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Physical and chemical properties of different types of honey have been reported by many scientists (Crane, 1975; White, 1979; Sancho et al., 1992; Gupta et al., 1992; Rodriguez-Otero et al., 1994; Caroli et al., 1999; Cowan 1999; Latorre et al., 1999; Wollgast and Anklem, 2000; Anklem and Radovic, 2001; Kefalas et al., 2001; Al-Mamary et al., 2002; Gheldof et al., 2002; McKibben and Engeseth, 2002; Terrab et al., 2002; Celechovska and Vorlova, 2001; Anupama et al., 2003; Azeredo et al., 2003; 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; Finola et al., 2007; Guler et al., 2007; Ouchemoukh et al., 2007; Guler et al., 2008; Kaskoniene et al., 2008; Iftikhar et al., 2011; Fasasi 2012; Ramnath and Venkataramegowda, 2012; Rane and Doke, 2012; Mondragon-Cortez et al., 2013; Olugbemi et al., 2013; Balkanska and Ignatova, 2013; Ligia et al., 2013; Kumar et al., 2013; Manzoor et al., 2013; Rahman et al., 2013; Shahnawaz et al., 2013; Ahmed et al., 2014, Akhtar et al., 2014; Rebiai and Lanez, 2014; Draiaia et al., 2015; Krishna et al., 2015; Linkon et al., 2015; Oshomah et al., 2015 and Prica et al., 2015).

Color is the most important characteristic which contributes to the appearance of honey. The price of honey in the market is largely determined by its color. Many scientists and researchers proposed various methods of detection of color in honey i.e. colorimetric method proposed by Townsend (1969), O.D. method by East African Standard (2010) and Pfund scale method by Pfund (USDA 1985). It is considered that lighter is the color of honey, more pure it is. Cited the major causes of variation in honey color as: the instability of fructose, amino acid – aldol reaction & combination of tenants and other polyphenols with iron salts. The concentration of fructose and glucose as well as their ratio are useful indicators for the color of honey (Kaskoniene and venskutonis, 2010). Einset and Clark (1957) reported that copper and iron contents affect the color of honey. The results of Schade et al. (1958) indicated that the rate of honey darkening may increase at higher moisture contents. The major criteria of interest are moisture content, sucrose, pH, electrical conductivity, ash content, acidity, and HMF content (Gomes et al., 2010).

Many studies have dealt with the relation of honey color to the floral origin, industrial
processing methods, and the temperature and/or time of storage (Varju, 1970; Free et al., 1983; Crane, 1984; Feller-Demalsy et al., 1989; Salas et al., 1993; Pereyra-Gozalez et al., 1999; Terrab et al., 2003a, 2003b, 2003c; Terrab et al., 2004; Rane and Doke, 2012; Fasasi, 2012; Balkanska and Ignatova, 2013; Ligia et al., 2013; Krishna et al., 2015; Linkon et al., 2015 and Oshomah et al., 2015). Researchers also found some possible reasons of color deterioration in honey. Mahajan (1984) observed wide variation in color of different seasons, honey from Shimla Hills. Gonnet et al. (1986) observed changes in the color of honey during crystallization. Some changes also occur during storage; browning/darkening of honey is due to Maillard reactions, caramelisation of fructose and polyphenolic reactions, depending on storage temperature and duration (Bertoncelj et al., 2007). Colour is related to the mineral content, pollen and phenolic compounds present in the honey and, as such, varies according to the geographical origin and botanical varieties visited by the bees (Ramalhosa et al., 2011). According to Szczesna et al. (2011) the colour of Rape honey ranged from 8 to 59 mm Pfund. According to Fasasi (2012), the variations in color of the honey samples may probably be due to the nectar sources of the honey from the wild or the age of the honey in the hives during storage by honeybees or prolonged and continuous usage of honeycomb cells for storage of honey by honeybees. Ligia et al. (2013) proposed the method of production and agricultural practices also influence the color. According to Shahnawaz et al. (2013) besides, the sensorial excellence of local honey likes color. According to Mehryar et al. (2013) the color of honey is one of the factors that determine its price in the world market and also its acceptability by consumers. Fahim et al. (2014) tested of color in Pakistan honey samples falls between amber to dark amber.

The pH of honey samples is important during the extraction process because it affects the texture of honey as well as its stability and shelf life (Terrab, et al., 2002). All of the tested honey samples were acidic in nature; with pH values rang 3.30 to 4.13. These values were similar to those previously reported for other honey samples from India, Brazil, Spain and Turkey, which were reported to have pH between 3.49 and 4.70 (Azeredo et al., 2003; Saxena et al., 2010). A highly acidic honey sample indicates the possible fermentation of sugars into organic acids. None of the investigated samples exceeded the allowed limit (3.7-4.5), which may be considered as an index of freshness of all honey samples.
Furthermore, the maximum pH value of 3.4 was found in Acacia variety whereas 3.5 and 3.2 was determined in Berry and Herbal varieties respectively. These observations are in accordance with those made by Codex Alimentariou Commission (2001) where acceptable ranges of pH of honey were predetermined between 3.2 and 4.5. The results of this study are also in agreement with those of Hussain (1989) who reported the pH of 3.0 to 5.0 in pure honey. These pH ranges are mainly due to the variation of different acid and minerals present in the honey. Likewise, the floral difference may also cause the ranges of pH.

All honey samples analyzed were acidic in nature, with pH values varying from 3.7 to 5. The pH values of honeys were in accordance with AOAC (AOAC, 1990). These results are comparable to 3.42 to 4.68 for Brazilian and 3.2 to 4.5 for Bangladeshi honeys (Islam et al., 2012). This parameter is of great importance during the extraction and storage of honey as it influences the texture, stability and shelf life of honey (Terrab et al., 2004). Also, floral and geographic origins can cause great variations in honey pH values, as the nectar pH and soil conditions can greatly influence honey physicochemical characteristics (Wang and QX, 2011). Habib et al. (2014) reported pH in Arid regions honey sample range from 3.99 to 6.33. Ahmed et al. (2014) showed that in Algeria honeys, pH value ranged from 3.7 to 5. Akhtar et al. (2014) reported pH in the range of 3.20 to 4 in local and imported honey samples in Pakistan. Rebiai and Lanez (2014) reported 3.80 to 5.24 pH value in different flora honey samples of Algeria. Krishna et al. (2015) reported of pH value in Natural honey 4.75 and Industrial honey 4.25. Umarani et al. (2015) reported of pH value in unbranded honey 4.13 to 4.56 and branded honey 3.14 to 4.09.

