UNIVERSITY OF CAPE COAST

AN EVALUATION OF HONEY PRODUCED IN THE VOLTA REGION OF GHANA TOWARDS CERTIFICATION AS A GEOGRAPHICAL INDICATIONS (GI) PRODUCT

BY

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AUGUST, 2018

DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the result of my own original research and that no part of it has been presented for another degree in this University or elsewhere.

Candidate's Signature.................................Date. 29/08/18

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Declaration of Supervisors

We hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

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ABSTRACT

Geographical Indication (GI) is a form of intellectual property identifying a product as originating from a region/locality/territory where its quality and reputation is associated with its geographical origin. GIs are considered as a place – specific quality assurance initiative that enhances the monetary value of a product, hence increase producers´ premium.

Honey produced by the honeybee (*Apis mellifera*) is the most commercialized hive product in Ghana. The country may have the opportunity to promote unique honey products through geographical indications (GIs), to improve the economic livelihood of the numerous honey producers across the country, the environment by way of biodiversity conservation, and the country through foreign exchange. Yet very little is known about the potential of Ghanaian honeys in terms of development and promotion through GIs. The same holds for botanical and geographical origins, quality, what a GI honey is and whether Ghanaian consumers appreciate information on food labels and are even aware of the concept of GIs.

This PhD investigated the potential of honey from the Volta Region as a GI product in Ghana. This study seeks to increase knowledge about the concept of geographical indications. The investigations also assessed how the GI concept could be introduced to the Ghanaian consumer by assessing how they utilise information of food labels and how familiar they are with a GI label. The study took place in the Volta Region (for the main honey case studies) and the Greater Accra Region (for consumer studies). In the Volta Region, four honey producing districts (Kadjebi, Adaklu, Ho west and Akatsi south) were selected for the studies. Data were collected from local producer groups on honey

production processes, harvesting and extraction as well as how honey quality is ensured among producers. Honey samples were also analysed for pollen and physico-chemical qualities. Results from pollen and quality analysis together with personal observations enabled the determination of botanical and geographical origins of the honeys and their quality parameters within international standards. Results on food label appreciation and GI awareness by consumers enables the interpretation of how the Ghanaian consumer could be engaged in terms of reaching them with the GI concept and its benefits. The main investigation was premised on four research questions stemming from the overall objective of the study. Each research question is presented as a full paper as illustrated below.

Paper 1 presents results on *the Characteristics of a Geographical Indications (GIs) Registered Honey through literature review*. This is necessary to assess the way forward for developing a GI honey in Ghana in terms of understanding all the important factors that must be developed in order to have one for Ghana looking at what others have done. Many elements were observed to characterise the GI process which I have grouped under three main themes for the purposes of this study. These are *Indicative Elements,* which include (reputation for quality, high average price and the coming together of producers into formal or informal organization); *Essential Elements*, consisting of clear natural or human link to the geographical area of production and *Supportive Elements* that include (relevant laws by the state and state institutions).

Paper 2 presents results on the *Botanical and Geographical Characterisation of Honey Samples*. Pollen types belonging to 21 plant families were identified. Seven families were found in >50% of the samples and are the most important: Malvaceae (*Ceiba* sp.), Combretaceae, Arecaceae (*Elaeis guineensis), Poaceae,* Asteraceae (*Viguiera* sp.), Anacardiaceae and Sapindaceae. Arecaceae (*Elaeis guineensis; oil palm) and* Asteraceae (*Viguiera* sp.) were found in 100% of the samples; Combretaceae in 94% and Poaceae in 88%. Pollen analyses also showed that eight of the honey samples could be described as monofloral, showing the most dominating pollen types which were Ebenaceae, Anacardiaceae, Moraceae, Combretaceae and Arecaceae (*Elaeis guineensis*). Also, the Volta Region was the geographical origins of the honey samples analysed since pollen representation in the honey samples could be traced to the vegetation in the Region. It was also easy to differentiate the geographical and botanical origins of honeys from the various Districts.

Paper 3 presents findings on the *Chemical Evaluation of Ghanaian Honeys within International Physicochemical Standards* including: Water (moisture) content, Hydroxymethylfurfural (HMF), pH, Diastase activity, Free acidity and Electrical conductivity. The mean values recorded included Water content 20.1%; pH 3.8; HMF 26.9 mg/kg; Diastase activity 15.3 DN; Free acidity 31.1 meq/kg % and Electrical conductivity 0.6 mS/cm. Six of the honey samples examined comply with the stipulated limits by the European Commission for 'Table Honey' (wholesome for direct consumption) while the remaining ten were described as 'Industrial Honeys' (only good for industrial use) as they did not meet all requirements in the EU.

Paper 4 presents findings on consumer knowledge of origin (GI) and quality food standard labels in Ghana. The habit of reading food labels is high among the youth in Ghana. The most important factor when reading food labels was date label; manufacture and expiry dates. It was also observed that

Ghanaians were most familiar with two main certifying bodies in Ghana; FDA and GSA. Familiarity with these national certifying logos was high among the youth and females. Results also buttressed the assertion that the GI concept is new and not known among most Ghanaians in Ghana.

This study reveals the urgent need for an expanded study for a total botanical and geographical description of Volta honeys. An elaborate strengthening of capacity across the honey production system is also required to ensure that all honeys meet international quality standards. In addition, producer organisations need to be strengthened in terms of harnessing the power of collective action in the promotion of their produce. Deliberate public education and awareness creation of GIs and its related benefits in the country is recommended through a national GI policy to develop, promote and protect GIs. The national law of GIs must also be made operational.

Key Words

Botanical origin of honey

Food labels

Geographical origin of honey

Geographical indications awareness

Honey value chain

Physico-chemical analysis

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DEDICATION

To my Family

Sophia, Klenam and Kekeli

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THESIS OUTLINE

This PhD study was on the Evaluation of Honey Produced in the Volta Region of Ghana towards Certification as a Geographical Indications (GI) Product. The justification is that Ghana may have such unique honeys with GI potentials which have not been tapped.

The thesis is organized into eight main chapters. The first chapter include a brief introduction, background and main literature review which present this study within the context of geographical indications (GIs). It covers the history and economics of geographical indications, honey and honey production around the world and Ghana as well as several contexts of GI application around the world. It also presents the problem statement, significance of the study as well as main objective and research questions.

The second chapter discusses the study site and general methodology, research design and data analysis procedures. Chapter three covers summaries of four research papers patterned after the four research questions followed to investigate the main objectives in this study.

Chapters 4, 5, 6, and 7 of this thesis consists of the four articles in the form of title, abstract, introduction, methodology, results, discussion, conclusion and references. The final chapter is the 8th and focusses on the summary of developing a GI honey in Ghana, general conclusions and recommendations for this study.

CHAPTER ONE

INTRODUCTION

Discussions on Geographical Indications (GIs) have been on the global front for many years and the subject of debate in a number of international fora (Grant, 2005). A GI is a form of intellectual property right (IPR) which is of great interest to international trade.

This chapter covers the background of the study and main literature review, which present this research within the context of geographical indications (GIs). It covers the history and economics of geographical indications, honey and honey production around the world and Ghana. It also presents the problem statement, significance of the study objective and research questions.

Background and Review of Literature

Geographical Indications (GIs).

Geographical Indications (GIs) are names, signs or logos of places (localities, regions or territories) used to identify the origin, quality, reputation or other characteristics of products, (UNIDO, 2010; Appiah, 2011). GIs originated from a concept known as *"Terroir"* (Allaire, Casabianca, & Thévenod-Mottet, 2011). The French word "*terroir*", is the peculiar quality of an agricultural product which is determined by the character of the place it comes from (Gade, 2004). This could be due to (1). The unique biophysical properties: micro climate (e.g. seasonal temperatures, humidity levels, wind, sun exposure); (2). The physical-chemical properties of soils and/or water; (3). Altitude; local animal breed or plant species (which adapt to a specific environment over time); (4). The traditional knowledge and (5). Skills and equipment (Giovannucci, Josling, Kerr, O'Connor, & Yeung, 2009, Vandecandelaere, Arfini, Belletti, & Marescotti, 2009). Since its introduction into the Trade-Related Aspects of Intellectual Property Rights (TRIPS) agreement, GIs have received an unprecedented global recognition as an intellectual property (IP) right (O'Connor & Company, 2007). Producers, (mainly agricultural products), lawyers and economists across the world (WIPO, 2013) including countries part of the WTO that have traditionally pursued active GI policies (WIPO, 2013). Globally, consumers have shown great interest in the geographical origin of products. Example, GI certified food amongst countries in the European Union is worth €54.3 billion euros worldwide (Chever, Renault, Renault, & Romieu, 2012).

Geographical Indications differ from other forms of intellectual property rights like patents. GIs are defined in Article 22 (1) of the TRIPS Agreement as "*indications which identify a good as originating in the territory of a member, or a region or locality in that territory, where a given quality, reputation or other characteristic of the good is essentially attributable to its geographical origin*" (WIPO, 2013). The TRIPS definition could be conceptualized as in (Fig. 1). They are important features under the regime of intellectual property rights (IPR) as shown in (Fig. 2). Examples include: Miel d'Alsace (honey), Pizza Napoletana and Roquefort cheese, (Table 1).

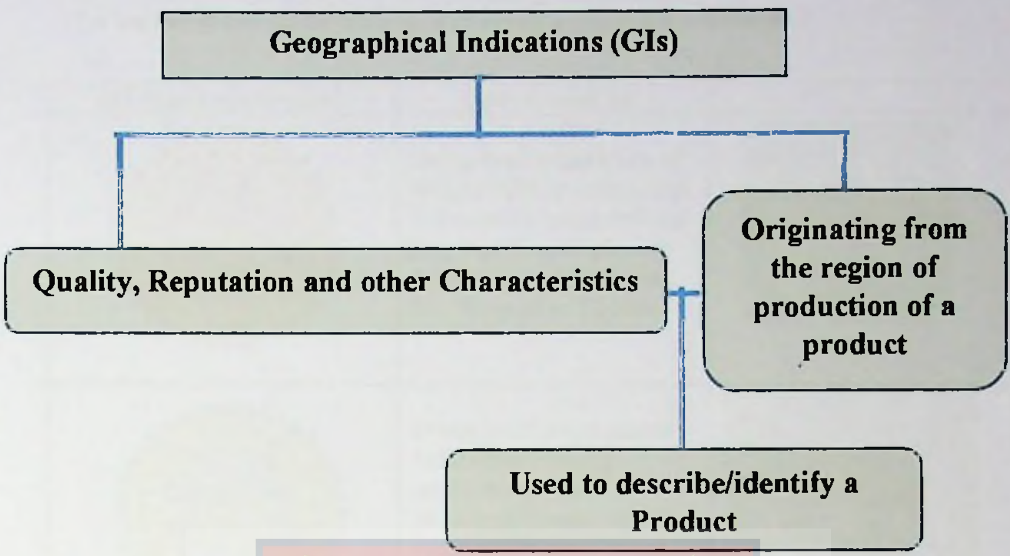


Figure 1: GI Concept as described in Article 22 (1).
Source: Author's own deduction.

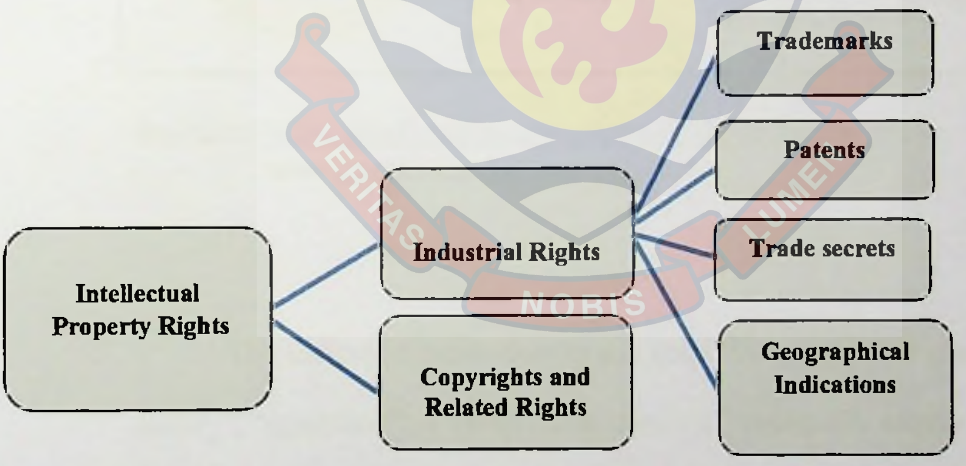
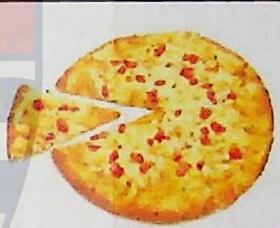


Figure 2: GIs as part of Intellectual Property Rights (IPR).
Source: www.fibre2fashion.com.

Table 1

The main GI labels/signs/logos currently used within the EU

GI Sign/Logo/Symbol	Representation	
	Protected Designation of Origin (PDO): the product is Produced, processed and prepared in same place or within geographical area. E.g. **Roquefort Cheese**	
	Protected Geographical Indications, (PGI): products are either Produced/ Processed/ Prepared. Within the stated geographical area. Eg. **Miel d'Alsace**	
	Traditional Specialty Guaranteed, (TSG): The product has traditional integrity for over a period of time. E.g. **Pizza Napoletana**	

Sources: (https://ec.europa.eu/agriculture/quality/schemes_en; www.google.com)

The indication must identify the good; the good must possess "given quality", "reputation" or "other characteristics" "essentially attributable" to the geographical area; the designated geographical area must be identified by the indication (Rangnekar, 2003). The box below illustrates the case of Oku White Honey of Cameroon.

Oku White Honey

The people of Oku classifies a distinctive white honey Produced in the North West province and Penga in the Littoral areas of the Oku region in Cameroon. It is produced within an area of 30000 hectares in the Kilum/Ijim forest reserve, made up of tree species such as *Prunus africana*, *Schefleria* and *Albizia* covering 20000 hectares. The honey is a rare, recognizable by its white colour and naturally creamy texture. It tastes fresh, with hints of flowers and citrus. The bees live on the slopes of Mount Oku, at heights of up to 2000 m above sea level or thereabouts, in the protected forest of Kilum-Ijim, a biodiversity hotspot covering an area of some 20 000 ha. The beekeepers install hives colonized beforehand in grassland areas. Oku white honey is a delicate product that is very hard to find.

A link between the product and the region

The characteristics of the honey obtained from indigenous plants. It is believed that, the characteristics of the honey is derived from the tree species within as well as the traditional know-how (hive construction, placement in the wild and harvesting) used in production processes of the honey gives it the unique features and taste.

Sources

(Nyuylime, 2008; www.allAfrica.com; www.thefarmer'svoice.org; blog.crystalsrawhoney.com)

GIs principally link a product to its geographical area. This feature is necessary for niche marketing and brand development (WIPO, 2013). Therefore, GIs are a form of branding (Gilaninia, & Mousavian, 2012) that focuses on the names used to connect products to their geographic origin (Menapace & Moschini, 2011). It is owned, protected and monitored by producer associations from the geographical regions. Every user must have a proven link of association with the geographical region and comply with any production code of ethics or rules regarding the product (Blakeney, 2009, p. 52).

Historical Background of Geographical Names.

Geographical names have long been used as marketing strategy to indicate the region or locality where goods had come from (Tritton, 2002).

These marks later developed into geographical indications, on one hand, and trademarks, on another (Jay & Taylor, 2013).

During the pre-urban economic era, business was limited to small groups of friends and associates, hence buyers could interact with sellers directly on product quality issues (Merges, 2004). However, due to increase in urbanization, this relationship was interrupted as trading activities expanded beyond small groups of buyers and sellers (Merges, 2004). Producers through a common code of understanding used a word or symbol to indicate the geographical origin of their products in order to distinguish themselves from other producers (Merges, 2004). An example of such initiative is the 'medieval guild marks', which were used to indicate the geographical location of products, such as Murano glass from the island of Murano and the "collective invention marks," that was famous in the case of steel technology (Merges, 2004). Consumers also begun to associate geographical names with certain products for their highly desirable and seemingly unique characteristics. For instance, the sparkling wine from the Champagne region of France gained a reputation for excellence (Hughes, 2006).

GIs in a Global Perspective: Protection of Geographical Indications in International Law

Globally, the earliest effort to protect GIs could be traced to the 19th century. The need for international protection became noticed quickly as a tool to show product authenticity (Oskary, 2006). This generated a common ground within the international community for the protection of GIs through various international agreements, paramount among them include the Paris Convention for the Protection of Industrial Property (1883), the Madrid

Agreement for the Repression of False or Deceptive Indications of Source on Goods (1891), the Lisbon Agreement for the protection of Appellations of Origin and their International Registration (1958) as well as the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) Agreement of 1994 (Organization for Economic Co-operation and Development, OECD, 2000; Oskary, 2006).

The Paris Convention

In the year 1873 in Austria, international delegates refused to participate in an exhibition of inventions organised by the government of the then Austria-Hungary Empire for fear of inadequate legal protection for their inventions (WIPO, 2004, p. 241). This led to the formation of a Diplomatic Conference in Paris in 1883 which ended up in what is known as the "Paris Convention on Industrial Property". This agreement was endorsed initially by 11 States namely: Belgium, Brazil, El Salvador, France, Guatemala, Italy, the Netherlands, Portugal, Serbia, Spain and Switzerland (WIPO, 2004, p. 241). When the treaty finally came to effect in 1884, other countries like Great Britain, Tunisia and Ecuador joined bringing the number of member countries to 14. Membership however, increased significantly during the first quarter of the 20th century and then particularly after World War II (WIPO, 2004, p. 241).

Article 1(2) of the Paris Convention states: *"The protection of industrial property has as its object patents, utility models, industrial designs, trademarks, service marks, trade names, indications of source or appellation of origin, and the repression of unfair competition"*. For instance, Champagne is a geographical name and therefore its reputation will be damaged if someone else uses the name in relation to a product in such a manner as to deceive consumers into believing the product has the same characteristics as Champagne (Rangnekar, 2004, p.2). Another important section worth noting in the Paris Convention is Article 19, which allows the parties *"to make special agreements between themselves for the protection of industrial property"*.

The Madrid Agreement

After ratifying the Paris Convention for the protection of Intellectual Property Rights (IPs), numerous attempts were made to make the IPs: indication of source or appellations of origin affordable to increase participation by member countries. These interventions led to the adoption of the Madrid Agreement for the Repression of False or Deceptive Indications of Source on Goods in 1891 (WIPO, 2013). The "Madrid Agreement" was signed with initial membership of 8 countries (WIPO 2007) and later increased to 113 countries (Idris, 2008). Article 1(1) of the Madrid Agreement provides that: *"(A) ll goods bearing a false or deceptive indication by which one of the countries to which this Agreement applies, or a place situated therein, is directly or indirectly indicated as being the country or place of origin shall be seized on importation into any of the said countries."* (Idris, 2008). The Madrid Agreement provided the first international rules specifically for the overthrow of false and deceptive indications of source. A deceptive indication of source could be the true name of the place where the good originates from, but nevertheless confusing the purchaser in respect to the true origin and quality of the good (WIPO 2007).

The Lisbon Agreement

There was a new international treaty for the protection of Appellations of Origin and their International Registration: The Lisbon Agreement, of 1958. The main aim of this agreement was to provide international protection for appellations of origin, that is, *"The geographical name of a country, region, or locality, which serves to designate a product originating therein, the quality and characteristics of which are due exclusively or essentially to the geographic environment, including natural and human factors"*[1] In Article 3 of the Lisbon Agreement, it is stated that the protection shall be ensured against any usurpation or imitation, even if the true origin of the product is indicated or if the appellation is used in translated form or accompanied by terms such as "kind," "type," "make," "imitation," or the like (www.wipo.int).

The Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) of the World Trade Organization (WTO).

The TRIPS Agreement of 1994, is the multilateral treaty that really dealt with the concept of geographical indications (O'Connor & Company, 2007). Article 22 (1) of the TRIPS Agreement define geographical indications as "*indications which identify a good as originating in the territory of a Member, or a region or locality in that territory, where a given quality, reputation or other characteristic of the good is essentially attributable to its geographical origin*". This definition gave more expansion to the GIs further than that of the Lisbon Agreement. GIs must be "an indication" (a sign or logo) necessarily of the geographical area or origin for it to be protected (O'Connor & Company, 2007). Furthermore, the TRIPS Agreement touched

[1] Article 2 of the Lisbon Agreement.

on the standard protection for GIs of various products, whatever the nature of the good to which it is applied. The scope of protection is restricted to producers located outside the region designated (O'Connor & Company, 2007). Also each Member shall provide the legal means for the protection of GIs according to their legal regimes. Procedures for registering GIs under the EU is shown in Fig. 3 below.

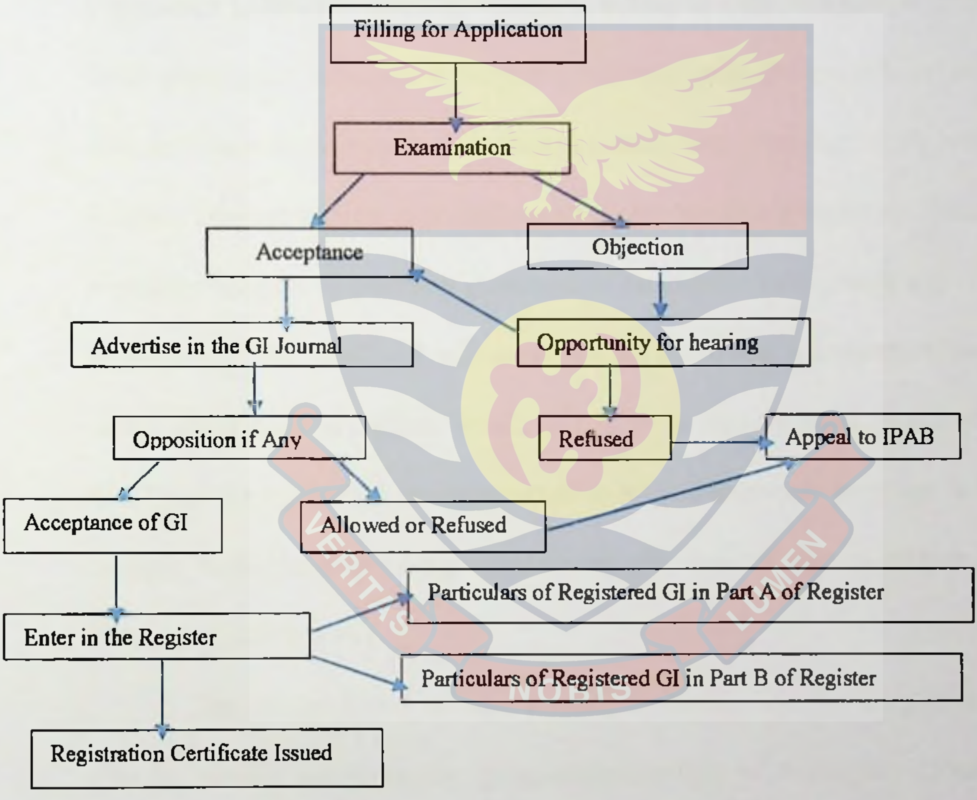


Figure 3: Procedure for Geographical Indication Registration in the EU
Source: www.novogress.com

Protection of GIs under Trademark Laws

The TRIPS Agreement provides protection for trademarks in Art.16. A trademark is a sign that distinguishes the products of a specific enterprise from the products of its competitor (Blakeney, Coulet, Mengistie, & Mahop, 2012). Its main purpose is to indicate the commercial origin of a product. Trademark owners have an "exclusive right to prevent all third parties from using identical or similar signs" on identical or similar goods. This makes trademarks to be individual by nature: referring to only one user or producer. With trademarks, consumers identify goods that meet their needs or wants. It also provides an incentive for manufacturers and distributors to meet the realistic product quality expectations of their consumers therefore, encourage trademark owners to maintain standards of quality for their goods and services (Blakeney, 2009, p.47). Trademarks could either be a collective mark or certification mark (Klopper, *et al.*, 2011). A collective mark is a trademark that "may be registered by an association whose members may use it if they comply with the regulations concerning the use of the collective mark" (Blakeney, 2009, p.49).

The United States of America employ trademarks for the protection of GIs by simply verifying the geographical origin of a product (Menapace, Colson, Grebitus, & Facendola, 2011). The U.S. Patent and Trademark office define a certification mark *"As any word, name, symbol, device, or any combination, used or intended for use in commerce with the owner's permission by someone other than its owner, to certify regional or other geographic origin, material, mode of manufacture, quality, accuracy, or other characteristics of someone's goods or services, or that the work or labor on* *the goods or services was performed by members of a union or other organization"* (U.S. Patent & Trademark Office. 2003). A certification mark in the U.S. covers more than one product and producer within a particular region. For instance Wisconsin Real Cheese and 100% Kona Coffee are covered by U.S. certification marks, which suggests that Wisconsin Real Cheese can only be produced in Wisconsin and 100% Kona Coffee can only be grown within the geographic borders of the North and South of the Kona Districts of Hawaii County, Hawaii (U.S. Patent & Trademark Office, 2003).

Protection of GIs under the *Sui Generis* (Separate) Law

A *sui generis* scheme, (in this case a separate law to protect GIs other than trademark laws) which combines geography and quality requirements better protects GIs than other certification marks (Menapace & Moschini, 2011). Under *sui generis,* GIs are viewed as an industrial property that is distinct from trademarks (Ibele, 2009). It is owned by the entire group and cannot be transferred from one owner to another outside the region (Blakeney *et al.*, 2012). More so, GIs are viewed as a results of collective decision-making under the *sui generis* system unlike trademarks that are usually privately owned (Biénabe, Jordaan & Bramley, 2013).

The EU, unlike the U.S. rely on *sui generis* legislation to protect GIs, through a law for the Protection of GIs and Designations of Origin (Reg. No. 2081/92) in 1992 (European Commission, 1992). This regulation established two types of GI designations: Protection of Designations of Origin (PDO) and Protection of Geographical Indication (PGI). PDO designation means the product is produced, processed, and prepared within the specified geographical area, and the product's quality or characteristics are "essentially due to that area." PGI designation means the product is produced, processed, or prepared in the geographical area, and the quality, reputation, or other characteristics are attributable to that area (European Commission, 1992). However, the 1992 GI regulation exists alongside earlier established trademark systems within individual member states prior to the development of the regulation and for trademark registration throughout the European Union.

GI Protection in Africa

Many African countries protect GIs under trademarks (Blakeney, 2009, p.199) while others use *sui generis* laws (Table 2). Two bodies in Africa are mainly responsible for IP related issues: the African Regional Intellectual Property Organization (ARIPO), and the African Intellectual Property Organization (OAPI) (Mupangavanhu, 2013). ARIPO has the mandate and capacity to process applications for the registration of trademarks and patents in its Member States who are parties to the Banjul Protocol on Marks as well as the Harare Protocol on Patents and Industrial Designs (www.inventa.com).

There is however an administrative challenge within the two major bodies for GI registration and protection in Africa (Mupangavanhu, 2013). Anyone or member country that wishes to ensure protection of GIs throughout Africa must file separate applications with OAPI, ARIPO, and the offices of all countries not affiliated to the two organisations (Mupangavanhu, 2013). This has led the proposal that the two bodies should merge (Otieno-odek, 2008) by establishing a Pan-African Intellectual Property Organisation (PAIPO), which will coordinate the registration and protection of GIs and IP issues in Africa (Mupangavanhu, 2013).

Table 2

Various GI Legal Regulations in some African countries

Countries	AU Model law for protecting indigenous knowledge	African model legislation for the protection of the rights of local communities, farmers and breeders, and for the regulation of access to biological resources
OAPI	Specific GI system	Bangui agreement (OAPI), March 1977, and amended 1999
ARIPO	Trade mark law	Banjul Protocol (ARIPO),1997
Angola	Trade mark law	
Benin	Specific GI system	Bangui agreement (OAPI), March 1977, and amended 1999
Botswana	Trade mark law	
Burkina Faso	Specific GI system	Bangui agreement (OAPI), March 1977, and amended 1999
Burundi	Trade mark law	
Central African Republic	Specific GI system	Bangui agreement (OAPI), March 1977, and amended 1999
Congo (GC)	Specific GI system	Bangui agreement (OAPI), March 1977, and amended 1999
Ethiopia	Trade mark law	TRM and licensing law enacted. The Trade Mark Registration and Protection proclamation law issued in 2006
Gabon	Specific GI system	Bangui agreement (OAPI), March 1977, and amended 1999
Gambia	Trade mark law	
Ghana	GI Act 2003 (no implementing regs.), draft law	
Guinea	Specific GI system	Bangui agreement (OAPI), March 1977, and amended 1999
Guinea-Bissau	Specific GI system	Bangui agreement (OAPI), March 1977, and amended 1999
Guinea Equitorial	Specific GI system	Bangui agreement (OAPI), March 1977, and amended 1999
Guyana	Specific GI system	Geographical Indications Act (proposed)
Ivory Coast	Specific GI system	Bangui agreement (OAPI), March 1977, and amended 1999
Kenya	Trade mark law, amended for protection of GIs	Draft GI Bill prepared
Lesotho	Trade mark law	Banjul Protocol (ARIPO),1997
Madagascar	Trade mark law	
Malawi	Trade mark law	Banjul Protocol (ARIPO),1997
Mali	Specific GI system	Bangui agreement (OAPI), March 1977, and amended 1999
Mauritania	Specific GI system	Bangui agreement (OAPI), March 1977, and amended 1999
Mauritius	Specific GI system	Geographical Indications Act N 23, 8.8.2002
Mozambique	Specific GI system	Industrial Property Code, Decree 18/99, 4.5.1999
Namibia	Trade mark law	
Niger	Specific GI system	Bangui agreement (OAPI), March 1977, and amended 1999
Nigeria	Trade mark law	
Rwanda	Trade mark law	
Senegal	Specific GI system	Bangui agreement (OAPI), March 1977, and amended 1999
Sierra	Trade mark law	
South Africa	Trade mark law and specific GI system	
Sudan	Trade mark law	
Swaziland	Trade mark law	
Tanzania	Trade mark law	
Togo	Specific GI system	Bangui agreement (OAPI), March 1977, and amended 1999
Uganda	Trade mark law. Draft GI law in Parliament	Banjul Protocol (ARIPO),1997
Zambia	Trade mark law	
Zimbabwe	Specific GI system	Geographical Indications Act No 24/2001

Source: www.wto.org

Protection of GIs in Ghana

The Ghanaian Geographical Indications Act, (GIA; 659) was passed in 2003 but, the country is yet to develop a secondary legislation to fully implement it on GIs. Under the GI Act, "*geographical indication" means an indication which identifies a good as originating in the territory of a country, or a region or locality in that territory, where a given quality, reputation or other characteristic of the goods is essentially attributable to its geographical origin;* Where "*goods" mean any natural or agricultural product or any product of handicraft or industry and includes Kente* (www.wipo.int).

Geographical indications could be registered under any one of three classes of goods in Ghana i.e., Class 1 (Wine, Spirit); Class 2 (Manufactured Goods, Handicraft, Food); and Class 3 (Natural Product, Mineral, Agricultural) in Ghana. The Registrar General's Department (RGD) maintains the registry of GIs. The registry is public, and any person may consult or obtain extracts from the registry, subject to certain regulations. As of the time of this thesis, there is no regulatory document for the full implementation of the GI law, it is not possible to register a product as a GI in Ghana and no party had ever applied to register a GI product in Ghana yet (C. Besah-Adanu, personal communication, May 15, 2014).

Any application for registration of a geographical indication is filed with the RGD. An application may be filed by either: a person or group of persons carrying on an activity as a producer in a geographical area specified in the application, with respect to the goods specified in the application; a group of consumers; or a competent authority. An application for the registration of a geographical indication shall specify;

(a) The name, address and nationality of the person or legal entity filing the application, and the capacity in which the applicant is applying for registration;

(b) The geographical indication for which registration is sought;

(c) The geographical areas to which the geographical indication applies;

(d) The goods to which the geographical indication applies; and

(e) The quality, reputation or other characteristic of the goods for which the geographical indication is used. The application is subject to the payment of a prescribed fee.

Checks at the relevant offices revealed that IP issues are being revised and the government has pledged to create a separate office specifically to be charged with the enforcement of IPR. The office will coordinate the enforcement and protective efforts of the Ghana Police Service, the Copyright Administration (Copyright Office), the Food and Drugs Authority (FDA), the Registrar-General's Department (RGD), the Customs Division of the Ghana Revenue Authority (GRA) and the Ghana Standards Authority (GSA). (C. Besah-Adanu, personal communication, May 15, 2014).

Economic Principles Underlying the Protection of Geographical Indications: Why GIs?

The main principles underlying use of GIs to protect special localized food products is founded on the economic theories of information and reputation (Lence, Marette, Hayes, & Foster, 2007; Moschini, Menapace & Pick, 2008). This is illustrated through: preventing market distortions that arise from information inconsistencies (asymmetry) between producers and consumers (OECD, 2000). They underlie the nature, scope and legal policies for the protection of GIs (WIPO, 2001; Oskari, 2006). The theories therefore emphasize the protection producers, consumers and by extension aide in rural development (communities and surrounding environment of geographical area) (Bramley, Biénabe & Kirsten, 2009).

Producer Protection Functions of GIs

Local producers have developed distinct products based on the interaction between local know-how (including selection, production and processing) and particular environmental conditions: soil and climate over the years (World Bank Report, 2004). This innovation however, has not necessarily rewarded much and where it does, the added value does not accrue to the producers. Reasons being the lack of regulations and enforcement mechanisms (World Bank Report, 2004).

Agricultural firms sometimes sell their products under a collective brand such as a GI or a group logo (Verbeke & Roosen, 2009) since small producers become vulnerable in national and export markets (Larson, 2007). Collective marketing is possible through registered producer groups or semblance of any such group. Producer grouping are essential to institutionalize a common code of conduct in the production processes (Belletti, 1999) necessary to successfully execute a collective action: *in this case referring to any action taken together by a group of people with a goal to enhance their status and achieve a common objective.*

A collective action is usually ratified by producer groups and is a key factor for implementing a GI (Barjolle & Sylvander, 2000; Blakeney *et. al.*, 2012). Collective brands are viewed as solutions to the inadequacies in information of quality that consumers cannot detect before purchasing a product (Moschini, Menapace & Pick, 2008) furthermore, collective brands bear the collective reputation of a regional or a group of producers that are not individually known to the consumer (Winfree & McCluskey 2005; Fishman, Finkelstein, Simhon, & Yacouel, 2010). Indeed it is widely known that price premiums for regional products depend on collective reputation (Quagrainie, McCluskey, & Loureiro 2003; Castriota & Delmastro 2008). For instance, Oku white honey had an established reputation at the domestic and national markets, strongly linked to its medicinal properties (Blakeney *et al.*, 2012). GIs promote production and marketing methods that are socially fair, economically viable and respect for the environment which include cultural values (World Bank Report, 2004) thereby, protecting producers and their reputations (Jay & Taylor, 2013).

Consumer Protection Functions of GIs

Credible information on a product's quality and reputation assures consumers that a product is authentic (Tim & Madeline, 2013). Reputation refers to the opinion consumer's form on a given product over a period of time and is associated with product quality (Bagal & Vittori, 2011). Consumers have become more demanding for food quality (Gragnani, 2012) in relation to nutritional properties, flavor, appearance, or the process and raw materials used to produce it (Bagal & Vittori, 2011). Distinct signs and logos such as GIs create a legal systems that regulates information asymmetry and free riding on reputation (OECD, 2000). Consumers are gaining interest in the geographical origin of products for a particular characteristics they desire in what they buy (WIPO, 2013). However, they are faced with many choices between similar products and hence require a bit of work to search for the origins of their product of interest (Oskari, 2006). Since consumers must assess the quality of a product before buying (OECD, 2000) they opt for GIs which communicates the quality characteristics they desire (WIPO, 2013).

The quality signals emitted by GIs to consumers are believed to eventually decrease the cost involved in searching for high quality products. This ability of GI labels increase the interest of consumers in terms of their willingness to purchase these kind of products, though these usually come with higher prices than other standard products (Loureiro & McClusky, 2000; Teuber, 2009). Wrongful use of GIs therefore becomes unfavourable to consumers (Correa, 2007, p.209).

Rural Development Functions of GIs

Rural development within the European Union was the main reason for endorsing the EU's Council Regulation (EEC) No. 2081/92 on the protection of GIs and designations of origin for agricultural products and foodstuffs. (Pacciani *et al.*, 2001). GIs have originated largely from less developed rural areas (Dogan & Gokovali, 2012) primarily applying to agricultural and cultural products (Marty, 1998; Blakeney, 2012). Since its protection provide employment opportunities and incomes, economic activities could increase and impact the development of rural economies where products originate (Dogan & Gokovali, 2012; Bramley & Biénabe, 2013). GIs are therefore a significant tool that could be enforced as a rural development policy within the areas of production (Tregear *et al.*, 2007; Belletti & Marescotti, 2011).

Geographical Indications and other Quality Standard Food Labels

Standards are an established set of rules or requirements, which must be met in order to achieve a target: be it access to certain geographic markets; selling to certain buyers; qualification to use a particular label or logo (Ellis & Keane, 2008). Labels, on the other hand are a visible symbol used to signal consumers at the point of sale that a product has met a certain standard (Ellis & Keane, 2008).

Food labels are very important for both producers and consumers as they provide consumers a means of evaluating the food before purchase. For instance it is a means of communicating to potential customers the attributes and qualities of the product by producers, and to standard authorities, a means of ensuring that food products meet the required standards (Desquilbet & Monier-Dilhan, 2014). The number of standards and labels have increased in response to consumer concerns. These concerns include: food safety; quality; traceability; nutritional impact; animal welfare; human rights; environmental and labour standards; social and economic impacts (Ellis & Keane, 2008). As a consequence, different product specific labelling systems, both public and private, have emerged in line with its quality attributes (Desquilbet & Monier-Dilhan, 2014). Noticeable among these standards include Organic Certification (where organic products must comply with production practices defined by public standards), Fair-Trade Certification (which involves international standards for fair trade covering both trade and production conditions), Rainforest Alliance Certification (for best practices in Sustainable Agricultural through social and environmental standards) and the mandatory labelling of genetically modified organisms (GMOs) in the European Union, to ensure consumer safety (Desquilbet & Monier-Dilhan, 2014).

