

Comparative Study of Honey Collected from Different Flora of Pakistan

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Abstract: A total number of 40 honey samples were collected from *Apis mellifera* colonies forged on the five flora i.e., *Ziziphus* spp., *Acacia modesta*, *Trifolium* spp., *Citrus* spp. and *Eucalyptus* spp. These samples were analyzed for fifteen standard physico-chemical parameters of honey quality control i.e., free acidity, lactone, total acidity, refractive index, specific gravity, reducing sugars, sucrose, total sugars, hydroxymethylfurfural (HMF) content, diastase value, ash contents, water insoluble solids and total soluble solids. The biochemical variation in the composition of honey due to floral type shows *Ziziphus* honey with high pH, ash and diastase value along with low acids and sucrose contents whereas *Trifolium* honey contained high moisture content, acids and sucrose along with low quantity of reducing sugars. Highest HMF was detected in *Acacia* honey along with lowest diastase and ash contents.

Key words: *Apis mellifera*, *Ziziphus* spp., *Acacia modesta*, *Trifolium* spp., *Citrus* spp., *Eucalyptus* spp., physico-chemical parameters

Introduction

Bee honey is a mixture of two monosaccharides, fructose and glucose dissolved in 14 to 20 % water with minor amounts of organic acids along with traces of minerals and vitamins. Chemical analysis reveals that it is a mixture of water, sugars, acids, proteins and different minerals along with some minor components like flavour and aroma substances, enzyme, vitamins and tannins. As a food, honey is easily digestible and a more palatable food. It supplies substantial energy since it is 75 to 85 % fructose and glucose. Albanese *et al.* (1952) suggested that rapid assimilation of fructose may be associated with increased nitrogen retention and also the presence of invertase enzyme in honey is good for old and sick people. Honey also proved useful in the treatment of burns, wounds, gastroenteritis stomach and skin ulcers because of its antibacterial properties (McCarthy, 1995). Emarah *et al.* (1997) reported the use of bee honey in the treatment of external eye disease. The variation in the composition of honey constituents is due to various physiological factors such as climate, soil, flora, bee species, etc.

Ihtisham-ul-haq (1997) reported that the soil type and climatic conditions varied from one region to the other, thus influencing the physico-chemical characteristics of honey. Clover honey is generally considered to be superior to canola honey, the differences if any are still unknown. Abell and Sporns (1996) investigated the difference between canola honey and clover honey but found no overall differences in either honey. This study comprises the investigation in the variability of physicochemical characteristics of honey with different flora of Pakistan.

Materials and Methods

The collection of forty honey samples was made by Honeybee Research Institute, National Agricultural Research Centre, Islamabad in the year 2000. These samples were of five different floral types such as *Ziziphus*, *Acacia*, *Trifolium*, *Citrus* and *Eucalyptus*. The samples of honey free from granulation were thoroughly mixed by stirring or shaking. Whereas granulated honey with closed containers was placed in water bath without submerging and heated for 30 min at 60 °C. then if necessary, further heated at 65 °C until liquefied. But honey intended for hydroxymethylfurfural and diastatic determination were not heated. If foreign matter such as wax sticks, bees, particles of comb, etc., were present, then samples were heated in the water bath at 40 °C and strained through cheesecloth in hot water funnel before sampling.

Physico chemical analysis: Free acidity, lactone and total acidity, total soluble solids, specific gravity, hydroxymethylfurfuraldehyde, diastase activity, total ash, reducing and non reducing sugars were analyzed according to the methods of Anonymous (1984). Moisture content and refractive index were estimated using the method of Chataway (1932) revised by Wedmore (1955).

Results and Discussion

pH: The investigations reveal a significant variation in pH among different floral sources of honey. The result shows the highest mean pH of 6.30 ± 0.01 in *Ziziphus* spp., whereas lowest pH of 3.3 ± 0.06 in *Citrus* (Table 1). This is mainly due to the variation of different acids and minerals present in the honey. Hussain (1989) observed a significant difference in honey of different floral types.

Acidity: The total acidity of all the samples analyzed are found well within the prescribed limits of 40 meq kg^{-1} proposed by Codex Alimentarius Commission (1969). White *et al.* (1962) reported free acidity $22.03 \text{ meq kg}^{-1}$, lactone 7.11 meq kg^{-1} and total acidity $29.12 \text{ meq kg}^{-1}$ in 490 samples of honey. In this study *Trifolium* honey has a higher level of free acidity and lactone whereas *Ziziphus* honey is found with lower values (Table 1). Ihtisham-ul-haq (1997) reported similar results in comparison to this study. The low acidity of *Ziziphus* honey may be considered as a factor for its preference over all other honey. The investigations further reveal that the variation of these factors is due to source of nectar and climatic conditions of the area. Average lactone contents are not found significant among each other in different honey (Table 1).

Moisture content, refractive index and specific gravity: The average moisture content of Pakistani honey is found within the limits prescribed by Codex Alimentarius Commission (1969) i.e. not more than 21%. Variation in moisture, refractive index and specific gravity are not significant among different types of floral honey (Table 1). The five floral types of honey are found with the excellent moisture content refractive index and specific gravity, as all these three parameters are highly negatively correlated to each other (Table 1). The water content was also influenced by the time of extraction from the comb in relation to ripening process by the bees (Chung *et al.*, 1984).

