Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 5, Issue, 10, pp.3029-3034, October, 2013

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

ANALYSIS OF VARIOUS HONEY SAMPLES COLLECTED FROM DIFFERENT LOCATION OF MADHYA PRADESH

Gajendra Singh Rajpoot, Rajesh Kumar and Om Prakash Agrawal

Entomology Research Unit, School of Studies in Zoology, Jiwaji University, Gwalior – 474011 (M. P.) India

ARTICLE INFO

Article History:
Received 26th July, 2013
Received in revised form
20th August, 2013
Accepted 15th September, 2013
Published online 23rd October, 2013

Key words:
Beekeeping, Honey,
Sampling,
Hydroxyl methyl furfural,
Carbohydrates,
Moisture, Gwalior

ABSTRACT

Honey is a natural product, procured from honey bee colonies. Besides high concentration of sugars, it contains other useful nutrients, vitamins, minerals, enzymes and several phyto-nutrients. In many Indian families, first food in the mouth of new borne child is a drop of honey followed by mother's milk. Therefore honey must be collected, purified and properly stored so that all its properties can be retained for longer period. In the present study, honey samples were collected from the beekeepers of three different locations of Gwalior-Chambal region of Madhya Pradesh and some samples were procured from local market. They were analyzed for colour, pH, moisture, total carbohydrate and hydroxy methyl furfural content. The colour of honey depends on their flora, storage time and storage conditions. The pH of honey samples was recorded to be acidic, but showed much variation in the range of 3 to 6. Moisture content was observed in the range 18.3 % to 23.2 %. Total carbohydrates were observed in the range of 76 to 80%. Honey samples, except for some market samples, were HMF negative. Thus none of the tested samples can be declared impure. However, some market samples appear to be sub standard as they have moisture content higher than 20%, are positive to Fiehe's test and show high level of HMF content.

INTRODUCTION

India is a country of great beekeeping potential. Diverse flowerings and pleasant climatic conditions make possible the management of bee colonies during the entire year. Beekeeping is an interesting activity to the rural/poor villagers because it requires little initial investment (Nogueira-Couto and Couto 2006). India produces large quantity of honey. According to an estimate out of 3,50,000 tons of honey exports to Germany, United States, Japan, United Kingdom, Italy, more than 20% comes from India, occupying second position as exporter country (Sabio and Santos, 2005). But, there are several reasons of non-popularity of honey in India like mis-conceptions, lack of proper understanding and awareness. Several people think that it is very difficult to get pure honey, is a costly item and is beyond their reach, crystallized honey is not pure and apiary honey is not pure as it is manufactured by artificial feeding of bees on jaggery or sugar syrup rather than on flowers. None of these statements is true. Most of the Indian beekeepers are villagers and illiterate persons and they do not have enough knowledge about proper procedure of honey extraction, handling, processing, storage and packaging for marketing. Usually honey is not properly handled after extraction. In preliminary survey, it was found that extracted honey is stored in tin canisters which are not properly cleaned and dried and are often rusted. It was also noticed that many beekeepers do not even filter honey that contains dead brood and bees, their body parts, fragments of comb, foreign bodies etc. All of these factors affect quality of honey including flavour, taste, colour and biochemical parameters including HMF content resulting in failure of samples during testing. A lot of work and studies have been carried out on honey in many foreign countries (Crane, 1975; White, 1979; Estupinan *et al.*, 1998; Caroli *et al.*, 1999; Cowan, 1999; Latorre *et al*., 1999; Wollgast and Anklam 2000; Anklam and Radovic, 2001; Kefalas *et al*., 2001; Al-Mamary *et al*., 2002; Gheldof *et al*., 2002; Mckibben and Engeseth 2002; Aljadi and Kamaruddin, 2004; Bogdanov *et al*., 2004; Marini *et al*., 2004; Beretta *et al*., 2005; Golob *et al*., 2005; Kaakeh and Gadelhak, 2005; Buratti *et al*., 2007; Kucuk, *et al*., 2007; Guler *et al*., 2008; Kaskoniene *et al*., 2008; Achudume and Nwafor, 2010; Aliferis *et al*., 2010; Pohl *et al*., 2011; Voidarou *et al*., 2011, Gobessa *et al*., 2012; Kasperova *et al*., 2102; Pavelkova *et al*., 2013; Shahnawaz *et al*., 2013). Detailed studies on honey have not been carried out in India and usually standard values of other countries have been followed. Also sufficient literature on sampling of honey is not available. The purpose of the present study is to carry out in-depth study on sampling and analysis of commercial honey samples with regards to pH, HMF, carbohydrate and moisture content.

