ACTA SCIENTIFIC NUTRITIONAL HEALTH (ISSN:2582-1423)

Volume 4 Issue 4 April 2020

Review Article

Utilization of Honey for Functional Food Product Development

Babita Sharma*, Devina Vaidya, Manisha Kaushal and Sury Pratap Singh

Department of Food Science and Technology, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

***Corresponding Author:** Babita Sharma, Department of Food Science and Technology, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India.

Received: March 04, 2020

Published: April 10, 2020

Abstract

Honey is a natural substance that is produced by honey bees from the nectar of flowers and it is sweet and flavourful liquid. It contains sugars, proteins, enzymes, amino acids, minerals and vitamins. It is used as a medicine for burns, ulcers, diabetes and wound healing, and act as antioxidant, anti-inflammatory, antibacterial and antimicrobial agent. The glycaemic index of honey is low which is between 32 to 87 depending on source and botanical origin. Honey has been used for different medicinal purpose since ancient time, as they are helpful in reducing many diseases. We conclude in this review about the classification, health benefits and the utilization of honey for development of functional food products such as bakery, confectionary and dairy products especially in Ayurveda medicinal system. Usually more money was spent for the children in the families. The new product could be successful on the local market and it could help to develop a family size apiary.

Keywords: Honey; Antimicrobial; Nutritional and Functional Foods

Introduction

Honey is a sweet, viscous liquid prepared by collecting nectar from plants [1]. The pleasant flavour, aroma and taste of this liquid varies according to geographical and seasonal conditions ranges from pale yellow to dark amber [2]. It has been used since ancient times and as sweetener worldwide [3]. The production of honey in India is 60000 tones [4]. Traditionally, its use in food has been as a sweetening agent. The quality of honey depends upon the origin, sensory perception and composition. Honey is a natural biological product that having sugars (glucose and fructose: 70 - 80%), water (10 - 20%) and other minor constituents such as organic acids, mineral salts, vitamins, proteins, phenolic compounds and free amino acids [5]. The nutritional value of honey is very high as it is liked by the consumers due to its characteristic flavour, sweetness, and texture [6]. Honey is largely used on a small scale as well as at an industrial level in beverages, baked products, confectionary, candy, marmalades, jams, spreads [7]. Honey is a natural sweet and appreciated natural substance, which have religious significance and Hindus considers honey as one of the five elixirs of immortality [2]. The bee has the capability to collect the honey from the flower or plant sources and to preserve it in the hives, taking about 3 - 6 weeks for collection [8]. The eyes of bee differ from that of others to discriminate colors and reported to be sensitive in short wavelength [9].

Classification

It is broadly classified into two categories

- Floral source
- Processing.

History of honey

The quality of honey extracted depends on the geographical area and climatic conditions. The overall quality determinations which are very important depend upon production, physical properties, chemical composition, utility, quality and sensory aspects. In the past, the practice of getting honey was mainly confined to the woods and other places where the bees would set up their hives. Honey guide birds that chatter noisily are helpful in attracting the attention of men or animals and lead them to hidden hives of wild bees. Later, honey would be squeezed out of the combs. In modern times, the bees are reared in planned manner in a box and the bees use them as their storage place [2].

Physico-chemical characteristics of honey (multifloral)