GIs unlike most food labels link the uniqueness of a product to the human ingenuity and/or the impact of natural elements of a particular delimited geographical area to food quality (Blakeney, 2014). One can also explain that GI labels go further to assure consumers that they are likely to enjoy a "particular quality" of production for a particular food for a long time under that certification. For instance, in the French definition of appellation of origin, includes "the geographical name of a country, region, or locality, which serves to designate a product originating therein, the quality and the characteristics of which are due exclusively or essentially to the geographical environment, including natural and human factors (Malorgio, Camanzi, & Grazia, 2007). In an increasingly highly industrialized and standardized global food market, GI labels are considered as a reliable link to assure consumers of a more genuine, unique, and higher quality food (Broude, 2005) since it has been used from classical times to identify products of exceptional quality (Blázquez, 1992).

Linking GIs and Green Economy (Sustainable use of Natural Resources)

Production technologies and consumer behavior are feared to threaten natural resources globally (OECD, 2011). A greener model of growth, Green Economy (GE) which seeks a balance between food production and sustainable environmental health is therefore being proposed (OECD, 2011). GE is anticipated to support human wellbeing, social equity and shared economic opportunities while reducing environmental risks and ecological scarcities, and maintaining biodiversity (Omilola, 2014). This GE is suggested to be achieved by assisting governments to direct policies and investments towards renewable energies, water services, green transportation, waste management, green buildings, sustainable agriculture and forest management (United Nations Environmental Programme, UNEP, 2011).

Agriculture is the main vehicle of implementation (Millennium Ecosystem Assessment (MEA), 2005). It provides income for majority of the world's population, source of most food, uses approximately 40 per cent of land, provides key goods and services, provides ecosystem services while destroying even more (MEA, 2005). Organic farming is one of the main vehicles suggested for the promotion of GEs (UNEP, 2011). According to the International Federation of Organic Agriculture Movements (IFOAM) organic agriculture is *a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved* (UNEP, 2011). Organic agriculture thrives on developed standards and certifications. Global markets in organic food and drinks was estimated at US$50 billion in 2008 (Willer & Kilcher, 2011).

Similar to organic certification, GIs also seek to establish the link between product's quality and geographical origin where it originates (Bagal & Vittori, 2011). GIs connote the notion of "terroir" (Vandecandelaere *et al.*, 2010) which indicates that the unique quality of an agriculture product is determined by the character of the place it comes from (Gade, 2004). GIs primarily apply to agricultural products (Marty, 1998; Blakeney, 2012). They can contribute to biodiversity conservation especially when a product is derived using natural resources and when code of practice by producers include biodiversity considerations (Larson, 2007). For instance Oku white honey (a registered GI honey) owe its originality to the unique ecosystem of the forest in which it is made (Agence Française de Développement (AFD), 2014). In situations where production limits are set, GIs are likely to impact positively on natural resource sustainability and on biodiversity conservation, thereby promoting "rational land use strategies" (Appiah, 2011). A related case here is South Africa's Rooibos industry (Rooibos tea is a registered GI), where biodiversity considerations and initiatives have been incorporated into the production code of practices due to the sensitive nature of the production environment (Biénabe, Leclercq, & Moity-Maïzi, 2009).

Honey

Honey is a sweet fluid usually, thick, gluey or sticky, largely a mixture of dextrose and laevulose (sugars) and other compounds (Fontana, Camargo, & Altamirano, 2010; Johnson, Jadon, Mathur, & Agarwal, 2010). It contains over 300 chemical substances belonging to different chemical compound groups. It contains about 70% monosaccharides (glucose and fructose) and 10% oligosaccharides. The minor constituents are composed of several units (from two to six) of glucose and fructose (Sanz, Sanz, & Martínez-Castro, 2004). Fructose is about 38.5% and glucose (about 31.0%) (Blasco *et al.*, 2011). Carbohydrates like maltose, sucrose, and other complex carbohydrates could also be found in honey (Johnson *et al.*, 2010). Also, water content for honey is about 18.0 %, with low mineral and protein content ranging from about 0.04 % in pale honey to 0.2 % in dark ones. Honey is also rich in both enzymatic and non-enzymatic antioxidants (Al-waili, Salom, Al-ghamdi, & Ansari, 2012) but the specific composition of any sample of honey, including the level of contaminants present in it depends on the crops surrounding the beehive (Blasco *et al.*, 2011).

Honeybees (*Apis mellifiera)* are the sole producers of honey using pollen, plant nectars and honey dew from flowers (Slebioda & Namie, 2013). It is estimated that honey bees forage on plants growing over a relatively large area (more than 7 km^2) for food (Bilandžić *et al.*, 2012). Honey is believed to be rich in minerals, antioxidants and simple sugars hence widely used for both nutritional and medicinal purposes (Al-Waili *et al.*, 2012). Indeed some people will prefer it as a healthier nutritional choice than sugar (Bilandžić *et al.*, 2012).

Global Honey Production

Worldwide production of honey was estimated around an amount of 1.5 million tonnes in 2010. The statistics of the 10 biggest producers show that China (400,000 tonnes) is the largest producer of natural honey followed by Turkey and the USA (80,000 tonnes each), Ukraine (70,000 tonnes), Argentina (60,000 tonnes), Mexico (55,000 tonnes each), Russia and Iran (50,000 tonnes each) and India (40,000 tonnes) (European Commission, EC, 2013). In 2006, Ethiopia was the highest producer in Africa (41,233 tons).

Global imports of honey between 2006 and 2011, increased by 7% from 352,581 MTs to 378,994 MTs with import values increase from $583.9 million to $1.17 billion or by 102% within same period (EC, 2013). The EU has the highest per capita honey consumption in the world. Between 2006 and 2011, EU imports increased by 8% from 135,325 MTs to 146,742 MTs and equivalent values rose by 91% from $222.9 million to $425.2 million In general, EU consumers prefer light honey (i.e. *white, extra light amber, light* *amber*) as opposed to dark honey (i.e. *amber*). Germany is the second largest EU producer of honey (after Spain) and produced 23,137 MTs in 2010 (EC, 2013).

Honey Production in Africa

"Honey from the continent is comparable to some of the premium honey in the global markets due to its unique flavour profile" said by Alexei Bezborodov, head of supply chain, Honey Care Africa, Kenya office (http://africanbusinessmagazine.com). Within Africa, Ethiopia leads the continent followed by Tanzania, Angola and the Central African Republic the top four largest producers as at 2017 include Ethiopia (50,000 t), Tanzania (30,000 t), Angola (23,300 t) and Central African Republic (16,200 t) (CTA, 2017).

Honey Production in Ghana

Ghana has largely moved from honey hunting to modern beekeeping (apiculture) since the late 70s (Aidoo, 2005; Paterson, 2006). In spite of that, the industry still requires more investment in order to reach its full potential in income generation and improve livelihood and foreign exchange for the national economy (Akangaamkum, Agbenorhevi & Okudzeto, 2010). The Technology Consultancy Centre (TCC) of Kwame Nkrumah University of Science and Technology, Kumasi, introduced the top-bar hive to farmers. This was subsequently followed by support from development organizations such as the World Vision International (WVI), Adventis Relief Agency (ADRA) and TECHNOSERVE, to improve the income levels of rural communities (Akangaamkum *et al.*, 2010: Ajaloo &Yeboah-Gyan, 2003). Honey yield has increased over the years from 236,795kg in 2007 to 428,836kg in 2008 with corresponding farm gate income from US$619,455 to over 1M USD US$1,076,378 during the same period (Akangaamkum *et al.*, 2010).

This has been possible because Ghana's agro-ecological conditions are considered suitable for the production of honey. The wide climatic and ecological variability have endowed Ghana with diverse and unique flowering plants that is highly suitable for sustaining a large number of bee colonies (Akangaamkum *et al.*, 2010). The tropical ecosystem has temperatures from warm to hot and moist all year-round. This promotes lush vegetation growth consisting of rainforests, dry deciduous forests, spiny forests and other types of flora friendly to bees and other pollinators (Akangaamkum *et al.*, 2010).

In the transitional zones of the Volta Region, higher honey production has been recorded with 34kg per beehive per annum as compared to the national average yield of 14kg per beehive per annum (Ahmed, 2014). Also, the African honeybee, (Apis mellifera) is well established and adapted to the tropical conditions and the lush vegetation with diverse agro environment (floral sources) across the regions (Akangaamkum *et al.*, 2010). Furthermore, the modern method of beekeeping produces quality honey and less labour intensive but rewarding (Akinnusi, Annor, Borketey-La & Kwenin, 2009) as compared with the normal traditional methods, (Figs. 4 and 5).

Figure 4: An Apiary in the Kadjebi District showing Kenya top bar hives

Figure 5: An Apiary in the Adaklu District showing a traditional beehive (made from trunk of *Borassus sp*).

The number of beekeepers in Ghana is estimated to be 22,063 with an average number of five beehives per person. About 52,883 beehives are said to be in production employing about 4,413 people in various beekeeping related jobs (Akangaamkum *et al.,* 2010). The sub-sector mainly involves crop farmers who are more technically efficient in production and own their hives (Akangaamkum *et al.*, 2010; Abdul-Malik & Mohammed, 2012).

Honey Quality

The most important criteria for assessing honey quality are the individual honey components (Sahinler & Aziz, 2004). Usually, the chemical component of honey differs depending on the source of forage, season and production methods. Storage conditions may also influence final composition, with the proportion of disaccharides increasing overtime (White & Subers, 1964). Quality will be greatly reduced if honey is not handled carefully. Some of the factors that mostly affects honey quality include: high temperature and moisture content greater than 21%. They lead to fermentation, high levels of Hydroxymethylfurfural (HMF), loss of enzymatic activity, changes in flavour, darkening and microbial growth (Bogdanov, Lüllmann, & Martin, 1999; Moguel, Carlos & Rosalva, 2005).

International standards limits (E.g. European Honey Directive and the Codex Alimentarius) have been set for honey from various regions of the world (Bogdanov *et al.,* 1999). The limits for honey of tropical regions like Ghana are summarised as follows: free acidity (not more than 50 mill equivalents); moisture content (20%); general ash content (0.6 g·100 g-1); Hydroxymethylfurfural, HMF (80 mg·kg-1); Diastase activity (not less than 8); Reducing sugars (60 g·100 g-1); Proline (180 mg·kg-1). There are however, some differences in these limits for honeydew honeys from same region. These include reducing sugars (not less than 45 g·100 g-1) and Ash content (not more than 1 g·100 g-1) (Bogdanov *et al.* 1999; Codex Alimentarius Commission, 2001). The following are some of the authenticity (honey quality) indicators acknowledged internationally as mentioned by (Bogdanov *et al.*, 1999; Ruoff, & Bogdanov, 2004) concerning honeys across the globe.

Moisture Content

This is the only composition criteria that must be fulfilled by a typical honey in the world honey trade. Usually honeys with high water content is prone to fermentation. A maximum value of 21 g/100g is suggested in the draft standard for moisture content of honey. Fermentation will result in off-taste, high levels of yeast, glycerol and butanediol and even ethanol

Sugar Content

Reducing sugars such as fructose and glucose are the main constituent of most blossom/nectar honeys unlike honeydew honeys which have non-reducing sugars like oligosaccharides such as melezitose, maltotriose and raffinose. Generally honeys should have a minimum of 45 g/100 g apparent sugar content.

Mineral Content (Ash)

Ash content is a quality criterion for determination of botanical origin. It has been established that blossom honeys have lower ash content than honeydew honeys. In recent times the measurement of electrical conductivity explains the same concept.

Acidity

Fermentation of honey causes an increase of acidity. Though some honeys naturally have higher natural acidity, the maximum measure by global standard is 50 mill equivalents/kg.

Diastase Activity

Honey diastase activity is influenced by honey storage and heating. It is therefore a quality criterion that measures the freshness and overheating of honey. The minimum global standard stands at a DN value of 8 though certain unifloral honeys have a naturally low diastatic activity.

Hydroxymethylfurfural (HMF) Content

This quality criterion measures the freshness and overheating of honey. There is virtually no HMF in fresh honey. However, it increases upon storage depending on the pH of honey and storage temperature especially in warm climate countries. The *Codex* proposal is a maximum of 60 mg/kg based on the experience that HMF increases on honey storage in warm climate countries.

Proline Content

This is a criterion that indicates the ripeness and in some cases, also of sugar adulteration. There is considerable proline variation, depending on the honey type. A minimum value for genuine honey of 180 mg/kg is accepted in honey

How Ecosystems Influence Production and Characteristics of Honey

As honey bees pollinate natural and agricultural ecosystems (Gallai, Salles, Settele, & Vaissière, 2009) they are rewarded. They benefit by harvesting nutrients (nectar and pollen) which is required for their growth and health. For instance, honey bees store floral nectar containing carbohydrates as honey, which provides the energy need of individual bees, while pollen provides most of the nutrients required for their physiological development (Brodschneider & Crailsheim, 2010).

The nature of landscape affects the nutrition (pollen and nectar usually stored as honey) of honey bees (Naug, 2009; Decourtye, Mader, & Desneux, 2010). Bee flora are the major sources of nectar and pollen for the bees (Partap, 1997). The quality of the honey produced depends on bees visiting diverse plant species. Many beekeepers have a rich indigenous knowledge on plant species and quality of honey (Adhikari & Ranabhat, 2012).

Honey varies greatly based on colour, flavour and density which is influenced by the plant species, climate, environmental conditions and the contribution of the beekeeper (da C Azeredo, Azeredo, De Souza, & Dutra, 2003). Various kinds of honey have different botanical sources (acacia, citrus, chestnut, rhododendron, rosemary and lime) (Pirini, Conte, Francioso, & Lercker, 1992) which by extension affects honey characteristics. For instance in Ethiopia, the areas endowed with natural tropical rain forests ecosystems with suitable climates favour high honeybee population density hence forest beekeeping is widely practiced (Nuru, 2007).

In the case of the Cameroon, Oku white honey producers, beekeepers move their beehives to selected points in the Kilum Ijim Forest instead of managing them in one place. The reason is due to the specific geographical features and ecosystem of the Kilum Ijim Forest, which harbour plants that when pollinated by the bees result in honey that yields unique characteristics (World Intellectual Property Organization, WIPO, 2016). Rising up to 2,000 meters above sea level, the Kilum Ijim forest is a rich, diverse ecosystem covering over 20,000 hectares (French Agricultural Research Centre for International Development, CIRAD, 2013). The Forest is the home for over 150 melliferous plant species (Ingram, University of Amsterdam, 2014), which that are collected by insects and turned into honey (WIPO, 2016). The amount of rainfall, sunlight, temperature, altitude, and soil quality in the Kilum Ijim forest all serve to influence the end product (Ingram, University of Amsterdam, 2014). Two plants that yield white flowers in particular - *Schefflera abyssinica* and *Nuxia congesta* - work in combination with the environment to give Oku white honey its unique properties, especially its creamy white color (Slow Food Foundation, 2014).

How GIs Sustain Pollination Services and Ecosystem Functioning.

The idea to integrate environmental concerns into GIs through product specificity issues (PSs; *in this case relates a products to its natural environment*) has been of global concern (Giovannucci, *et al.*, 2009). This is because biodiversity conservation and its related issues are not a direct objective of GI protection (Larson, 2007), not even in countries where GIs are very much developed. Indeed researchers observed that the EU legislation (Regulation EC 510/2006, currently 1151/2012) make no mention of environmental protection among its specific objectives (Belletti, Marescotti, Sanz-Cañada, & Vakoufaris, 2015). In spite of the silence on environmental stewardship, policymakers and supply-chain actors, however, suggest biodiversity conservation could be one of the justifications for GI protection (European Commission 2009; Thévenod-Mottet, 2010).

GIs take into account the long-standing process of interaction between cultural practices, farmers' know-how and environmental resources: the French concept of *terroir*, (Bérard & Marchenay, 1995). Specific uniqueness of the products are linked to unique features in the region of origin (Giovannucci *et al.*, 2009). This could support the possible theories of biodiversity conservation functions of GI being proposed by researchers (Vandecandelaere *et al.*, 2009). For instance, it is suggested that the GI concept reveals an accepted relationship between a product's characteristic qualities and the geographical environment which includes the natural resources (Blakeney *et al.*, 2012).

As a marketing tool, GIs add economic value to products through the acknowledgement of the value of natural resources in the production process, thereby creating a unique identity for the product (Addor & Grazioli 2002; Babcock & Clemens, 2004). Ecosystem services is associated with new market mechanisms and is applied to the management of natural resources which has created promising avenues for trade-offs between conservation and development (Bayon, 2004). This thinking is realized within the idea of

Payment for Ecosystem Services (PES). The PES concept is based on a principle that external beneficiaries (Human societies) compensate for these services through contractual agreements with the local communities that have adopted management practices for the ecosystem which guarantee the continuous delivery of these services (Wunder, 2007). For instance the "value" of managed honeybee pollination has been used to justify honey price support schemes (Allsopp *et al.*, 2008) and funding for honeybee research and extension programmes (Cook, Thomas, Cunningham, Anderson, & De Barro, 2007).

Highlighting these special attributes give consumers additional information about the quality characteristics of a product in order to influence them to choose it over other similar products on the market. A GI will serve as a tool for legally regulating harvesting practices and promoting rational land use strategies that relate directly to *in situ* conservation of biological diversity (Larson Guerra, 2004; Rangnekar, 2004). Biodiversity conservation could therefore be incorporated into GI labelling. GIs therefore could aide in processes towards biodiversity conservation (Appiah, 2011).

How Bee Keeping Increases the Quality and Quantity of Fruits, Vegetables and Biodiversity.

Management of bees for crop pollination started in the early to mid-1900s mainly in United States (Kasina, Mburu, Kraemer, & Holm-Mueller, 2009). Pollination is essential for the production of a host of agricultural crops world-wide (Allsopp, De Lange, & Veldtman, 2008). Though the bulk of the world's staple foods are either wind pollinated, self-pollinated or propagated vegetatively (Ghazoul, 2005) insects are responsible for 80–85% of all pollinated commercial farms (Richards, 1993; Williams, 1996). These commercial crops include fruits, vegetables, oilseeds, legumes and fodder (Richards, 2001). The honeybee is regarded as the most important commercial pollinator. At least 90% pollination of crops is performed by honeybees (Richards, 1993; Williams, 1996). They possess several characteristics that make them good insect pollinators (National Research Council, NRC, 2007). They are excellent generalist pollinators (Morse, & Calderone, 2000; Richards, 2001). This specialization results in more efficient pollination and the production of larger and more abundant fruit from certain crops (National Resources Conservation Services, NRCS, 2007).

In some parts of the world, bee pollination is tradable in the market (i.e., bees can be rented for pollination of crops) by specialized firms that rear bees in those countries, e.g., Koppert of the Netherlands (Kasina *et al.*, 2009). The bees are often used in greenhouses or on large plantations for pollination services which is then paid for (Kasina *et al.*, 2009). Production of fruit and seed crops is often enhanced by bringing in additional honeybee colonies (Anderson, Buys & Johannsmeier 1983) especially in many crop species where seed or fruit production or quality is increased by the addition of honeybees (Johannsmeier, 1995). This has made commercial pollination one of the most important benefits of commercial beekeeping (Morse, & Calderone, 2000; Richards, 2001) since bees are the main agents relied on in agriculture to pollinate different crops (Kasina *et al.*, 2009).

A comparison between the value of crops that are pollinator-dependent and non-pollinator-dependent showed that pollinated crops were valued at 761 Euros/ton (approx. 1050 USD in 2009), whereas non-pollinator dependent crops realized only 151 €/ton (approx. 208 USD) (Gallai, Salles, Settele, & Vaissière, 2009).

Global debates on the contribution of pollinators for increasing genetic diversity, adaptation, seed set, crop quality and quantity and natural regeneration of wild and cultivated crops species has been highlighted (Kasina *et al.,* 2009; Munyuli, 2011). By ensuring reproduction of many plants, pollinators, like honey bees, are essential to the functioning of natural and agricultural ecosystems (Klein *et al.*, 2007; Gallai, *et al.*, 2009).