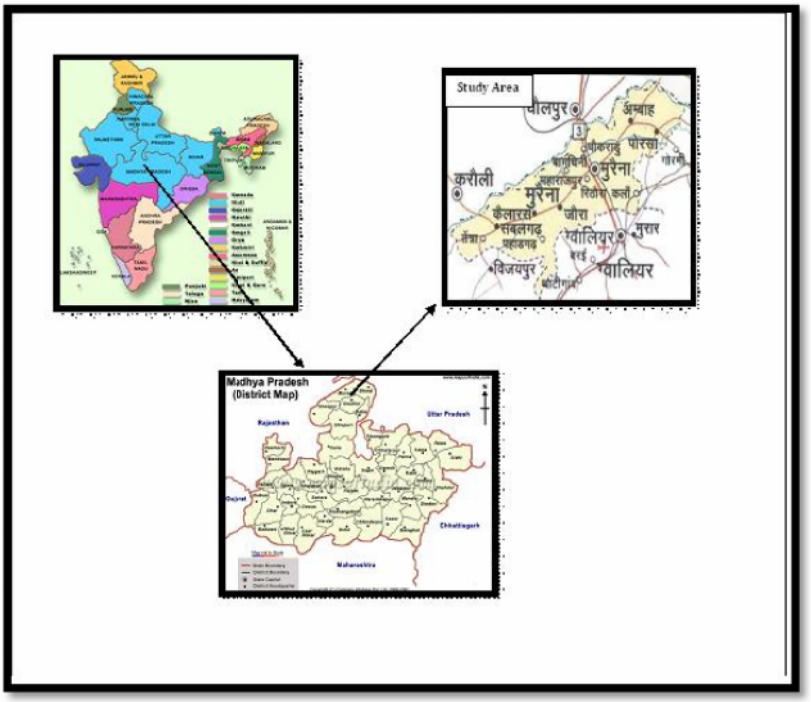
MATERIALS AND METHODS

Honey samples were collected from different locations of Gwalior-Chambal region in Madhya Pradesh (Figure 1 and 2). Samples were directly collected from farmers in pre-labelled air tight glass containers (Figure 3). Before collection, it was

Corresponding author: Om Prakash Agrawal
Entomology Research Unit, School of Studies in Zoology, Jiwaji University, Gwalior – 474011 (M. P.) India

Source: Google Earth

Figure 1: Satellite image of study area



Source: Google Map

Figure 2: Showing study area

Figure 3: Apiary at District Morena

Fig 4: Samples packed in air tight containers

ensured that all the samples were of definite or specific flora. Also the samples must be free from any contamination and the colonies from which honey was collected should be disease free. Samples were again filtered, properly labeled and stored in dust proof area, at room temperature (Figure 4). Samples from Gwalior were purchased directly from shopkeepers of local market. Honey samples were analyzed for pH, percentage of moisture, HMF and total carbohydrate content in the laboratory. The colour and granulation of honey samples was observed and recorded visually. Hydroxy methyl furfural was analyzed by Fiehe's test (Finola *et al*., 2007). Percent moisture and total carbohydrates were calculated by AOAC (1990) methods. Data thus collected was subjected to differential statistics (Mean ± S. E.).

RESULTS

Details of the samples collected are depicted in table 1-4. Perusal of Table 1 showed the samples purchased from shopkeepers of Gwalior. Data of samples collected from district Morena, Guna and Shivpuri are shown in table 2, 3 and 4. All the samples were collected in the month of March from the beekeepers directly. Bee species domesticated in the study areas is *Apis mellifera*.

