Academic Journal of Entomology 8 (4): 168-173, 2015
ISSN 1995-8994

DOI: 10.5829/idosi.aje.2015.8.4.96210

Production and Quality Characteristics of Ethiopian Honey: A Review

Haftu Kebede Sebeho

Department of Animal Sciences (Animal Production), Faculty of Agricultural Sciences,
Wachemo University, P.O. Box 667, Hossana, Ethiopia

Abstract: Ethiopia has about 1.4–1.7 million households that are engaged in beekeeping and produce different types of honey that vary regionally as well as in terms of color, consistency and purity. Although Ethiopia is recognized as top ten producers of honey globally, the nation's output is still below 10% of its production capacity and this entails the existence of notable challenges strangulating the sector. Ethiopian honey production is characterized by the widespread use of traditional technology resulting in relatively low honey supply and poor quality of honey harvested when compared to the potential honey yields and quality gains associated with modern beehives. Modern beehive yields around 20kg of higher quality honey as compared to 6-8 kg of yields from traditional beehives. Physicochemical parameters such as electrical conductivity, ash content, water content, free acid and pH. All these parmeters considered as criteria for the characterization of honeys. Electrical conductivity is a good criterion of the botanical origin of honey. The electrical conductivity of the honey is closely related to the concentration of mineral salts, organic acids and proteins and proved useful for discriminating honeys of different floral origins. The ash content in honey is generally small and depends on nectar composition of predominant plants in their formation. The total content of elements or ash must be lower than 0.6% for nectar honey and lower than 1.0% for honeydew honey. The most common substances usually added to honey as adulterants are as sugar syrup, maize and/or wheat flour syrup, banana and sweet potato.

Key words: Ethiopia · Honey · Quality Characteristics · Production

INTRODUCTION

Beekeeping is an important agricultural activity in Ethiopia. Owing to its varied ecological and climatic conditions, the country is home to some of the most diverse flora and fauna in Africa. This diversity makes it highly suitable for sustaining a large number of bee colonies [1]. It provides nutritional, economic and ecological security [2]. This makes the country one of the leading honey producers in Africa and one of the ten largest honey producing countries in the world. Ethiopian honey production accounts for approximately 2.5 % of world production and 21.7 % of African honey production [3]. Ethiopia has the potential to produce high amount of honey per year, but currently production is limited to 48.71 million kilograms of which the greater portion is harvested from traditional hives [4].

Honey has a content of 80-85 % carbohydrates, 15-17 % water, 0.3 % proteins, 0.2 % ashes and minor quantities of amino-acids and vitamins as well as other components in low levels of concentration [5]. The quantity and quality of Ethiopian honey in general is poor, as 95% of beekeepers follow traditional method of beekeeping practice with no improved techniques or technology [6,7] Reported that the composition and quality of honey are greatly influenced by geographical and environmental factors. Similarly the change in the composition and properties of honey depends on the floral and honeydew sources collected by honeybees, as well as on regional and climatic conditions [8, 9]. Despite the large number of honeybee colonies and diversified honey floral resources, production of honey is far below its potential in the country. One of the prominent factors for this low honey and productivity is traditional hives. Therefore, the

Corresponding Author: Haftu Kebede Sebeho, Department of Animal Sciences (Animal Production), Faculty of Agricultural Sciences, Wachemo University, P.O. Box 667, Hossana, Ethiopia.

present paper briefly reviews major reported production and quality characteristics of honey in wide ecological bee keeping areas of Ethiopia. An attempt has been made to briefly the major honey Markers in the country so as to help the researchers to develop well-organized strategies to improve production and honey quality in Ethiopia.