Statement of the Problem

GIs have assumed both political and economic interest in countries of the Global South (Ilbert & Petit, 2009). It is tipped as an economic development tool for countries (Bramley *et al.,* 2013) especially outside Europe, (Vandecandelaere *et al.*, 2009; Bowen, 2010). These developing countries have put in place GI legal frameworks over the years to protect product GIs (Giovannucci, *et al.*, 2009; Marie-Vivien, 2012). For example, China, Colombia, India, and Vietnam have registered more than 14 GI products within the EU (European Union, 2014).

The need for Africa to promote her unique and diverse natural resources through GIs have been discussed (Nyaga, 2004; African Regional Intellectual Property Organization [ARIPO] & European Union [EU], 2012). A number of African countries have GI laws in place (Appiah, 2011). In West Africa, three products have recently been registered as GIs. These include: Oku white honey and Penja pepper by Cameroon and Ziama-Macenta Coffee by Guinea (Chabrol, Mariani, & Sautier, 2015). The price of Oku white honey increased from around Central African CFA franc 2,000 per kilogram to 40, 000 CFA/kg after registration as a GI product. That of Penja pepper increased from 5,000 CFA/kg to 7,500 CFA/kg while Ziama-Macenta coffee received a price premium of 10% after registration (Chabrol *et al.*, 2015). Ghana has a GI law (ACT, 659), however, the country is yet to have any product registered even though it is said to have potential products that could greatly benefit from GIs (Appiah, 2011).

Honey from the Volta Region is said to have reputation for quality and uniqueness as in sweet taste, thickness and consistency and enjoys higher price compared with honey from the other regions of Ghana (Akangaamkum *et al.*, 2010). These features are attributable to the region due to its unique vegetation zones (ranging from forest to savannah and semi-deciduous) as well as the skills of producers (Besah-Adanu, Kwapong, Hansted & Bosselmann, 2015).

The main problems for this investigation are that the GI concept is relatively new and not being used in Ghana though it is being practiced internationally. Ghana produces a lot of quality honey, but there is no record indicating that the Ghanaian honey meets GI standards and labelled as such. The botanical and geographical origins of honey from the major producing area: The Volta Region had not been investigated and same holds for the country at large. Also, information on how the honey from the Volta Region compared with International quality standards is not available. Furthermore, putting a GI label on a commodity implies that the buyer or the consumer will have to read the label on the commodity. But whether Ghanaians have knowledge about the benefits of GIs in terms of food quality is not known.

This study aims at investigating honey from the Volta Region as a GI product in Ghana. This will contribute to their valorisation: "*Valorisation" in this context is adding value to a product through GIs.*

Objectives of the Study

The overall purpose of this study is to investigate the potential of honey from the Volta Region as a GI product in Ghana. Specifically, this studies has the objectives to:

1. *Assess common structure and storylines that best describe GI products (especially honey), around the world*
2. *Identify the floral resources for honeybees in the study area*
3. *Analyze beekeeper honey within international standards.*
4. *Assess consumer knowledge on food labels (including GIs) in Ghana*

In order to achieve the above objectives, four research questions were followed which include:

Research Questions

1. *What are the Characteristics of a Geographical Indications (GIs) Registered Honey? A literature review.*
2. *What is the botanical and geographical origin of honeys from the study sites?*
3. *How does the quality of Volta honey compare with international quality standards?*
4. *What is the level of consumer knowledge on GI and other quality food standard labels in Ghana?*

Significance of the Study

The research will lead the way for many products in Ghana to be developed into GIs thereby placing premium for better economic gains. Specifically, the road map to developing GI honey in Ghana will contribute to the knowledge and understanding and appreciation of pollination services by honey bees. Through pollination, many flowering plants including fruit and seed crops reproduce leading to food security and livelihoods. Beekeeping and honey production will be enhanced thereby raising the economic status of beekeepers and for that matter the country. Again, the study will also provide knowledge on the Ghanaian consumer in terms of label awareness, what inform their food choices as well as their readiness to pay for quality that comes with location specific food products.

CHAPTER TWO

MATERIALS AND METHODS

In this study different methods were used in the field data collection. This section describes the study sites, research designs, data collection methods, validity and reliability of data as well as approach to data analysis

Study Sites

Two man study sites were used in this studies. Field data for honey production and producers took place in four Districts in the Volta Region of Ghana during the 2014 and 2015 honey harvesting seasons (Figure 6). Consumer studies on quality food label and GI knowledge was done in the Greater Accra, which is also the national capital of Ghana (Figure 7). Some key state institutions in Accra were also surveyed on the current knowledge of GIs and whether there is any state directed project in developing GIs in Ghana.

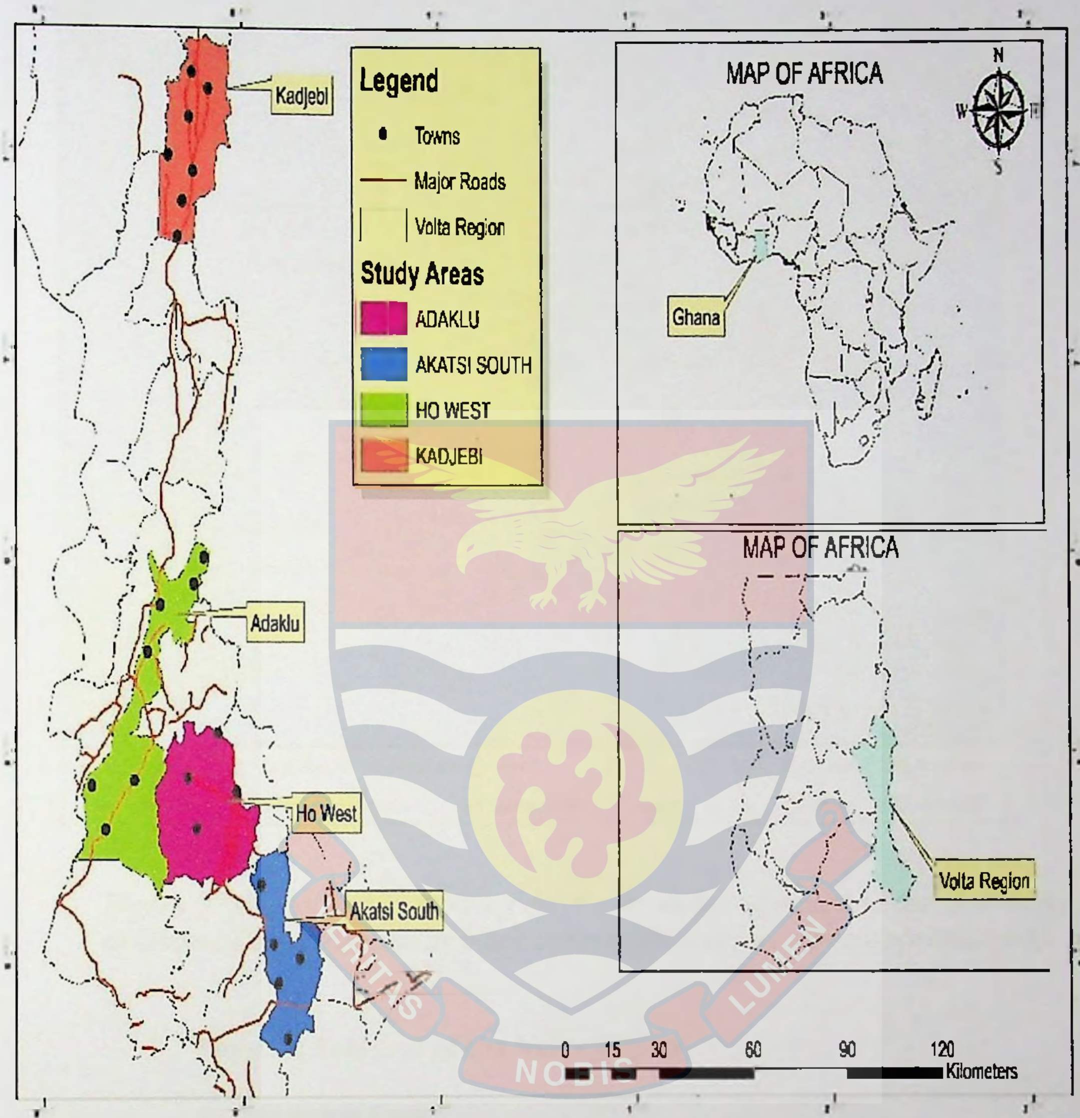


Figure 6: Map of Africa highlighting Ghana (top right), Map of Ghana highlighting the Volta Region (down right) and Map of the Volta Region highlighting the study sites

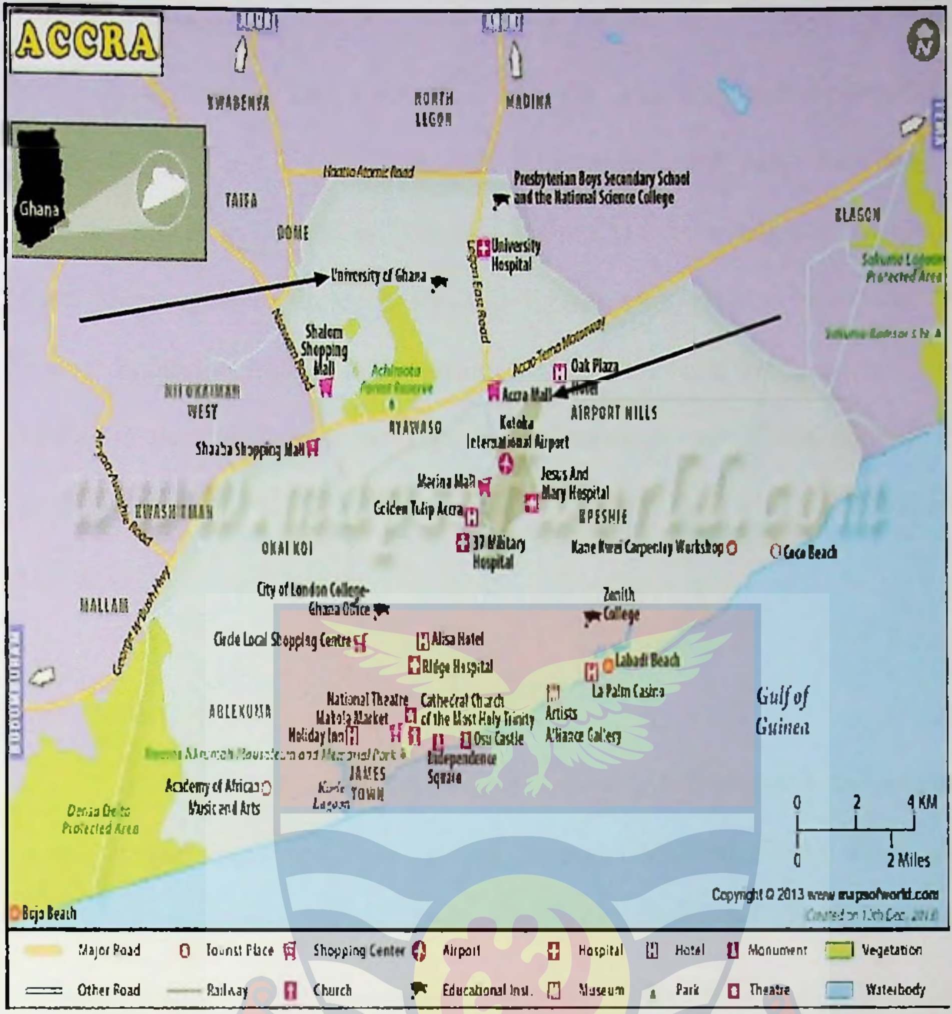


Figure 7. *Map of Accra showing the Accra shopping mall and the University of Ghana, Legon directed by black arrows. (Source: www.mapsofworld.com).*

Physical Features of the Volta Region

Location and Area

The Volta Region is located between latitudes 50 45‘‘N and 80 45‘‘N along the south eastern part of Ghana and shares boundaries with the Republic of Togo. It also shares boundaries with Greater Accra, Eastern and Brong Ahafo regions to the west, the Northern Region to the north, and the Gulf of Guinea to the south. It has a total land area of 20,570 square kilometres, representing 8.7 percent of the total land area of Ghana (GSS, 2013).

Climate

The Region has a tropical climate, characterized by moderate temperatures of 21-32^0 Celsius (70-900 F) for most of the year. There are two rainfall regimes in the region. The first is from March to July and the second from mid-August to October. Rainfall figures vary greatly throughout the region. Rainfall is highest in the central highland area and the forest zones but lowest in the Sahel-savannah zone in the northern part of the region. The average annual rainfall is between a low of 1,168 mm and a high of 2,103 mm (GSS, 2013).

Vegetation

The region is about 500 kilometres in length from south to north and spans all the vegetation zones of the country including Costal Grassland, Mangrove Swamps, Guinea Savannah, Semi-Deciduous Forests, Sahel-savannah and mountainous wooded savannah in the north. This give the region a competitive advantage over other regions for the cultivation of many crops. The middle and northern belts are mainly mountainous, with Mount Afadzato (885 m) being the highest peak in the country. The south is flat with marshy and sandy portions. These coastal areas are estimated to be less than 15 metres above sea level (GSS, 2013).

Research Design

Research questions usually determine the research method (Hammond, 2005) hence a sound methodology deemed appropriate for the research questions is required (Mason 2002; Cresswell 2003). The research questions in this study require an investigation into multifaceted aspects of the potential of honey as a GI product for Ghana which involve diverse stakeholders. These include honey producer groups, local representatives of state institutions, NGOs and consumers. A mixed method was therefore chosen for this study as it is believed to strengthen the interpretations to be made at the end (Sammons *et. al*, 2005).

Mixed methods are believed to produce better outcomes than single methods (Brannen, 2005). It combines different methods and provides different perspectives on the subject, research questions, the data and the ways in which evidence is understood and interpreted (Brewer & Hunter, 1989). As each approach has its own limitations or 'imperfections', they compensate each other (Brewer & Hunter, 1989). For instance the mixed method combines qualitative and quantitative approaches within a research process (Tashakkori Teddlie, 2008). Research questions are therefore answered from several perspectives, reducing 'gaps' in the data. This approach therefore allows diverse types of data which best provide the understanding of each research problem (Bulsara, 2015; Creswell, 2013).

The approach was also needed because the topic (labelling products through GIs) is new and has never been studied (Morse, 1991) in relation to honey producers in Ghana. The mixed method strategy also fits with the political discourse accorded to 'practical enquiry' that speaks to policy and policymakers, and informs practice (Hammersley, 2000). Again, the mixed method allows different roles and relationships between researchers and the researched, being respondents, subjects, participants or informants (Barbour, 1998).

Several types of mixed method designs are described in literature. For instance Tashakkori and Teddlie (2003b) pointed out over 40 different types of mixed method designs. These designs have further been summarised into four main types over the years into: the Triangulation Design, the Embedded Design, the Explanatory Design, and the Exploratory Design (Creswell, & Plano Clark, 2011). In this study, the "concurrent triangulation design" (Creswell, Plano Clark, Gutmann, & Hanson, 2003) was used (Fig. 8). This method involved the concurrent, but separate, collection and analysis of qualitative data (literature reviews, key informant interviews, group discussions, and field observations) and quantitative data (physico-chemical and pollen analysis of honey, consumer survey through questionnaire). Which were fully integrated in a single analysis (Creswell, 2013; Greene & Caracelli, 1997). The quantitative results were related to the qualitative findings during the interpretation and discussions sessions (Creswell, 2013).

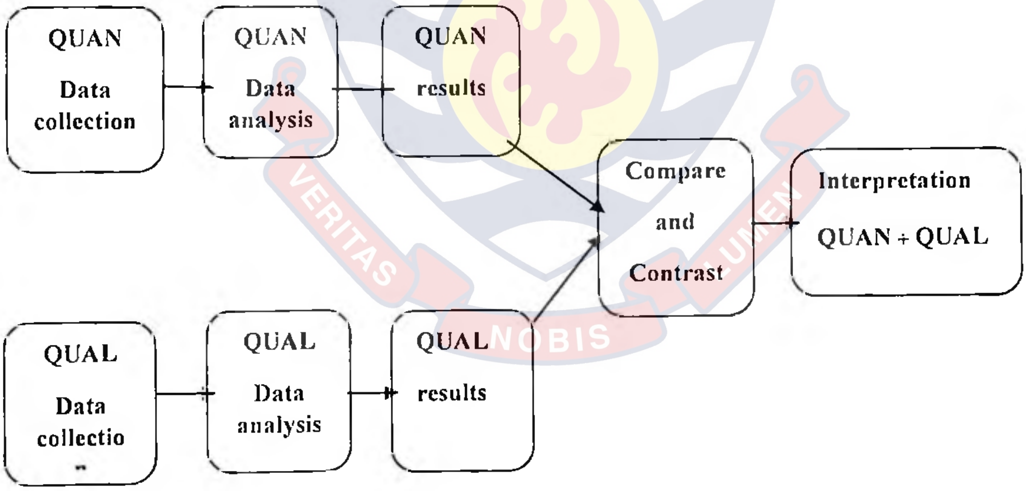


Figure 8: An illustration of Convergence Triangulation Design

Selection of Potential Cases

The knowledge regarding regions and potential honey cases included many gaps and uncertainties when this PhD study was initiated hence initial scoping for potential cases was necessary for final selection of cases for the study. The initial broad scoping survey was mainly through an inventory of locally branded Ghanaian honey in open markets, pharmaceutical shops and shopping malls within Accra. A list of phone contacts of the respective packagers of those local brands were generated. They were subsequently contacted via phone interviews for their views on regions with quality honey in Ghana. There were also visits to a number of honey producing communities in Greater Accra and Volta regions. Furthermore, research scientists working in the honey sector were also contacted for inputs. In addition to literature, honey packagers, research scientists and some key beekeepers, such as the Ghana Beekeepers' Association President, unanimously suggested that the Volta and Eastern Regions were possible cases for study. These regions were known to produce quality honey in the country characterised mainly by volume, processing and price premium.

Using fundamental parameters core to successful GI development processes such as presence of registered association or semblance of same, which allows for common code of conduct in production processes (Belletti, 1999), the Volta region was chosen for this project. Operationalization common code of practices led to collective action, which is key to developing and implementing a GI policy (Barjolle & Sylvander, 2000; Blakeney *et. al.*, 2012). The executives of the Volta Regional Association of Beekeepers (VORAB) were contacted for the final selection of plausible districts and communities. Four districts in the Volta Region namely: Kadjebi District; Ho West; Adaklu and Akatsi South Districts were selected for the studies.

Honey Producer Sampling Method

The purposive sampling method for respondents' selection was the main sampling method adopted for the study. Purposive sampling is a non-random technique used in selecting respondents who can and are willing to provide information by virtue of their knowledge or experience (Bernard 2002, Lewis & Sheppard 2006). Purposive sampling has widely been used as an informant selection tool for both qualitative and quantitative studies. Apart from its use in social sciences, this sampling method has widely been used in natural science research over the years. For instance in both ecological and ethnobotanical studies (Tongco, 2007).