In total 12 samples were procured from all the four locations. The sample numbers 1 to 6, collected from Gwalior market were of mustard and 7 to 12 were of mixed flora as mentioned on the label of the bottles. The sample numbers 1 to 6, collected from beekeepers of Morena, Guna and Shivpuri were of mustard and sample nos. 7 to 12 were of coriander flora. Colour of fresh honey samples collected from beekeepers was light extra white, white (transparent) like water or light amber as compared to market samples which were darker. It was observed that fresh honey samples also become darker in due course of storage. It appears that the colour of honey may also depend on their flora. Mustard honey was lighter in colour than coriander honey. No granulation was observed in any of the samples during March to October, 2013. The pH values of honey samples were recorded to be acidic showing variation in the range of 3 to 6. HMF content was found positive only in few samples collected from market (Sample 1, 2, 3, 5, 6, 10, 11 and 12). HMF (Fiehe's test) was found negative in rest of market samples and fresh samples collected from beekeepers directly. The moisture content of honey depends on various factors, for example harvesting season, degree of maturity of honey and climatic factors. Percent moisture in market samples was observed to be 18.5, 19.0, 21.0, 18.1, 19.1, 23.2, 20.0, 19.5, 21.5, 20.1, 19.3 and 21.1 percent in sample no.1 to 12 respectively, with an average of 20.40%.

Table 1: Samples Collected from Gwalior Market

Sr. No.	Place of Collection	Colour	pH	Moisture	HMF	Total Carbohydrate
1.	Gwalior Market	Light Amber	4.53±0.11	18.50±0.12	0.14±0.01	80.72±1.58
2.	Gwalior Market	Light Amber	4.52±0.16	19.00±0.12	0.35±0.01	80.11±1.63
3.	Gwalior Market	Light Amber	4.47±0.15	21.00±0.06	Absent	78.21±1.46
4.	Gwalior Market	Extra Light	3.38±0.65	18.10±0.15	Absent	80.42±1.49
5.	Gwalior Market	Light Amber	4.48±0.11	19.10±0.12	0.19±0.01	79.48±1.15
6.	Gwalior Market	Light Amber	4.45±0.12	23.20±0.06	0.19±0.01	76.03±1.00
7.	Gwalior Market	Extra Amber	4.52±0.11	20.00±0.12	0.15±0.01	79.38±1.65
8.	Gwalior Market	Extra Amber	3.99±0.14	19.50±0.62	Absent	79.81±1.24
9.	Gwalior Market	Extra Amber	4.31±0.11	21.50±0.06	Absent	78.00±.89
10.	Gwalior Market	Amber	4.67±0.10	20.10±0.06	0.08±0.01	79.37±1.04
11.	Gwalior Market	Light Amber	4.18±0.12	19.30±0.06	0.13±0.01	79.02±1.25
12.	Gwalior Market	Amber	4.31±0.10	21.10±0.06	1.34±0.11	78.28±0.96

* values expressed as Mean ± S. E.

Table 2: Samples collected from Morena District

Sr. No.	Place of Collection	Color	pH	Moisture	HMF	Total Carbohydrate
1.	Morena	White	4.48±0.09	18.80±0.23	Absent	80.04±0.71
2.	Morena	White	4.34±0.12	18.33±0.29	Absent	80.81±0.98
3.	Morena	White	4.86±0.07	19.47±0.18	Absent	79.76±0.92
4.	Morena	Extra White	4.25±0.09	18.60±0.15	Absent	80.56±0.89
5.	Morena	White	4.36±0.07	18.97±0.18	Absent	80.27±0.89
6.	Morena	White	4.40±0.13	19.43±0.15	Absent	79.76±1.03
7.	Morena	White	4.42±0.14	18.67±0.15	Absent	80.42±0.92
8.	Morena	White	4.43±0.13	19.47±0.18	Absent	80.64±0.90
9.	Morena	Extra White	4.42±0.12	18.67±0.15	Absent	80.46±0.83
10.	Morena	White	4.46±0.13	18.80±0.23	Absent	80.27±0.89
11.	Morena	White	4.42±0.12	18.60±0.15	Absent	80.54±0.93
12.	Morena	White	5.22±0.07	19.4±0.21	Absent	79.77±0.93

* Values expressed as Mean ± S. E.

