International Journal of Applied and Natural Sciences (IJANS)
ISSN 2319-4014
Vol. 2, Issue 3, July 2013, 45-52

International Academy of Science, Engineering and Technology
Connecting Researchers; Nurturing Innovations

ESTIMATION OF MINERAL CONTENTS OF APIS *CERANA INDICA, APIS DORSATA AND APIS MELLIFERA* HONEY FROM PLAINS, HILLS AND WESTERN GHATS OF TAMIL NADU AND JAMMU & KASHMIR

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ABSTRACT

Honey samples of *Apis mellifera*, *Apis dorsata* and *Apis cerana* were collected from Hills, Plains and Western Ghats of Tamil Nadu and Jammu & Kashmir. In order to achieve nutritive and medicinal value of honey regular monitoring of food quality is necessary. In current study mineral analysis (Quantitative analysis) of honey samples were performed by Atomic absorption spectrophotometer and flame photometer. The mineral elements with high frequency were Ca 53.01±4.06, Mg 4.14±0.03, Na 25.17±0.04 in *Apis cerana* from Plains of Jammu & Kashmir, while as K content 71.34±3.95 were high in *Apis dorsata* from Western Ghats of Tamil Nadu. All the mineral contents were within range and varied highly significantly at the level($P \leq .000$). From present study, it is observed that the Indian honey is good in quality although they are not completely deprived of heavy metals.

KEYWORDS: Mineral Contents, Honey, Hills, Plains, Western Ghats of Tamil Nadu and Jammu & Kashmir

INTRODUCTION

Honey is a carbohydrate rich naturally complex product produced by honeybees from floral nectar. Honey has been used by all civilizations as nutrient food and in traditional medicine. Honey has different physical, chemical and pollen spectra depending on the floral Sources from which it has been collected. The quality of honey depends on various physiological factors such as climate, soil, etc. (Asif 2002 & White *et al*., 1964). Honey contains sugar, proteins, moisture, vitamins, minerals, enzymes, polyphenols and flavonoids (Al-manary *et al.* 2002**).** Because of this unique and complex nature, honey is proved to be useful in the treatment of burns, wounds, skin ulcers, as an antioxidant, and in the treatment of external eye diseases (McCathy 1995 & Balasubramanyam 2011). Furthermore, honey is a highly valuable ingredient in condiments, beverages, sauces and sweets (Rasmussen *et.al.* 2008). Unifloral honeys of a particular origin may be greatly accepted by consumers, so the importance of understanding the composition of honey from human point of view is valuable (Seijo 1997**).** In fact numerous studies have been reported on physical, chemical, and melissopalynological parameters of honeys from all over the world (Azeredo *et al*., 2003, Downey *et. al*., 2005, Finola *et. al*., 2007, Al *et.al*., 2009, Xesus *et.al*., 2010).

Studies on honey have been carried out with emphasis on organic, but little has been done on inorganic aspect (Ramos *et al.* 2008). Mineral content in honey is of interest not only for quality control, but also for determination of environmental contamination (Maurizio, 1975b). Pollution of water, soil and air has led to increase in levels of mineral content in honey. The nectar, from which the honey is made, contains metals absorbed by the roots from the polluted soil, and may also contain metals carried by the bees from polluted water sources.

High concentration of metals in honey can be a source of illness to human beings, especially heavy metals which are related to health problems in man. It has been reported that lead can cause damage of brain, kidney, nervous system and red blood cells. Other problems caused by heavy metals include metabolic anomalies, respiratory disorders, nausea and vomiting (Anonymous, 2002; Garcai-Fernadez *et al.,* 1996) Poor methods of honey harvesting, processing and storage are another source of change in the mineral content in honey. Most beekeepers in Kenya use low cost metallic containers instead of stainless steel containers due to low purchasing power. Honey is acidic in nature (pH 3.1-4.5) thus corrodes damaged metal containers (Anklam, 1998). Use of agrochemicals in growing of flowers is another factor causing contamination of nectar with metals (White, 1975b).

The aim of this study is to determine essential metals (K, Na, Ca, Mg, Fe) and heavy metals (Zn, Cu, Pb, Cd, As) in honey samples collected from various regions of Jammu and Kashmir and Tamil Nadu India.

MATERIALS AND METHODS

Atomic absorption spectrophotometer (ELICO India,SL 173), Flame atomic absorption spectrometer (AA-6200), flame photometer (Systronics Flame Photometer-128), hollow cathode lamps, air/acetylene flame.