Honey Production in Ethiopia: Ethiopia is known for its tremendous variation of agro climatic conditions and biodiversity which favored theexistence of diversified honeybee flora and huge number of honeybee colonies [1]. It has the largest bee population in Africa with over 10 million bee colonies, out of which about 5 to 7.5 million are estimated to be hived while the remaining exist in the wild [3, 4]. The annual honey production of Ethiopia is estimated to be 45,300 metric tons which makes the country to rank first honey producing country in Africa and tenth in the world [10, 11]. In the country, more than ten types of traditional hives are used with an average honey yield of 5 to 8 kg per colony per year, the variation of hives is based on their volumes, shapes and the type of materials used to construction [1]. It is characterized mainly by forest beekeeping that is common in the forest covered the south and southwest Ethiopia and backyard beekeeping which is practiced in the majority of the country [1].Traditional beekeeping is mostly practiced with different types of traditional hives that are very much diversified in shape, volume and the materials used depending on the cultural differences and the local materials available for construction [3]. Reports indicate that the colonies in traditional beehives account for about 94% of the total hived honeybee population [4]. However, with this existing practice the annual honey production in the country is increasing and has reached quite higher than 53 thousand tons in 2012 [12]. Currently, intermediate or transitional beehives that are either the Kenyan top bar hives or the locally made “chefeka” hives and frame box hives are being highly disseminated to the beekeepers by different GOs and NGOs. However, finance and gaps in operational skills have constrained the adoption of frame beehives by beekeepers [3].

The estimate of total honey production in Ethiopia in 2014 is about 43.8 million kilograms of which the greater portion is harvested from traditional hives [4].The annual average of the honey yield obtained from “chefeka” hive is about 20kg, while that of the frame hive is about 30kg [3]. The most commonly used method of honey production in Ethiopia relies on traditional beehives that are usually handmade from old logs found in the forest. These beehives present low-productivity rates (around 5–7kg/beehive/year) and low-quality honey that contains brood, wax and other impurities. The yield from transitional and modern beehives is significantly higher (8–15kg/transitional beehive and 15–20kg/modern beehive) and these improved beehives produce better-quality honey as well [13, 3,14] indicated on average 33 and 16 kg of honey per hive was harvested from modern and traditional hives inthe northern Ethiopian highlands respectively. Honey production is very low, only about an average of 8 to 15kg of honey could be harvested per hive per year but in areas where improved technology has been introduced, an average of 15 to 20 kg/hive/year has been harvested [15,16] and [17] reported that the average honey yield per year/colony was 7.20, 14.70 and 23.38kg for traditional, transitional and moveable frame hives, in around Gondar and in jimma zone, south-west Ethiopia respectively. Haftu and Gezu, 2014 in Hadiya Zone of southern Ethiopia also indicated 3.04, 4.9 and 8.2kg for traditional, transitional and moveable frame hives, respectively.

Table 1: Production of Crude Honey in Ethiopia

	Yield (in Kg/hive)			
Hive Type	Farmers	Research Center	National Production (Average)	Potential Yield (Kg/Hive)
Traditional	3-5	Na	5	10
Transitional (Intermediate)	10-15	15-20	18	40
Modern / Box (Frame Hive)	15-20	20-30	15-20	60

Source: Apitrade Africa 2010

Table 2: Annual Honey Production from the Three Beehives in Ethiopia

	Total Annual honey production(Kilogram)			
Region	All type of Beehives	Traditional	Intermediate	Modern
Tigray	3,611761	2,111,128	NA	1,433,920
Amhara	11,118,249	10,262,193	293,386	562,671
Oromia	19,063,088	18,276,825	426,367	359,896
Somale	8,584	8,584	NA	NA
SNNP	9,749,336	9,156,967	137,087	NA
Benshangul-Gumuz	3,785,532	3,096,103	NA	NA
Dire Dawa	10,560	10,240	NA	NA
Harari	6,630	6,630	NA	NA
Ethiopia	48,711,892	44,280,365	927,639	3,503,889

Source: CSA, 2014/15, NA = Not Available

Harvesting of Honey: Ethiopian honey differs not only in color, taste and quality but also in the quantity produced and the timing of harvesting seasons that vary by region and type of honey. In Ethiopia, honey was harvested once or twice and in some cases even three times [15]. There are two major honey harvesting periods, November to December in the lowlands and midlands and from April to May in the highlands. However, in addition to these major harvesting periods, there are many small harvesting periods which depend on the availability of bee forage and rainfall patterns in different agro – ecologies as reported by Nuru [1] and Beyene and Phillips [15] and Haftu and Gezu [18] in Hadiya Zone of southern Ethiopia; [19, 20] in Western Amhara region), which experienced beekeepers and local peopleeasily associate the harvesting season with the botanicalorigin of honey in their locality [21].