Moisture content in honey is the most important characteristics, having profound influence on honey quality. Hanson (1951) on analyzing 17 Swedish honey found that their average water content was 18.7 per cent as compared with 19.5 for summer honeys. Latif et al. (1956) showed that in Pakistani honeys, water content ranged from 14.3 to 18.6%. Phadke (1967) reported 20.90 per cent average moisture contents in 80 honey samples from India. El-sherbing and Rizk (1979) analyzed clover and cotton honey samples from different parts of Egypt. Imported samples had higher moisture contents than the local samples. Chang et al. (1988) reported 19.5% average moisture content for 5 types of Korean honey (acacia, bushclover, chestnut, rape and multifloral). Laude et al. (1991) analyzed four groups of honey: 27 from Apis
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*mellifera*, 5 from *A. dorsata*, 9 from *A. cerana* and 14 of unknown origin (described as commercial). Values for moisture content of honey from different *Apis species* differed significantly; mean values were 19.5, 23.1, 22.00 and 20.00, respectively. Ghoshdastidar and Chakrabarti (1992) recorded 16.0-23.4% moisture of the samples received from the Central Bee Research Institute, Pune. Finola et al., 2007; Cantarelli et al., 2008; Omafuvbe et al., 2009; Amir et al., 2010 and Buba et al., 2013 showed a wide range of the moisture content in honey samples.

Habib et al. (2014) reported moisture content in Arid regions honey sample range from 13.63 to 20.60%. Fahim et al. (2014) reported of moisture content in Pakistan honey sample range from 13.80 to 16.60%. Boussaid et al. (2014) reported of moisture content in various flora honey of Tunisia range from 17.27 to 19.73%. Ahmed et al. (2014) showed that in Algeria honeys, water content ranged from 15.87 to 18.05%. Akhtar et al. (2014), Kayode et al. (2014), Rebiai and Lanez (2014), Krishna et al. (2015), Oshomah et al. (2015), Prica et al., 2015, Linkon et al. (2015), Umarani et al. (2015) & Juan-Borras et al. (2015) also reported moisture content in apiary honey in the range of 13.9 to 24.1%.

Specific gravity is an important physical characteristic of honey. As per US standards, “A” Grade honey must have specific gravity not less than 1.4155 (g/cm^3), Standard honey should have specific gravity more than 1.406 (g/cm^3). The British National Mark scheme has covered honey under the best quality if Specific gravity of honey is at least 1.315 (all at 60°F). Deans (1953) reported specific gravity (at 60°F) between 1.411 and 1.420 the mean was given as 1.415. Perti and Panday (1967) studied samples of *Apis dorsata* honey collected from forests in Nainital. Specific gravity varied from 1.3492 to 1.4401 (mean 1.4043). Ibrahim, et al. (1977) reported that clover honey had the lowest specific gravity among the major Egyptian honeys. Hussain (1989) reported that specific gravity on 153 Oman honey samples in the range of 1.357 to 1.446. Krishna et al. (2015) reported specific gravity in Natural honey as 1.433 and in Industrial honey, it was found 1.427.

According to the European Legislation (European Economic Community, 2002), blossom honeys have electrical conductivity values below 0.80 ms/cm, while the honeydew honeys exceeded this value. However, there are many exceptions to this rule. Some mono-floral honeys such as those from chestnuts, strawberry plants, heather, eucalyptus, lime, manuka tea tree or jelly bush honeys, regarded as blossom
hones, often have electrical conductivity values above 0.8 ms/cm (European Economic Community, 2002; Persano and Piro, 2004). Habib et al. (2014) reported of electrical conductivity in Arid regions honey sample range from 0.25 to 0.69mS/cm. Boussaid et al. (2014) reported of electrical conductivity in various flora honey of Tunisia range from 0.39 to 0.89mS/cm. Andualem (2014) reported of electrical conductivity in honey 0.488 to 3.27mS/cm. Ahmed et al. (2014) showed that in Algeria honeys, electrical conductivity ranged from 0.23 to 1.52mS/cm. Oshomah et al. (2015) analyzed 0.61 mS/cm electrical conductivity mean value of commercial honey from EDO state, Nigeria. Krishna et al. (2015) reported of Electrical conductivity in Natural honey 0.35 and Industrial honey 0.27ms/cm.

Krishna et al. (2015) reported of optical density in Natural honey 1.061 and Industrial honey 1.056.

Ash content is an important physical characteristic which influence the quality of honey. Johnson et al. (1950) compared samples of honeydew honey with white and amber honey from commercial sources in Quebec and Ontario in 1949. Honeydew honey had higher average ash content (average 0.69% for 6 samples) than white and amber honey (average 0.12% for 18 samples). According to the definition of honey in the Canadian food and Drug Act, honeydew honey could not be classed or sold as honey. However, good quality honey produced from cotton (Gossypium sp.) in California was found to average 0.36 per cent ash, and a review of literature of the three extensive investigations showed that 23-39 per cent of the samples from various floral sources exceeded the limit. Phadke (1968) studied Indian honey and observed higher ash content in the wild honeys. Hase et al. (1973) studied 60 samples of Japanese “domestic” honey, 89 samples of imported honey and 190 commercial honey samples. Some of the later were of inferior quality for the reason: crude ash content was below 0.04 per cent. Ebrahimzadeh and Haghchenasse (1979) gave the results of ash content varied from 0.07 to 0.60 per cent for 17 samples of provinces. Mahajan (1984) reported mean ash content (0.27-0.36%) for multifloral, plectranthus and Eucalyptus honey collected in summer and autumn for (hived) Apis cerana colonies. The majority (56.3%) of the samples had a low ash content, 0.01 per cent; 29.0 per cent contained 0.1-0.2 per cent ash; 11.6 per cent contained 0.2-0.3 per cent ash, and the rest 0.3-0.5 per cent ash. All confirmed to the Spanish standard for floral honey, which allows a maximum of 0.6 per cent. Honeys with low ash content tended
to be pale in color and those with a comparatively high content were darker, but for intermediate ash content there was no correlation. Laude et al. (1991) analyzed four groups of honey: 27 from *Apis melifera*, 5 from *A. dorsata*, 9 from *A. cerana* and 14 of unknown origin (described as commercial). Values for ash content for honeys from different *Apis* species did not differ significantly. Apart from this, differences between honeys seemed to be due to different methods of beekeeping and of honey treatment rather than to differences in plant sources. Only 6 of the 55 honey confirmed to all the standards proposed by the Codex Alimentarius commission. Two samples exceed the particular limit. Gupta (1992) revealed and average ash content 0.47 per cent of honey samples collected from Indian beehive, *Apis cerana* colonies located in different parts of Jammu and Kashmir with different altitudes and climatic conditions. Ghoshdastidar and Chakrabarti (1992) recorded 0.1 to 0.6 per cent total ash in the samples received from the Central Bee Research Institute, Pune. Gomez et al. (1993) analyzed Spanish Commercial Eucalyptus honeys and found average ash 0.206%. Fasasi (2012) reported of ash 0.4% in Nigerian natural honey samples. Rahman et al. (2013) reported ash in branded honey 0.23 and unbranded honey 0.12%. Hasan (2013) reported of ash 0.112% in fresh honey samples. Kayode et al. (2014), Habib et al. (2014), Fahim et al. (2014), Boussaid et al. (2014), Krishna et al. (2015), Prica et al. (2015), Oshomah et al. (2015) and Umarani et al. (2015) reported of ash value in between 0.7 to 0.50%