Table1

On the basis of floral source	
Blended	Most commercially available honey. It is a mixture of two or more honeys differing in floral source, color, flavor, density or geographic origin.
Polyfloral	Polyfloral honey also known as wildflower honey and is derived from the nectar of many types of flowers. Taste, aroma and flavour vary depending on the bloom prevalent.
Monofloral	Primarily from the nectar of one type of flower. Different monofloral honeys have a distinctive flavor and color because of differences between their principal nectar sources.
Honeydew honey	The sweet secretions of aphids or other plant sap-sucking insects. Honeydew honey is very dark brown in color, with a rich fragrance of stewed fruit or fig jam, and is not as sweet as nectar honeys.
Source: [2,10].	
On the basis of processing	
Crystallized honey	Is honey in which some of the glucose content has spontaneously crystallized from solution as the monohydrate. Also called “granulated honey” or “candied honey.
Pasteurized honey	Is honey that has been heated in a pasteurization process which requires temperatures of (72°C) or higher.
Raw honey	Is honey as it exists in the beehive or as obtained by extraction, settling or straining, without adding heat.
Strained honey	Has been passed through a mesh material to remove particulate material (pieces of wax, propolis, and other defects) without removing pollen.
Filtered honey	is honey which has been filtered to the extent that all or most of the fine particles, pollen grains, air bubbles, or other materials normally found in suspension, have been removed.
Creamed honey	Creamed honey contains a large number of small crystals, which prevent the formation of larger crystals that can occur in unprocessed honey
Dried honey	In which moisture is removed to create completely solid, non-sticky granules
Ultrasonicated honey	processed by ultrasonication (non-thermal processing)
Source: [11-13]	

Table

Composition of honey

Natural honey contains high amount of substances including amino acids, vitamins, minerals and enzymes, but it primarily contains sugar and water. Honey contains small amount of enzymes. Diastase, invertase and glucose oxidase are the main enzymes present in honey, as catalase and acid phosphatase are present in minimum quantity [1,29]. The principal carbohydrate of honey is fructose (32.56 to 38.2%) and glucose (28.54 - 31.3%) [30]. The sugars present in honey are fructose and glucose in a ratio of 2.1:1.0. Other sugars present in minimal quantities such as sucrose, reducing disaccharides and higher oligosaccharides [29]. The water content, time of extraction and ripening process influences shelf life of honey [31], at 40 - 100°F (4 - 37°C) temperature, water activity of honey ranges between (16 - 18.3%). Different trace elements and minerals are present in honey. Trace elements such as (Al, Ba, Sr, Bi, Sn, Te, Tl, W, Sb, Cr, Ni, Ti, V, Co, Mo) and minerals like (P, S, Ca, Mg, K, Na, Zn, Fe, Cu, Mn) play crucial role in the biomedical activities [32].

The protein content of honey is 1000 µg/g, and variation is due to floral source, geographical conditions and temperature. Honey

Parameters	Honey	References
Total soluble solids(°B)	60.00 - 70.00	[14,15]
Free acid (meq/100 g)	3.55 - 3.60	[16,17]
Lactone (meq/100 g)	0.50 - 0.98	[8,16]
Total acid (meq/100g)	4.20 - 4.47	[14,16,18]
pH	2.89 - 3.86	[5,14,15,17-19]
Reducing sugars (%)	40.00 - 59.30	[5,14]
Non - reducing sugars (%)	5.00 - 5.74	[5]
Total sugars (%)	62.45 - 65.34	[5,20]
Moisture (%)	15.0 - 16.5	[5,14-16,21]
Total solids (%)	70.0 - 83.5	[5,19,22]
Ash (%)	0.10 - 0.19	[5,16,19,23]
Fructose (%)	30.00 - 35.85	[17,23,24]
Glucose (%)	28.45 - 30.24	[17,25]
Glucose: Fructose ratio	1.09 - 1.18	[5,25]
Diastase Number (DN)	19.00 - 20.50	[8,17,26-28]
Total phenols (mg/100g)	60.56 - 65.45	[8,28]
HMF (mg/kg)	9.35±0.01	[8,17,26-28]

Table 1: Physico-chemical characteristics of multifloral honey.

contain 1% (w/w) amino acid, which ranges between 10 and 200 mg/100g and have 26 amino acids. Proline is a major contributor as their relative proportions depending on its origin (nectar or honeydew).

Figure 1: Composition of honey.

Therapeutic values of honey

According to [33] honey is an important food product having medicinal value and is best known for nutritional and therapeutic value. And its therapeutic value depends upon various aspects like sensorial, chemical, physical and microbiological characteristics. Honey acts as antimicrobial, anti-inflammatory and anti-oxidant agent for boosting of the immune system.