Sample Collection and Preparation

Honey samples were collected from Plains, Hills and Western Ghats of Tamil Nadu and Jammu & Kashmir during 2012-2013. The honey was put in air tight sterilized plastic containers and stored at room temperature under hygienic conditions. 5 g of each sample was weighed using an analytical balance, transferred into a beaker, digested using nitric/perchloric acid and filtered into a 50 ml volumetric flask. Distilled water was used to make the solution to the mark. For the determination of calcium and magnesium, strontium was added to reduce interferences from aluminum and phosphorous (A. Mbiri *et al* 2011).

Analysis of Metal Elements in Honey Samples

Potassium and sodium was determined using flame photometer. Calcium, Magnesium, Iron, Zinc, Copper, Manganese and Chromium were determined using Atomic absorption spectrometer.

Statistical Analysis

Data of all mineral contents of honey samples were analyzed by Analysis of Variance (ANOVA) along with F test, highly significant values were determined by using F table ($P \leq .000$).

RESULTS AND DISCUSSIONS

The mean results and basic statistics obtained for various Mineral Contents of the honey samples of *A.dorsata A. mellifera* and *A. cerana*, collected from different regions of Jammu and Kashmir and Tamil Nadu are summarized in (Table 2) and Figure (1,2,3,4).

Table 1: Fuel Required for Different Mineral Constituents and their Wave Length

Sl. No	Element	Wave Length (nm)
1	Sodium	166.6
2	Potassium	766.6
3	Magnesium	285.20
4	Calcium	228.85
5	Copper	324.80
6	Iron	248.37
7	Manganese	279.9

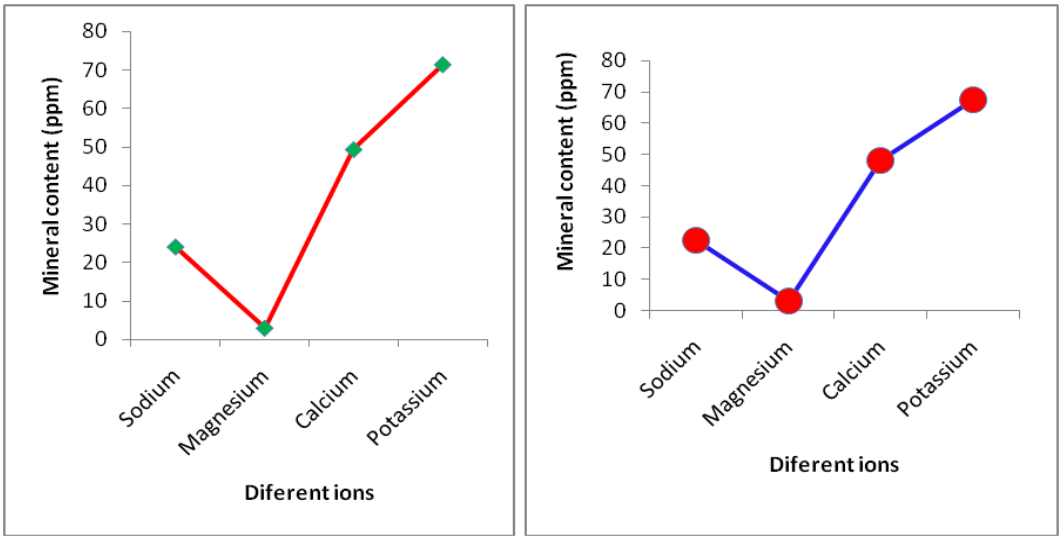
Table 1: Contd.,		
8	Zinc	213.90
9	Chromium	357.90

Lamp Current: 3.5 m A
Fuel Used: Air/Acetylene

Table 2: Concentration of Mineral Elements in Honey Samples Collected from Different Regions