Honey is mainly a solution of glucose and fructose with other minor constituents. There are great variations in the sugar composition of honey.

Curylo (1954) analyzed several hundred honey samples for sucrose content. It was found that the majority of samples contained less than 5 per cent sucrose. White and Mahr (1954) found the average sugar composition to be glucose (32.29%), fructose (39.28%), sucrose (1.62%) and higher sugars (1.03%). Latif et al. (1956) reported that sample of Pakistan honey had reducing sugars 71.1-76.9 per cent (fructose 39.01-53.8%, glucose 27.3-34.2%) and sucrose 1.9-2.75%. Analysis of five honey from each species of honey bee (*Apis indica*, *A. florea*, *A. dorsata*) showed differences in reducing sugars. Sunflower honey: invert sugar 76.94%, sucrose 2.34%, Swamp flower honey: invert sugar 75.29%, sucrose 3.38%. Raspberry honey: invert sugar 74.70%, sucrose 2.58%. Lime (Tilia) honey: invert sugar 76.26%, sucrose 2.74%. Phadke (1967) found reducing sugar to vary between 66.45 to 77.79% and non-
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reducing sugars between 0.73 to 10.03%. Phadke (1968) studied honeys from A. dorsata, A. florea and Trigona. A. florea honey has high F/G ratio did not granulate even after 2-3 years. There was more D-fructose but less D-glucose in A. dorsata honey than in A. mellifera honeys.

Honeys contain a number of components to act as preservatives; these include a-tocopherol, ascorbic acid, flavonoids, and other phenolics and enzymes such as glucose oxidase, catalase, and peroxidase (Ioyrish, 1974; Crane, 1975; Ferreres et al., 1993). The monosaccharide’s, fructose and glucose, are the main sugars found in honey (Nagai et al., 2002). The composition of honey has a role on the HMF formation kinetics (Singh & Bath, 1997). Glucose and fructose together correspond for 85–95% of honey carbohydrates and their amounts depend on the honey source (Cavia et al., 2002) subsequently, composition of honey as well as storage conditions affects both crystallization and HMF formation.

Analysis of 175 Bulgarian honeys by Ivanov and Mitev (1972) showed that amount of invert sugar varied from 62.20 to 77.76 per cent and total sugar content ranged from 68.98 to 79.80 per cent. Cirilli et al. (1973) reported that amount of glucose plus fructose as 72.3 per cent, sucrose as 5.55 per cent in Italian honeys. Iwaida et al. (1969) determined reducing sugars ranged from 0 to 4.81 per cent. There values were within the limits of the Japanese standard: not less than 65 per cent and not more than 5 per cent, respectively. White (1975) recorded 79.59, 69.47 and 10.12 per cent total sugars, reducing sugars and other sugars (sucrose, maltose and other disaccharides), respectively.

Thirteen honey samples produced in Taiwan analyzed by Lin et al. (1977) showed that invert sugar ranged from 66 to 77, glucose 30 to 36, fructose 34 to 40 and sucrose 0.1 to 5.7 per cent. The invert sugar content ranged from 65 to 74 per cent. The ratio of glucose to fructose was 1.3:1.1 in liquid honeys, 1.1:1.0 in soft honeys and 1.0:1.1 in solid honeys. The sucrose content was 0.5 – 6.6 per cent.

Fahim et al. (2014) reported reducing sugar and non-reducing sugar in the range of 57.748 to 70.467%, 1.95 to 3.93% in Pakistan honey sample respectively. Linkon et al. (2015) reported total carbohydrates in Bangladesh honey was in the range of 83.97 to84.49%. Hasan et al. (2015) reported total carbohydrates in Libyan honey was in the range of 78 to80%.
Twelve honeys produced in different parts of Fogi and compared with those for honeys of other countries, and with Codex Alimentarius, 2001. Values for total reducing sugars ranged from 61.6 to 73.8 per cent. Dozo (1984) analyzed 66 samples of honey from different localities of Buenos Aires. The reducing sugars were in excess of 65.5 per cent, the lowest value being 71.1 per cent. The samples contained 4.5 per cent sucrose and one was found to contain more than 8 per cent. Deifel et al. (1985) analyzed German honey samples which were produced by honeybees fed with sugar syrup (sugar/water ratio 3.2), these contained 70 per cent fructose + glucose and 15 per cent sucrose. Honey from _A. cerana_ contained 40.25 per cent fructose, 34.01 per cent glucose and 2.51 per cent sucrose. Honey from _A. laboriosa_ had 36.05 per cent fructose, 28.65 per cent glucose and 3.34 per cent sucrose. Chang, _et al._ (1988) found average values for five types of honey (acacia, bushclover, chestnut, rape and multifloral): fructose 33.74 per cent; glucose 35.3 per cent and sucrose 4.67 per cent. Kaushik (1988) analyzed a fresh Himachal honey and reported 80.70, 68.33, 12.37, 32.43 and 35.90 per cent total sugars, reducing sugars, non-reducing sugars, glucose and fructose, respectively. Ghoshdastidar and Chakrabarti (1992) reported 65.5-75.1 per cent total reducing sugars, 0.8-6.2 per cent sucrose and 1.0-1.3 fructose/dextrose ratio of the samples received from the Central Bee Research Institute, pune. Gomez, _et al._ (1993) made physic-chemical analysis of Spanish Commercial Eucalyptus honeys. He found a mean of 68.625 per cent (2.968 s.d.) reducing sugars and sucrose 2.02 per cent.


