

Aspects of Honey Quality in Ghana: Evaluation of Artisanal and Retail Honey Samples within EU Quality Standards for Improved Markets

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ABSTRACT

Honey quality is influenced by a swarm of factors: Production, climate, maturity, processing and storage, the environment and nectar sources. Honey adulteration is global, with significant economic, nutritional and organoleptic consequences. Detecting good or bad honey based on physical and sensorial analysis before purchase is difficult. While sensorial properties are perhaps most important for consumers, chemical qualities are necessary factors for accessing premium markets. 21 honeys samples (16 from artisans and 5 from local processors) were analyzed within EU standards: Water, 5-Hydroxymethylfurfural (5-HMF), pH, diastase activity, acidity and electrical conductivity. However, adulteration was suspected in retail samples designated IH as well as the rejected sample. The result suggests artisanal honeys could be safer compared to retail samples. In conclusion, there is a need for a holistic structuring of the honey subsector along the value chain in order to harness its full potential in Ghana.

Keywords: Artisanal and Retail honey; EU Physicochemical quality Standards; Beekeepers; Honey adulteration; Ghana honey value chains

INTRODUCTION

Honey quality is essential in honey trade worldwide. The output of quality honey can be influenced by many variables which are related to the production methods, climate, maturity, processing and storage conditions, as well as the nectar sources [1]. Honey adulteration is currently a serious issue in Ghana. The phenomenon is getting complex by day as it is becoming difficult to even differentiate between good and bad honey. This problem is having a significant economic impact and undeniable nutritional and organoleptic consequences [2].

Over the years, the physicochemical properties and sensorial, microbiological characteristics have been used to determine the quality of honey [3]. While the sensorial properties are perhaps most important for the consumer, the physicochemical properties and their compliance with national and international standards for honey are important for accessing national, regional and international markets.

The physicochemical qualities of honey, which include sugar and moisture content, electrical conductivity, free acidity, diastase activity and Hydroxymethylfurfural (HMF), are specified in an

EU council directive. The directive sets upper and lower limits for each of the physico-chemical parameters. Honey sold within the EU must comply with these parameters making them important when characterizing honey. Characterizing honey help to reveal the hygienic aspects such as contamination with mineral dust, soot, or starch grains [4]. The authenticity and origin of the honey may enhance its market access and value [5].

Honey is a global commodity with many variations in the international market. On the African continent, honey production remains a vital means of subsistence as well as for international exports. Domestic markets in Africa have expanded and in Ghana, honey has been in high demand [6]. Ankrah, et al. [7], reported that Ghanaian honey were of good quality and acceptable for the international market, based on chemical components such as 18.8% moisture content, 0.8% ash content, 57% sugar levels, 0.10%, nitrogen, 55 mg calcium and 1.44 mg iron (per 100 g of sample). Despite this standard, there is a high perception of honey adulteration in Ghana. A phenomenon is usually linked to middle men or honey packagers in Ghana.

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Substances such as melted Styrofoam, wax, sugar and water have been reported as some of the items used to adulterate honey during processing. Adulteration of honey had been common among artisanal honey production and retail honey in Ghana [7]. This study is an investigation into the quality of honey along the honey value chain in Ghana. Honey samples were sourced from selected Ghanaian supermarkets (locally packaged ones) as well as artisanal or apiary honey from beekeepers. This study is meant to investigate quality assurance along the honey value chains. Authenticating honey quality along the value chain would boost market reputation and generate a price increase. This is because; quality is one of the most important factors that attract price premiums from consumers [8].

Generally, work on the physico-chemical parameters of Ghanaian honey is limited save for a few studies on the chemical composition of five honey samples in Accra [7], analysis of the chemical and microbial components of artisanal honey sold on the local Ghanaian market and a physicochemical and microbiology analysis of 24 honey samples from bee farms located in two districts in the Brong Ahafo region of Ghana [9]. Also, though Akangaamkum, et al. [9], reported high production volumes of good honey by beekeepers in the Volta region Ghana, little information is available on their physicochemical properties. Furthermore, little is known about how quality assurance is guarded along the honey value chain in Ghana, information which is crucial to ensure quality monitoring on the market.

MATERIALS AND METHODS

The study was carried out in the Volta and greater Accra (capital city) regions of Ghana. Artisanal honey samples were sourced directly from beekeepers. While retail honey (local honey brands) samples were purchased from selected supermarkets in Accra. All samples were not treated with heat and were no more than two months after extraction from the hives. A total of 21 honey samples were analyzed in this study of which sixteen were collected directly from beekeeper associations while five (locally branded honeys) were bought from the supermarkets. The honeys were produced by honeybees (*Apis mellifera Adansonii*). They were kept in food grade plastic containers, labelled and stored under room temperature between 24°C and 30°C and prepared for analysis.

