Physicochemical characterization of industrial and artisanal honeys in morocco

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Abstract—This study made it possible to obtain scientific data on the physicochemical characteristics of industrial and artisan honeys from Morocco. Physico-chemical parameters, such as pH, acidity, water content, reducing sugars, polyhenols content, measured revealed the quality of honeys sold in Morocco.
The pH ranges from 4.02 to 5.01 with an acidity between 12.5 and 25 meq / kg. They have a high total 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 total sugars. On the other hand, 71, 42% of the samples meet this standard for the protein content. The Student's test shows that no significant difference between industrial honeys and artisanal honeys.

Keywords— acidity, honey, pH, physicochemical characteristics, polyphenols, protein, reducing sugars, scientific data, water content.

1 INTRODUCTION

HONEY products 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] reported by the Holy Quran. 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 northwest 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 (artisanal and industrial) and the comparison between them by the determination of the physicochemical characteristics and by referring to the standards of Codex Alimentarius "[9].

2 MATERIALS AND METHODS

2.1 Physicochemical characterization of honeys

2.1.1 Honey samples

The study was carried out on 7 Moroccan honey samples, 3 samples of artisanal honeys and 4 samples of industrial honeys. All samples were kept at light and at room temperature (25-30 ° C) until analysis. 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.

2.1.2 pH

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

2.1.3 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].

2.1.4 Density

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

2.1.5 Free Acidity

Free acidity was determined according to the method described by Bogdanov [11] by titration at pH 8.5 on 5 g of honey homogenized in 50 ml of distilled water.

2.1.6 Total sugar

The total reducing sugars assay was performed by the colorimetric method in the DNS described by Bogdanov [11]2 ml of the honey solution (10%), add 5 ml of DNS solution. It is then heated for 15 minutes. After incubation for one hour, the absorbance is measured at 530 nm. Glucose was used as a reference

2.1.7 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).

4 RESULTS AND DISCUSSION

4.1 Physicochemical parameters

4.1.1 pH

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 with an average of 4.09. 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.

Compared to the recommended standards for the pH of honey, we can conclude that industrial honeys are honey nectar. While artisanal honeys, are a mixture of nectar and honeydew. The pH student's test shows that there is no significant difference between industrial honeys and artisanal honeys.

TABLE1: PH OF HONEYS STUDIED

Industrial Honeys		Artisanal Honeys
4.03 ± 0.035		**4.3 ±0.029**
4.3 ± 0.19		
		4.18 ±0.086
4.04 ±0.089		**5.01 ±0.01**
4.02 ±0.056		
AVERAGE	4.097	4.496
STUDENT	0.259	

4.1.2 Water content

Water samples content is between 13.2 and 18.96% with an average 16.63 these values are well within the range recommended by the Codex Alimentarius[9], and which does not exceed 21 % in general, and does not exceed 25% for industrial honeys. According to Chauvin [14], industrial 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 except samples H1, H2, and H4, which have the highest moisture content, 18.80%, 18.96%, 18.50% respectively. This can be explained by: - An 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. –

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It is the industrial honeys 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. Samples H3 and H6 are the honeys with the lowest water content, 13.20% and 14.30% respectively. 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. According to the Student's test there is no significant difference between artisan and industrial honeys.

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.

TABLE 2: WATER CONTENT OF HONEYS STUDIED

Industrial Honeys		Artisanal Honeys
4.03 ± 0.035		**4.3 ± 0.029**
4.3 ± 0.19		
		4.18 ± 0.086
4.04 ±0.089		**5.01 ± 0.01**
4.02 ±0.056		
AVERAGE	**17.365**	**15.666**
STUDENT	**0.334**	

4.1.3 DENSITY

Examination of Table of density reveals the densities of honeys sampled from our study. We note that the density values range from 1.39 to 1.49 with an average of 1.43. 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 3 has the highest density of honey at 1.49 with the lowest water content (13.20%).

The Student's Honey density test of the different samples shows no significant difference between industrial honeys and artisan honeys.

TABLE 3: DENSITY OF HONEYS STUDIED

Industrial Honeys		Artisanal Honeys
4.03 ± 0.035		**4.3 ±0.029**
4.3 ± 0.19		
		4.18 ±0.086
4.04 ±0.089		**5.01 ±0.01**
4.02 ±0.056		
AVERAGE	4.097	4.496
STUDENT	0.259	

4.1.4 ACIDITY

According to Bogdanov [11] and Gonnet[13], acidity is an important quality index gives important indications of the state of honey. Samples H2, H5, H7 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].

The Student's acidity test shows no significant difference between industrial honeys and homemade honeys.

TABLE 4: ACIDITY OF HONEYS STUDIED

Industrial Honeys		Artisanal Honeys
4.03 ± 0.035		**4.3 ±0.029**
4.3 ± 0.19		**4.18 ±0.086**
4.04 ±0.089		**5.01 ±0.01**
4.02 ±0.056		
AVERAGE	17.365	15.666
STUDENT	0.334	

4.1.5 REDUCING SUGARS

The table below gives us the values of the total reducing sugar content obtained from the various samples and which oscillate between (72.39-82.68 g / 100g) with an average of 78.17g / 100g . We note that samples representing industrial honeys (H1, H2, H3, H4), have higher levels of sugars than artisanal honeys (H5, H6, H7).

Considering the Codex Alimentarius limits for total reducing sugars, all of our honey samples have values that meet the standard Codex [9].

TABLE 5: REDUCING SUGARS CONTENT OF HONEYS STUDIED

Industrial Honeys		Artisanal Honeys
82.03 ± 0.35		**72.39 ±0.076**
82.68 ± 0.67		**73.4 ±0.043**
80.04 ±0.078		**76.09 ±0.04**
79.1 ±0.53		
AVERAGE	81.5	73.8
STUDENT	0.321	

4.1.7 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 artisanal honey samples; 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). These differences can be attributed to the botanical origin, period of harvest and the hive environment.

Indeed, the botanical and geographical origin affects phenolic compounds concentration, distribution pollen and honey antioxidant activity [22]. In general, darker honeys contain higher phenolic amounts and have better antioxidant activity than lighter honeys [23].

TABLE 6: PHENOLIC COMPOUNDS OF HONEYS STUDIED

Industrial Honeys		Artisanal Honeys
105.03 ± 0.88		**177.9 ± 0.072**
68.87 ± 0.9		**344.57 ±0.078**
47.97 ± 0.067		**223.1 ± 0.76**
122.43 ±0.55		
AVERAGE	98.88	298.2
STUDENT	0.456	

CONCLUSION

All honeys samples are essentially consistent with the Codex Alimentarius quality standards for pH, moisture, acidity, density and total sugars. On the other hand, 71, 42% of the samples meet this standard for the protein content. The Student's test shows no significant difference between industrial honeys and artisan honeys

This study made it possible to obtain scientific data on the physicochemical characteristics, industrial and artisan honeys from Morocco. Physico-chemical parameters, such as pH, acidity, water content, reducing sugars, protein, measured revealed the quality of honeys sold in Morocco.

The pH ranges from 4.02 to 5.01 with an acidity of between 12.5 and 25 meq / kg. They have a high total 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, phenol compounds vary considerably from 47.97 to 344.57 mg of EAG / 100g of honey.

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