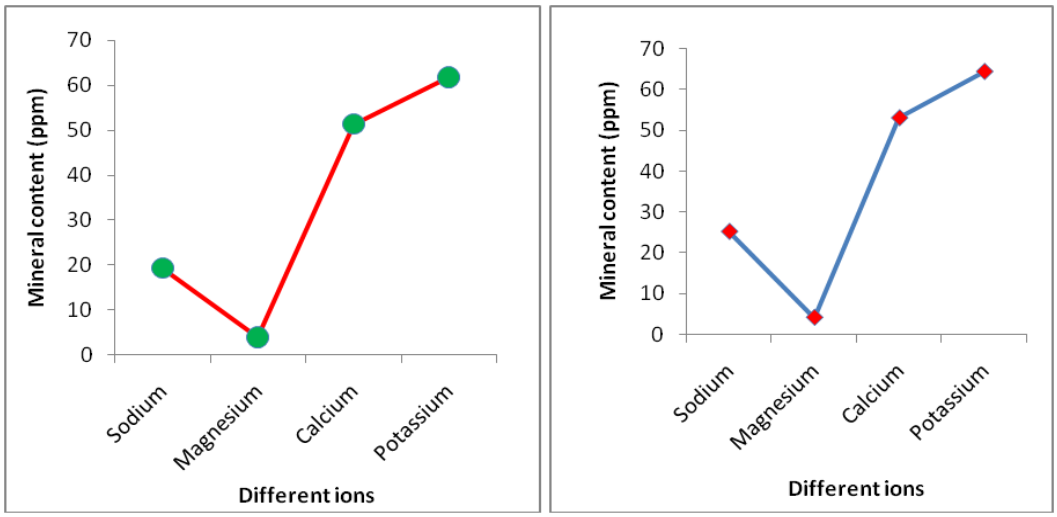
Samples from Tamil Nadu			Samples from Jammu & Kashmir	
Mineral Contents	**Apis dorsata**	**Apis cerana**	**Apis cerana**	**Apis mellifera**
Na(ppm)	24.10 ±0.04	22.34 ±0.06	25.17 ±0.04	19.34 ±4.03
K(ppm)	71.34 ±3.95	67.57 ±3.82	64.34 ±0.06	61.77 ±4.09
Ca(ppm)	49.34 ±0.32	48.01 ±0.30	53.01 ±4.06	51.34 ±0.01
Mg(ppm)	3.05 ±0.03	2.89 ±0.40	4.14 ±0.03	3.95 ±0.5
Mn(ppm)	1.126 ±1.8	1.115 ±1.3	0.519 ±3.2	1.454 ±0.04
Fe(ppm)	0.71 ±0.02	0.69 ±0.07	1.963 ±1.4	2.800 ±0.9
Cu(ppm)	0.624 ±0.06	0.498 ±1.3	0.370 ±3.7	0.275 ±0.32
Cr(ppm)	0.29 ±0.08	0.024 ±0.03	0.29 ±0.71	0.32 ±1.3

Highly Significant (P≤.000)



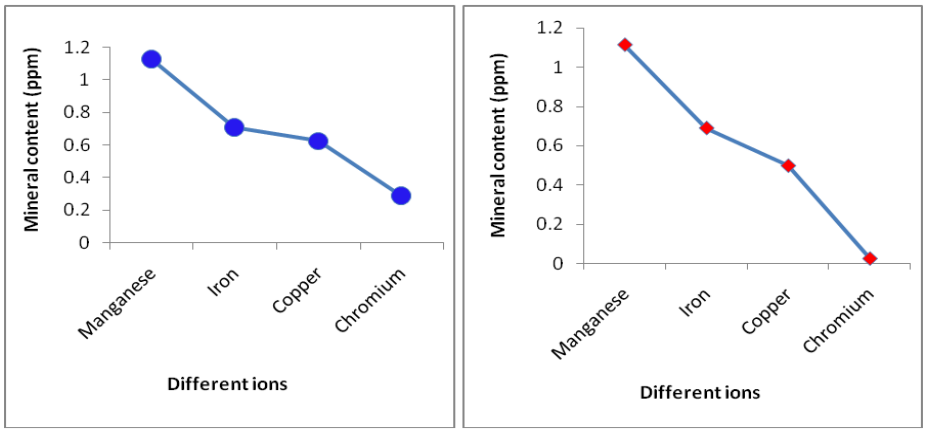
Apis Dorsata ***Apis Cerana***

Figure 1: Major Mineral Content of Honey of *A.dorsata* and *A.cerana* from Plains &Western Ghats of Tamil Nadu in the Year 2012-13