The method usually focuses on key informants (human elements) who are observant, reflective members of the community of interest with special know how about the issues under study and are both able and willing to share their knowledge (Tongco, 2007). For example, purposive sampling was used in studies on how wild edible plants are used (through focus group discussion) in some selected districts of Ethiopia (Addis, Urga, & Dikasso, 2005); Cacao farmers' understanding regarding shade trees (through Semi-structured interviews and survey) in in Ecuador (Bentley, Boa, & Stonehouse 2004); If farmers perceive forests positively or negatively (through focus group discussion and questionnaire) in Haiti (Dolisca, McDaniel & Teeter, 2007) and use of poisonous plants as insecticides (through interviews, survey, focus group discussion) with farmers in Kalimantan, Indonesia (Belcher, Imang, & Achdiawan, 2004).

Developing Data Gathering Instruments

Empirical information and experiences gathered during the inventory exercise provided insight leading to the development of data collection instruments for the main study. Four different interview instruments were developed for each group of informants. There was a separate survey questionnaire for individual beekeepers in local associations and consumers, separate interview guide for key informants and local state institutions involved in related beekeeping activities and a guide for group discussions.

Questionnaire was developed by re-correcting, removing and adjusting the previous one used during the scoping in order to suit the scope and depth of various research questions to simplify and enhance understanding. This was achieved through consultations with various team members and supervisors on the project. All Semi-structured questions (interview guides) were also developed for key informants. To finalize the questions, the completed questions were discussed with field assistants and selected beekeepers in the local language at the study sites, making available local names and meanings for some of the terms and equipment used where necessary in order to enhance communication.

Data Collection

In the Volta Region, data on honey production systems were collected from Xelekpe (Elv. 342ft, N. 06°28.399', E. 000°25.363') in the Adaklu District; Torveh (Elv. 117ft, N. 06°07.057', E. 000°47.018') in the Akatsi South District; Dzolopuita (Elv 427ft, N 06°32.493', E.000°17.410') in the Ho West District; Koru (Elv 823ft, N.07°53.285', E. 000°35.426') and Dodo

Tamale (Elv.77ft, N 05° 34.025', W 000° 14.278') communities in the Kadjebi District.

Honey Producing Associations and Key Informants

This study was carried out between 2014 and 2017. Data collection for main field work was done during the 2014 and 2015 honey harvesting seasons between the periods of October to December 2014 and January to May, 2015. There were however pockets of data collections and surveys throughout the period of 2014 to 2017. The target population comprised members of local beekeeping groups. The beekeeping groups include: Adaklu Beekeepers Association (Adaklu); Akatsi South Beekeepers Association, (Akatsi South); Ho West Beekeepers Association (Ho West) as well as Dodo Tamale and Koru Beekeepers Association, (Kadjebi). Both individual beekeepers and leaders of the associations were interviewed. Identifiable local NGOs or government institutions in the local communities were also interviewed as key informants.

Honey Samples

Collection of honey samples were done from the minor season (October to December, 2014) through to the major harvesting seasons (February to May, 2016). Key figures within each producer group were contacted to select experienced group members (people with at least five years of beekeeping) in their groups to prepare part of their harvest as a sample for the study. Honey samples were collected taking into consideration proper harvesting, extraction and storage. Honey producers were asked to apply little smoke, harvest only capped combs, store honey in food plastic containers, cover airtight and keep in dry cool places. In all, 16 honey samples were collected from members belonging to community beekeeping associations Samples were collected from different beekeepers. Samples from members of different beekeeping associations were harvested from November, 2014 to May, 2015. All the samples were kept in plastic food containers and stored in a clean dry place, with temperature between 20 °C and 30 °C.

Consumer Survey

The consumer survey was conducted in the Greater Accra, in September, 2016 with shoppers at the Accra Shopping Mall and the University of Ghana campus, Legon (Fig.7 above). Initially, the consumer studies was intended to be carried out only at the Accra Shopping Mall. However, I faced some challenges due to the administrative policies of the operators at the Mall, who would not all for a direct research with consumers as they enter their space to shop. With this I could not interview consumers directly but only focus on few who had sat on the stools provided on the central spaces and were assumed to be potential shoppers. This situation also affected the numbers needed to be interviewed. Dealing with the situation lead to the addition of students of the University of Ghana. Selection of consumers for the study was therefore based on these assumptions.

Firstly, the Accra Shopping Mall is the largest, busiest and centrally located shopping centre, where the upper and middle class Ghanaian consumers could easily be located hence suitable for this study. Secondly, University students belong to the knowledge group of the young Ghanaian population. Together, these two segments of society usually have the purchasing power and also care about the products they buy in the supermarkets. It was therefore necessary to find out what affect their food choices, food label reading habits and knowledge of GIs as part of the development program. In all, 206 questionnaires were administered over a period of two days. On the average, about fifteen minutes was spent on a question using a face to face interaction.

Validity and Reliability of Data

Data validity and reliability is the ability of reproducing the conclusions of a particular research by other researchers (Bryman, 2012; Kvale & Brinkmann, 2009) hence is mainly concerned with the accuracy and openness of the scientific findings (Le Comple & Goetz 1982). In order to confirm the validity and reliability of the data, the collection process infused the notion of data triangulation in order to confirm the validity of the process.

In order to reduce or avoid biases in relation to the researcher, contacts were first made with key leaders (regional beekeepers) in the community for discussions around the research theme and permission obtained in order to gain direct access to the people under study (Leininger, 1991). I took part in training workshops on qualitative studies as a researcher to fully understand the dynamics involved in the phenomena under study before undertaking the studies (Field & Morse, 1985). Enough time was spent during the initial scoping exercise, putting into practice the techniques of asking questions, listening, and observing respondents' attitudes. With this, participants and I had the opportunity to become familiar to each other before the main data collection (Le Comple & Goetz, 1992, Miles & Huberman 1984).

The main form of bias during this form of study comes from selection of informants and respondents where the researcher is likely to select only people perceived to be brilliant and knowledgeable. Informant biases were curtailed by not interviewing only 'well-informed' (leaders of beekeeper groups at local and regional levels) but also, individual members were purposefully selected for their views on the various processes of production, extraction, processing and general management in the sector under study (Miles & Huberman, 1984, Sandelowski 1986). In some cases, observations were also made on the field. For instance there was a visit to selected apiaries in Ho West and Kadjebi Districts in order to confirm the siting and hygiene issues around the beehives as narrated by respondents.

Group discussions were also held including all available individual members of each producer group from which both key informants and respondents were purposefully selected. The intention was to discuss other general issues but also meant to pick signals that confirmed answers to previous questionnaire based interviews, thus making the sources of information in each community diverse. In this way, from key informants, individual member interviews and then from group discussions.

Finally, four different Districts were selected in the region for the study so as to have a wider perspective. This was also necessary for data validation across the regions instead of focussing on just one district. It was also important as producers are coordinated under one regional association (VORAB). These empirical data collection methods in addition to literature review goes to triangulate and strengthen the data validity and reliability.

Data Analysis

Identification of Pollen Types in Honey Samples

Determination of the pollen in honey samples (botanical origin) was done by the Quality Services International, GmbH in Germany based on the pollen spectrum proposed by Louveaux *et al.*, (1978). This analysis is aimed at establishing the pollen content deposits (Godwin, 1934) in honey samples.

Physico-Chemical Analysis of Honey Samples

Pollen and physico-chemical analyses of honey samples were carried out by the Quality Services International, GmbH in Germany, under the EU parameters and regulations. Physico-chemical analyses were carried out following prescriptions described in the official methods of analysis of the Association of Official Analytical Chemists (AOAC, 1990) and the Harmonized Methods of the European Honey Commission (Bogdanov *et al.*, 1997). This is to establish the relation between the properties of quality honeys in the EU and the samples in this study. The chemical components of honey analysed include: Water (moisture) content, 5-Hydroxymethylfurfural (HMF), pH and Free Acidity, Diastase activity and Electrical Conductivity (EC).

Statistical Analysis

Data were analysed using Microsoft Word, Excel and Statistical Package for Social Sciences (SPSS) version 20. Data from pollen and physico-chemical analysis of honey were entered into an excel spreadsheet for easy manipulation and analysis. Survey data were first of all coded, and entered into the SPSS platform for easy management and analysis. Through descriptive statistics (Crosstabs), the association between demographic variables were established, using an alpha level of .05, Chi Square values and Cramer's V.

Field Observation

Literature is clear on the race of honey bees in Africa and for that matter Ghana. This knowledge was readily available in tracing the entomological source of honey in the study region. Also, apart from practical observation of bee foraging activities, the field observation was critical in understanding the foraging activities during the studies. It also informed whether pollen or nectar were being collected at a particular time on a plant.

Key Informant and Focus Group Interviews

All key informant and focus group interviews were transcribed into text using Microsoft word (MS word) for onward use as part of the data analysis.

CHAPTER THREE

SUMMARY OF RESEARCH PAPERS

Paper 1

What are the Characteristics of a Geographical Indications (GIs) Registered Honey? A literature review

Intended for submission to the African Journal of Intellectual Property

Objectives

The main aim of this paper is to evaluate the characteristics of registered GI honeys through an extensive literature review (especially in Europe) as well as other GI products to understand GI attributes. The objectives are to examine documented information on GI products and GI honey through; literature search on Google Scholar- (for General GI literature), literature search using EU database (DOOR)- (on registered GI honeys) and finally, field observation through visitation to the production sites of both GIs and potential products, including honey and other products.

Materials and Methods

The main characteristics and storylines that describe GI honeys

An extensive review of literature was done on registered and potential GI products around the world. Also, 21 registered GI honeys in the EU (cases from 1996 to 2016), in Europe and Africa was carried out in order to identify the parameters that were characterized GI products and the storylines that described them. In addition to this, producers and production sites of some GIs were visited to gain supporting knowledge through field observations in Europe (Wadden sea lamb-Denmark) and Africa (unique honey producers in Kenya and Tanzania).

Results

I observed a number of elements and storylines that were important for the characterization of GI products which were largely applied for the GI honeys reviewed. For the purposes of this study, I grouped these parameters into three main themes as *Indicative Elements*, which include reputation for quality and high average price. *Essential Elements*, such as link between product quality and the natural or social environment of its origin. And *Supportive Elements*, availability of a relevant GI legal framework and institutions that promote GI development and production.

Going by the elements, there are some potentials in the case of the honeys in this study but more have to be done for its registration as a GI honey.

Paper 2

Botanical and Geographical characterisation of honeys from Ghana (Volta Region) based on pollen analysis

Submitted to the Journal of Apicultural Research

Objectives

The aim of this study was to analysis the botanical origins of honeys from the Volta region of Ghana through pollen analysis. In terms of which plant species are present in each honey sample in order to have an idea of the possible floral sources available to honey bees. A second objective was to evaluate the identified pollen types in relation to the vegetation zones in the respective districts where honey samples were collected in order to understand the geographical origin of the samples.

Materials and Methods

Sixteen (n=16) honey samples from ***Apis mellifera adansonii*** were collected from different beekeepers in the selected districts and were analysed for their respective pollen contents according to the pollen spectrum proposed by Louveaux *et al.*, (1978).

Results

Botanical Origin

The analysis showed that, several pollen types belonging to 21 plant families were identifiable in the sixteen honey samples. I observed that, eight of the honey samples could be classified as monofloral (they contained at least 45% of pollen of a single plant). The remaining eight samples could also be designated polyfloral honeys, with varying frequencies of different plant pollens with none dominating.

Several vegetation zones span the Volta region. Including costal grassland, mangrove swamps, guinea savannah, Sahel-savannah, mountainous wooded savannah and semi-deciduous forests. Each honey sample in relation to the respective district, could be linked to the vegetation types observed, which could aid in the final geographical origin determination.

Paper 3

Developing Geographical Indications (GIs) in Ghana: A Chemical Evaluation of Honeys from Volta Region

Submitted to the journal of Food Composition and Analysis

Objective

The aim of this paper is to evaluating the chemical quality of honeys from the Volta region within international standards (Mainly the EU standards) through physicochemical analysis, and to identify possible weakness in the Ghanaian honey industry by analysing the honey value chain.

Materials and Methods

The chemical analysis of the sixteen honey samples in this study were done according to the official methods of analysis of the Association of Official Analytical Chemists (AOAC, 1990) and the Harmonized Methods of the European Honey Commission (Bogdanov *et al.*, 1997). The various components analyzed were Water (moisture) content, 5-Hydroxymethylfurfural (HMF), Diastase values, pH values, Free acidity and Electrical conductivity.

Leaders of the honey producer associations in the study areas were interviewed one-on-one on honey value chain. This was supported with information from focus group discussions.

Results

Chemical analysis of honey samples

The results revealed the strength of honey samples in terms of its chemical components in relation to being wholesome or otherwise per the international quality standards. Honey samples recorded a mean water content of 20.1%; HMF of 26.9 mg/kg; Diastase activity of 15.3 Schade; pH value of 4.1; Free acidity of 31.1 meq·kg−1 and electrical conductivity of 0.6 mS/cm. In terms of quality, I observed that only six of the honey samples were designated as wholesome honey while 10 samples were designated as industrial honeys.

Beekeepers, honey packagers, retailers, consumers and supporting agencies such as NGOs and Government agencies, form the main honey value chain in Ghana.

Paper 4

Geographical Indications in Ghana: Assessing Consumer awareness for origin and certification labels

Summited to international Journal of Consumer Studies

Objective

The aim of this study was to assess how consumers in Ghana utilize food label information, factors that influence purchasing decision as well as awareness of the GI concept and other quality labels.

Materials and Methodology

I interviewed 206 consumers who were deliberately selected in a face-to-face interview using a questionnaire. The respondents were located at the Accra shopping mall and the University of Ghana Campus, all in the capital city of Ghana.

Results

I observed that most consumers read food labels mainly to check for manufacture and expiry dates. I also observed that two main certifying bodies; the Food and Drugs Authority and Ghana Standards Authority were well known by the consumers. These logos were more popular among consumers between the ages 18-25 and was gender sensitive in terms of females. Knowledge of the GI concept was very low among the Ghanaian consumer. Developing a GI in Ghana may be possible, however, a deliberate effort towards public education is key in the overall GI development process.

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CHAPTER FOUR

What are the Characteristics of a Geographical Indications (GIs) Registered Honey? A literature review

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ABSTRACT

A Geographical indication (GI) identifies a product as originating from a particular territory, where certain characteristics, qualities and a reputation of the product are essentially associated with that origin. GIs are an opportunity for livelihood improvement among producers of unique local products. However, this potential is unexploited in Ghana.

This papa discusses the various elements and storylines that mostly characterize all registered GI products especially, honeys registered within the EU with one example from Africa.

Various elements characterize GI registered honeys. These elements have been grouped into three for the purposes of this study and they include: *Indicative elements* (reputation for quality, high average price and producer organizations); *essential elements* (clear natural or human link to the geographical area of production) and *supportive elements* (relevant laws by the state, state institutions and supports by non- governmental research institutions). These elements would be necessary for the development, production and promotion of GIs in Ghana.

Key words: Geographical Indications, European countries, characteristics of a GI honey, Ghana.

INTRODUCTION

Geographical Indications (GIs) and the associated benefits such as market access, premium prices and protection of local brands (Bagal & Vittori, 2011), as well as the possible positive impacts on the diverse natural resources are of great interest in Africa (Nyaga, 2004). A geographical indication (GI), which is one of the intellectual property rights, is a sign used on goods that have a specific geographical origin and possess qualities, reputation or characteristics that are essentially attributable to that origin (WIPO, 2013). In general, GIs are collective rights, which protect reputation largely in agricultural economies, protecting goods obtained from endemic species, traditional breeds or specific know-how (Bérard, 2005; Vandecandelaere, *et al.*, 2009).

Many countries around the world have developed legal and policy frameworks for the support and protection of unique products as GIs (Barham & Sylvander, 2011). The government of Ghana also developed a GI ACT, (ACT 659) as far back as 2003 but it has still not been implemented. This may change soon, as a National Intellectual Property Policy and Strategy (NIPPS) is being developed. With this agenda, the country is currently collaborating with Switzerland in a Swiss-Ghana Intellectual Property Rights (SGIP) project under Ghana's trade policy reforms which has seen a review of the GI ACT for smooth implementation and GI building in Ghana.

In Ghana, beekeeping is an important part of agriculture, mainly for nutrition and as an alternate income source in diverse livelihoods (Nuru, 1999; Akangaamkum, *et al.*, 2010). In addition, the Ghana Standards Authority (Ghana Standard, GS 1064:2013) allows for and recognizes labelling honeys with geographical and botanical origins. The contribution of honey to a Ghanaian beekeeper's annual income has been estimated to be between 23% (Akangaamkum *et al.*, 2010) and 37% (Nyntsikor, 2009). The returns on investment measured in some part of Ghana in 2014 were 281%, demonstrating the profitability of the sub-sector (Ahmed, 2014). Furthermore, farm gate sales of honey contributed over 1 million USD to the Ghanaian economy in 2008 (Akangaamkum *et al.*, 2010). Over the years, beekeeping has generally increased across the regions of Ghana. Honey yield increased from a little over 236 tons in 2007 to over 428 tons in 2008 (Akangaamkum *et al.*, 2010). Beekeepers in the Volta region are among the best performing in the country, with an annual regional production of 34kg per beehive compared to the national average yield of 14kg per beehive (Ahmed, 2014). In addition, the Volta region is known to produce quality honeys that enjoys higher market premiums (Akangaamkum *et al.*, 2010).

The European Union (EU) certified Ghana as one of the African countries accredited to export honey to the EU market in 2011 (Ahmed, 2014). Though GIs have been touted as one of the best legal tools for the protection of goods in developing countries (Mara, 2008), Ghana is yet to register any unique products under a GI scheme. This means that the origin specialty market, associated with a consumer segment with substantial purchasing power, is not being tapped by Ghanaian producers. Thus, this study evaluated the characteristics of GI registered honey products in order to identify all the parameters and storylines that best describe them. This was done through review of general literature on GI products and registered GI honey cases in the EU DOOR data base and field observation. An outline of these elements would serve as a standard to measure the potential of honeys from Ghana for GI registration. The study will contribute to developing GI awareness and program building in Ghana.

MATERIALS AND METHODS

Examination of registered GI products and honeys within the European Union

A strong observation across the various GI literature reviewed so far shows that identifying a GI product is an important step in the development of GIs in every nation. Literature is replete with various elements that identify products with GI potentials (Vandecandelaere *et al.*, 2010; Blakeney *et al.*, 2012; Bramley & Biénabe, 2013).

This session employed three main data collection methods. The first step involved an extensive search and review of published literature on Google Scholar. The main focus was to review all published documents on potential GI products, registered GI products and any related literature on GIs. All documents that popped up on GIs were collated. Abstracts were read to filter relevant papers in connection with respective themes during each search. The selected papers were read fully for relevant information and literature cited. This exercise enabled a good review of both current and earlier literature spanning from 1973 to 2017.

The second phase involved general review of all published literature on registered GI foods within the EU with special focus on honey. This was possible with a special access to the EU DOOR data base at the University of Copenhagen. Many GI registered honeys were available on the DOOR data base, however, it was not possible to get access to full documentation on each of them. The search was therefore limited to registered GI honey cases with available access to documentation. In all, 21 GI registered honey cases in the EU from 1996 to 2016. This was to identify and understand all the other attributes of a potential GI products that are not described in the various GI honey application documents available on the EU DOOR database.

The third phase of data collection was through field observations at sites where potential GI products were being produced. Specifically, three such sites were visited in Denmark (the Warden sea lamb), Kenya and Tanzania (for honey production sites). These field visits largely contributed to the overall understanding of the criteria and key characteristics and storylines 'typical' to GI products especially, honeys. The reviewed GI honey cases and respective GI elements are condensed in Table 3 with further details on specific factors under each element in (appendix).