Antimicrobial activity

Honey is used as antimicrobial, anti-inflammatory and antioxidant agent and it has been used as body's immune response to clear infection. They contain huge antimicrobial complexes and some bacteria are present in honey which produces antimicrobial activity, which are beneficial for consumer health. It has major antimicrobial defence system against many diseases. Honey is effective against pathogenic and non-pathogenic microorganisms [34].

Anti-inflammatory activity

Anti-Inflammation is the property that reduces swelling and inflammation activity or these are the drugs which reduces injury and infection in body. Honey contains compounds like flavonoids, polyphenols and other compounds which are effectively used as antioxidant and play important role in reducing free radical formation, that are effective in minimizing the risk of cancer [35,36]. However, the anti-inflammatory properties of honey have been well established without any side effects.

Anti-oxidant activity

In recent years, increasing attention has been paid to the role of diet in human health. Several epidemiological studies have indicated that a high intake of these products is associated with a reduced risk of a number of chronic diseases, such as atherosclerosis and cancer. It is the process of reducing the oxidation reaction in body or has capability to prevent the oxidation in body due to chronic diseases such as cancer and coronary. Honey contains therapeutic potential associated with antioxidant activity against reactive oxygen species. Antioxidants may guard against ROS toxicities by the prevention of ROS construction, by disruption of ROS attack, by scavenging reactive metabolites and converting them to less reactive molecules or by enhancing the resistance of sensitive biological target to ROS attack [35].

Nutritional and health benefits of honey

As far as nutritional and health benefits has been concern, honey has many health benefits as it has used for medicinal purpose to treat a wide variety of illnesses. Honey can be used alone or in combination for the minimizing certain diseases. The beneficial actions of honey have been established in the following. Honey is used effectively as wound healing, skin ulcers and gastrointestinal health all over the world with honeys from different sources. It is certified that honeys licensed as medical product for professional wound care in Europe, America and Australia. Honey is equally found as an active ingredient in products such as ointments for the treatment of minor burns and cuts in Nigeria [37]. Honey also stimulates the regrowth of epithelial cells that form the new skin cover over a healed wound. Thus, prevents scarring and wound formation, and removes the need for skin grafting even with quite large wounds [6,38].

The main advantage of honey includes managing inflammation such as reduction of pain, reducing inflammation lessens exudates production and dressing change frequently, which may conserve resources in terms of dressings used, staff time, and unnecessary disturbance of the patient and the wound bed and exudates [39]. However, isolates also exhibit antimicrobial property.

Vitamins and minerals content in honey

Vitamins	Amount (mg/100g)
Ascorbic acid (C)	2.2 - 2.5
Pyridoxine (B6)	0.01 - 0.32
Pantothenic acid (B5)	0.02 - 0.11
Riboflavin (B2)	0.01 - 0.02
Thiamine (B1)	0.00 - 0.01
Phylloquinone (K)	0.025
Source: [20,41]	

Table 2: Vitamins content of honey.

Utilization of honey for product development

Honey powder

In most of the applications, liquid honey is used as such and like any other viscous liquid food, honey poses problems in handling.

Minerals	Amount(mg/100g)	References
Potassium (K)	40 - 40- 3500	[16,17,20,41,42]
Calcium (Ca)	3 - 31	[16,20,41,42]
Sodium (Na)	1.6 - 17	[16,20,41]
Phosphorus (P)	2 - 15	[20]
Magnesium (Mg)	0.7 - 13	[17,20,40,42]
Iron (Fe)	0.03 - 4	[17,41,42,43]
Manganese (Mn)	0.02 - 2	[17,43]
Zinc (Zn)	0.05 - 2	[16,17,20,41,42]
Copper (Cu)	0.02 - 0.6	[16,42]

Table 3: Mineral content of honey.

Application	Uses	References
Additive to poultry and other meat, to fruit and vegetable processing	Antioxidant and preservative (anti-bacterial) properties, reduces browning, improves sensory properties	[44]
Additive to microwave foods: cakes, muffins, cookies, glazes	Superior microwave reactivity and water activity manage-ments than synthetic sugars	[45]
Additive to frozen ice cream and dough	Better stability and sensory properties	[44,45]
Additive to fruit spreads, peanut butter, nut spread,	Better storability and sensory properties	[2,45]
Additive to fried or roasted beef, poultry	Reduces the forma-tion of heterocyclic aromatic amines and their mutagenic effects	[44]
Dried honey	Convenient as con-sistent in texture, flavour and colour,	[2,44,45]

Table 4: Application of honey in food industry.