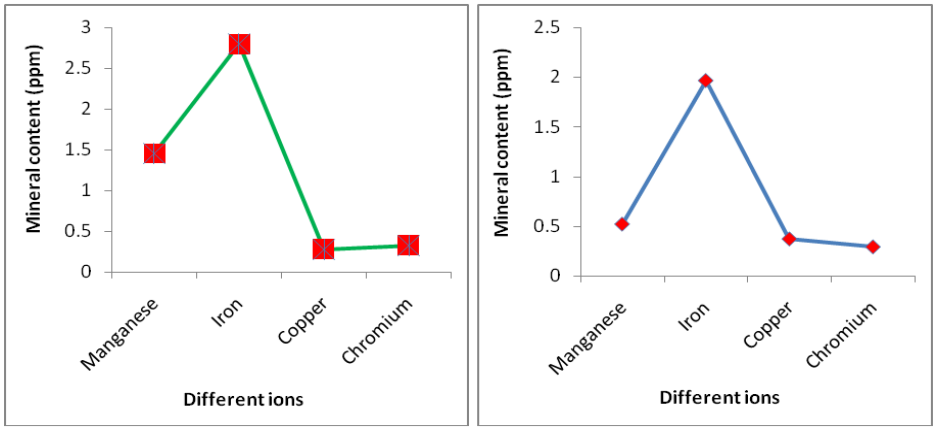
Apis mellifera ***Apis cerana***

Figure 2: Major Mineral Content of Honey of *A. mellifera* and *A. cerana* from Plains and Hills of Jammu and Kashmir in the Year 2012-13



Apis dorsata ***Apis cerana***

Figure 3: Minor Mineral Content of Honey of *A.dorsata* and *A.cerana* from Plains &Western Ghats of Tamil Nadu in the Year 2012-13



Apis mellifera ***Apis cerana***

Figure 4: Minor Mineral Content of Honey of *A.dorsata* and *A.cerana* from Plains and Hills of Jammu and Kashmir in the Year 2012-13

From the results obtained, the mineral Characteristic of honey from all the three species varies from one sample to another depending upon floral origin, temperature conditions, and extraction and storage techniques. The minerals of honey of three honeybee species were categorized as major minerals (potassium, phosphorous, calcium, sodium and magnesium) and minor minerals (iron, manganese, copper, chromium and zinc) based on quantity of individual elements. The basic statistical data obtained for the content of K, Na, Ca and Mg with mean content values ranging from 71.34-61.77ppm, 25.17-19.34ppm, 49.34-53.01, and 2.89-4.14ppm respectively. The Apis cerana from plains of Jammu and Kashmir region has mean content of Na, Ca, Mg higher than the Tamil Nadu region, while the potassium content is high in *Apis dorsata* from Western Ghats of Tamil Nadu. Analysis of variance along with F test has shown that mineral contents of all the honey samples varied highly significantly ($P \leq .000$).

DISCUSSIONS

From past several years, there has been an increase in studies focusing on evaluation of mineral concentrations in honey. The aim of these reports is not only monitoring trace element levels in honey from the point of view of human health but also characterization of honey adulteration (Alissandrakis et al. 2007). In addition to this, since travelling bees can cover areas as large as 50 km^2 (Ponikvar et al. 2005), honey could be an indicator of environmental pollution (Podgorski and Kanoniuk 2004). Heavy metal contamination and trace element composition could also be caused by inappropriate actions during processing and conservation steps. As a matter of fact, the acidic property of honey could lead to release of heavy metals from metallic tools and containers (Pisani et al. 2008).

The highest concentration of Na were recorded in the honey sample *Apis Cerana* from plains of Jammu and Kashmir with a mean value of 25.17ppm and lowest value were recorded in sample *Apis Mellifera* from hills of Jammu and Kashmir with a mean value of 19.34ppm(Table2) . Concentration of Na recorded in this study was higher than in earlier studies where the mean values were found to be 116.7 and 11.88ppm respectively in Kicevo and Berovo (Elena *et al., 2008).* The highest Ca value of present honey samples may be influenced by the time of extraction from the comb in relation to ripening process by the bees, tempature conditions, seasons or geographical zone.

The highest concentration of K were recorded in the honey sample *Apis dorsata* with a value of 71.34ppm from Western Ghats of Tamil Nadu and lowest value were recorded in honey sample *Apis mellifera* from hills of Jammu and Kashmir with a mean value of 61.77ppm(Table2). The values of K in this study were less than the values recorded in earlier studies where mean values in honey were found to be 2310, 1774 and 3166 ppm from Kicevo, Zulia and Tenerife respectively (Frias *et al.,* 2008; Betzabé Sulbarán de Ferrer *et al.,* 2004). The lower values of K content in present samples may be influenced by climatic factors, storage conditions or lowest values of NPK in that particular area.