Quantitative data

Physico-chemical analyses of the honey samples were carried at the Quality Services International, GmbH in Germany, following prescriptions described in the official methods of analysis of the Association of Official Analytical Chemists (AOAC) and the Harmonized Methods of the European Honey Commission [10]. Water content was determined by the harmonised method, using an Abbe refractometer. All measurements were performed at a temperature of 20°C. Hydroxymethylfurfural content (HMF) was determined by the standard method. Diastase activity was determined by the standard method. Honey pH and free acidity of honey were measured using a pH meter (accurate to 0.01 units). The

Electrical Conductivity (EC) was measured using a conductivity meter with lower range 10^{-7} S.

Qualitative data

In-depth interviews and focus group discussions were conducted among leaders of the local beekeeper associations and association members to elicit information on activities along the value chains. Interview focused on production, harvesting, processing and marketing.

RESULTS AND DISCUSSION

Honey industry in Ghana- value chain analysis

Many actors at different levels are involved in the beekeeping sector with each playing significant roles from inputs, production through to marketing of honey, as summarized in the value chain (Figure 1).

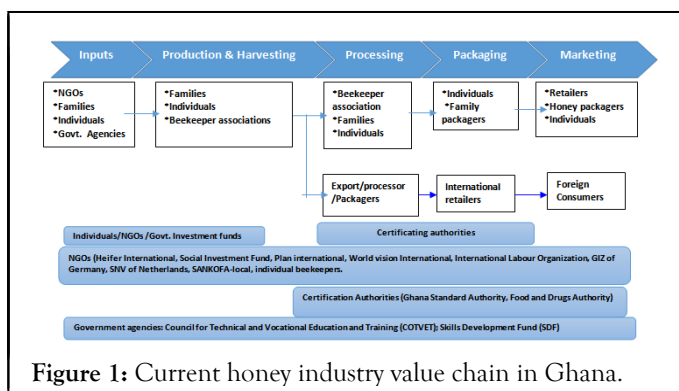


Figure 1: Current honey industry value chain in Ghana.

The main operators and actors in the honey value chain in Ghana are beekeepers, honey packagers (also known as processors), retailers, consumers and other supporting agencies such as Non-Governmental Organizations (NGOs) and government agencies. Beekeepers own the beehives, place them in strategic locations in the wild or closer to their farms, bait honey bees for colonization of the hives, manage hives, harvest and extract honey from honey combs. The top bar hive is the main beehive used in Ghana followed by log hives or local hives with various modifications. In this study, three main methods of honey extraction are employed by members of producer associations which include: solar extraction, cold extraction and centrifugal extraction. The most popular honey extraction method is the cold extraction. By this method, honeycombs are chopped into pieces and placed into a draining setup in their homes and is left overnight for honey to gradually drain out of the comb. In the case where the set is placed on the sun to enhance draining, it is termed the solar extraction. These methods are affordable since financial investment is very minimal compared with honey press or use of centrifuge, which in some cases, is available for a whole community. A few of the beekeepers are sometimes involved in direct sales of honey as a refined and packaged brand. Beekeepers in the region stated they are unable to meet local demand for honey supplies per each harvesting season hence the need to expand production.

Honey packagers are private business men and women who purchase their honey from beekeepers. In most cases, there is an informal contract between beekeepers and honey packagers where transactions are done based on good will and trust. Honey packagers do further refining, package and brand for the retail market. In some cases, honey packagers do the retailing themselves. The retailers are a diverse group, from beekeepers and honey packagers selling directly to consumers, supermarkets like shop rite, game, the marina shopping mall, pharmaceutical shops or smaller outlets that sell packaged honey to final consumers. By far, majority of honey producers are producing for local and/or national markets, even though the export market is available.

The consumption of honey is widespread in the country. Honey is consumed pure, as ingredients in food and for medicinal purposes. Other important actors in the value chain include non-governmental organizations, state institutions and private investors, who play supporting and facilitating roles and provide expertise and funding for hive construction and trainings in beekeeping for instance. Furthermore, state agencies like the Ghana standards authority, food and drugs authority perform quality checks on honey especially packaged ones before final certification for the general public.

Implications of non-compliance to quality along honey value chain

Three main factors, water, 5-HMF and Diastase levels affected the honey samples analyzed in this study. All three parameters are essential to determine freshness of honey hence the overall shelf life of honeys sold on the market for consumers as well as premium price.

The maximum water levels recorded by honey samples from beekeepers were above the 20% limit by local and international standards. This indicates a challenge along the production stage of the honey value chain, since the final water content of honey among many other factors, also depend on the method of harvesting, extraction and storage. It reveals that the beekeepers might have harvested un-ripened honey, exposed honey to high humidity during extraction, or stored under unsuitable conditions thus suggesting a careful look at the control measures followed by beekeepers during honey harvesting, processing and storage. The method used for honey extraction, for instance cold extraction, have been observed to negatively affect the final water content of honey [9], this might have therefore, contributed to water levels. Beekeepers may not only need capacity building in the area of proper harvesting and storage of honey, but also, an investment in modern equipments like centrifuge extractors or similar extracting equipments by the support of stakeholders such as NGOs, producer groups or state agencies in order to correct the exposure of honey to high humidity during extraction.