Since honey has high viscosity (1.36 N.s/m^2 at 25°C and 21.5% moisture), loss in adherence to the containers is appreciable unless special efforts are taken to recover it completely. Honey in the dried form could overcome these problems, and therefore, has good commercial potential in the bakery and confectionary industry. Usage of honey powder in dry mixes for cakes and bread found to improve the sales appeal, as well as flavor, color, aroma, texture, and the keeping quality of the product. The product had reasonably good honey content (~52%), characteristic honey flavor, acceptable color (L: 77.87, a: -1.60 and b: 18.71) with a yellow tinge, and a free-flowing nature. Honey was mixed with additives such as dextrin, maltose and anticaking agent, and the mixture was spray dried at inlet and outlet temperatures in the range of 115 - 125°C and 80 - 85°C, respectively, which are much lower than the conditions employed in the other known methods. Considering the thermolabile nature of honey, mild drying conditions were applied to get a good quality product. The product was packed in laminated aluminum foil pouches [12.5 µm Polyethylene terephthalate (PET)/9 µm Aluminium foil/38 µm Low density polyethylene (LDPE)] for long-term storage (one year) of the product. The above process uses a novel approach of adding the anticaking agent during the feed preparation stage itself, which also served as a base, increasing the pH of the feed solution [2].

Honey flakes

The continuous process involves rapid concentration of liquid honey, either in pure form or with the addition of sucrose syrup in an agitated thin-film evaporator. The concentrate obtained from the evaporator is fed to a pair of chilled rollers to squeeze it into a thin sheet and then further in to flakes. The flakes are converted into powder using a hammer mill. According to the inventors, the organoleptic evaluation of the product indicated that the reconstituted honey almost matched the flavor, color, and aroma of original honey. The product had a shelf life of more than a year when stored at room temperature. Although, caking of the product was noticed during storage, no appreciable loss in flavor and color were reported [2].

Honey based spreads

The commonly known spread like products are honey spread, honey-fruit spread and honey-fat spread. There is an ever-increasing demand for consumer based diversified honey products, which lead to value addition to the raw material. The honey based spreads increase the demand for honey and provide superior products to the customers in terms of nutrition and taste. These spreads prepared by employing controlled heat treatment with or without incorporation of fruit pulp and other essential ingredients (sugar, citric acid, and pectin) have a large market potential as they are consumed with bread and sandwiches. Preparation of honey based fruit spreads may be considered as one of the best ways of utilization of fruits besides being an important preservation technique. Low fat spreads having various flavors prepared by blending butter or margarine with honey are also commercially successful products. The process for the honey spread can be selected based on the type of ingredients used for its preparation. Honey spread could be produced by adopting the Dyce method proposed for the preparation of granulated honey. In this process, honey was pasteurized at 63°C for 30 minutes, which resulted in the inactivation of yeast as well as liquefaction of crystals formed during previous storage. During heating honey, continuous stirring with mild agitation was employed below the surface so as to avoid formation of air bubbles. Honey was then filtered through 2 - 3 layers

of cheesecloth to remove extraneous matter such as wax, pollen etc. and cooled to 24°C. The 10% of the honey required for the formulation was mixed with an equal amount of finely crystallized seed honey and mixed till uniform consistency was achieved. Then, the remaining honey was added slowly to this homogeneous mixture to avoid incorporation of air. After a few hours, when the desired consistency was achieved, other ingredients such as dried fruits, nuts, spices, natural flavors, and colors were added. The mixture was filled in non-transparent glass bottles and stored for 3 - 5 days at 14°C, allowing for crystallization, before distribution [2,23].