RESULTS

Main Elements that Characterised a GI Process

Various elements: reputation for quality; high average market value; organised producer associations; proof of geographical natural link or human link; product specificity; clear production processes; relevant GI legislation and relevant institutions, were key in the description and characterisation of the GI registration process observed during the study, (Table 3). For the purposes of this study, the elements have been grouped further under three main themes as ***indicative elements***, ***essential elements*** and ***supportive elements***. Factors within both indicative and essential elements were prominent in all 21 GI honeys registered within the EU while those of SE are mostly in the general literature.

Table 3

Summary of Registered EU GI honeys reviewed from 1996-2006

GI Honey	Country	Year of Reg.	Summary of GI descriptive elements and Freq. of occurrence
Mel Do Alentejo	Portugal	1996	
Miel De La Alcarria	Spain	1996	
Miel De Corse'/'Mele Di Corsica	France	2000	
Miel De Granada'	Madrid	2004	
Miel D'alsace	France	2005	
Miel De Sapin Des Vosges	France	2005	Description of the agricultural product /20 times
Miel De Galicia	Spain	2007	
Miód Wrzosowy Z Borów Dolnośląskich	Poland	2008	
Podkarpacki Miód Spadziowy	Poland	2010	Concise definition of geographical area /20 times
Miód Kurpiowski	Poland	2010	
Miód Drahimski	Poland	2011	
Miele Delle Dolomiti Bellunesi	Italy	2011	
Kočevski Gozdni Med	Slovania	2011	Link with the geographical area / 20 times
MiódzSejneńszczyzny/Łoździejszczyzny'/'Seinų/Lazdijų Krašto Medus'	Poland and Lithuania	2012	
Slovenski Med	Slovania	2013	
Miele Varesino	Italy	2013	National requirements /4 times
Miel De Tenerife	Spain	2013	
Miele Varesino	Italy	2013	
KRAŠKI MED'	Slovenija	2013	
Miel Des Cévennes	France	2015	
Miel De Liébana	Spain	2016	

Source: (http://ec.europa.eu/agriculture/quality/door/).

DISCUSSIONS

Indicative Elements (IEs)

The indicative elements consist of positive established reputation of the product, market prices that are higher than similar products, and the existence of producer groups or associations. The three elements are all relatively easily observable or measurable and indicate consumer perceptions and preferences, as well as possible collective efforts among producers. Each of the indicative elements are shortly described below.

Product's Reputation for Quality

Reputation, an opinion formed by consumers over a period of time (Bagal & Vittori, 2011) is a critical element for the marketing of GI products (Vandecandelaere *et al.*, 2009). For instance the sparkling wine from the Champagne region of France (Hughes, 2006). Information irregularities in the market conceal the real quality indicators usually on food labels and hinders purchasing choices. Consumers therefore base their choices on perceived average quality (Moschini *et al.*, 2008) with emphasis on the reputation of companies (Klein & Leffler, 1981; Shapiro, 1983). Quality is a key factor known for determining premium for a GI product (Deselnicu *et al.*, 2013).

Food quality may include safety routines. Safety analysis for food is key for its acceptance due to food safety pressures and mistrust of standardized foods produced by industrial agriculture, leading to increased consumer awareness and demand for transparency (Goodman, 2004). An example is where pesticide residues have been reported in hive products including honey. This condition could obviously, pose a threat to the health of consumers (Eissa, El-Sawi, & Zidan, 2014; Kiljanek, *et al.*, 2016). This could there explain why the EU for instance, has in place certain safety standard limits for honeys, which among other things include physico-chemical parameters such as: Water content (Max. 20%), HMF (Max. 80%), Diastase activity (Min. 8) ; pH value (Max. 4.5) and Electricity conductivity (Max. 0.8). Based on these standards, the honey is declared as of good quality and safe for consumption.

Higher Average Price

One way to evaluate a successful GI is its ability to offer opportunity for producers to differentiate their products and obtain higher prices (Deselnicu, *et al.*, 2013). Consumers place a higher market value on a product from a specific region, compared to the same product from different regions, usually due to special unique features attributable to the region (Giovannucci *et al.*, 2009, Vandecandelaere *et al.*, 2010). Example is the Rooibos tea from South Africa. Before its registration, there was a significant price difference between ordinary Rooibos and Rooibos with attributes such as originating in the mountain, wild harvested and organically or fair trade certified (Troskie, 2013). Similarly, the Nakornchaisri pummelo, known to be the principal ancestor of the present day grapefruit, was sought after by discerning consumers who were willing to pay a high market price even prior to its registration and protection as a GI in 2005 (Vandecandelaere *et al.*, 2009).

Organised Producer Associations

In most cases, producer groups and the like offer substantial advantages for GI production, e.g. Belletti (1999) argues that producer associations are necessary for the proper implementation of and compliance with a common code of conduct in production processes. This is for example the case for the South African Rooibos herbal tea (Leclercq, 2007). No single actor may successfully muster all dimensions of the GI process except with the collective expertise of all actors (Vandecandelaere *et al.*, 2009) which is possible through producer groups; key to implementing a GI policy (Barjolle & Sylvander, 2000; Blakeney *et. al.*, 2012). Collective action could help famers surmount the many challenges they face (i.e. funding, marketing of product and acquiring implements), enhance smallholders' position and promote inclusive agrifood value chains (Kilelu, Klerkx, & Leeuwis, 2016). Collective actions by producer groups aid in implementing new technologies, extension and advisory services, transportation and finance as well as policies and institutions (Poulton *et al.*, 2010; Hounkonnou *et al.*, 2012). It also enhances the producers' capacity towards the commercialization of their produce (Poulton *et al.*, 2010; Shiferaw *et al.*, 2011).

Since collective brands bear the collective reputation of a Regional product or a group of producers that are not individually known to the consumer (Winfree & McCluskey 2005; Fishman *et al.*, 2010) agricultural and other industrial firms sometimes sell their products under a collective brand such as a geographical indication (GI) or a group logo (Verbeke & Roosen 2009).

Essential Elements (EEs)

Proof of origin seems to be the main foundation of GI development. Essential elements show the links of a particular GI product to the region of production. In this case we describe both Natural and Human link of the product to the origin within the concept of terroir, product specificity and clear description processes within the production areas.

Geographical Natural Link

The proof of origin could either be through natural or human connections to the uniqueness of the product. For instance, the proof of origin the Mongolian Cashmere (An animal fiber harvested from a special goat) is natural link. Tseelei, (2008), explained that the quality of cashmere is determined by its diameter which is strongly dependent on climate and Mongolia has a very harsh climate (extremely cold and long winter) which makes the goats grow longer and finer wool than anywhere in a moderate climate. A GI honey from Poland ('Podkarpacki miód spadziowy') is from an area where the soils tend to be poor; mostly leached, and podsolic soils, both powdery and clayey. These soils and the topography (the Carpathian Foothills are located at an altitude of 350-600 m above sea level, and in the Lower Beskids and Bieszczady Mountains elevations reach 850 m above sea level) create ideal habitats for coniferous trees, in particular the European silver fir *(Abies alba)* (EC 2009/C 299/08).

Geographical Human Link

In terms of human link, the relationship factors may include cultural heritage, local know-how, folklore, traditional knowledge and skills (Vandecandelaere *et al.*, 2009-2010; Bagal & Vittori, 2011). For instance, in the Darjeeling tea of India, the human link is identified as the ''magical'' fingers of local women tea workers on the field (Besky, 2014) as part of elements that enhances its uniqueness of taste.

Product Specificity

Product specificity is one of the major factors that have had impact of GIs in Europe as it is critical to defining a clear niche market necessary to set up and implement the GI (Barjolle & Sylvander, 2000). The consent of consumers for specific attributes of agricultural and food products, particularly their culture, identity and means of sustainable production has increased in recent years (Vandecandelaere *et al.*, 2009). Different specific product characteristics can appeal to consumers. It can relate to intrinsic quality: such as aroma, texture, flavour, shape and colour, or extrinsic attributes: production methods, preparation and consumption (Vandecandelaere *et al.*, 2009).

According to the FAO (2012), a specific-quality product possesses characteristics that may be linked to its composition, production or processing method or marketing, and thus allow its differentiation. These characteristics could include factors such as issues on environmental conservation, fairer trade, and optimization of a heritage or the link to geographical origin. For Miód drahimski, a GI honey from Poland, this is what is said about its specificity… *'Miód drahimski' is high-quality honey characterised by a low HMF content and a high reducing sugar content. A specific feature of 'miód* *drahimski' is its high dominant pollen content, as indicated in 3.2. Apart from a high dominant pollen content, its main distinguishing feature is the proportion of pollen from unique relict and endemic plants. A particular feature of the poly floral honey is the great diversity of its pollen composition, no plant accounting for more than 35 % of the total, which is what imparts its rich* bouquet *of flavours*[2]

In the case of the Oku white honey, it is white in nature, only peculiar to the Kilum-Ijim forest, (presence of endemic flora sources for honey bees) that produces the honey perceived to be highly medicinal, nutritious with a strong flavour. These specific characteristics identified as its distinct white color give it its specificity (Blakeney *et. al.*, 2012).

Clear Production Processes

Clear Production processes are among other factors frequently mentioned in GI honey registration in the EU data base. Description of the production process, are a crucial element of a GI's credibility (Bagal & Vittori, 2011). The *sui generis* legislation requires that producers apply for protection of the GI by submitting a request accompanied by Product Specifications (PSs) which must contain the rules applying to the production process (Barham & Sylvander, 2011). In the application submitted for 'Miel de Tenerife' (Spanish GI honey registered in 2013 as PDO), description of

2 See EC (2009/C 260/10) (30.10.2009): Council Regulation (EC) No 510/2006- Application pursuant to Article 7 and Article 6(2) 'Miód Kurpiowski' (PGI). Official Journal of the European Union C 260/38.

production processes was a key component. Below is the specific steps in production that must take place in the defined geographical area[3].

'Miel de Tenerife' is produced, extracted and prepared for sale in the defined geographical area, i.e. on the island of Tenerife.

The honey is obtained from hives installed in the island's different ecosystems. The combs containing the capped honey are transported to rooms on the premises where the honey is extracted by cold centrifuging only and filtered as soon as it comes out of the extractor, so that the stored honey is free of physical impurities, ready for packaging, irrespective of its physical state. The extracted honey is poured off into special honey settling tanks or pails made from food-grade material, labelled with the information needed to ensure traceability.

Supportive Elements (SEs)

The third category of elements that characterizes the GI framework is what we call the Supportive Elements, which also covers enabling elements. These are usually external to the local producing community or region. For purposes of this study these elements are defined as supporters or enablers provided by the state as well as local or international NGOs during the entire process of developing a GI product. The state dimensions include the provision of GI laws, policies, regulations and relevant institutions. These come in the form of GI protection laws (*Sui generis* or trademarks), appropriate regulations, long term policy directions on the various processes,

[3] EC (2013/C 235/05) (14.8.2013): Council Regulation (EC) No 510/2006 - application, pursuant to Article 51 and Article 50(2)(a) 'Miel De Tenerife' (PDO). Official Journal of the European Union C 235/5

as well as dedicated national offices with right staff and accessories to implement the processes, registration and protection of products. Non-governmental organizations (local NGOs or international development organizations and agencies), usually promote such initiatives with an aim to drive improved economic empowerment in rural communities through rural livelihood improvements interventions: in this case capacity building and training workshops, provision of basic equipments to start production and sometimes, the provision of capital for start-ups. All these institutions also serve largely as consultants at the various levels of the GI development.

Relevant GI Legislation

A relevant legislative instrument is key for protection and promotion of GI products. From the various GI cases reviewed, it is worthy to note that several issues (strategic GI policies, Laws and intuitions) necessary for developing a successful GI regime were important. Indeed Bowen & Zapata, (2009), explained that GIs are protected under a wide range of institutions and arrangements which are found throughout the world. For instance, one of the earliest systems for GI protection of food products is the French appellation d'origine coˆ ntroleˊe (AOC), first codified in 1905 where food products that meet AOC regulations: link to show that they are made in a particular geographical area, can have a French government issued stamped on them (Colman, 2008). This system spread outside France so that by 1958, the Lisbon Agreement made way for common ''appellation of origin'' protection for products originating in signatory countries, mostly from Europe.

Currently in the EU, member states have subscribed to a *sui generis* legislation (Barham & Sylvander, 2011; Gragnani, 2012) under a regional instrument, Council Regulation 2081/92, providing protection for certain agricultural products and foodstuffs, where there is a clear link between the product or foodstuff and its geographical origin (O' Connor & Company, 2005).

In the United States, protection of origin products (known within EU and Ghana mainly as GIs) is provided under the regular trademark doctrine through the concepts of "certification marks" and "collective marks" (U.S. Patent & Trademark Office, 2003). This is demonstrated in the protection in the Real Wisconsin cheese and 100% Kona Coffee (U.S. Patent & Trademark Office, 2003). Also, in South Africa, Rooibos tea is protected under a Trademark law[4]. These laws together with relevant regulations and policies have seen the registration of numerous products especially within the EU.

State Institutions

In the development of GIs, researchers have stressed the importance of state institutions (Sonnino & Marsden, 2006). Strong national support for GIs should not be underestimated especially to ensure that local populations share in the long term benefits (Bowen, 2010). In Europe for instance where GIs are probably widely developed, the concept had benefited largely from strong institutions (Chabrol, 2015). The support of the state through political and institutional environment including legal recognition play key roles in implementing GIs in helping local populations benefit from origin-based schemes (Giovannucci *et al.*, 2009; Sautier *et al.*, 2011). For instance the

[4] South African Rooibos Council "Rooibos Plant" available at *http://www.sarooibos.org.za/rooibos-plant-factfile-74* (Last visited, May 3, 2016)

European Union and the Ministry of Agriculture are major driving forces of GIs in Europe (Marie-Vivien *et al.*, 2014).

Local and International Non-Governmental Institutions

Though not widely spread in most of the EU GI honey cases reviewed, it was obvious in the processes of other cases. For instance aaccording to Blakeney *et al.*, (2012), the Government of Cameroon through its Ministry of Agriculture and the Ministry of Trade and Industry, various international development agencies such as SNV (Netherlands Development Organization) and AFD (French Development Agency), including bigger beekeeper groups, in particular, the Apiculture and Nature Conservation Organization, (ANCO), were instrumental towards the GI protection for Oku White Honey.

CONCLUSION

In conclusion, various attributes are known to best describe GI honeys and have been identified and grouped as *Indicative, Essential* and *Supportive* elements according to this study.

Based on these identified characteristics, a guide for the assessment of GI potentials for various honeys in Ghana could be developed and implemented. This will enable Ghana to identify all qualified honey products for further registration and protection of GIs under its laws.

This studies will therefore inform GI policy in Ghana, especially in the case of the honey industry.

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CHAPTER FIVE

Botanical and Geographical characterisation of honeys from Ghana (Volta Region) based on pollen analysis

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ABSTRACT

Different types of honey attract different premium due to attributes such as taste, colour, wholesome, and floral sources. Globally mono/unifloral usually command higher commercial value. Determination and certification of the floral sources and the geographical origin of honey plays an important role in honey quality control. However, the botanical and geographical origin of honeys are largely unknown in Ghana. This study examines the pollen sources of 16 honey samples using pollen analysis.

Pollen from 21 plant families were identified. Seven families were found in >50% of the samples: Malvaceae (*Ceiba* sp.), Combretaceae, Arecaceae (*Elaeis guineensis*-Oil palm), Poaceae, Asteraceae (*Viguiera* sp.), Anacardiaceae and Sapindaceae. Arecaceae, and Asteraceae were found in 100% honey samples; Combretaceae in 94% and Poaceae in 88%. Eight honey samples had pollen loads which exceed the minimum for mono/unifloral honeys making them qualify as monofloral honey (Ebenaceae 67%; Anacardiaceae 54%; Moraceae 49; Combretaceae 81%, 60% &53%; and

Arecaceae 56%). The identified pollen links honey samples to the vegetation in the various localities in the Volta region.

Keywords: Pollen analysis, honey, geographical origin, botanical origin, Ghana

INTRODUCTION

Honey commercialization is a global phenomenon involving nearly 150 countries, hence honey identification as well as proof of origin and authenticity is an important discuss around the world (Kaškonienė, & Venskutonis, 2010). The components of honey is closely associated with its botanical source and the geographical area of origin (Castro-Vázquez, Díaz-Maroto, De Torres, & Pérez-Coello, 2010). Honey components like nectar and pollen, as well as sensory and physico-chemical features, can be used to determine the geographical and botanical origin of honey (von der Ohe, Oddo, Piana, Morlot, & Martin, 2004). Differences in nectar content, together with other factors such as climatic conditions, soil type and beekeeper activities, contribute to the existence of different types of honey (Anklam, 1998).

Each flower species has a unique pollen grain which may be studied to determine the geographical origin and major floral sources of a honey (Petersen & Bryant, 2011). The analysis of pollen in honey gives information about the important plants more or less depended on by honey bees for their pollination. Pollen analysis also provide information about honey extraction, filtration and fermentation (Russmann, 1998), adulteration (Kerkvliet, Shrestha, Tuladhar, & Manandhar 1995) and hygienic aspects such as contamination with mineral dust, soot, or starch grains (Louveaux, Maurizio, & Vorwohl, 1978).

African governments, are promoting various small-scale income generating activities and beekeeping to create jobs (Abdulai & Abudakari, 2012; Micheal, 2008). This also include various innovative path ways such as labelling and certifying local produce through geographical indications (GIs), as a way of adding value to local produce, to increase monetary value for producers (Grant, 2005). This study forms part of an agenda to develop and label food product under a GI scheme in Ghana.

Since its introduction into the Trade-Related aspects of Intellectual Property Rights (TRIPS) Agreement, GIs assumed political and economic interest in countries of the global south (Ilbert & Petit, 2009). It is considered as one of the schemes appropriate for rural development (Bramley *et al.*, 2013). E.g. GI food products in the EU is worth €54.3 billion worldwide (Chever, Renault, & Romieu, 2012). GIs principally link a product to its geographical area which is necessary for niche marketing and brand development (Correa, 2007; WIPO, 2013). A number of factors in a particular territory may impact unique features onto the final food product. The factor may include: the physical-chemical properties of soils and/or water; altitude; local animal breed or plant species (which adapt to a specific environment over time); as well as traditional knowledge; skills and equipment (Giovannucci *et al.*, 2009, Vandecandelaere *et al.*, 2009).

In Ghana, honey is produced in all ten regions since the agro-ecological conditions are suitable. The Volta region is credited for producing high volumes of quality honey. Although current data on the honey sector is limited, a comparative price analysis of honey across the ten regions of Ghana suggested that, honey from the Volta and Eastern regions enjoy high price premium compared to other regions (Akangaamkum *et al.*, 2010). Over one million USD was contributed to the local Ghanaian economy in 2008 through newly improved method of beekeeping (Akangaamkum *et al.*, 2010). The country also has potential to participate in the ever growing international honey market (Akangaamkum, *et al.*, 2010).

However, the local honey market is not yet characterised in terms of the use of pollen, sensory and other parameters to differentiate honeys in Ghana. A number of studies have been done on the chemical and microbial components of Ghanaian honeys (Ankrah, 1998; Akpabli-Tsigbe, 2015). However, information about the botanical and geographical origin is limited. Honey packaging has been shown to have a strong influence on consumer preference (Gyau, Akalakou, Degrande & Biloso, 2014). The botanical and geographical information could improve quality labelling by way of quality information on honey package.