The major sugars present are glucose and fructose followed by lower concentrations of sucrose and maltose (Siddiqui and Furgula, 1976). It also contains vitamins such as Vit B1, B2, C and nicotinic acid. About 18 organic acids have been detected in honey. The mineral content and trace element in honey samples could give an indication of the geographical origin of honey (Rodriguez-Otero _et al._, 1992).

Acidity is one of the most essential chemical characteristic which influences the honey quality. Latif _et al._ (1956) carried out researches on the composition of Pakistan honey and found acidity (as formic acid) 0.07-0.16 per cent. The maximum limit of 0.2 per cent prescribed in the ‘Agmark’ specifications (Phadke, 1962) and also prescribed by I.S.I., 1974 for special, A grade and standard grade honeys.
Kaushik (1988) found average acidity (as formic acid) 0.11 per cent in the multi floral Indian honeys. Rahman et al. (2013) reported acidity in branded honey 42.2 and unbranded honey 41.4 meq/kg. Rane and Doke (2013) Fasasi (2012) reported of free acidity 19.3 meq/kg in Nigerian natural honey samples. Hasan (2013) reported of acidity 23.38 meq/kg in fresh honey samples. Balkanska and Ignatova (2013) reported free acidity in rape honey 14.98 meq/kg and coriander honey 16.09 meq/kg. Kayode et al. (2014) analyzed acidity in Nigeria honey & reported in the range of 21.5 to 33.6 meq/kg. Habib et al. (2014) reported total acidity in Arid regions honey sample range from 10.88 to 40.69 meq/kg. In India, Ahmed et al., 2015 reported that the free acidity in honey was in the range from 10.2 to 26.1 meq/kg.

Hydroxymethyl furfural aldehydes are the compounds formed during commercial conversion of sucrose to form invert sugar. Its presence or absence has been used as a test for determining purity of honey. Winkler (1955) showed that fresh honey contained small amounts of HMF (0.06 to 0.2 mg/100 gm honey). Phadke (1968) used Fiehe’s test for quantitative analysis of honey samples in India. Honeys may then be graded as follows: 0 to 10 µg HMF/gm of honey (grade I), 11 to 20 µg HMF/gm of honey (grade II) and 21 to 30 µg HMF/gm of honey (grade III).

This test in applied qualitatively in India at present. Deifel et al. (1985) showed that HMF content can serve as an indicator showing the influence of heat on honey during bottling and storage. Out of the 1724 samples of honey from Germany analyzed by him it was found that samples lying in range between 0 to 15 ppm and 5.4 per cent had greater than 40 ppm HMF. Krauze et al. (1970) analyzed HMF content in 110 polish honeys, which had been stored for up to 14 hours at 18°C to 25°C had been heated at 52°C, 75°C or 100°C for 540 minutes before storage. They found that light honeys had less HMF than dark honeys. Fini and Sabatini (1972) determined HMF content in 400 samples of honey obtained direct from beekeepers (group A) and in 400 honeys commercially available in Italy group B, samples (average 13.4 mg/kg), all contained less than the maximum of 40 mg/kg allowed by the European Codex, but in group B (average 59.6 mg/kg), only 292 samples confirmed to the Cordex, and 24 samples contained more than 100 mg/kg. Dhar et al. (1973) investigated that HMF levels above 40 ppm indicated either deterioration of honey through faulty or prolonged storage or presence of invert sugar as an adulteration, in honey samples from West Bengal in India. White (1980) reported that HMF in honey samples from
U.S.A. rose from heating which could affect the validity of tests for HMF as an indicator of adulteration with invert syrup. It was suggested that a level of 20 mg HMF/100g honey would allow differentiation of honeys possibly adulterated with invert syrup (HMF content 170-650 mg/100g from normally stored and processed (4 mg/100g).

Hase and Aida (1985) summarized and discussed results of analysis on 360 samples of raw honey and 997 samples of processed honey from the market in the period 1977-84. Comparisons with results of previous surveys were made. Japanese honey was found generally with a lower HMF concentration than imported honeys. Processed honeys, irrespective of source showed higher HMF values than raw honeys. Mean HMF content of 42 other samples stored at the processing plant increased by 1.0 ppm/month. Bricage (1989) reported that the legal threshold of 40 mg HMF/kg honey exceeded in 16 of 88 French honey, white 35 of 38 honeys sold directly by local beekeepers had an HMF content of below 15 mg/kg. Imported honeys were mainly of quality equivalent to that of locally sold French honeys; 18 of 32 samples had an HMF content of below 15 mg/kg. Balenovic et al. (1988) determined HMF content in 22 samples of honey obtained directly from apiaries and 22 samples of industrial honey of the 44 honeys, 54.5 per cent met the standard requirements (HMF should not be > 40 mg/kg). In general, apiary honey was of a higher quality than industrial honey. Kaushik (1988) reported the absence of HMF in the fresh Himachal honeys. Thompson et al. (2003) investigated the effect of the treatment (in the “Easy Bee” method of extracting granulated honey, the combs are put in a stainless steel melting tray which is heated by hot water) on the HMF level. Frías-Tejera and Torre (1991) reported results for 38 samples; mean HMF content was 16.9 gm/kg; all except 8 samples contained less than 40 mg/kg. Ghoshdastidar and Chakrabarti (1992) reported nil – 12.0 ppm HMF in the honey samples received from the Central Bee Research Institute, Pune. Gomez et al. (1993) made physic-chemical analysis of 25 Spanish Commercial Eucalyptus honey and reported an average value of 3.63 ppm for HMF. Several techniques were proposed to determine metallic impurities in honey, but in most cases, a matrix mineralization is required. Habib et al. (2014) reported of HMF in Arid regions honey sample range from 0.17 to 79.26mg/kg. Boussaid et al. (2014) reported of HMF in various flora honey of Tunisia range from 12.07 to 27.43mg/kg. Umarani et al. (2015) reported HMF value in unbranded & branded
honey in the range of 2.41 to 2.86% & 9.73 to 22.88% respectively. Ahmed et al. (2015) reported HMF in honey in the range of 3.8 to 21.4 mg/kg.