Honey candy

Honey candy is another popular commercial product. Honey candy, normally containing many other ingredients, is consumed either as a health food or for therapeutic applications such as asthma and cough. However, very little information is available on the production of honey candy, as many of the inventions are proprietary in nature. In one of the common methods described, honey candy is prepared by boiling the mixture of honey, sugar, water, and butter until it reaches the hard crack stage, and then it is spread on to a glazed surface. Tadao patented a process for the production of honey candy, wherein a mixture of honey, granulated sugar and corn syrup is heated (120 - 150°C) to a get a homogenous viscous liquid, which was then rolled to form a rod with royal jelly at the centre. Doner LW [46] developed a method for the preparation of a honey candy that could be used for prevention and cure of cough and asthma. A decoction of plant materials (29 items), including pear, peach kernel, almond, turnip, walnut kernel, etc., was mixed with honey and concentrated to get the desired viscosity before packing in pre-sterilized bags. Cheng described a process for preparing a honey candy containing only fructose. Honey-water (1:1) mixture was refined using active carbon and then calcium hydroxide was added to the mixture and filtered through a filter press to separate out fructose in the form of fructo-calcium cake [24]. The diluted cake was subjected to acid treatment to separate out the calcium and passed through ion-exchange column to remove the impurities and finally concentrated to get honey candy containing only fructose. There are number of ingredients, which can be added to produce candy with different tastes. These ingredients include milk powder, soy milk, cinnamon, peanuts, corn starch, oats, dry fruits, nuts, pecans, lemon rinds, coconut gratings, vanilla and corn flakes.

Osmo-dried honey apple pops and apple rings

Apple is one of the most important woody perennial crop of the world. It is rich source of vitamins, minerals, antioxidant, phenols and fibre. Apple is perishable fruit with high nutritional value and losses occurring during harvesting, transportation, marketing and storage are quite high; so to avoid such huge losses and to extend the shelf life drying can be done [47]. Dried fruits are beneficial to human health. As market demands for fruit based functional products is increasing day by day because people become health conscious, so honey can be used as osmotic agent for drying of rings which can fetch high price in market. As appearance and taste is one of the main criteria in any product. The apple pops and apple rings can be good option increase the life span of fruits. However osmotic dehydration is a type of drying and is considered as a preservation method that provides high quality product by means of water removal without phase change [48]. This method modifies the texture, flavour, composition and the taste of final product as well as block the layers of the fruit.

Apple honey choco shots

Nowadays chocolates became favorite among all ages specially childrens and teenagers. Honey based products as snacks can be a friendly product in market due to its nutritional value. As they are coated with chocolate. Osmo-dried apple pops can be utilized for the preparation of apple honey choco shots. Dried apples can be used for the development of novel products like in bakery and confectionary. Due to highly nutritious source, with a fast metabolism and good digestibility [49]. In baking, pie filled with dried apples can be another novel product [50].

Apple pie (honey)

Pie is baked product in which the main filling ingredient is apple. As osmo-dried apple honey rings can rehydrate and further can be used for the preparation of apple pie in off seasons as a double crust baked product. In this process dried apple rings filled in between pie [50].

Conclusion

Honey has potential antioxidant and being used in different products due to its low cost. Nowadays the use of honey as a cheap source of sweetening agent is increasing day by day in industries for product formation without any side-effects. Its use has been rediscovered as antioxidant, anti-inflammatory and antimicrobial agent in many products. Due to variation of botanical origin it differs in appearance, composition and sensory perception. In present times due to its medicinal nature, it is widely used in products. Many products can be prepared from honey with nutritional enriched components and potential health benefits, which can boon the industries. The antioxidant capacity of honey which plays an important role in its useful effects, related to a wide range of compounds including phenolics, peptides, organic acids and enzymes.

Bibliography

1. White JW. Composition of honey". In: Crane E (eds). Honey, a comprehensive survey". London: Bee research Association and Chalfont, St Peter (1975a): 157-206.

2. Aparna AR and Rajalakshmi D. "Honey- Its characteristics, sensory aspects, and applications". *Food Reviews International* 15 (1999): 455-471.

3. FAO. Food and Agriculture Organization. Value-added products form beekeeping". FAO Agricultural Services Bulletin. Orme, Italy (1996).