The highest concentration of Ca was recorded in honey sample from *Apis Cerana* from plains of Jammu and Kashmir with a value of 53.01 ppm while the lowest value was recorded in honey sample from *Apis cerana* from hills of Tamil Nadu with a value of 48.01 ppm(Table2). In this study the value of Ca are comparable to those reported in Kitui (A. Mbiri, *et al* 2011) ranging from 19.33-56.00.

The Mg level was found high in sample *Apis cerana* with a value of 4.14ppm from plains of Jammu and Kashmir and the lowest was recorded in honey sample Apis *cerana* from hills of Tamil Nadu with a value of 2.89ppm(Table2). The levels of Mg in this study is lowest as comparable to those reported in Macedonia (Elena, Trajce, Robert , 2008) ranging from 11.78 to 116.7 ppm and those from Zulia (Betzabé *et al* 2004).which had a mean of 52 ppm.

The Fe content was recorded highest in the honey sample *Apis mellifera* with a value of 2.800 ppm from hills of Jammu and Kashmir and the lowest level was recorded in the honey sample *Apis cerana* from hills of Tamil Nadu with a value of 0.69 ppm (Table2). In our study the values of Fe recorded were lower than those values of 13.5 and 3.37 ppm reported earlier in Zulia and Tenerife (Frias *et al.,* 2008), and closer to values reported earlier by (A. Mbiri,*et al* 2011) ranging between 0.08-0.59.

The highest concentration of Mn was found in *Apis dorsata* from Western Ghats of Tamil Nadu with a value of 1.126ppm and lowest were recorded in *Apis cerana* from plains of Jammu and Kashmir (Table2).

The highest concentration of Cu was recorded in honey sample *Apis dorsata* from Western Ghats of Tamil Nadu with a value of 0.624 ppm while the lowest concentration of Cu was recorded from honey sample *Apis mellifera* from Jammu and Kashmir with value of 0.275 ppm(Table2). The concentration of Cu in present samples were lower, compared to the values recorded in Swiss and Tenerife honey which were 0.88 and 1.28 ppm (Stefan, Max, Werner, Gallman, 2007) a and closer to values reported earlier by (A. Mbiri,*et al* 2011) ranging between 0.02-0.03.

All honey samples were recorded lower contents of Cr as compared to other minerals (heavy metals) in our study. The level of Cr was recorded in *Apis mellifera* with a value of 0.32 ppm from Jammu and Kashmir and lowest were recorded in *Apis cerana* 0.024ppm from Tamil Nadu (Table2).

CONCLUSIONS

The present study concludes that the mineral analysis of honey is essential for nutritional quality and safety of honey with regards to the contents of major, minor and trace elements. Of all the minerals tested in the honey samples,

A.cerana honey from Jammu and Kashmir have high contents of Na,Ca, and Mg as compared to the rest of the honey samples, while the K content is high in *A.dorsata* from western Ghats of Tamil Nadu. The results of the present study reveal that Indian honey quality with respect to the concentration of these mineral elements in safety baseline levels for human consumption

ACKNOWLEDGEMENTS

Author wish to acknowledge Department of Soil Science and Agricultural Chemistry Annamalia University Tamil Nadu for allowing to carrying out the study in their laboratory, and our sincere thanks goes to G.Seenuvasam (Lab Tech.) Department of Soil Science, Annamalia University Tamil Nadu for providing substantial help in honey analysis.