The largely preferred analytical approaches to the determination of transition metals in honey are spectroscopy techniques (Caroli et al., 1999). For metal ion analysis, electrochemical techniques are potentially the cheapest and quickest method of carrying out a determination when compared with instrument technique such as atomic absorption spectroscopy and inductively coupled plasma (Bersier et al., 1994). Potassium is the major metal, followed by calcium, magnesium, sodium, sulphur and phosphorus. Trace elements include iron, copper, zinc and manganese. Golob et al. (2005) detected up to 16 elements in Slovenian honey by total X-ray fluorescence spectroscopy and established statistically significant differences between different types of honey originating from acacia, flowers, lime, chestnut, spruce, fir and forest honeydew.

Many trace elements in different types of bee honeys, have been analyzed (Rashed & Soltan, 2004) and new methods for their determination have been developed (Taddia et al., 2004; Ioannidou et al., 2005). Gonzalez-Miret et al. (2005) by multiple linear regression analysis found and established significant correlations and equations relating honey lightness and color to the mineral content.

The application of multivariate analysis to the general physicochemical parameters, minerals, trace elements, and sugars has been used to differentiate types of monofloral honeys, honeydew and blossom honeys over the last few decades (Terrab et al., 2002; Terrab et al., 2003; Marini et al., 2004). Golob et al. (2005) detected up to 16 elements in Slovenian honey by total X-ray fluorescence spectroscopy and established statistically significant differences between different types of honey originating from acacia, flowers, lime, chestnut, spruce, fir and forest honeydew.

The mineral content of honey is recognized as an environmental indicator at least since 1984, when Crane published the first data on metals content in honey collected near or far from highways (Buldini et al., 2001). Several techniques were proposed to determine metallic impurities in honey, but in most cases, a matrix mineralization is required. The largely preferred analytical approaches to the determination of transition metals in honey are spectroscopy techniques (Stein and Umland, 1986; Jones, 1987; Chung & Tsai, 1992; Rodriguez-Otero et al., 1992; Vinas et al., 1997
and Caroli et al., 1999). For metal ion analysis, electrochemical techniques are potentially the cheapest and quickest method of carrying out a determination, that is, when they are compared with instrument techniques such as atomic absorption spectroscopy and inductively coupled plasma (Bersier et al., 1994). The mineral content and trace elements in honey samples could give an indication of the geographical origin of honey (Rodriguez-Otero et al., 1992).

Trace elements include iron, copper, zinc and manganese. Golob et al. (2005) detected up to 16 elements in Slovenian honey by total X-ray fluorescence spectroscopy and established statistically significant differences between different types of honey originating from acacia, flowers, lime, chestnut, spruce, fir and forest honeydew.

Krishna et al. (2015) reported minerals K (16.76), Ca (6.31), Mg (0.19), Cu (0.03) and P (1.06) in Natural honey K (14.78), Ca (4.50), Mg (0.15), Cu (0.01) and P (1.18) ppm in Industrial honey.

Anklam (1998) published a review of the analytical methods used to determine the geographical and botanical origins of honey. Such methods include the determination of amino acids and proteins, aroma compounds, sugars, enzyme activity, fermentation products, flavonoids, organic acids, phenolic compounds, pollen analysis, minerals and trace elements, and specific stable isotopic ratios. Habib et al. (2014) reported of total protein in Arid regions honey sample range from 0.2 to 0.57%.

