indicating that studied honeys are poor in minerals. The accumulation amounts of heavy metals (Cd and Pb) are very low, hovering around 10 ppb.

Correlations: The observation of correlation matrix (Table 5) shows us the followings (in parentheses, the correlation coefficients):

The studied honeys EC is related to acidity expressed as pH (0.841) and it operates in reverse of the color (-0.663), which means that the color is not dependent on the mineral composition like it is common to find [14].

Table 4: Mineral composition of ziziphus or containing ziziphus honeys.

Minéral composition (ppm)											
		Cd	Pb	Ni	Mn	Fe	K	Ca	Na	Co	Mg
Sample		Multifloral with *Z. lotus* (n=7)									
	Mean±SD	0,0139±,0097[b]	0,0163±0,0188[b]	0,0307±0,0232[b]	0,077±0,047	0,969±0,625	20,066±15,791[a]	47,486±32,905[b]	30,766±33,871[b]	0,0266±0,015	1,072±1,145
	Median	0,0120	0,0105	0,0209	0,0645	0,975	19,470	35,461	23,738	0,0293	0,675
	Min	0,0042	0,0025	0,0130	0,0240	0,276	0,970	16,000	1,520	0,0075	0,2498
	Max	0,0270	0,0540	0,0743	0,1380	1,940	42,4286	95,000	95,000	0,0422	3,230
		Z. lotus (n=8)									
	Mean±SD	0,0107±0,0047[a]	0,0092±0,0033[a]	0,0234±0,0084[a]	0,0685±0,038	0,923±0,378	40,396±21,051[b]	29,510±24,999[a]	17,370±10,543[a]	0,0315±0,019	0,926±0,494
	Median	0,0096	0,0101	0,0246	0,0690	0,882	39,488	18,821	12,041	0,0319	1,038
	Min	0,0066	0,0033	0,0122	0,0255	0,404	13,305	10,916	9,557	0,010	0,3276
	Max	0,0190	0,0123	0,0352	0,1245	1,547	71,739	77,500	35,870	0,0570	1,567
Al khalifa	Asser	Nd	0.090±0.050	-	0.080±0.001	1.04±0.08	483.0±4.3	-	37.1±2.92	-	-
et al. (sidir)	Albaha	0.008±0.008	0.030±0.110		0.180±0.001	1.64±0.22	93.3±4.9		27.5±0.01		

(a,b) Différents lettres indicat différents groups

Table 5: Correlation matrix between different characterization parameters.

	Pearson Coefficient Corrélation											
	pH	FA	CE	ROT	COL	POLY	FLAV	G	F	S	F/ P	ARA
pH	1											
FA	-,171	1										
CE	,841**	,043	1									
ROT	,680**	,196	,703**	1								
COL	-,611**	-,214	-,663**	-,596**	1							
POLY	,058	-,082	,198	,175	,141	1						
FLAVO	-,248	-,149	-,318	-,328	,527**	,445*	1					
G	-,435*	,012	-,460*	-,681**	,279	-,293	,248	1				
F	,100	,092	,161	,312	,032	,281	-,025	-	1			
S	,134	,153	,255	,364*	-,127	,232	-,039	-	-	1		
F / P	-,301	-,088	-,482**	-,458*	,458*	-,292	-	,463*	-,207	-,170	1	
ARA	,197	,265	,246	,416*	,158	,169	,079	-,082	-,024	-,033	-,042	1

**. Correlation is significant at the 0.01 level (1-tailed). *. Correlation is significant at the 0.05 level (1-tailed).

G: glucose, F: fructose, S: sucrose, POLY: polyphénols, FLAVO: flavonoids, FA: free acidity, CE: électrical conductivity, rot: spécific rotation. ARA: antiradicalar activity. F/P: ratio flavonoids on polyphénols

The specific rotation ROT is correlated with the color, which means that the type of sugars affects its color, in our case it is the glucose that causes this difference. Honey color is determined in a large proportion by its flavonoids rate (0.527).

CONCLUSION

Algerian *Ziziphus lotus* and *Euphorbia bupleuroides* Honey seems to be very particular comparing to other blossom honeys, there richness in flavonoids make them very healthy. It is a resource to protect and to develop in that arid area, were agricultural activities are very modest. They must be labeled and controlled to be eventually exported.

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