Table 3: Samples collected from Guna District

Sr. No.	Place of Collection	Color	pH	Moisture	HMF	Total Carbohydrate
1.	Guna	Extra White	5.12±0.47	20.13±0.18	Absent	79.11±1.14
2.	Guna	Extra White	4.44±0.17	20.57±0.15	Absent	78.60±1.02
3.	Guna	Extra White	5.46±0.36	20.03±0.18	Absent	79.23±1.05
4.	Guna	Extra White	5.68±0.17	21.47±0.18	Absent	77.86±1.19
5.	Guna	Light Amber	4.88±0.23	19.50±0.15	Absent	79.71±1.15
6.	Guna	Light Amber	4.42±0.36	19.77±0.20	Absent	79.42±1.11
7.	Guna	Extra White	4.97±0.26	20.40±0.17	Absent	78.85±1.09
8.	Guna	Extra Light Amber	5.42±0.36	20.43±0.18	Absent	78.90±1.17
9.	Guna	White	5.58±0.37	21.43±0.15	Absent	78.07±1.54
10.	Guna	Extra White	5.38±0.23	20.03±0.18	Absent	79.18±1.08
11.	Guna	Extra White	5.49±0.15	19.70±0.15	Absent	79.56±1.02
12.	Guna	Extra Light Amber	4.62±0.23	19.43±0.15	Absent	79.89±1.16

* Values expressed as Mean ± S. E.

Table 4: Samples collected from Shivpuri District

Sr. No.	Place of Collection	Color	pH	Moisture	HMF	Total Carbohydrates
1.	Shivpuri	Extra White	4.31±0.17	21.40±0.21	Absent	77.89±0.76
2.	Shivpuri	Extra White	4.22±0.36	20.60±0.12	Absent	78.72±1.21
3.	Shivpuri	Extra White	4.21±0.17	21.47±0.12	Absent	77.96±0.78
4.	Shivpuri	Extra White	4.24±0.16	20.07±0.15	Absent	79.19±1.26
5.	Shivpuri	Extra White	4.26±0.24	19.67±0.15	Absent	79.55±1.12
6.	Shivpuri	Extra White	4.21±0.17	20.53±0.12	Absent	78.84±1.04
7.	Shivpuri	Extra White	4.24±0.15	21.43±0.20	Absent	77.96±0.85
8.	Shivpuri	Extra White	4.24±0.23	21.43±0.15	Absent	78.04±1.09
9.	Shivpuri	Extra White	4.26±0.14	20.67±0.15	Absent	78.57±1.18
10.	Shivpuri	Extra White	4.25±0.17	21.37±0.18	Absent	78.06±1.05
11.	Shivpuri	Extra White	4.25±0.17	20.43±0.15	Absent	78.90±0.84
12.	Shivpuri	Extra White	4.24±0.31	21.53±0.20	Absent	77.89±1.19

* Values expressed as Mean ± S. E.

Moisture in the samples collected from Morena district was analyzed to be 18.8, 18.3, 19.4, 18.6, 18.9, 19.4, 18.6, 19.4, 18.6, 19.4, 18.6, 18.8, 18.6 and 19.4 percent in sample no. 1 to 12 respectively, with an average of 20.50%. In Guna district, moisture content was in the range of 19.4 to 21.4 percent, values being 20.1, 20.5, 20.0, 21.4, 19.5, 19.7, 20.4, 20.4, 21.4, 20.0, 19.7 and 19.4 in sample no. 1 to 12 respectively, with an average of 20.20%. In district Shivpuri, percentage of moisture in sample no. 1 to 12 was found to be 21.4, 20.6, 21.4, 20.0, 19.6, 20.5, 21.4, 21.4, 20.6, 21.3, 20.4 and 21.5 respectively with an average of 20.84%. Total carbohydrates were analyzed to be 80.72, 80.11, 78.21, 80.42, 79.48, 76.03, 79.38, 79.81, 78.00, 79.37, 79.02 and 78.28 in samples 1to12 respectively with an average of 79.06%. In the samples collected from Morena, total carbohydrates were analyzed to be 80.04, 80.81, 79.76, 80.56, 80.27, 79.76, 80.42, 80.64, 80.46, 80.27, 80.54 and 79.77 in samples 1 to 12 respectively with an average of 80.27% and in the samples collected from Guna district, value of total carbohydrates was observed to be 79.11, 78.60, 79.23, 77.86, 79.71, 79.42, 78.85, 78.90, 78.07, 79.18, 79.56 and 79.89 in samples 1 to 12 respectively with an average of 79.03%.