This paper evaluates the botanical and geographical origin of honey samples from the Volta region of Ghana by studying the pollen content of honey samples from the study area (pollen analysis). This is essential to determine the most important floral resources available and exploited by *Apis mellifera* in the region. The information is also crucial towards the development and labelling of honeys as a GI product in Ghana.

MATERIALS AND METHODS

Study Site

This study was done in four districts in the Volta region: Kadjebi, Adaklu, Ho West and Akatsi South as shown in figure 6 above. An essential parameter for the development of a particular GI product is the presence a producer association or semblance of same. This is necessary for the implementation of common code of practice among producers (Belletti, 1999; Blakeney *et. al.*, 2012). The region was therefore chosen for this reason. The Volta region produced high volume per hive (34kg per beehive per annum) of honey compared to the national average yield of 14 kg per beehive per annum (Akangaamkum *et al.*, 2010; Ahmed, 2014).

Honey samples

Sixteen (n=16) honey samples from *Apis mellifera adansonii* were collected from different beekeepers in the Volta region of Ghana, during the 2014 and 2015 harvesting season (Table 4). Kadjebi (n=6); Adaklu (n=4); Ho west (n=3) and Akatsi south, (n=3). The honeys were obtained by draining decapped combs and it was stored in plastic containers used to store food. Each honey sample was labelled with date, locality, district and region and kept at clean dry place in room temperatures between 28 - 30 °C until analysis were carried out in June 2015.

Table 4

Honey samples and date of harvest from the districts

District	Number of samples	Date of harvest
Kadjebi	6	March and April, 2015
Adaklu	4	November, 2014 and May, 2015
Ho west	3	December, 2014 and January to May, 2015
Akatsi south	3	November, 2014

Brief Background on the Districts

Kadjebi District

The Kadjebi District is located on Longitude 7.5299° N and Latitude 0.4738° E. With an average height of 180 metres above sea level, and peaks at 600 metres towards the Ghana-Togo border. The District is characterised with landscape of hills, mountains and valleys with three major rivers, namely; Asukawkaw, Wawa and Menu Rivers. The average monthly temperature is about 25°C with a general heavy rainfall between 1400mm and 1800mm which starts from March, peaks in June, and ends between October and November each year. The vegetation generally is green with trees covering a landscape of mountains, hills and valleys especially in the rainy season. About 90 percent of the district is predominantly covered with secondary rain forest and here are several animal species including an abundance of honey bees.

Adaklu District

The Adaklu District is located on Longitudes 06°41′1″N and 6.68361°N and Latitudes 00°20′1″E and 0.33361°E. It is characterized by hills, mountains, lowland and generally rather undulating landscape. The very high areas rise to heights of 305 metres above sea level with the Adaklu Mountain featuring prominently. They are dominated by rivers like Awator, Tordze, Todzoto, Dawa, Kalakpa and other streamlets like Kpoduekpodue, and Anfoe. Mean monthly temperature ranges between 22°C and 32°C. The rainfall pattern is characterized by two rainy seasons. The major season starts from mid-March to July while the minor from August to November. The mean annual rainfall of the District ranges between 20.1mm and 192mm and peaks in June. Savannah woodland is the major vegetation cover in the District. However, few areas, mostly Adaklu-Aboadi and the river banks of Kalakpa and Awator have semi-deciduous forest. There are also strands of *Borassus* sp. (Agorti) used mainly for construction works as well as local beehives by honey producers (observed during this study).

Ho West District

Ho West District is located between latitudes 6.33˚ 32" N and 6.93˚ 63" N and longitudes 0.17o 45" E and 0.53o 39" E. with a land area of 1,002.79 square kilometres. Annual mean temperature range is from 16.5˚C to 37.8˚C. The major rainy season is from March to June while the minor is from July to November. The general drainage pattern is southwards and dominated by rivers like Tsawe (Alabo) and Kalakpa, which eventually flow into the lower Volta or Avu Lagoon. Mean annual rainfall is between 120.1mm and 192mm which in June. The main vegetation zones include the moist semi-deciduous forest which mostly covers the hills in the District and savannah woodland.

Akatsi South District

The Akatsi South District is located between latitudes 6^0S 7^0N and longitudes 0^0W 1^0E. The district falls within the coastal savannah equatorial climatic regime characterized by high temperatures between 21°C and 34.5°C, relative humidity 85% and rainfall regime of 1,084 mm with Distinct wet and dry seasons of about equal lengths. The vegetation is made up of coastal savannah with marshy and sandy portions. The velvet tamarind' (*Dialium guineense)* is a predominant tree species found in most parts of the areas surrounding Akatsi town. The around the Avu lagoon is also dominated by reeds.

Pollen Analyses

Determination of the botanical origin of honey samples was based on the pollen spectrum proposed by Louveaux *et al.,* (1978) as described in the introduction under the general study sites and methodology section.

RESULT AND DISCUSSION

Pollen spectrum of the analysed honey samples is given in Table 3 and the predominant pollens also in Table 5. Pollen types were mostly identified to the family level. However, pollen types in about half of the samples were identified to species levels. Identifying pollen types to species level give more information about the actual diversity in resources utilized by honey bees and therefore about habitats visited, time of day visited, and plant distance from the hive, (Jones & Bryant, 2014). For the purposes of this study, pollen types will be represented mostly by their family names with species or common names in brackets.

In the Kadjebi district, a total number of 57 pollen types of varying percentages belonging to 13 families were recorded. Predominant pollens recorded in samples from the district include, 67% Ebenaceae; 54% Anacardiaceae and 83%, 81% and 49% Moraceae (Table 5). This suggests they are among the important resources for honeybees in the district. Also, Asteraceae and Arecaceae might be important resources as pollen was found in all samples as either secondary pollen, minor pollen or identified pollens in samples from the District (Table 6).

Table 5

Predominant pollen (PP) per percentage concentration by individual samples by study sites.

	Districts							
	Kadjebi				Adaklu			Ho west
Honey samples	1	2	4	5	7	8	9	13
Frequency class	Ebenaceae, (67%)	Anacardiaceae, (54%)	Moraceae, (49%)	Moraceae, (83%)	Combretaceae, 81%)	Combretaceae, (60%)	Combretaceae, (53%)	Arecaceae (*Elaeis guineensis*), (56%)

A total of 33 pollen types belonging to 15 families were recorded in honey samples from the Adaklu District (Table 6). Combretaceae was found as a predominant pollen in three of the four samples and as minor pollen in the last one indicating that, plants from this family could be a significant flower source for honey bees in the district. Other important flower sources are Arecaceae (*Elaeis guineensis*) and Fabaceae (*Julbernardia* sp.) which were found as minor or secondary pollens in all four samples.

In the Ho West District, 27 pollen types belonging to 14 families were recorded (Table 6). The Asteraceae (*Viguiera* sp.), Combretaceae and Arecaceae (*Elaeis guineensis*) families seems to be the most plant sources visited by bees as their pollen is found in all samples either as Secondary pollen or Minor pollen, apart from Arecaceae (*Elaeis guineensis*) where it was recorded as predominant pollen in one sample. Although Poaceae and Sapindaceae pollen were identified in all samples, the small amounts indicate that they are not significant plant sources.

A total of 25 pollen types belonging to 14 families were recorded in samples from Akatsi South District (Table 6). Pollen from the three families Asteraceae (*Viguiera* sp.), Combretaceae and Arecaceae (*Elaeis guineensis*) was found in all samples as either secondary pollen or minor pollen apart from one sample were it was only identified indicating that they are the most important floral sources. No predominant pollen was found

Table 6

Pollen spectrum of honeys studied. (Where SP, refers to secondary pollen; MP, minor pollen and PP,

Family	Pollen type	Honey samples															
Districts		Kadichi						Adaklu			Ho west				Akatsi south		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Acanthaceae		IP	IP	IP	IP	-	-	-	-	-	-	-	-	-	-	-	-
Anacardiaceae		-	PP	SP	MP	IP	SP	-	-	-	IP	IP	IP	IP	IP	-	-
Asteraceae	*Viguiera sp.*	SP	SP	IP	MP	MP	MP	IP	IP	IP	SP	SP	SP	MP	SP	SP	IP
Araliaceae	*Schefflera sp*	-	-	-	-	IP	IP	-	-	-	MP	IP	-	IP	IP	IP	-
Arecaceae	*Phoenix*	-	-	-	-	-	-	-	-	-	-	IP	-	-	-	-	IP
Arecaceae	*Elaeis guineensis*	M-	MP	MP	SP	MP	MP	MP	SP	SP	MP	SP	SP	PP	SP	SP	SP
Apiaceae		-	-	-	-	-	-	-	-	-	IP	IP	-	-	-		-
Combretaceae		IP	MP	-	IP	IP	SP	PP	PP	PP	MP	MP	MP	MP	MP	MP	SP
Ebenaceae		PP	-	SP	-	-	-	-	-	-	-	-	-	-	-	-	-
Fabaceae	*Acacia sp*	-	IP	IP	IP	-	-	-	-	-	IP	IP	IP	-	-	-	-
	Mimosa pudica	-	-	-	-	-	-	-	-	-	SP	-	-	MP	-	SP	IP
	Dichrostachys sp.	-	-	-	-	-	-	MP	MP	MP	-	-	-	-	-	-	IP
	Julbernardia sp	IP	-	IP	IP	-	-	-	-	-	-	-	-	-	-	-	-
Malvaceae	*Ceiba sp*	MP	MP	MP	IP	IP	IP	IP	IP	IP	-	-	-	-	-	-	-
Moraceae		-	-	-	PP	PP	MP	-	-	-	IP	MP	SP	-	-	-	-
Myrtaceae		IP	IP	IP	IP	IP	SP										
Poaceae		IP	IP	IP	IP	IP	IP	-	IP	IP	IP	IP	IP	IP	SP	IP	-
	Zea mays	-	-	-	-	-	-	-	IP	IP	-	-	-	IP	IP	IP	-
Palmae		-	-	-	-	-	-	-	-	-	IP	IP	-	-	IP	-	-
Sapindaceae		-	-	-	-	-	-	IP	IP	IP	IP	IP	IP	IP	IP	IP	-
Rutacea																	SP

Source: Pollen analysis of honey samples from this study.

Across Districts

The Asteraceae (*Viguiera* sp.) Arecaceae (*Elaeis guinensis*) and Combretaceae families formed a major source of food across the districts. Pollen of plants belonging to Asteraceae and Arecaceae were found in all 16 honey samples analysed, while Combretaceae was found in 15 samples. Members of the family Poaceae were found in 14 samples. This suggest many grasses were of importance to honey bees within these districts. The greatest number of different pollen types across the districts was found in the Arecaceae, Fabaceae and Poaceae families which for the last two families has also been recorded in similar studies from Eastern Texas in USA, (Jones & Bryant, 2014) and some districts in Portugal (Feás, Pires, Iglesias & Estevinho, 2010). In these two studies, four pollen types from Fabaceae (*Acacia* sp., *Mimosa pudica*, *Julbernardia* sp., and *Dichrostachys* sp.), two from Arecaceae (*Phoenix dactylifera* and *Elaeis guineensis*) and two from Poaceae (various grasses and *Zea mays*) were recorded.

Botanical Origin

The pollen frequencies show that eight honey samples could be classified as a monofloral or unifloral honey and eight samples as multifloral or polyfloral honey. Monofloral/unifloral honeys contain at least 45 % of nectar from a single plant species (Maurizio, 1975) although there might be exceptions as the degree to which pollen of different plant species is represented in honey varies (Persano Oddo *et al.*, 2004). The possible monofloral honeys identified in this study are honeys with 67% pollen from Ebenaceae (sample from Kadjebi), 54% pollen of Anacardiaceae (sample from

Kadjebi), 49% and 83% pollen from Moraceae (samples from Kadjebi), 81%, 60% and 53% pollen from Combretaceae (samples from Adaklu) and 56% of pollen from Arecaceae (sample from Ho West). It seems a consistent production of monofloral honey is most possible from Adaklu district as three of the four analysed samples had a predominant content of Combretaceae pollen whereas for the other districts only one or two of the samples had the same PP if any at all.

Botanical origin of honey is a key quality indicator that affect honey prices. Monofloral honeys are appreciated more than polyfloral ones, due to their flavour and aromatic properties (Ferreres, Andrade, Gil, & TomaÂ s-BarbeÂran, 1996). Therefore from the economic standpoint, the assessment of a monofloral origin may increase the commercial value of these honeys (Pires, Estevinho, Feás, Cantalapiedra, & Iglesias, 2009).

Geographical Origin

The geographical origin of honey can be established through the pollen content (Anklam, 1998; von der Ohe *et al.*, 2004). Important considerations for determining geographical origin of honey include the type of predominant pollen, secondary pollen, minor taxa, the overall pollen spectra and the percentages of each pollen type (Maurizio & Louveaux 1965). The Volta Region spans vegetation zones including costal grassland, mangrove swamps, guinea savannah, Sahel-savannah, mountainous wooded savannah and semi-deciduous forests (Population and Housing Census; PHC (2013). The variation observed in the botanical diversity of honey samples could be explained by the different vegetation found in the sampling locations, although all honey samples were harvested at locations within the same region during this study.

For instance the presence of Arecaceae *(Elaeis guineensis)*, Asteraceae *(Viguiera* sp.) Combretaceae pollen in the honey samples reflects the vegetation of lowland rainforest and Guinea Savanna (White, 1983) hence suggesting the origin of the honey samples.

Ten out of the 13 pollen types recorded in the Kadjebi district: Anacardiaceae, Fabaceae, Araliaceae, Malvaceae, Combretaceae, Ebenaceae, Arecaceae, Moraceae and Myrtaceae belong to plant species that are located in tropical forest landscapes (White, 1983) and this is not surprising. About 90% of the district is covered with secondary rain forest (GSS, 2013). Anacardiaceae found in five of the six samples (54%, 42%, 28%, 11%, IP) from Kadjebi and only identified in honeys from the three other districts might be the most important indicator of the geographical origin of honey from the district. Another indicator might be Ebenaceae (67%, 19%) which although only recorded in two samples was only found in Kadjebi. Moraceae recorded from three districts but only as predominant pollen in honey from Kadjebi district (83%, 49%) might contribute to making the honey from the district different from the honeys from the rest of the districts.

The main vegetation in the Adaklu district is the woodland savannah with few areas, mostly Adaklu-Aboadi and the river banks of Kalakpa and Awator having semi-deciduous forest (GSS, 2013). According to White, (1983) members of Anacardiaceae, Fabaceae (*Acacia* sp), Araliaceae (*Scheflerra* sp.), Combretaceae, Moraceae, Palmae, Sapindaceae Poaceae, Asteraceae, Apiaceae, Arecaceae (*Elaeis guineensis*) and Malvaceae (Ceiba tree) could be found in both woodland savannah and forest vegetation only. Occurrence of these pollen types in honey can therefore confirm the vegetation of the Adaklu district. Combretaceae pollen which were recorded as PP in three of the samples and as MP in the last sample from the district seems to be the most important indicator making honeys from the district distinguishable from honey from the other districts where although recorded in all samples it was only found as secondary in two samples from two different districts (4%, 11%) or less (M, IP).

Plant families such as the Anacardiacea, Araliaceae (*Scheflerra* sp.), Asteraceae (*Viguiera* sp.), Combretaceae, Arecaceae (*Elaeis guineensis*), Poaceae, Moraceae, Sapindaceae, Apiaceae, Poaceae (*Zea mays*), Palmae, Arecaceae (Phoenix dactylifera) and Fabaceae (*Mimosa pudica*) depicts a vegetation types of forest, semi-deciduous forest and woodland savannah as found in Ho West District (White, 1983, GSS, 2013). Arecaceae (*Elaeis guineensis*) which was recorded as PP or SP in the three samples from Ho West seems to be an important nectar source in the District. However, it was also recorded as either SP or MP in all samples from the other three Districts hence could necessarily indicate the geographical origin for samples from the District.

The vegetation in Akatsi District is mainly coastal savannah (GSS, 2013). Pollen types of the Anacardiacea, Araliaceae (*Scheflerra* sp.), Asteraceae (*Viguiera* sp.), Combretaceae, Arecaceae (*Elaeis guineensis*), Poaceae, Moraceae, Sapindaceae, Poaceae (*Zea mays*), Palmae, Arecaceae (*Phoenix dactylifera*) Fabaceae (*Mimosa pudica*), Rutacea and Fabaceae (*Dichrostachys* sp.) which represent savannah vegetation (White, 1983) were recorded in honey samples from the district confirming the geographical origin of the honey. Although pollen from Asteraceae, Arecaceae and Combretaceae were found as IP, MP or SP in all three samples from the district they were not found in amounts which differ from samples from the other districts.

CONCLUSION

This study has provided important floral sources for honey bees in the study areas.

The pollen analyses showed that eight of the honey samples could be classified as unifloral or monofloral honeys. Ebenaceae, Anacardiaceae and Moraceae are key plant families in Kadjebi District; Combretaceae is a key plant family in Adaklu and Arecaceae was a key plant family in the Ho West District.

The Arecaceae and Asteraceae were recorded in all honey samples analysed. Pollen of the family Fabaceae (*Dialium guineense)* was not recorded in honey samples from the Akatsi south district though it is believed to be widely distributed in the District.

The botanical and geographical origin of honey samples analysed have been determined. It is possible to differentiate the geographical and botanical origins of honeys from the various Districts of the Volta Region based on variations in vegetation.

The analysis therefore confirms the geographical origins of honeys from the Volta Region as represented by the pollen in the plant families.

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CHAPTER SIX

Developing Geographical Indications (GIs) in Ghana through Chemical Evaluation of Honeys from Volta Region

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ABSTRACT

Honey quality is influenced by a swarm of variables related to production, climate, maturity, processing and storage, environment and nectar sources. Sixteen honey samples were analysed for water (moisture) content, Hydroxymethylfurfural (HMF), pH, diastase activity, free acidity and electrical conductivity, and its implications along the honey value chain.

Results showed mean value for water content at 20.1%; pH 3.8; HMF 26.9 mg/kg; diastase activity 15.3 DN; free acidity 31.1 meq/kg and electrical conductivity 0.6 mS/cm. Six honey samples complied with limits stipulated by the European Union and Ghana Standards as 'Table honey' and ten samples qualified as 'Industrial honeys'.

The results suggest a need for an urgent capacity building for honey producers on proper handling (harvesting, processing and storage) of honey. Improved honey quality is necessary for the development of GI honey in Ghana. It will equip beekeepers in Ghana supply both domestic and the ever

growing global honey market, and reap the benefits associated with these markets.

Keywords: Honey; chemical evaluation, geographical indications, Ghana

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 (Bogdanov *et al.*, 1999). Over the years, the physicochemical properties and sensorial, microbiological characteristics have been used to determine the quality of honey (Cantarelli, Pellerano, Marchevsky, & Camiña, 2008). 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 criteria for physicochemical qualities of honey, which include sugar and moisture content, electrical conductivity, free acidity, diastase activity and Hydroxymethylfurfural (HMF) are specified in European Union Council Directive (EU Directive, 2002). 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 (Louveaux, Maurizio, & Vorwohl, 1978). The authenticity and origin of the honey, may enhance its market access and value (Castro-Vázquez, Díaz- Maroto, & Pérez-Coello, 2007).

Honey is a global commodity with many variations in the international market (EU, 2014). On the African continent, honey production remains a vital means of subsistence as well as for international exports. Domestic markets in Africa has expanded and in Ghana, honey has been in high demand (Akangaamkum *et al.*, 2010).