4. FAO (2013).

5. Ouchemoukh S., *et al.* "Physicochemical characteristics and pollen spectrum of some Algerian honeys". *Food Control* 18 (2007): 52-58.

6. Subrahmanyam M. "Topical application of honey for burn wound treatment-an overview". *Annals of Burns and Fire Disasters* 20 (2007): 3.

7. Juvvi P., *et al.* "Optimization of process variables to develop honey based extruded product". *African Journal of Food Science* 6 (2012): 253-268.

8. Silva IC., *et al.* "Rearing Africanized honey bee (*Apis mellifera* L.) brood under laboratory conditions". *Genetics and Molecular Research* 8 (2009): 623-629.

9. Andrade P., *et al.* "Analysis of honey phenolic acids by HPLC, its application to honey botanical characterization". *Journal of Liquid Chromatography and Related Technologies* 20 (1997): 2281-2288.

10. Abu-Tarboush HM., *et al.* "Floral-type identification and quality evaluation of some honey types". *Food Chemistry* 46 (1993): 13-17.

11. Chen YP and Siede R. "Honey bee viruses". *Advances in Virus Research* 70 (2007): 33-80.

12. Maulny AP., *et al.* "Physical properties of co-crystalline sugar and honey". *Journal of Food Science* 70 (2005): 567-572.

13. Formato G., *et al.* "Risk management in primary apicultural production. part 2: a hazard analysis critical control point approach to assuring the safety of unprocessed honey". *Veterinary Quarterly* 31 (2011): 87-87.

14. Anupama D., *et al.* "Sensory and physico-chemical properties of commercial samples of honey". *Food Research International* 36 (2003): 183-191.

15. Mateo R and Bosch-Reig F. "Classification of Spanish uni-floral honeys by discriminant analysis of electrical conductivity, color, water content, sugars and pH". *Journal of Agricultural and Food Chemistry* 46 (1998): 393-400.

16. Nanda V., *et al.* "Physico-chemical properties and estimation of mineral content in honey produced from different plants in Northern India". *Journal of Food Composition and Analysis* 16 (2003): 613-619.

17. Terrab A., *et al.* "Palynological, physico-chemical and colour characterization of Moroccan honeys. II. Orange (Citrus sp.) honey". *International Journal of Food Science and Technology* 38 (2003): 387-394.

18. Singh N and Bath PK. "Quality evaluation of different types of Indian honey". *Food Chemistry* 58 (1997): 129-133.

19. Ahmed J., *et al.* "Physico-chemical, rheological, calorimetric and dielectric behavior of selected Indian honey". *Journal of Food Engineering* 79 (2007): 1207-1213.

20. Bogdanov S., *et al.* "Honey for nutrition and health: a review". *Journal of the American College of Nutrition* 27 (2008): 677-689.

21. Esti M., *et al.* "Valorisation of the honeys from the Molise region through physico-chemical, organoleptic and nutritional assessment". *Food Chemistry* 58 (1997): 125-128.

22. Juszczak L and Fortuna T. "Rheology of selected Polish honeys". *Journal of Food Engineering* 75 (2006): 43-49.

23. Alvarez-Saurez JM., *et al.* "Contribution of honey in nutrition and human health: a review". *Mediterranean Journal of Nutrition and Metabolism* (2009): 1-9.

24. Guler A., *et al.* "Determination of important biochemical properties of honey to discriminate pure and adulterated honey with sucrose (*Saccharum officinarum* L.) syrup". *Food Chemistry* 105 (2007): 1119-1125.

25. Higes M., *et al.* "The presence of Nosema ceranae (Microsporidia) in North African honey bees (*Apis mellifera* intermissa)". *Journal of Apicultural Research* 48 (2009): 217-19.

26. Goras G., *et al.* "Rearing Drones in Queen Cells of *Apis mellifera* Honey Bees". *Journal of Apicultural Science* 60 (2016): 119-128.

27. White JW. "The role of HMF and diastase assays in honey quality evaluation". *Bee World* 75 (1994): 104-117.

28. Schade JE., *et al.* "Diastase activity and hydroxymethyl-furfural in honey and their usefulness in detecting heat alteration". *Journal of Food Science* 23.5 (1958): 446-463.

