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QUALITY OF MOROCCAN HONEY

Tlemcani I, Bouchamma E,Bouayad K, Idrissi Z, Errachidi F, Chabir R, Haloti S, El Ghadraoui L

a Laboratory of Functional Ecology and Environment, faculty of sciences and technology, Sidi Mohamed Ben Abdellah University, po.box 2202 – route d'Imouzzer, Fez, Morocco.
b Laboratory of Physiopathology and Nutrition, Faculty of Medicine and Pharmacy, Sidi Mohamed Ben Abdelah University, BP 1893 Km 2200 Road of SidiHrazem, Fez, Morocco.

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Acidity, honey, pH, physicochemical characteristics, polyphenols, protein, sugars,mineral content, water content.

ABSTRACT

The qualities of 10 different honey samples from Morocco were evaluated. Six common physico-chemical parameters were analysed, such as pH, acidity (free, lactonic and total), density, water content, sugars, polyphenols, protein content and mineral composition, including potassium (K), sodium (Na), calcium (Ca), magnesium (Mg), phosphorus (P). Most samples showed proper maturity.
The pH ranges from 4.02 to 5.01 with an acidity between 12.5 and 25 meq / kg. They have a high sugar content (72.39 to 82.68 g / 100 g) with a density of 1.39-1.49 mg / kg. They contain 13.20 to 18.96% water and 0.082 to 0.87% protein.
All honeys samples are essentially consistent with the Codex Alimentarius quality standards for pH, moisture, acidity, density and sugars. On the other hand, the samples meet this standard for the protein content. Within the mineral content, potassium was quantitatively the most important mineral, having an average content of 560 ppm; sodium and calcium were present in moderate amounts in the honeys and accounted for 16% and 10% of the minerals.

INTRODUCTION

Honey have been for thousands of years exploited by man. They are derived from natural substances produced by bees [1]. Their varied uses ensure a good market and represent a supplementary income for the beekeeper. Among these products, honey is one of the oldest foods of humanity [2] which has always been appreciated, as much for its incomparable taste as for its undeniable nutritional and therapeutic virtues [3]. Developed by bees from the nectar of flowers or secretions from the living parts of plants (honeydew) [4], it is widely appreciated as the only concentrated form of sugars available in the world [5] and is also used as a food preservative [6]. It is a marketable commodity in both domestic and international markets, also playing an important role in food and some cultural traditions [7, 8] Moroccans have long treated honey as a medicine and even if it is used as a sweetener and is an integral part of Moroccan cuisine, in total they eat a little, 200 g average per person per year against 1,300 kg for a German. The first Moroccan beekeeping region is by far that of Gharb, in the north-west of the country, where 40 to 60% of the country's domestic honey production is predominant, 15% of modern beekeepers and 91% of modern beehives. Then comes the region of Loukos, which produces about 10% of the country's honey. Both regions are favored by the climate and the diversity of the melliferous flora. Beekeeping in the desert regions of the south is more difficult. The rest of the production is divided mainly between the regions of Essaouira, Sous or Souss, Massa (Oued Oulghas, whose region of Tiznit), Tadla, and areas of the southern Sahara to Oasis of Draa or Daraa, in particularly around Ouarzazate and Tafilalet.

50% of honey production from Moroccan hives is marketed via structured circuits. There, the prices vary between 100 and 450 DH / kg according to the quality of the honey. The rest as well as the production resulting from the farms carried out in a traditional way are either sold in rural souks, or self-consumed. At this level, prices vary between 80 and 300 dirhams per kilo.

Thus the general objective of this study is to contribute to a better knowledge of the quality of honeys sold in Morocco and handled with metal by the determination of the physicochemical characteristics to and mineral content.

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MATERIALS AND METHODS

Honey samples

The present study was carried out on 10 Moroccan honey samples, from different botanical origins. The mineral content ,the physicochemical characteristics most frequently used as better indicators of the quality and stability of honey, and having a great influence on its organoleptic properties (pH, water content, determination of free acidity, and content of total reducing sugars, polyphenols and proteins), were determined according to various methods.