Antibiotic residues in honey have recently become a major consumer concern. It has become evident that residues of antibiotics in honey originate mostly not from the environment but from improper beekeeping practices. There are several international reports of antibiotic residues in honey samples; however there are very few reports of antibiotics in honey sold in domestic market in India. There are reports of tests conducted by Agricultural Processed Food Product Export Development Agency (APEDA) and EIC from 2005 onwards show high levels of antibiotics and heavy metals in honey exported from India to EU and US. In 2006, about 14 per cent samples were contaminated with tetracycline. In 2007-08, about 28 per cent samples were contaminated with this an antibiotic of the 362 honey samples it tested in 2009-2010 by the EIC, 29.2 per cent samples had more than the prescribed limit of antibiotics and heavy metals (EIC documents). Another consignment belonging to Lee Bee Impex, a big exporter based in Ludhiana in Punjab, was barred from entering
the US market in 2007—the honey was found to have originated in China and had residues of fluoroquinolone. According to the Alert Notices issued by FSA (Food Standards Agency) of UK in March 2003 on the contamination of Indian foods based on the tests at importing points Dabur Honey was contaminated with antibiotic Streptomycin (Mayande, 2007). In the period 2000-2001, 248 samples of locally produced and imported honey were monitored for the presence of residues of veterinary drug residues. Streptomycin was detected in 4 out of 248, tetracycline in 2 out of 72, sulfonamides in 3 out of 72 samples. No residues of lactam antibiotics and chloramphenicol were found. In imported honey samples streptomycin was detected in 51 out of 102 samples, tetracyclines in 29 out of 98 samples, sulfonamides in 31 out of 98 samples, chloramphenicol 40 out of 85 samples. For the streptomycin and tetracycline contamination, most cases involved the beekeeper admitting to having added foreign honey to his production (Reybroeck, 2003). 75 samples of honey obtained commercially in Switzerland, 34 which originated from Asian countries, 13 samples (17%) contained chloramphenicol residues. Concentration of chloramphenicol measured in honey between 0.4 and 6.0µg/kg, with six samples containing approximately 0.8–0.9µg/kg (just below the Swiss limit) and two containing approximately 5µg/kg (Ortelli et al., 2004). Another study in which 251 honey samples produced across Greece was analyzed by Liquid chromatography to detect tetracycline-derived residues. 29% of the samples had tetracycline residues. Majority of samples contained residues from 0.018-0.055mg/kg of honey while some others had residues in excess of 0.100mg/kg (Saridaki-Papakonstantadinou et al., 2006) Centre for Food Safety (CFS) found that two of the 19 samples of honey collected for examination for antibiotics contained trace amounts of chloramphenicol, one brand of honey produced in Jiangxi (under batch number 20060424, with "best before" date 24.4.2008) and another brand produced in Zhuhai (with "best before" date 30.6.2008). Other antibiotics found in the honey samples in trace amount, namely streptomycin, sulfamethoxazole (a kind of sulfonamides) and ciprofloxacin (a kind of quinolone), they can normally be used in food animals. (CFS, 2006) In February 2006, the Florida Department of Agriculture and Consumer Services reported that residues of two fluoroquinolones of concern, ciprofloxacin and enrofloxacin were found in honey samples that were traced back to a firm from China. The State subsequently, on August 14, 2006, FDA issued Import Alert No. 36-04 requiring detention without physical examination of honey due to presence of fluoroquinolones. Nectar and
Honey samples collected from bee hives during the peak flowering seasons of rubber (March to April) and banana (December to January) plantation crops in southern part of Tamil Nadu were analyzed for antibiotic residues. Nectar and honey samples showed 4-17 and 11-29g/kg of streptomycin, 2-29 and 3-44g/kg of ampicillin and 17-34 and 26-48g/kg of kanamycin respectively (Solomon et al., 2006). Out of the 3855 honey samples tested 1.7% samples were non-compliant with the EU standards Antibiotic were detected in the honey samples in the range- Streptomycin 3 – 10,820µg/kg, Sulfonamides 5 – 4,592µg/kg, Tetracyclines 5 – 2,076µg/kg, Chloramphenicol 0.1 – 169µg/kg, Nitrofurans 0.3 - 24.7µg/kg, Tylosine 2 – 18µg/kg, Quinolones <1 - 504µg/kg (Diserens, 2007). 50 honey samples comprising chestnut, pine, linden and multiflower honeys collected from the hives in Southern Maramar region of Turkey were analyzed for erythromycin residues by Liquid Chromatography-mass spectrometry using Electrospray ionization in the positive ion mode (LC-ESI-MS). Four of the honey samples were contaminated with erythromycin residues at concentrations ranging from 50 to 1776 ngg⁻¹. An erythromycin-fortified cake feeding assay was also performed in a defined hive to test the transfer of erythromycin residue to the honey matrix. In this test hive, the residue level in the honey, 3 months after dosing was approximately 28 ngg⁻¹ (Gunes et al., 2008). Another study aimed to assess oxytetracycline (OTC) residue levels in honey after treatment of honeybee colonies with two methods of application (in liquid sucrose and in powdered icing sugar. The samples of honey were extracted up to 12 weeks after treatment and following metal chelation and analyzed by HPLC showed that the current method of application of Oxyteracyclin (Terramycin) in liquid form results in very high residue levels in honey with residues of 3.7 mg/kg, eight weeks after application (Thompson et al., 2005). Recently researchers have developed a method to simultaneously detect the presence of 17 antibiotics (macrolides, tetracyclines, quinolones, and sulfonamides) in honey samples taken from supermarkets while five were collected from various private beekeepers throughout Granada and Almeria. The results of the study show that one of the commercial honey samples contained 8.6µg/kg, while another contained traces of sarafloxacin and residues of tylosin, sulfadimidine and sulfachlorpyridazine were found in the honey from one bee farm (Vidal et al., 2009). A total of 57 real royal jelly samples collected from beekeepers and supermarkets were analyzed for seven fluoroquinolones used in beekeeping, viz. ciprofloxacin, norfloxacin, ofloxacin, pefloxacin, danofloxacin,
enrofloxacin, and difloxacin, were analyzed by high performance liquid chromatography with fluorescence detection. Ofloxacin, ciprofloxacin, and norfloxacin, were detected in concentrations ranging from 11.9 to 55.6 ng/g in some royal jelly samples and difloxacin was found at concentrations of about 46.8 ng/g in one sample though it is rarely used in beekeeping (Zhou et al., 2009).

In a survey of unioral New Zealand honeys, Allen et al. (1991) found several which exhibited non-peroxide antibacterial activity. The greatest activity was observed in manuka honey, a very popular and economically important product derived from the native New Zealand manuka” tree Leptospermum scoparium (Myrtaceae). However, not all manuka honey exhibits non-peroxide antibacterial activity. Instead, the bioactivity is recorded in manuka honey only from specific localities (Molan, 1992), particularly the East Cape region of the North Island of New Zealand. Manuka honey contains a number of aromatic acids (Russell et al., 1990) of which syringic acid and phenylactic acids are the most abundant (Wilkins et al., 1993). Recently we described the identification of some phenolic acids and avonoids in bioactive manuka honey (Weston and Brocklebank, 1999). Phenolic acids and avonoids, particularly those derived from propolis, exhibit weak antibacterial activity (Marcucci, 1995) and we believed that different absolute levels of these constituents might explain why some manuka honey, especially that from the East Cape region of New Zealand, exhibits non-peroxide antibacterial activity and why manuka honey from most other regions of the country, along with nearly all other honeys, does not possess this property (Allen et al., 1991). Another unique feature of Eastland manuka is discussed below in Section 3.2. Much work has been published by a Spanish group on the use of chromatographic profiles of both avonoids and phenolic acids to relate honeys to geographical origin and oral source (Ferreres et al., 1993; Toma-Barberan et al., 1993; Andrade et al., 1997). This approach appealed to us as a potential means of distinguishing manuka honey with non-peroxide antibacterial activity, from inactive manuka and other honeys in New Zealand and whether a unique oral marker was responsible for that activity. Preliminary results of this work (see title footnote) indicated that there were no differences between any manuka honeys using the profiles of phenolic components and, in fact, manuka honey was homo-geneous with respect to these constituents. More comprehensive results of that work are reported in this paper. A search for other products, which conceivably might con-tribute to the
non-peroxide antibacterial activity of man-ukahoney, is also described. HPLC profiles of the phenolic components of one sample each of heather, clover and beech honeydew honey indicated that different unifloral honeys can be successfully distinguished by this method.

Traditionally, honey has been considered to have therapeutic properties since ancient times (Molan, 1992). At present, great amount of research is focused on its antimicrobial activity (Allen et al., 1991a, b; Molan, 1992; Alnaqdy et al., 2005). Others have determined its potential role in cancer care as well as its antimicrobial properties (Estevinho et al., 2008).