Moreover [22] reported that the main harvesting seasons in Tigray and Lalibela honey are October through December, with an additional harvest period for Tigray's white honey in June and July; November and December for yellow honey; April and May for white honey from the southwest and southeast Highlands; and February, March, May and June for dark-brown varieties of honey. This shows the possibilities of harvesting and supplying different types of honey at different time implying the possibility of continuous supply of honey along the market chain.

Domestic Consumption of Honey: According to the report of the USAID [13] Ethiopia has about 1.4–1.7 million households that are engaged in beekeeping and produce different types of honey that vary regionally as well as in terms of color, consistency and purity. The most in-demand honey among Ethiopians comes from Eastern Tigray, where bees forage on the regionally specific Tebeb plant (*Basium clandiforbium*) and produce distinctive low-moisture white honey. Most Ethiopians traditionally consume honey in small quantities. The honey is typically diluted with water, mixed with herbs and fermented in big pots. Honey wine or Tej is a very popular honey drink in Ethiopia and is consumed by people across the country. According to Assefa [23], domestic honey consumption is increasing due to highly increasing demand for *tej*, which increased consumption of processed table honey in most urban areas and increased demand for honey in the local industries. Almost all honey that is currently produced in Ethiopia (about 98 percent of the total yearly production) is consumed in the domestic market, with only about 2 percent of the total yearly production being exported [13]. Similarly [24] reported honey is considered as cash crop and only about 10% of the honey produced in the country is consumed by the beekeeping households. The remaining 90% is sold for income generation [25]. Honey has long traditional and cultural values in Ethiopia, like as article of trade in old days, as a gift largely in dowries during marriage, as an important ingredient for honey mead (honey-wine) locally called tej [15]. In Ethiopia households consume less than 10% of their total harvest at home (mainly for medicinal, ritual or cultural ceremonies) and the remaining is available for sale. The large portion (70%) of the marketed honey goes to the production of local beverage called (tej) and around 30% is used as a table honey [15].

Table 3: Honey production and domestic consumption, 2007–2011

Year	Total production volume (in kg)	Total domestic consumption (in kg)
2007–2008	42,180,346	41,960,457
2008–2009	39,660,647	39,517,235
2009–2010	41,524,967	41,110,852
2010–2011	39,891,460	39,371,159
Total 2007–2011	163,257,420	161,959,703

Source: The Central Statistical Agency of Ethiopia (CSA) for volume of domestic production.

Characterization of Ethiopian Honey: According to Bogdanov [26] honey is a complex substance, made up of closer to 600 different substances. Honey is the product of the honeybees processing of the nectar or honeydew from flowering plants. Nectar is a sugar solution produced by the glands of flowers that has functions in the attraction of insects and birds to visit the flower to allow cross-pollination. The average content of mineral, moisture, acidity, invert sugar, pH, sucrose, specific gravity and water insoluble solids in traditional hive honey samples in Tigray region were 22%, 18.25%, 29.89 meq kg-1, 70.95%, 4.13, 2.37%, 1.41 and 0.07%, respectively. On the other hand, the corresponding values for honey samples from modern hive production system in Tigray region were 0.18%, 18.60%, 29.12meqkg-1, 71.42%, 4.04, 2.71%, 1.40 and 0.03%, respectively [27]. Similarly [16] reported that honey samples collected from the North Western parts of Amhara region had (moisture =18.52%, Ash= 0.23%, sugar reducing = 67.83%, SU=7.55%, Free acidity=28.24milli.equiv.acid/kg, hydroxymethylfurfural (HMF) = 6.32mg/kg pH= 3.81 and Water insoluble material = 3.2) which is within the acceptable range of world and national standard, except