Physicochemical Characterization Of Honeys

pH

pH was measured in a 10% honey solution using a pH meter (Codex Alimentarius, 2001) [9].

Water content

The moisture content of honey is a quality criterion that determines honey's ability to resist fermentation and deterioration during storage. This content is determined by the CHATAWAY tables which give the direct correspondence between refractive index and water content [10].

Density

The density is obtained by calculating the quotient of the honey density and the same density of distilled water [11].

Acidity

The free, lactonic and total acidity were determined as follows, by the titrimetric method: the addition of 0.05 M NaOH was stopped at pH 8.50 (free acidity), immediately a volume of 10 ml 0.05 M NaOH was added and, without delay, back-titrated with 0.05 M HCl to pH 8.30 (lactonic acidity). Total acidity results were obtained by adding free and lactone acidities (AOAC, 1990).

Sugar Content

Sugar content was determined utilising a special refractometer with direct reading display, and the results were expressed as brix degrees.

Total Phenolic Compounds

The determination of total polyphenols is evaluated according to the Folin-Ciocalteu colorimetric method according to the protocol of [13]. The honey solutions were prepared at a concentration of 0.05 g / ml, and 0.5 ml of the stock solution was mixed with 0.5 ml of Folin-Ciocalteu reagent. After 5 min, 2 ml of sodium carbonate (Na_2CO_3) at 20% was added. After incubation in the dark for 60 min, the absorbance was measured at 760 nm against a blank (distilled water). The phenolic compound content of each sample is expressed in mg equivalents of gallic acid per 100 g of honey. (mg EAG / 100 g) with reference to the calibration curve made with gallic acid(0_ 100mg/ml).

Protein contents

The Biuret method described by Bogdanov [11] was used to determine the protein content. The determination of the protein content is based on their absorbance at 540 nm. Five grams of honey was diluted with 50 ml of distilled water and filtered. This solution (1 ml) was then mixed with 4 ml of Gornall's reagent. The absorbance of the reaction mixture was measured at 540 nm against a blank (4 ml of Gornall's reagent and 1 ml of physiological saline) after 30 minutes of incubation in the dark. The albumin standard solution (BSA) of 10 g / L was used as a reference.

Determination of mineral elements

A Jobin Yvon Ultima 2 inductively coupled plasmaoptical spectrophotometer was used for metal determinations. The instrument was operated in the following conditions: RF frequency, 27 MHz; operating power, 1200 W; pump rate, 20 rpm; plasma argon flow rate, 2 l/ min; carrier argon flow rate, 2 l/min; burner type ; ultrasonic nebuliser type Cetac; sample flow rate, 0.02 ml/min; and nebulisation pressure, 1 bar. Five ml of nitric acid (0.1 N) were added to the resultant ash, and the mixture was stirred on a heating plate to almost complete dryness. Then, 10 ml of the same acid were added, and brought up to 25 ml with distilled water. The minerals (Na, K, Ca, Mg, and P) were determined by inductively coupled plasma optical emission spectrophotometer (ICP-OES). The emission wavelength (nm) for the determination of each metal, together with its linear working range and correlation coefficient from the calibration graph, were as follows: K (766.490; 0–400.87 mg/l; 0.9999), Mg (382.935, 0.04– 28.34 mg/l, 0.9999), Ca (422.673, 0.33–99.93 mg/l, 0.9999), Na (589.592, 0.85–249.71 mg/l, 0.9998), and P (255.473, 0–2000 mg/l, 1).