Numerous studies demonstrate that a great number of medicinal and aromatic herbs, as well as fruits and leaves of some berry plants biosynthesize phytochemicals possessing antioxidant activity and may be used as a natural source of free radical scavenging compounds (Javanmardi et al., 2002; and Miliauskas et al., 2004). Flavonoids pinobanksin, pinocembrin, quercetin, chrysin, galangin, luteolin and kaempferol were reported in honey (Gheldof et al., 2002 and The National Honey Board, 2002), while pinocembrin, pinobanksin and chrysin are characteristic flavonoids of propolis; these flavonoids were determined in the most previously analyzed European honey samples (Yao et al., 2003). It was reported that the composition and antioxidant capacity of honey depend on the floral source used to collect nectar; seasonal and environmental factors, as well as processing may also have an effect on honey composition and antioxidant activity (Frankel et al., 1998; Chen et al., 2000; Al-Mamary et al., 2002; Gheldof and Engeseth, 2002; Gheldof et al., 2002; Yao et al., 2003). Some reports showed possible correlations between floral origin and flavonoid profiles (Anklam, 1998; Yao et al., 2004). In general, higher antioxidant capacity was found for darker honey samples (Frankel et al., 1998; Chen et al., 2000; Nagai et al., 2001; Gheldof and Engeseth, 2002) as well as in honey with higher content of water (Frankel et al., 1998; Aljadi and Kamaruddin, 2004). Honey color depends on the potential alkalinity and ash content, as well as on the antioxidant active pigments, such as carotenoids and flavonoids (Frankel, et al., 1998). Draiaia et al. (2015) reported the presence of oxytetracycline 0.03ppb in honey.

The composition of active components in plants depends on various factors, particularly plant bio and chemo type and climatic conditions. Consequently, it can be reasonably expected that honey properties from different locations should be
different. Honey production in Lithuania has very long traditions tracking to ancient times; however, its composition and bioactive properties until now have not been studied more comprehensively. The major purpose of this work was to evaluate the radical scavenging activity of different botanical origin Lithuanian honey samples and some other bee products. Although regarded as a first step in characterization of Lithuanian honey and other bee products this study is expected to expand existing knowledge on biological properties of honey and bee bread and to assist in more focused design of further research, e.g. aiming at more specified applications of honey and other bee products as natural remedies and/or functional food ingredients.

The application of multivariate analysis to the general physicochemical parameters, minerals, trace elements, and sugars has been used to differentiate types of monofloral honeys, honeydew and blossom honeys over the last few decades (Terrab et al., 2002, 2003; Marini et al., 2004). The chemical composition of honey is dependent on its origin and thus the composition of nectar and honeydew honeys differ.

Honey serves as a source of natural antioxidants (Vit et al., 1997; Antony et al., 2000; Nagai et al., 2001; Al-Mamary et al., 2002; Gheldof et al., 2002; Aljadi and Kamaruddin, 2004; Beretta et al., 2005 and Kucuk et al., 2007), which play an important role in food preservation and human health by combating damage caused by oxidising agents e.g., oxygen, namely reducing the risk of heart disease, cancer, immune-system decline, cataracts, different inflammatory processes, etc. (The National Honey Board, 2003). The antioxidants present in honey include both enzymatic: catalase (Schepartz, 1966), glucose oxidase, peroxidase (Ioyrish, 1974) and non-enzymatic substances: ascorbic acid, a-tocopherol (Crane, 1975), carotenoids, amino acids, proteins, organic acids, Maillard reaction products (Gheldof et al., 2001, 2002; Al-Mamary et al., 2002; Schramm et al., 2003; The National Honey Board, 2003; Aljadi and Kamaruddin, 2004; Baltrusaityte et al., 2007 and Bertoncelj et al., 2007), and more than 150 polyphenolic compounds, including flavonoids, flavonols, phenolic acids, catechins, and cinnamic acid derivatives. In the literature, several studies for the identification and quantification of antioxidant components of honeybee products have been reported (Ferreres et al., 1994; Gheldof et al., 2002 and Buratti et al., 2007). Many methods for determining the antioxidative activity in honey have been used, e.g., determination of total phenolic content (Beretta et al., 2005). Linkon et al. (2015) reported polyphenol in Bangladesh honey in the
The addition of Maillard reaction products formed by heating honey–lysine mixtures also had an anti-oxidative effect in a linoleic acid model system and in a turkey meat model system (Antony et al., 2002). Moreover, Antony et al. (2002) reported the effect of dry honey on oxidation in turkey breast meat, and they showed that an addition of up to 15% dry honey inhibited the development of oxidative compounds in cooked turkey meat. Ferric-reducing/antioxidant power (FRAP) is another widely used antioxidant activity measurement method, which has been used for the assessment of antioxidant and reducing power of many different samples, including honey (Aljadi and Kamaruddin, 2004). Honey contains a variety of phenolics and represents a good source of antioxidants, which makes it a good food antioxidant additive and increases its usability potential in ethnomedicine (Al-Mamary et al., 2002; Aljadi and Kamaruddin, 2004; Beretta et al., 2005). The total phenolic content of natural samples, such as plants and honey, reflects, to some extent, the total antioxidant capacity of the sample (Beretta et al., 2005).

Numerous studies demonstrate that a great number of medicinal and aromatic herbs, as well as fruits and leaves of some berry plants biosynthesize phytochemicals possessing antioxidant activity and may be used as a natural source of free radical scavenging compounds (Javanmardi et al., 2002; Pizzale et al., 2002; Miliauskas et al., 2004; Sacchetti et al., 2005; Yu et al., 2005 and Blasa et al., 2007).

MRL’s (Maximum Residue Limit) for acaricides have been framed by some countries but for insecticides these are neither included neither in the Codex Alimentarius nor in the EU (European Union) (Al-Rifai and Akkel 1997; Blasco et al., 2003 and Khan et al., 2004). Pesticides consumption in the state of Himachal Pradesh is very low compared to other states of India. So it is speculated that honey collected from the state is free from the pesticide residues. In contrary to this Sharma and Kashyap (2002) recorded pesticide residues in honey. The current international honey market trend, regarding quality is more demanding. Therefore, it is necessary to promote all feasible activities in order to produce residue free honey (McKee, 2003).

Pigment betalain, responsible for red colour in the beet is known to be the active component for the antioxidant activity of beet (Parkin et al., 2003). Similar to beet, honey, which has been used as sweetening agent from ancient times also serve as a
good source of natural antioxidants that are effective in preventing oxidative deterioration in foods (Wang et al., 2004) such as inhibiting browning reaction in fruits and vegetables (Oszmianski and Lee, 1990; Mc Lellan et al., 1995; Chen et al., 2000) and lipid oxidation in cooked ground poultry (Antony et al., 2000, 2002; Mc Kibben and Engeseth, 2002).