REFERENCES

1. Asif, K., Saeeda, R., Nouman, R., Tabassum, H., Musarrad, G., Amjad, Q. and Khalid, N. (2002) Comparative study of honey collected from different flora of Pakistan. On Line Journal of Biological Sciences, 2, 626-627.
2. White, J.W. and Subers, M .H. (1964) Studies on honey inhibine. 3 effect of heat. *Journal of Applied Research*, 3**,** 45-50.
3. Al-Mamary, M., Al-Meeri, A. and Al-Habori, M. (2002) Antioxidant activities and total phenolics in different types of honeys. Nutritional Research**,** 2, 1041- 1047
4. Mccarthy, J. (1995) The antibacterial effects of honey: Medical fact or fiction? American Bee Journal, 135: 341-342.
5. Balasubramanyam, M. V. (2011)Chemical Characteristics of multifloral wild and apiry honey from Western Ghats of Karnataka. The Bioscan, 6, 467-469.
6. Rasmussen, C. N., Wang, X., Leung, S., Andrac- Nightingale, L.M., Schmidt, S.J. and Engeseth,N.J. (2008)Selection and use of honey as an antioxidant inFrench salad dressing system. Journal of Agriculture and Food Chemistry, 56, 8650-8657.
7. Seijo, M.C., Jato, M.V., Aira, M.J. and Iglesias, I.m (1997)Unifloral honeys of Galicia (north-west Spain). Journal of Apiculture research, 36**,** 133-139
8. Azeredo, L.C., Azeredo, M.A.A., Souza, S.R. and Dutra, V. M. L. (2003) Protein content and Physicochemical properties in honey samples of *Apis mellifera* of different floral origins. Food chemistry, 80, 249-254.
9. Downey, G., Hussey, K., Kelly, J.D., Walshe, T.F. and Martin, P.G. (2005) Preliminary contribution to the characterisation of artisanal honey produced on the island of Ireland by palynological and physico-chemical data. Food Chemistry 91, 347–354
10. Finola, M.S., Lasagno, M.C. and Marioli, J.M. (2007) Microbiological and chemical characterization of honeys from central Argentina. Food Chemistry 100, 1649–1653.
11. Al, M. L., Daniel, D., Moise, A., Bobis, O., Lasio, L. and Bogedanov, S. (2009) Physico-chemical and bioactive properties of different floral origin honeys from Romania. Food Chemistry, 112, 863-867.
12. Xesus, F., Jose, P., Maria, L. E., Antonio, I. and Jose, P. A. (2010) Palynological and physicochemical data characterization of honeys produced in the Entre-Douro e Minho region of Portugal. International journal of Food Science and Technology, 45, 1255-1262.

13. Maurizio A. (1975b). Microscopy of honey, from Honey: a comprehensive survey ed. E.Crane, **7,** pp 240-257

14. Anonymous (2002). Neb Guide. Cooperative Extention Institute of Agriculture and Natural Resources, University of Nebrasaka, Licoln

15. Garcai-Fernadez A. J., Gomez-Zapata A. and Luna M. A. (1996). Distribution of Cadmium in blood and tissuses of wild birds. *Archives of Environmental Contamination Toxicology,* **30,** pp 252-258.

16. Anklam, (1998), A Review of the Analytical Methods to Determine the Geographical and Botanical Origin of Honey. *Journal of Food Chemistry,* **4**, pp 549–562

17. White J.W. (1975b) Physical Characteristics of Honey, **6,** pp 207-239.

18. *A. Mbiri, A. Onditi, N. Oyaro and E. Murago* (2011). Determination of Essential and Heavy Metals in Kenyan honey by Atomic absorption and Emission Spectroscopy *JAGST* Vol. 13(1).

19. Elena S., Trajce S., Robert S., (2008). Monitoring of trace elements in honey in the Republic of Macedonia by atomic absorption spectrometry. *Springer e-journals*. Environ Monit. **,142** , pp 117-126.

20. Frias, Inmaculada, Gonzalez-Iglesias, Rubio, C., Angel, J., (2008).Metals in fresh honey from Tenerife Island, Spain. *Bulletin of Environmental Contamination and toxicology*, **80**(1), pp 30-33.

21. Betzabé Sulbarán de Ferrer, Graciela Ojeda de Rodríguez, Jorge Peña, Janeth Martínez y María Morán, (2004), Mineral content of the produced in Zulia state. *Edicone Publicadas* Ario ,**54**(3).

22. Stefan Bogdanov, Max Haldlman, Werner Luginbuhi and Peter Gallman, (2007), Mineral in honey: enviromental, geographical and botanical aspects. *Journal of Agriculture Research and Bee World* ,**46** (4), pp 269-275**.**

23. Alissandrakis E, Tarantilis PA, Harizanis PC, Polissiou M. 2007. Aroma investigation of unifloral Greek citrus honey using solid-phase microextraction coupled to gas chromatographic- mass pectrometric analysis. Food Chem. 100:396–404.

24. Ponikvar M, Snajder J, Sedej B. 2005. Honey as a bioindicator for environmental pollution with SO2. Apidologie. 36:403–409.

25. Pisani A, Protano G, Riccobono F. 2008. Minor and trace elements in different honey types produced in Siena County (Italy). Food Chem. 107:1553–1560.

26. A. Mbiri, A. Onditi, N. Oyaro and E. Murago. 2011. Determination of Essential and Heavy metals in Kenyan honey by Atomic Absorption and Emission Spectroscopy. *JAGST Vol. 13(1) 2011*.