RESULTS AND DISCUSSION

Physicochemical parameters

Table1

Distribution data for common physicochemical parameters in Moroccan honeys

sample	pH	Moisture(%)	Brix(%)	Free Acidity (meq/kg)	Lactonic acidity (meq/kg)	Total acidity (meq/kg)	Density (mg/kg)	Protein content (%)	Total phenolic (mg of EAG / 100g)
1	4.02	13.20	82.68	19.6	5.2	30.8	1.49	0.082	47.97
2	4.04	17.98	80.45	30.1	7.3	30.7	1.39	0.86	57.98
3	5.01	16.70	78.87	24.6	6.4	32.6	1.41	0.87	344.57
4	4.45	18.9	72.39	25.8	5.1	33.44	1.39	0.79	223.7
5	4.5	18.32	72.88	25.22	7.3	40.66	1.39	0.57	143.9
6	4.03	18.96	81.55	20.9	5.03	40.32	1.46	0.67	99.7
7	4.02	16.89	73.09	24.7	7.08	34.56	1.39	0.48	102.6
8	4.21	17.98	76.33	23.8	6.88	34.77	1.39	0.76	114.9
9	4.98	18.8	82.3	30.0	5.05	40.03	1.41	0.23	123.6
10	4.65	18.85	80.70	28.6	7.09	40.54	1.39	0.77	245.74
Mean	4.3	18.3	79.3	24.6	6.9	36.5	1.39	0.67	184.5
SD	0.34	1.76	2.1	1.16	0.56	4.6	0.03	0.02	54

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Physicochemical parameters

pH is important during the extraction process as it affects texture, stability and shelf life. It is low enough to slow down or prevent the growth of many species of bacteria [12].Therefore; none of our samples studied exceeded the allowable limit, which can be considered as an index of freshness.

The pH values of our honey samples range from 4.02 to 5.01 So all honeys studied are acidic. Its value generally varies between 3.5 and 5.5; it is due to the presence of organic acids [12]. Gonnet [13] adds that pH is a measure that allows the determination of the floral origin of honey. Honey obtained from nectar has a pH between 3.5 and 4.5, while those from honeydew are between 5 and 5.5.

The same author asserts that a low pH of about 3.5 for a honey, predetermines a product "fragile" for the conservation of which will take a lot of precautions. On the other hand a honey with pH 5 or 5.5 will keep better and longer.

Water content

Water samples content is between 13.2 and 18.96% these values are well within the range recommended by the Codex Alimentarius[9], and which does not exceed 25 % in general. According to Chauvin [14]. Honeys have a very varied water content, ranging from 14 to 25, the optimum being in 17 and 18%. The water content is a very important data to know, because it conditions the quality of honey, indeed only honeys whose water content is less than 18% are good to keep [16] The registered values of our honeys do not exceed this standard. This can be explained by Aa early harvest of these honeys, that is to say before their maturation. extraction in a humid environment. Louveaux [15] and Prost [16]report that the extraction of honey in a fairly humid environment can lead to moisture absorption, in this context Gonnet[13] reports that a relatively high humidity during harvesting will lead to a difficult dehumidification of the nectar by the bee, thus producing a honey rich in water, unstable on the physical and biological plan and likely to deteriorate quickly. It is honeys that kept for a long time at room temperature in commercial displays, but they have not shown signs of fermentation, this can be explained by a pasteurization that killed the yeasts responsible for the fermentation. Sample1 the honey with the lowest water content, 13.20%. These offer a very good conservation. Their low water content can be explained by an extraction carried out during a very hot period. These samples can be stored regardless of the temperature of the storage and the number of yeast that contains it, because according to Gonnet[13], below 15% of water, fermentation never occurs.

The water content is therefore a highly important element because it allows the estimation of the degree of maturity of the honeys and can provide information on the stability against fermentation and crystallization during storage; it therefore conditions the preservation of the product [17]. In addition, the variation in water content is due to different environmental conditions such as: climate, floral origin, season of harvest of honey samples, water content of nectars, treatment techniques and conditions storage "[18, 19]". It is concluded that our samples can be stored without risk of altering their physicochemical properties.

DENSITY

Examination of Table 1 reveals the densities of honeys sampled from our study. We note that the density values range from 1.39 to 1.49. From there we can say that all the honey samples meet the standards recommended by the Codex Alimentarius and that are from 1.39 to 1.41 up to 1.52. Louveaux [15], indicates that the variations in the density of honeys come mainly from variations in the water content. The more honey is rich in water and the less dense it is, sample 1 has the highest density of honey at 1.49 with the lowest water content (13.20%).