Agents with antioxidant properties improve the function of the vessels in animal models of diabetes (DaRos et al., 2004 and Hamilton et al., 2007). We have recently reported that impaired endothelial dysfunction and increased oxidative stress was improved by lipoic acid, in old Goto-Kakizaki diabetic rats (Sena et al., 2008). It has been seen that the presence of flavonoids may contribute to antioxidant effects observed in some honeys (Aljadi and Kamaruddin, 2004 and Kucuk et al., 2007).

Azeredo et al. (2003) determined protein contents and physico-chemical properties and the mineral content in honey. They found that moisture content, free acid, lactone and total acidity were physicochemical properties that depended on the flower types used by honey bees for nectar.

With increasing international interest in honey characterization, various studies have been carried out in relation to physicochemical parameters (Felsner et al., 2004); many major and trace elements in different types of bee honeys, have been analyzed (Rashed and Soltan, 2004) and new methods for their determination have been developed (Ioannidou et al., 2005 and Taddia et al., 2004). Gonzalez-Miret et al. (2005), by multiple linear regression analysis, found and established significant correlations and equations relating honey lightness and color to the mineral content.

Quality control methods, in conjunction with multivariate statistical analysis, have been found to be able to classify honey from different geographical regions, detect adulteration and to describe chemical characteristics (Anklam, 1998; Anklam and Radovic, 2001; Cordella et al., 2002, 2003 and Serrano et al., 2004).

The composition of honey is variable, owing to the differences in plant types, climate, environmental conditions, and contribution of the beekeeper (Anklam, 1998; Azeredo et al., 2003). Thyme honeys of various origins have been studied for their physicochemical properties (Terrab et al., 2004). The Codex Alimentarius Standard for honey quality includes several chemical and physical parameters, comprising moisture content, mineral content, acidity, hydroxymethylfurfural (HMF) content,
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diastase activity, apparent sugar content, and water insoluble solids content. These analyses help the food analyst to determine the “chemical” quality of the honeys analyzed. Moreover, Devillers et al., (2004) suggest that they may be used in association with multivariate analyses to assign floral origin.

Other traditional analytical and quantitative techniques including physicochemical analysis, HPLC, GC with headspace sampling, GC–MS analysis with solid phase micro extraction and electronic nose have also been used to classify honeys according to their botanical origins and/or their geographical origin (Guyot et al., 1999; Moreira et al., 2002; Perez et al., 2002; Zhou et al., 2002; Bonvehi and Coll, 2003; Ampuero et al., 2004 and Corbella and Cozzolino, 2006).

The combine activity of many components in honey (ascorbic acid, phenolic compounds, Maillard reaction products, enzymes like peroxidase and catalase etc.) might be responsible for overall antioxidant property of honey (Wang et al., 2004). One antioxidant in particular, pinocembrin, which is unique to honey, is currently being studied for its antibacterial properties (Anon, 2005d). In addition, processing, handling and storage of honey may influence its composition (Gheldof and Engeseth, 2002; Turkmen et al. 2005). It has been an excellent nutritional option for many generations due to its health benefits. The chemical composition of honey is rather variable and primarily depends on the floral source (Tewari and Irudayaraj, 2005; Corbella and Cozzolino, 2006).

The chemical composition of honey can be dependent on several factors such as weather conditions, botanical species, soil nature, bee breed, honey maturation and physiology status of the hive (Crane, 1975, 1987 and Almeida- Muradian et al., 2007).

These volatile compounds may provide information about the botanical origin of honey, whether this has been produced by honeybees from the nectar of flowers or from exudates secreted by plants or insects (Radovic et al., 2001; Serra-Bonvehi and Ventura-Coll, 2003).

Many authors agree that certain volatile compounds such as furan derivatives (i.e. furfural, methylfurfural, and furfuryl alcohol) are normally good indicators of heat treatment and storage conditions (Castro-Vazquez et al., 2006a,b). Wootton et al. (1978), for example, used gas chromatography–mass spectrophotometry to study the
effect of heating Australian honey at a temperature of 50°C.

Honey is known to be rich in both enzymatic and non-enzymatic antioxidants, including glucose oxidase, catalase, ascorbic acid, flavonoids, phenolic acids, carotenoid derivatives, organic acids, Maillard reaction products, amino acids and proteins (Al-Mamary et al., 2002; Gheldof and Engeseth, 2002; Gheldof et al., 2002; Schramm et al., 2003 and Aljadi and Kamaruddin, 2004). In general, higher antioxidant capacity was found for darker honey samples (Frankel et al., 1998; Chen et al., 2000; Nagai et al., 2001 and Gheldof and Engeseth, 2002) as well as in honey with higher content of water (Frankel et al., 1998 and Aljadi and Kamaruddin, 2004).

As a source of energy, the beneficial characteristics of honey are its high nutritional value and the fast absorption of its carbohydrates upon consumption (Viuda-Martos et al., 2008).

The physico-chemical parameters of natural honeys, such as moisture, sucrose and hydroxymethylfurfural (HMF) contents, acidity and specific conductivity, are strictly defined and constitute the quality indicators which characterize individual honey varieties. Their measuring is comparatively simple and they provide a good information value (Perez-Arquillue et al., 1995; Al-Khalifa and Al-Arify, 1999; Downey et al., 2005 and Naab et al., 2008).

Honey has been found to have a significant antioxidant content (Frankel et al., 1998), measured as the capacity of honey to scavenge free radicals. The antioxidant activity of honey has also been demonstrated as inhibition of chemiluminescence in a xanthine-xanthine oxidase-luminol system that works via generation of superoxide radicals (Ali and Al-Swayeh, 1997). But even if the antioxidants in honey do not directly suppress the inflammatory process they can be expected, by scavenging free radicals, to reduce the amount of damage that would otherwise have resulted from these. Honey inhibition the formation of free radicals, a potential to exert antioxidant activity. Superoxide formed during inflammation is unreactive; this is then converted to hydrogen-peroxide a much less reactive peroxide radical generated (Cross et al., 1987). Formation of the oxidant-peroxide radical is then catalyzed by metal ions (e.g.; iron and copper). Sequestration of these metal ions in complexes with organic molecules is an important antioxidant defense system (Halliwel and Cross,
1994). Flavonoids and other polyphenols, common constituents of honey, will do this (Daily and Imming, 1999).

Lead author (Susan and Meschwitz, 2014); presented the findings at the 247th National Meeting of American Chemical Society. She reported that the ability of honey to fight infection lies in its multiple levels; this makes it difficult for bacteria to develop resistance.