29. White JW. "Physical characteristics of Honey". In: Crane E, (eds). Honey A Comprehensive Survey. Heinemann, London (1975b): 207-239.

30. Ezz El-Arab AM., *et al.* "Effect of dietary honey on intestinal microflora and toxicity of mycotoxin in mice". *BMC Complementary and Alternative Medicine* 6 (2006): 1-13.

31. ADA. "Use of nutritive and non-nutritive sweeteners". *Journal of the American Dietetic Association* 104 (2004): 255-275.

32. Stocker A., *et al.* "Trace and mineral elements in royal jelly and homeostatic effects". *Journal of Trace Element in Medicine and Biology* 19 (2005): 183-189.

33. Meda A., *et al.* "Therapeutic uses of honey and honeybee larvae in Central Burkina Faso". *Journal of Ethnopharmacology* 95 (2004): 103-107.

34. Tanih NF., *et al.* "An African perspective on Helicobacter pylori: prevalence of human infection, drug resistance, and alternative approaches to treatment". *Annals of Tropical Medicine and Parasitology* 103 (2009): 189-204.

35. Van den Berg AJ., *et al.* "An *In vitro* examination of the antioxidant and anti-inflammatory properties of buckwheat honey". *Journal of Wound Care* 17 (2008): 172-174.

36. Simon A., *et al.* "Medical honey for wound care-Still the "latest resort". *Evidence-Based Complementary and Alternative Medicine* 6 (2009): 165-173.

37. Williams ET., *et al.* "Studies on the effects of the honey of two floral types (Ziziphusspp. and Acelia spp.) on organism associated with burn wound infections". *African Journal of Pure Applied Chemistry* 3 (2009): 98-101.

38. Tan HT., *et al.* "The antibacterial properties of Malaysian tualang honey against wound and enteric microorganisms in comparison to manuka honey". *BMC Complementary and Alternative Medicine* (2009).

39. Manyi-Loh CE., *et al.* "Treatment of Helicobacter pylori infections: Mitigating factors and prospective natural remedies". *African Journal of Biotechnology* 9 (2010): 2032-2042.

40. Compos MG., *et al.* "Pollen composition and standardisation of analytical methods". *Journal of Apicultural Research* 47 (2008): 154-161.

41. De Alda-Garcilope C., *et al.* "Characterization of Spanish honeys with protected designation of origin "Miel de Granada" according to their mineral content". *Food Chemistry* 135 (2012): 1785-1788.

42. Henriques A., *et al.* "Free radical production and quenching in honeys with wound healing potential". *Journal of Antimicrobial Chemotherapy* 58 (2006): 773-777.

43. Matei N., *et al.* "Determination of c vitamin and some essential trace elements (Ni, Mn, Fe, and Cr) in bee products". *Acta Chimica Slovenica* 51 (2004): 169-175.

44. Antony S., *et al.* "Effect of dry honey on oxidation in turkey breast meat". *Poultry Science* 79 (2000): 1846-1850.

45. Hebbar HU., *et al.* "Microwave and infrared heat processing of honey and its quality". *Food Science and Technology Research* 9 (2003): 49-53.

46. Doner LW. "The sugars of honey - a review". *Journal of the Science of Food and Agriculture* 28 (1977): 443-456.

47. Famurewa JAV., *et al.* "Dehydration of osmosised red bell pepper (Capsicum annum)". *Research Journal of Biological Science* 1 (2006): 36-39.

48. Lerici CR., *et al.* "Osmotic dehydration fruits: influence of Osmotic agents on drying behaviour and product quality". *Journal of Food Science* 50 (1985): 1217-1220.

49. Pedro NAR., *et al.* "Study of the mineral content of chocolate flavoured beverages". *Food Chemistry* 95 (2006): 94-100.

50. Sharma B., *et al.* "Development of novel products from osmodried apples: Apple choco shots and apple pie". *Journal of Food Processing and Preservation JFPP* (2018).