In the samples of Shivpuri district, value of total carbohydrates was recorded to be 77.89, 78.72, 77.96, 79.19, 79.55, 78.84, 77.96, 78.04, 78.57, 78.06, 78.90 and 77.89 in samples 1 to 12 respectively with an average of 78.46%.

DISCUSSION

The HMF content is indicative of honey freshness (Terrab *et al*., 2002), and from this point of view the majority of the analyzed samples were fresh except few market samples. Presence of high HMF content in some market samples can be due to reason that samples may be packed and stored long ago. Previous studies on the formation of HMF in honey samples have also reported a considerable increase in HMF concentration when honey is stored at room temperature (Hase *et al*., 1973; Consentino *et al*., 1996; Langridge, 1977; Singh and Bath, 1998; Kalabova *et al*., 2003). Results obtained in case of total carbohydrates are in line with that of Crane, 1975; Estupinan, 1998 and Finola, 2007 who reported 75-80% total carbohydrates in honey samples. The percentage of moisture in honey samples was found to be variable. Results obtained are

in accordance with Conti, 2000; White, 1969; Bogdanov, 1999; Ojeda de Rodriguez *et al*., 2004 who reported that water or moisture content in honey generally depends on the botanical origin of the sample, climatic conditions, degree of maturity of the honey, different bee-hive handling practices applied by beekeepers, the processing techniques and the storage conditions.

Conclusion

The results of analysis of honey samples may be useful for quick assessment of its quality. The present study seems to be the first attempt of honey sampling and analysis in Gwalior-Chambal region. On the basis of findings of the study, none of the tested samples were found to be impure. Some of the market samples were found to contain high moisture content and some other samples showed increased HMF values.

Acknowledgement

Authors are grateful to Professor and Head, School of Studies in Zoology, Jiwaji University, Gwalior for necessary facilities and encouragement. Financial support by University Grants Commission, New Delhi, under SAP programme and research fellowship to first author and supply of authentic honey samples by beekeepers are also thankfully acknowledged.

REFERENCES

Achudume, A.C. and Nwafor, B.N. 2010. The ecological assessment of metals in local brands of honey in Southwest Nigeria. *African Journal of Agriculture Research*, 5(18): 2608-2610.

Aliferis, K.A., Tarantilis, P.A., Harizanis, P.C. and Alissandrakis, E. 2010. Botanical discrimination and classification of honey samples applying gas chromatography/mass spectrometry fingerprinting of headspace volatile compounds. *Food Chemistry*, 121: 856-862.

Aljadi, A.M. and Kamaruddin, M.Y. 2004. Evaluation of the phenolic contents and antioxidant capacities of two Malaysian floral honeys. *Food Chemistry*, 85: 513–518.

Al-Mamary, M., Al-Meeri, A. and Al-Habori, M. 2002. Antioxidant activities and total phenolics of different types of honey. *Nutrition Research*, 22: 1041–1047.

Anklam, E. and Radovic, B. 2001. Suitable analytical methods for determining the origin of European honey. American Laboratory, 5: 60–64.

AOAC. 1990. Official methods of analysis (15th edition). # 958.09, 925.23, 925.10, 985.25, 970.56, 962.19. Association of Official Analytical Chemists Washington, DC, USA.

Beretta, G., Granata, P., Ferrero, M., Orioli, M. and Facino, R. M. 2005. Standardization of antioxidant properties of honey by a combination of spectrophotometric/fluorimetric assays and chemometrics. *Analytica Chimica Acta*, 533: 185–191.