for water insoluble material which is poor mainly due to lack of appropriate handling during harvesting and storage of the product. Similar study conducted by Awraris *et al*. [28] reported honey samples were evaluated for total acidity, HMF, reducing sugars, sucrose, moisture and mineral content and found to be 28.32±14.14 meq/kg, 19.52±9.41mg/kg, 66.79±6.96 %, 4.46±2.59 %, 22.86±1.03 % and 0.22±0.16 %, respectively in three locations of Southwest Ethiopia (Masha, Gesha and Sheko districts). Almost all quality parameters of honey found to meet national and international honey specifications but not moisture for all samples and sucrose in the case of Gesha district.

Honey Quality: The honey market is not homogeneous. The bulk market is characterized by low-priced honey of fair to good quality, but distinct quality differences exist [15]. The quality of honey and its specific character are determined by the specific flora and vegetation in the area from which the honey originates and the diversity of the ecosystem in which the bees are kept, specifically in non-industrial areas [29]. According to report [30] inadequate of production knowledge and poor post-harvest handling system often results in poor of honey quality. Excessive using smoking materials during honey harvesting and inappropriate storage containers are the main problems in honey quality. Honey is almost exclusively used for local consumption mainly for the brewing of mead also called Tej, even though the national honey production satisfies the local demand it is so crude that it could not compete in the international market in Oromia region [30]. Moreover [31] revealed that all honey samples obtained from apiary sites and many of commercial samples collected from local markets in northern parts of Ethiopia are good quality and met the national and international standard limits. However, the physicochemical test results for some honey samples collected from local markets had higher level of certain parameters than recommended suggesting some level of adulteration is practiced by few honey traders.

Adulteration of Honey: Honey is one of humankind's oldest food products. It contains a number of nutritionally important substances that support good health and recovery. It is a characteristic sugary foodstuff; according to current regulations, apart from other forms of honey no other substances or additives can be added to it [32]. Honey adulteration is a topical issue because increasingly sophisticated adulteration methods are constantly being developed and the official determination of the quality indicators of honey is unable to detect most methods of honey adulteration. In addition, while the popularity among consumers is constantly growing, the worldwide production of honey is unstable [29].

Direct and Indirect Adulteration of Honey: Direct adulteration is the addition of foreign substances directly to honey. Traditional analyses of chemical composition and physical properties of honey are commonly used to detect direct adulteration [29]. But these analytical methods are relatively time-consuming and require tedious preparation of the samples as well as complex analytical equipment [33]. Indirect adulteration of honey is accomplished by feeding honeybees with industrial sugars at the stage when broods become naturally available [29]. Such indirect adulteration is extremely difficult to detect. Similarly [31] revealed that the common substances usually added to honey as adulterants are: Sugar syrup, maize and/or wheat flour syrup, banana and sweet potato in eastern Tigray region. These adulterants are usually added to honey individually or in combination by some honey traders to maximize their profit.

CONCLUSION

Although Ethiopia is recognized as top ten producers of honey globally which is clearly observed in the last few years with significant increment, even if the nation's output is still below 10% of its production capacity and this entails the existence of notable challenges strangulating the sector. Physicochemical parameters such as electrical conductivity, ash content, water content, free acid and pH considered the main criteria for the characterization of honeys. The present review indicated that most honey quality parameters analyzed from different locations of Ethiopia fulfilled national and international honey quality standards. The most common substances usually added to honey as adulterants currently in Ethiopia are sugar syrup, maize and/or wheat flour syrup, banana and sweet potato.

ACKNOWLEDGMENT

The authors would like to express their gratitude to all the previous researchers for provided availed research articles for this review paper.