ACIDITY

According to Bogdanov [11] and Gonnet[13], acidity is an important quality index gives important indications of the state of honey. Samples predetermine fragile products for preservation because the strong acidity of medium favors the degradation of hexoses in HMF which depreciates the quality of the honey. According to international Codex standards [9], the free acidity of honey should not exceed 50 milliequivalents of acid per 1000 g. Our honeys comply with the recommended standards. Gonnet states that all honeys are acidic. They contain free or combined organic acids in the form of lactones. The presence of certain acids in these honeys is probably due to nectar or honeydew, but their main origin is to be found in the salivary secretions of the bee and in the enzymatic and fermentative processes [15].

SUGARS CONTENT

The table1 gives us the values of the total sugar content obtained from the various samples and which oscillate between (72.39-82.68 g / 100g). Considering the Codex Alimentarius limits for total reducing sugars, all of our honey samples have values that meet the standard Codex [9].

Protein Content

Table analysis found that honey has a protein content of between 0.082% and 0.7% with an average of 0.30%. Louveaux reports that the protein content is about 0.26% on average with a maximum of 0.83%. He adds that nitrogenous materials may be present in the salivary secretions of the bee. White reports that properly harvested honeys are poor or very low in protein Our samples comply with the required standards. Samples 2 and 3 are excepted, with a protein content of 0.86 and 0.87% respectively, these samples

record values exceeding the norm, but are very close. This content can be explained by the high concentration of pollen in these honeys. Gonnet [13] reports that during the manual pressure extraction of wax cakes, some bee larvae and pollen are very often crushed. The other samples have protein levels that meet the required standard, these samples are properly harvested and therefore they are generally low in protein [15]. The lowest value is recorded for Sample 1 which is the clearest with a value of 0.082%.

Phenolic compounds content

It is noted that the determination of total polyphenols gives us an overall estimate of the content in different classes of phenolic compounds contained in the samples analyzed [19]. the polyphenol content in honeys vary considerably from 47.97 to 344.57 mg of EAG / 100g of honey. The lowest value is (47.9 mg EAG / 100g honey), while the highest concentration of polyphenols, 344.57 mg EAG / 100 g, is dosed in honey sample 3; which suggests that the latter has a better antioxidant potential.

These results are lower than those reported by Reibai [20] (697.22 mg EAG / 100g honey), and Tlemcani [21] (474. 23 mg EAG /100 g). While, [22] reported very low values (2-181 mg EAG / 100 g honey) when compared to our results. These differences can be attributed to the botanical origin, period of harvest and the hive environment [23]. Indeed, the botanical and geographical origin affects phenolic compounds concentration, distribution pollen and honey antioxidant activity [24]. In general, darker honeys contain higher phenolic amounts and have better antioxidant activity than lighter honeys [25].

SAMPLES	Ca	K	Mg	Na	P
1	101	261	49	367	24
2	178	954	77	334	58
3	123	876	78	401	71
4	215	1010	65	339	54
5	224	544	57	389	36
6	198	618	65	356	38
7	167	344	76	398	48
8	170	565	59	365	38
9	156	843	87	324	56
10	118	453	98	312	59
MEAN	169	780	32	392	19
SD	30	103	15	94.2	18.6

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MINERAL ELEMENTS

The results of the metals determined in honey samples are summarized in Table 2; five minerals were identified and quantified: potassium (K), sodium (Na), calcium (Ca), magnesium (Mg), phosphorus (P) The potassium is, quantitatively, the most important mineral, and accounts for 48% of the total mineral quantified, having an average content of 780 ppm; sodium and calcium are present in moderate amounts in the honeys and account for 27% and 13% of the minerals, respectively. Magnesium ranges between 49 and 98 ppm (average: 32ppm). Phosphorus show a low average value, and represent less than 3% of the total mineral content.

CONCLUSION

The results obtained for the mineral contents are in agreement with the dark amber colour characteristic, since the amber honeys show a medium content of minerals values (White, 1978).This study made it possible to obtain scientific data on the physicochemical characteristics of honeys from Morocco and handled with metal. Physico-chemical parameters, such as pH, acidity, water content, reducing sugars, protein, measured revealed the quality of honeys sold in Morocco.

In conclusion, the metal does not affect the quality of honey.

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