Bogdanov, S. 1999. Harmonised Methods of the International Honey Commission, Responsible for the Methods, pp. 1–54.

Bogdanov, S., Ruoff, K. and Oddo, L.P. 2004. Physico-chemical methods for the characterization of unifloral honeys: *A review. Apidologie*, 35: S4–S17.

Buratti, S., Benedetti, S. and Cosio, M.S. 2007. Evaluation of the antioxidant power of honey, propolis and royal jelly by amperometric flow injection analysis. *Talanta*, 71: 1387–1392.

Caroli, S., Forte, G., Iamiceli, A.L. and Galoppi, B. 1999. Determination of essential and potentially toxic trace elements in honey by inductively coupled plasma-based techniques. *Talanta*, 50(2): 327–336.

Consentino, S., Tuberoso, C.I.G., Pisano, B., Cherchi, A., Spanedda, L. and Palmas, F. 1996. Influence of different storage conditions on honey quality. *Riv. Sci. Aliment*., 25(3): 253–260.

Conti, M.E. 2000. Lazio region (central Italy) honeys: determination of mineral content and typical quality parameters. *Food Contr*., 11: 459–463.

Cowan, M.M. 1999. Plant products as antimicrobial agents. *Clinical Microbiology Reviews*, 12: 564–582.

Crane, E. 1975. Honey: A comprehensive survey. New York, USA: Crane Russak and Company.

Estupinan, S., Sanjuan, E., Millan, R. and Gonzalez Cortes, M.A. 1998. Quality parameters of honey. II. Chemical composition. *A review. Alimentaria*, No. 297: 117–122.

Finola M.S., Lasagna M.C., Marioli J.M. 2007. Microbiological and characterization of honey from central Argentina. *Journal of Food Chemistry*, 100: 1649-1653.

Gheldof, N., Wang, X.H. and Engeseth, N.J. 2002. Identification and quantification of antioxidant components of honeys from various floral sources. *Journal of Agricultural and Food Chemistry*. 50: 5870–5877.

Gobessa, S., Seifu, E. and Bezabih, A. 2012. Physicochemical properties of honey produced in the Homesha district of western Ethiopia. *Journal of Apicultural Science*, 56(1): 33-40.

Golob, T., Dobersek, U., Kump, P. and Necemer, M. 2005. Determination of trace and minor elements in Slovenian Honey by total reflection X-ray fluorescence spectroscopy. *Food Chemistry*, 91: 593–600.

Guler, A., Bek, Y. and Kement, V. 2008. Verification test of sensory analysis of comb and strained honeys produced as pure and feeding intensively with sucrose (Saccharum officinarum L.) syrup. *Food Chemistry*, 109: 891-898.

Hase, S., Suzuki, O., Odate, M. and Suzuki, S. 1973. Changes in quality of honey on heating and storage. I. Changes in hydroxyl methyl furfural (HMF) content of honey. *J. Food Sci. Technol*., 20(6): 248–256.

Kaakeh, W., and Gadelhak, G. 2005. Sensory evaluation and chemical analysis of Apis mellifera honey from the Arab Gulf region. *Journal of Food and Drug Analysis*, 13(4): 331–337.

Kalabova, K., Vorlova, Borkovcova, I., Smutna, M. and Vecerek, V. 2003. Hydroxymethylfurfural in Czech honeys. Czech. *J. Anim. Sci*., 48(12): 551–555.

Kaskoniene, V., Rimantas, P. and Ceksteryte, V. 2008. Composition of volatile compounds of honey of various floral origin and beebread collected in Lithuania. *Food Chemistry*, 111: 988-997.

Kasperova, J., Nagy, J., Popelka, P., Dicakova, Z., Nagyova, A. and Mala, P. 2012. Physic-chemical indicators and identification of selected Slovak honeys based on colour measurement. *Acta Vet. Bro*., 81: 57-61.

Kefalas, P., Gotsiou, P., Gotsiou, P. and Chougoui, N. 2001. Contribution to the identification of Greek honey.