REFERENCES

1. Nuru, A., 2007. Atlas of pollen grains of major honeybee flora of Ethiopia. Holeta Bee Research Centre. Commercial Printing Enterprise. Addis Ababa, Ethiopia. pp: 152.
2. Masuku, M.B., 2013. Socioeconomic analysis of beekeeping in Swaziland: A case study of the Manzini Region, Swaziland. J. Dev. Agri. Econ., 5(6): 236-241.
3. Mo, A.R.D., 2007. Livestock Development Master Plan Study. Phase I Report - Data Collection and Analysis, Volume N -Apiculture. Addis Ababa, Ethiopia, Ministry of Agriculture and Rural Development.
4. CSA. 2014/15. Central Statistical Agency, Agricultural Sample Survey, Report on Livestock and Livestock Characteristics, Vol. II, No 578, March 2015 Addis Ababa, Ethiopia, pp: 28.
5. Cantarelli, M.A., R.G. Pellerano, E.J. Marchevsky and J.M. Camiña, 2008. Quality of honey from Argentina: Study of chemical composition and trace elements. Journal of the Argentine Chemical Society, 96(1-2): 33-41.
6. Oxfam, 2008. Partner Progress Report. The honey produced in traditional hives is often mixed with wax, pollen, dead bees and extraneous matter. This means that it cannot be used for processing or for export as table honey, but is only suitable for use in *tej*brewing. Addis Ababa, Ethiopia.
7. Jones, S.L., H.R. Jones and A. Thrasyvoulou, 2011. Disseminating research about bee products. A review of articles published in the Journal of Apicultural Research over the past fifty years. Journal of ApiProduct and ApiMedical Science, 3(3): 105-116.
8. Diego, G.D., M.N. Jose and C.Q. Lourdes 2005. Effects of water content upon the Galician honey viscosity. Electronic Journal of Environmental, Agricultural and Food Chemistry, 4: 949-95.
9. Atrooz, O.M., M.A. Al-Sanayleh and S.Y. Al-Abbadi, 2008. Studies on Physical and Chemical Analysis of Various Honey Samples and Their Antioxidant Activities. Journal Of Biological Science, 8(8): 1338-1342.
10. FAO. 2010. FAOSTAT database on Agriculture and Nutrition. Food and Agricultural Organization of the United Nations, Rome, Italy. Available at:http://faostat.fao.org/site/569, accessed 12th Aug. 2012.
11. Rivera, J., H. Losada, M. Lopez, J. Cortes, J.Y. Vieyra and D. Grande, 2007. Production system of honey bees in the periurban area of the south east of Mixico city. Liv. Res. for Rural Dev. 19 (2). http://www.cipav.org.co/lrrd/lrrd19/2/rive19029.html
12. CSA. 2012. Statistical Abstracts. Central Statistical Agency. Report on Livestock and Livestock Characteristics Addis Ababa, Ethiopia.
13. USAID., 2012. Cost-Benefit Analysis of the Honey Value Chain in Ethiopia, Graduation With Resilience To Achieve Sustainable Development - Grad Project Final Report.
14. Teferi, M.., G. Yirga, T. Hailemichael and S. Amare, 2011. Prospects of beekeeping in the Northern Ethiopian highlands Scientific Research and Essays Vol. 6(29), pp. 6039-6043, Available online at http://www.academicjournals.org/SRE
15. Beyene, T. and D. Phillips 2007. Ensuring Small Scale Producers in Ethiopia to Achieve Sustainable and Fair Access to Honey Markets. pp: 64.
16. Addis, G. and B. Malede, 2014. Chemical Analysis of Honey and Major Honey Production Challenges in and Around Gondar, Ethiopia. Aca. J. Nut., 3(1).
17. Chala, K., T. Taye, D. Kebede and T. Tadele, 2012. Opportunities and challenges of honey production in Gomma district of Jimma zone, South-west Ethiopia. Journal of Agricultural Extension and Rural Development Vol. 4(4), pp. 85-91, 5 March, 2012. Available online http://academicjournals.org/ JAERD
18. Haftu, K. and T. Gezu 2014. Survey on Honey Production System, Challenges and Opportunities in selected areas of Hadya Zone, Ethiopia, journal of agricultural biotechnology and sustainable development, vol.6(6), pp.60-66, http://www.academicjournals.org/JABSD
19. Tessega, B., 2009. Honeybee Production and Marketing Systems, Constraints and opportunities in Burie District of Amhara Region, Ethiopia. A Thesis Submitted to the Department of Animal Science and Technology, School of Graduate Studies Bahirdar University.
20. Tesfa, A., K. Ejigu and A. Kebede, 2013. Assessment of current beekeeping management practice and honey bee floras of Western Amhara, Ethiopia. Int. J. Agric. Biosci., 2(5): 196-201. www.ijagbio.com.