The maximum 5-HMF level recorded for locally packaged honey samples was over 1000 mg/kg. This parameter is critical in determining honey freshness since its formation is linked to exposure of honey to high heating during processing. The high 5-HMF levels recorded therefore suggests exposure of honey to

heating by middle men before packaging. Furthermore, high levels of 5-HMF is linked with foreign substances added to honey which suggests adulteration. However, apart from the fact that 5-Hydroxymethylfurfural (HMF) formation increases with increasing heat application to honey, high HMF levels have been reported in freshly harvested honeys as well [11], even though this may not be the reason for the current results in this study.

Finally, the minimum diastase level of 0.99 recorded for locally packaged honeys suggests the honey is denatured and corroborates the high levels of 5-HMF in the samples. Diastase activity is another marker for honey freshness, indicating the freshness of the honey samples since it measures the presence of the enzyme diastase. Limited presence or absence indicates they are denatured and therefore honey exposed to heating. These parameters must be worked on if honey products in Ghana should attract premium price locally by informed consumers let alone cross the borders of Ghana for other high premium markets in EU and America or markets in the East.

Discussions with value chains suggested artisans were blaming retail middle men for over processing the honeys before bottling for retail shops. A careful look at the results of the samples, substances found in the retail samples suggested some levels of adulteration and this was corroborated by the high levels of 5-HMF and low levels of diastase activities recorded in four of the retail honey samples. This implies that policy makers and standard authorities in Ghana must be a bit careful with retail honeys to ensure quality and safety at all times.

Implications of honey quality for the market

The physico-chemical qualities have implications for market opportunities, as compliance with requirements with food safety and product authentication is mandatory for gaining access to international honey markets. Producers whose honey did not meet both the EU and Ghana standards must use better techniques in handling production processes in order to access the market.

The challenges recorded in this study test the readiness of honey producers in Ghana to take advantage of the huge market opportunities available locally and abroad. Firstly, beekeepers will have to pay critical attention to the maturity of honey, the time of harvesting and proper handling of honey before and after harvesting. Critical attention must also be paid to mode of storage and the environment in which honey is stored in order to avoid exposure of honey to unfavorable conditions such as prolonged storage under high temperatures. This will enhance the quality of the honey and potential for the domestic and export market.

Information regarding acceptable standards for honey trade within the African regional market is limited. Tanzania has set a standard which require honey to have moisture content not more than 20% to be accepted as table honey and not more than 22% for industrial honey. Furthermore, HMF content must not exceed 80 mg/kg. On the other hand, accessing the EU market requires complying with more requirements and food safety regulations are strictly enforced. Hence, any honey not in compliance will be rejected. There is therefore a crucial need for

beekeepers to pay attention to how best to build-in precautions in production along the value chain is ensured as the challenge of not producing to meet most of these standards could easily be avoided.

In order to achieve the production of good honey, there will be a need for capacity building among beekeepers and other stakeholders along the value chain. The possible areas of attention may include determination and harvesting of mature honey, extraction methods that ensure less exposure to high temperatures and humid conditions, proper handling and transportation of honey, as well as storage. Inferences from beekeeper interviews show that, the state, (for instance, in terms of policy direction and proper investment) is not involved in the beekeeping subsector in Ghana. But for the benevolence of conservation oriented non-governmental organizations (GIZ of Germany or SNV of Netherlands) that have helped trained few beekeepers who are then asked to train others in their districts. These further training exercise usually gets stalled due to lack of finance and thought through sustainable systems and structures that ensure the implementation of proper business models that benefit producers and supports further research and development in the sub-sector. These beekeepers must therefore be brought on board and trained with current technologies in the beekeeping sector in order to secure quality honey in future for the country.

CONCLUSION

This study adds new institutional knowledge for the physicochemical characterization of honey from Ghana, which is important for honey labelling and commercialization. Some honey samples are wholesome for consumption as table honey per the EU and the Ghana standards, while some honey samples did not comply with national and international requirements, mostly due to water content, HMF, and diastase activity. The main stakeholders along the honey value chain include honey producers, packagers, retailers, consumers and other supporting agencies. The non-compliance with quality requirements has implications at various levels along the value chain and points towards mishandling of honey at various stages from harvesting to processing and storage. This therefore calls

for capacity building along the production, processing, packaging and storage activities. Taking into account that Ghana is one of the countries with access to the EU market, these quality constraints in the honey sector must be studied so the necessary action is taken to ensure the production of quality honey for premium markets home and abroad to ensure sustainable income for rural farmers to improve their livelihoods, and also generate some foreign exchange for the country.

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