International Honey Commission. *Athens Meeting*, 26-27 September, 2001.

Kucuk, M., Kolayli, S., Karaoglu, S., Ulusoy, E., Baltaci, C. and Candan, F. 2007. Biological activities and chemical composition of three honeys of different types from Anatolia. *Journal of Food Chemistry*, 100: 526-534.

Langridge, D.F. 1977. A study of some quality factors of Australian honey. *Food Technology*, 29: 109–112.

Latorre, M.J., Pena, R., Pita, C., Botana, A., Garcıa, S. and Herrero, C. 1999. Chemometric classification of honey samples according to their type. II. Metal content data. *Food Chemistry*, 66: 263–268.

Marini, F., Magri, A.L., Balestrieri, F., Fabretti, F. and Marini, D. 2004. Supervised pattern recognition applied to the discrimination of the floral origin of six types of Italian honeys samples. *Analytica Chimica Acta*, 515: 117–125.

McKibben, J. and Engeseth, N.J. 2002. Honey as a protective agent against lipid oxidation in ground turkey. *Journal of Agricultural and Food Chemistry*, 50: 592–595.

Nogueira-Couto, R.H., Nogueira-Couto, R.H. and Couto, L.A. 2006. Beekeeping: management and products. Funep, Jaboticabal, SP, Brazil.

Ojeda de Rodriguez, G., Sulbaran de Ferrer, B., Ferrer, A. and Rodriguez, B. 2004. Characterization of honey produced in Venezuela. *Food Chemistry*, 84: 499–502.

Pavelkova, A., Kacaniova, M., Cubon, J., Svecova, Z., Knazovicka, V. and Felsociova, S. 2013. Physicochemical and microbiological quality of honey from liptov region. *Journal of Microbiology, Biotechnology and Food Sciences*, 2(1): 1185-1193.

Pohl, P., Sergiel, I. and Prusisz, B. 2011. Direct analysis of honey for the total content of Zn and its fractionation forms by means of flame atomic absorption spectrometry with solid phase extraction and ultrafiltration approaches. *Food Chemistry*, 125: 1504-1509.

Ramanujan, C. G. K. and Khatija, F. 1990. Melittopalynology of the agricultural tracts in Guntur district, Andhra Pradesh (India). *Indian Bee Journal*, 52(1-4): 44-46.

Sabio, M. and de los Santos, M. 2005. Informe Apicola. Sintesis Apicola. SAGPyA. Secretaria de Agricultura, Ganderia, Pesca y Alimentos. Direccion de Industria Alimentaria. *Area Apicola*, 102: 1–10.

Singh, N. and Bath, P.K. 1998. Relationship between heating and hydroxyl methyl furfural formation in different honey types. *J. Food Sci. Technol*., 35(2): 154–156.

Shahnawaz, M., Sheikh, S.A., Hussain, M., Razaq, A. and Khan, S.S. 2013. A study on the determination of physicochemical properties of honey from different valleys of Gilgit-Baltistan. *International Journal of Agricultural Science Research*, 2(2): 49-53.

Terrab, A., Diez, M. J. and Heredia, F. J. 2002. Characterization of Moroccan unifloral honeys by their physicochemical characteristics. *Food Chemistry*, 79: 373–379.

Voidarou, C., Alexopoulos, A., Plessas, S., Karapanou, A., Mantzourani, I., Stavropoulou, E., Fotou, K., Tzora, A., Skoufos, I. and Bezirtzoglou, E. 2011. Antibactirial activity of different honeys against pathogenic bacteria. *Anaerobe*, 17 (6): 376-379.

White, J.W. 1979. Composition of honey. In: E. Crane (Ed.), Honey: A comprehensive survey (pp: 157–158). London: Heinemann.

White, W.J. 1969. Moisture in honey: Review of chemical and physical methods. *Journal of the Association of Official Analytical Chemists*, 52: 729–737.

Wollgast, J. and Anklam, E. 2000. Review on polyphenols in the aroma cacao: changes in composition during the manufacture of chocolate and methodology for identification and quantification. *Food Research International*, 33: 423–447.

****