21. Gemechis, L., 2013. Identification and characterization of major mono-floral honeys in Ethiopia. pp: 121-128. EthiopianSociety of Animal Production (ESAP) 2013. Livestock at the crossroads of climate change variability. Proceeding of the20th Annual Conference of the Ethiopian Society of Animal Production (ESAP) held in Addis Ababa, Ethiopia. October 03 to 05, 2012. ESAP, Addis Ababa 284 pp.
22. Global Development Solutions, LLC. 2009. Integrated Value Chain Analysis for Honey and Beeswax Production in Ethiopia and Prospects for Exports. The Netherlands Development Organization (SNV).
23. Assefa, M., 2011. Pro-poor value chains to make market more inclusive for the rural poor: Lessons from the Ethiopian honey value chain. Danish Institute for International Studies, Copenhagen, Denmark. pp: 35-50.
24. Mo A.R.D., 2003. Honey and Beeswax marketing and development. In Development, M. O. A. A. R. (Ed.) Plan 2003. Addis Ababa, Ethiopia.
25. Hartmann, I., 2004. The management of resources and marginalization in beekeeping Societies of Southwest Ethiopia. Paper submitted to the conference: Bridge Scales and Epistemologies.
26. Bogdanov, S., 2009. Harmonised Methods of the International Honey Commission [online] http://www.bee-hexagon.net/en/network.htm.
27. Gebreegziabher, G., T. Gebrehiwot and K. Etsay, 2013. Physiochemical characteristics of honey obtained from traditional and modern hive production systems in Tigray region, northern Ethiopia. Momona Ethiopian Journal of Science (MEJS), Volume 5(1):115-128.
28. Awraris, G., G. Hailemariam, A. Dejen and T. Zerihun, 2014. Physico-Chemical Properties of Honey Produced In Masha, Gesha and Sheko Districts In Southwestern Ethiopia. Current Research in Agricultural Sciences, 1(4): 110-116
29. Blanka, Z. and V. Lenka, 2014. Adulteration of honey and available methods for detection – a review. ACTA VET. BRNO, 83: S85–S102; doi:10.2754/avb201483S10S85.
30. Beyene, T. and V. Marco, 2014. Assessment of constraints and opportunities of honey production in Wonchi District South West Shewa Zone of Oromia, Ethiopia. American Journal of Research Communication, 2(10): 342-353} www.usa-journals.com.
31. Tadesse, G. and B. Gebregziabher, 2014. Determination Of Quality And Adulteration Effects Of Honey From Adigrat And Its Surrounding Areas. International Journal Of Technology Enhancements and Emerging Engineering Research, VOL 2, ISSUE 10 ISSN 2347-4289.
32. Codex Alimentarius Commission, 2011. Revised Codex Standard for Honey, Standards and Standard Methods.Codex Standard for Honey, 2011).
33. Cozzolino, D., E. Corbella and HE. Smyth, 2011. Quality control of honey using infrared spectroscopy: A review. Appl. Spectr. Rev., 46: 523-538.