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Table 1: Physico-chemical parameters of honey from different flora of Pakistan

Flora	pH	F. acidity	Lactone	T. acidity	Moisture	Ref. index	Sp. gravity	Red. sugar	Sucrose	Total sugar	HMF	Diastase	Ash
<i>Ziziphus</i> (n=10)	6.306 ± 0.10	5.836 ± 0.08	0.879 ± 0.16	6.733	17.340 ± 0.22	1.4931	1.4216	68.5 ± 0.36	1.115 ± 0.20	69.465 ± 0.36	31.008 ± 10.72	13.040 ± 1.93	0.774 ± 0.03
<i>Acacia</i> (n=10)	3.595 ± 0.07	15.031 ± 0.83	1.566 ± 0.33	16.614	17.640 ± 0.26	1.4923	1.4195	75.74 ± 0.93	3.452 ± 0.72	79.198 ± 1.01	35.933 ± 7.19	10.720 ± 1.29	0.052 ± 0.01
<i>Trifolium</i> (n=7)	3.704 ± 0.07	21.064 ± 0.97	1.872 ± 0.34	22.937	17.971 ± 0.42	1.4915	1.4172	66.00 ± 0.83	12.135 ± 1.70	78.121 ± 2.10	40.065 ± 10.59	9.667 ± 0.53	0.155 ± 0.01
<i>Citrus</i> (n=7)	3.330 ± 0.06	15.51 ± 0.81	0.830 ± 0.32	16.311	17.142 ± 0.27	1.4936	1.4228	79.20 ± 0.71	2.565 ± 0.44	81.631 ± 0.78	16.395 ± 2.03	9.165 ± 1.20	0.178 ± 0.1
<i>Eucalyptus</i> (n=6)	5.803 ± 0.02	7.15 ± 0.35	1.461 ± 0.33	8.611	17.333 ± 0.30	1.4931	1.4216	78.87 ± 0.82	2.228 ± 0.60	81.163 ± 0.69	42.896 ± 13.80	8.54 ± 0.62	0.046 ± 0.00

HMF= Hydroxymethylfurfural, n= No. of samples, F. acidity= Free acidity, T. acidity= Total acidity

Reducing sugars: The average composition of reducing sugars of Pakistani honey is found above 65% as recommended by Codex Alimentarius Commission (1969). Latif *et al.* (1956) reported Pakistani honey with 71 to 76.9% reducing sugars. The sugar spectrum of honey depends upon the sugar present in the nectar and enzymes present in the bee and nectar (Maurizio, 1959). Citrus honey is found with high reducing sugars (79%). Abu-Tarboush *et al.* (1993) also reported high reducing sugars of 79.40% in citrus honey. *Trifolium* honey exhibited a lower percentage of reducing sugars (66%).

Non reducing sugar (sucrose): Codex Alimentarius Commission (1969) permits the maximum of 10% sucrose contents. Effect of flora shows *Trifolium* honey with high sucrose (12%) and *Ziziphus* honey with low sucrose content (1.15%) in almost all the samples collected from different locations. The high level of *Trifolium* honey have also been reported by Ihtisham-ul-haq (1997). This feature of high sucrose content may be a plant characteristic and is not an indication of sugar feeding to the bees. Sugar fed honey are low in water content and pH along with high sucrose content (Abu-Tarboush *et al.*, 1993).

Hydroxymethylfurfural (HMF): Analysis of variance of HMF reveals that there is a significant differences among HMF of different honey (Table 1). The average hydroxymethylfurfural (HMF) content of Pakistani honey is found within the limits prescribed by the Codex Alimentarius Commission (1969) of not more than 40 mg kg⁻¹ in normal honey. Citrus honey exceeded the recommended limit of 15 mg kg⁻¹. The HMF Content, which is used as an index of heat treatment of honey, indicated that *Eucalyptus* honey with highest HMF. The accumulation of HMF was due to processing of honey at high temperature above 75 °C or storage above 27 °C for months (Rodgers, 1979). *Ziziphus* honey indicated a good quality with a low level of HMF which may be due to the different methods adopted by the farmers for the extraction and storage of honey.

Diastase activity: The average diastase value of Pakistani honey is found within prescribed limits of Codex Alimentarius Commission (1969) of 8 in normal honey and 3 in citrus honey. This factor is also considered to be a quality parameter and therefore nothing to do with floral type. There is no significant difference found among diastase activity in different honey (Table 1). All the floral honey is found with good diastase activity. Shah and Mehmood (1987) reported similar values for *Trifolium* honey. This is mainly due to excessive heat treatment during processing of honey that lowers the diastase enzyme in honey.

Ash contents: There is no significant difference among ash contents of different floral honey (Table 1). *Ziziphus* honey exceeded the 0.6% ash contents limit prescribed by Codex

Alimentarius Commission (1969). Ihtisham-ul-haq (1997) observed the ash contents of *Ziziphus* (0.47%), *Citrus* (0.08%), *Acacia* (0.13%) and *Trifolium* (0.13%). The mark difference in the ash contents could be attributed to the floral origin and the materials gathered by the bees during foraging. The variation was apparently due to many factors such as differences in soil and atmospheric conditions as well as in the type and physiology of each plant.

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