Ankrah (1998) 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 clacium and 1.44 mg iron (per 100 g of sample). Despite this standard, there is a high perception of honey adulteration in Ghana (Akpabli-Tsigbe, 2015). Though specifics are not given, Abdulai & Abukari (2012) reported honey is sometimes adulterated in order to meet local demand.

This study is part of an investigation into developing a geographical indication for honey meant to enhance monetary value of honey in Ghana. This price premium may be achieved by protection through an intellectual property law in the form of geographical indications (GIs) labels. The chemical qualities of Ghanaian honey are being analysed in this study because, quality is one of the most important factors that attracts price premiums from consumers when using a GI label (McCluskey, 2007). GI labels may assure consumers of a more genuine, unique, and higher quality food (Broude, 2005).

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 (Ankrah, 1998), analysis of the chemical and microbial components of artisanal honey sold on the local Ghanaian market

(Akpabli-Tsigbe, 2015) and a physicochemical and microbiology analysis of 24 honey samples from bee farms located in two districts in the Brong Ahafo region of Ghana (Adjaloo, Asare, Appaw, & Boahene, 2017). Although Akangaamkum, *et al.*, (2010) reported high production volumes of good honey by beekeepers in the Volta region as compared to other regions in Ghana, no information is available on the physicochemical properties of the Volta honey. The aim of this study is to fill this knowledge gap by evaluating the quality of Ghanaian honey according to international standards (focussing mainly on the EU standards) through chemical analysis, and to identify possible weaknesses in the Ghanaian honey value chain. The latter is done through a mapping of the Ghanaian honey value chain and a discussion of how identified weaknesses are related to operators and actors at different stages of the value chain.

MATERIALS AND METHODS

Study Area

The sites for this study are located in the Volta Region of Ghana. The Region has a total land area of 20,570 square kilometres and lies along the South-Eastern part of Ghana. It is about 500 kilometres in length from South to North and spans all the following vegetation zones: Costal Grassland, Mangrove Swamps, Guinea Savannah, Semi-Deciduous Forest, Sahel-Savannah and Mountainous Wooded Savannah. Mean annual temperatures range from 21-32 degree Celsius and rainfall lies between 1,168 mm and 2,103 mm (GSS, 2013). The study expanded four districts: Kadjebi, Ho West, Adaklu and Akatsi South (Fig. 6 above). The selection of the region was based on the existence of organized and controlled beekeeper activities in a form of a regional association.

The Kadjebi District covers 690 Km^2 in the northing part of the Volta Region where the average monthly temperature is 25˚C and rainfall reaches as much as 1800mm per year. The average altitude is 180m.a.s.l. with some peaks at 600 metres, and the landscape is characterised by hills, mountains and river valleys, being covered mainly by secondary rainforest.

The Adaklu District is located on central part of the Volta Region and is characterized by hills, mountains, lowland and generally rather undulating landscape. Mean monthly temperature ranges between 22°C and 32°C. The mean annual rainfall of the district is 1250mm and peaks in June. Savannah woodland is the major vegetation cover with few river banks of semi-deciduous forest.

Ho West District is located in the central part of the Volta Region with annual mean temperature range from 16.5˚C to 37.8˚C. Mean annual rainfall is between 120.1mm and 192mm. The main vegetation include the moist semi-deciduous forest which mostly covers the hills in the District and savannah woodland.

The Akatsi South District is located in the Southern part of the Volta Region and falls within the coastal savannah equatorial climatic regime characterized by high temperatures between 21˚C and 34.5˚C, relative humidity 85% and rainfall regime of 1,084. The vegetation is made up of coastal savannah with marshy and sandy portions.

Honey Value Chain

Information regarding the Ghanaian honey value chain and the different phases of production were collected through literature review, key informant interviews and group discussion. One interview session was conducted with two key leaders of local producer associations in each of the four districts, focusing on general knowledge on production, harvesting and processing and marketing of honey in the districts. Finally, group discussions with members of each local association in the district focused on mainly confirming issues discussed above during key interviews with group leaders.

Honey samples

Sixteen honey samples (HS) from different beehives were collected from beekeepers. The honey were produced by honeybees (*Apis mellifera,* Adansonii). Honey samples were kept in food grade plastic containers, labelled and stored under room temperature between 24°C and 30°C. The honey samples were harvested from November 2014 to May 2015; six from Kadjebi, four from Adaklu, three from Ho west and three from Akatsi south (Table 7). Apart from the Akatsi district where honey samples were sourced from beehives located in wild and near farms where the velvet tamarind' (*Dialium guineense*) is a predominant tree species, all remaining samples were sourced from beehives located in the wild and also near farms with crops such as plantain, maize, cocoa, pepper, garden eggs, tomatoes, pea nut and cow pea.

Table 7

Honey samples and date of harvest from the districts

District	Honey samples	Month/Date of harvest	Weather Condition
	1	March, 2015	Wet Season
Kadjebi	2	March, 2015	Wet Season
	3	March, 2015	Wet Season
	4	May, 2015	Wet Season
	5	March, 2015	Wet Season
	6	March, 2015	Wet Season
Adaklu	7	May, 2015	Wet Season
	8	May, 2015	Wet Season
	9	May, 2015	Wet Season
	10	November, 2015	Dry Season
Ho West	11	May, 2015	Wet Season
	12	December, 2014	Dry Season
	13	January, 2015	Dry Season
Akatsi south	14	November, 2014	Dry season
	15	November, 2014	Dry season
	16	November, 2014	Dry season

Physicochemical Analysis

Physico-chemical analyses of the sixteen honey samples were carried out by the Quality Services International, GmbH in Germany, following prescriptions described in the official methods of analysis of the Association of Official Analytical Chemists (Helrich, 1990) and the Harmonized Methods of the European Honey Commission (Bogdanov *et al.*, 1997). By this method, the various parameters were analyzed as described in the general methodology section above.

Water (moisture) Content

The water content in honey higher than 20% might lead to rapid fermentation and spoilage of the honey (Codex Alimentations, 2001). Water content is crucial to avoid unwanted fermentation, which usually results in the honey having an off-taste and high levels of dead yeast, glycerol and butanediol and shorter shelf life (Bogdanov & Martin, 2002). The amount of water in honey depends on harvesting season, climatic factors, techniques, the degree of maturity and the ripening process in the hive (Silva, Videira, Monteiro, Valentão, & Andrade, 2009).

Hydroxymethylfurfural Content (HMF)

According to Bogdanov and Martin (2002) the HMF level in honey is one of the most commonly monitored parameters for determining honey freshness. HMF is therefore a measure for the degree of freshness and correct handling of honey (Mehryar, & Esmaiili, 2011) and is critical for honey quality assessment. HMF was determined by the standard method (Helrich, 1990) as described above.

Diastase Activity

Diastase activity also determines the freshness of honey (Bogdanov & Martin, 2002).

pH Value and Free Acidity

These parameters are critical during the extraction and storage of honey. It is known to influence honey texture, stability and shelf life (Terrab *et al.*, 2004). Honey pH is an important indicator of possible microbial growth (Conti, 2000; Silver *et al.*, 2009) and low values could therefore inhibit the presence and growth of microorganisms. This influences texture, stability and shelf-life (Silver *et al.*, 2009).

Electrical Conductivity (EC)

The electrical conductivity (EC) of honey indicates the concentration of mineral salts, ash, organic acids, proteins, some complex sugars and polyols

(Belay, Solomon, Bultossa, Adgaba, & Melaku, 2013). EC shows great variability according to the floral origin and it is important for the differentiation of honey of different floral origins (Terrab *et al.*, 2002).

RESULT AND DISCUSSION

The Honey Value Chain

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 summarised in the value chain below Fig. 9. The main operators and actors in the honey value chain in Ghana are beekeepers, honey packagers, retailers, consumers and other supporting agencies such as 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 Kenyan top bar hive is the main beehive used in the study area followed by log hives. Three main method of honey extraction are employed by members of the producer association 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. This method is mainly due to affordability since financial investment is very minimal compared with solar, honey press or use of centrifuge, which in some cases, is available for a whole community.

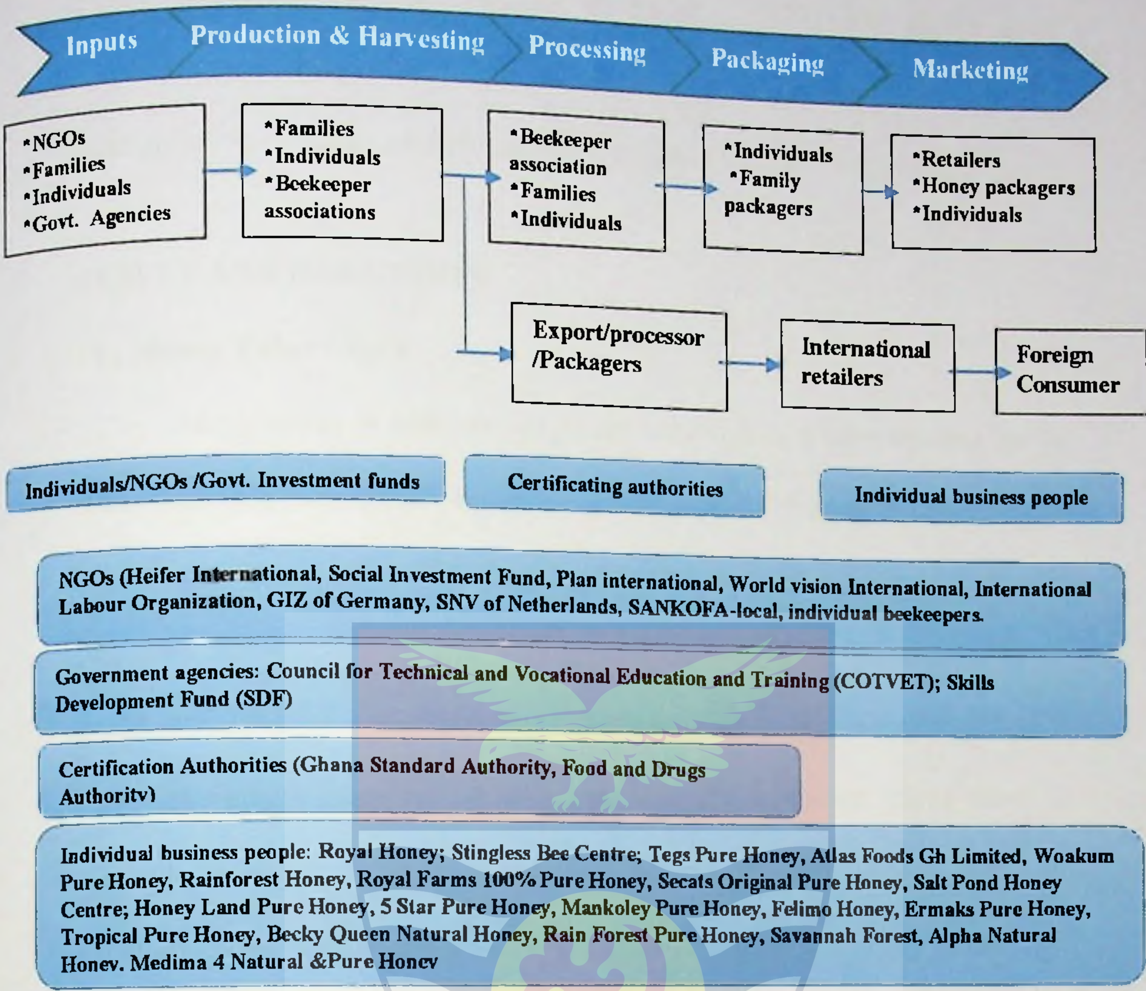

Figure 9: Honey production value chain in Ghana

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 ShopRite, 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. Another 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.

Physico-Chemical Analysis of Honey Samples

Results of the various chemical components of the honey samples under this studies in relation to global standards are summarised in (Table 8).

Moisture Content

The water content of honey samples range between 17 and 23.2% with a mean value of 20.1 (Table 8.0). For 9 samples the water content was higher than 20% which is the limit in EU (Council Directive 2001/110/EC, 2001) and Ghana Standards Authority, (GSA) GS 1064:2013). The average water content was higher than earlier found in studies of honeys from the Ghanaian market (Ankrah, 1998, Akpabli-Tsigbe, 2015).

Table 8

The physicochemical analysis of the 16 honey samples

Honey Producing Communities	Sample ID (HS)	Water content (Max. 20)	HMF, mg/kg (Max. 80)	Diastase activity, Schade (Min. 8)	pH value 3.2-4.5	Free Acidity, meq/kg (Max. 50)	Electricity conductivity, µS/cm (Max. 0.8)	EU classification
	1	19	13.6	15	4.2	25.5	0.56	TH
	2	17	16	13.8	4.5	22	0.66	TH
	3	19	13.6	15	4.2	25.5	0.52	TH
Kadjebi	4	18.7	33.6	19.1	4.2	29	0.71	TH
	5	21.4	13.9	19.1	4.3	32.5	0.82	IH
	6	17.2	100	15.6	4.3	29	0.77	IH
	7	23.2	4.0	12.2	3.7	50	0.64	IH
Adaklu	8	22	3.8	8.4	3.7	40	0.51	IH
	9	22	4.0	11.2	3.7	41	0.52	IH
	10	19.5	26.6	23.4	4.0	36	0.65	TH
	11	20.4	9.7	20.7	4.5	28	0.66	IH
Ho West	12	20.1	17.2	21.1	4.0	16	0.21	IH
	13	20.6	73	8.8	3.9	20	0.25	IH
	14	20.8	65	10.8	4.0	20	0.21	IH
Akatsi South	15	19	19.3	10.5	3.7	32.5	0.44	TH
	16	21.7	17.4	19.5	4.0	51	0.77	IH
Min		17	3.8	8.4	3.7	16	0.21	
Max		23.2	100	23.4	4.5	51	0.82	
Mean		20.1	26.9	15.3	4.1	31.1	0.6	

Key: TH (Table Honey); IH (Industrial Honey)

In both studies some samples recorded water contents above 20 %, as in the present study. These results are suggesting a quality problem for honey from Ghana as water content in honey higher than 20% might lead to rapid fermentation and spoilage (Codex Alimentations, 2001). Other honey studies conducted in the North Western parts of Africa recorded values less than 20% moisture (Belay *et al.*, 2013; El Sohaimy *et al*, 2015). This indicates that the problem of high moisture in honey might be larger in Ghana than in these countries. Though consumers within rural settings may not be very much worried of a high water content in honey mainly due to lack of knowledge on proper handling of honey, for international marketing, it may constitute a major challenge.

Water content depends on harvesting season, climatic factors, techniques, the degree of maturity and the ripening process in the hive (Silva, Videira, Monteiro, Valentão, & Andrade, 2009). From this study, the main harvesting periods are between November and February each year, which is within the dry seasons in Ghana (GSS, 2013). During this time, honeys are expected to have lowest moisture as air humidity is low and honey combs are normally well sealed and dehydrated. However, four samples (HS 12-14, HS 16) harvested within this period had moisture >20%. This result suggests the application of improper techniques such as harvesting of unsealed honey combs or deliberate addition of water during processing. In contrast, honey harvested during the major rainy season from March to May (GSS, 2013), might easily be exposed to high air humidity while in the comb and during extraction. This rather than improper techniques might explain the water content >20% in 5 samples (HS 5, HS 7, HS 8, HS 9, and HS 11) harvested in this period.

HMF- Hydroxymethylfurfural

HMF values ranged from 3.8 to 100 mg/kg with mean of 26.9 (Table 1.0). One honey sample had a high HMF larger than the 80 mg/kg maximum limit by the EU and the Ghana Standards Authority (Council Directive 2001/110/EC, 2001, GS 1064:2013). The mean HMF value is comparable with those reported in previous studies of honey conducted in Ghana (Akpabli-Tsigbe, 2015) and Ethiopia (Belay *et al.*, 2013). In both studies average HMF values were lower than the 80 mg/kg suggesting adherence to quality controls by producers.

When honey is exposed to high temperatures, HMF is produced by acid-catalysed dehydration of hexoses, such as fructose and glucose (Silver *et al.*, 2009). Shelf-life of honey is established worldwide according to HMF content criteria set by national regulations and they must be obeyed by honey packagers, when adding expiry date on labels. Compliance with HMF content restrictions is important as it provides consumers with a partially guarantee that the honey they are buying has been handled correctly and altered minimally (Escriche, Visquert, Carot, Domenech, & Fito, 2008). The high value of 100mg/kg HMF for HS6 may suggest a problem along the value chain. During extraction, producers sometimes place chopped honey combs in the sun to allow honey to gradually drain into a receiving bowl. It is also possible honey may have been stored under much warmer condition which might have affected its freshness. Furthermore, adulteration with invert sugar (Zappalà *et al.*, 2005) during further refining of honey by packagers or producers could influence HMF formation in honey. Apart from exposure to heat and adulteration, high HMF content could be due to the kind of floral sources for of honey. For instance high levels of HMF was found in freshly harvested honey in two honey cases in Kenya (Muli, Munguti, & Raina, 2007).

Diastase Activity

Diastase is an enzyme naturally occurring in honey. Diastase values recorded for honey samples in this study ranged between 8.4 and 23.4 Schade units with a mean of 15.3 (Table 8.0). Diastase activity is one of the indicators that determines the level of exposure of honey to heat during processing. Enzymes in honey are vulnerable to heating and storage factors and may influence texture, stability and shelf-life of honey (Silver *et al.*, 2009). All samples analysed recorded values above the minimum 8% limit by the EU (2001/110/EC) and Ghanaian authorities (GS 1064:2013). The values are similar to those reported for honey samples from Spain (Terrab *et al.*, 2004) and indicate appropriate storage or processing measures by the producers.

Honey pH

The pH values of the honey samples ranged from 3.7 to 4.5 with a mean of 4.1 (Table 8.0). The pH values recorded are believed to be typical in floral honeys (Terrab, *et al.*, 2004) and all honey samples recorded pH values within the 4.5 maximum limit by the EU and Ghana authorities.

The average pH for samples analysed are similar to those recorded earlier for honeys in Ghana (Akpabli-Tsigbe, 2015) as well as for other origins. For instance, Poland (EU DOOR Data base), Portugal (Andrade *et al.*, 1999) and Serbian unifloral honeys (Lazarević, Andrić, Trifković, Tešić, & Milojković-Opsenica, 2012). These values are also consistent with published values of European monofloral honeys (Iglesias *et al.*, 2012). Honey pH is an important indicator of possible microbial growth (Conti, 2000; Silver *et al.*, 2009) and low values could therefore inhibit the presence and growth of microorganisms. This influences texture, stability and shelf-life (Silver *et al.*, 2009).

Free Acidity

Free Acidity ranged between 16 and 51 meq/kg with a mean of 31.1 meq/kg (Table 8). For one of the samples, the free acidity exceeded the acceptable limits by the EU and GSA at maximum 50 meq·kg−1. The high level suggests the presence of fermentation which is an indication high water content (Silva, *et al.*, 2009). The values are similar to those reported for honey samples in Serbia (Lazarević *et al.*, 2012). While lower acidity shows proper handling of samples during processing and storage, a higher level suggests a possible mishandling by actors during harvesting processes.

Electrical Conductivity (EC)

The electrical conductivity of the samples in this study ranged from 0.21 to 0.82 mS/cm with a mean value of 0.6 mS/cm (Table 8.0). EC values of honey from beekeepers may range from 0.119 mS/cm to 1.515 mS/cm (Soria, Martınez-Castro, & Sanz, 2003). One sample recorded an EC value exceeding the 0.8 mS/cm limits of the EU and the GSA standards.

The average EC value was similar to those reported earlier for Ghanaian honeys (Akpabli-Tsigbe, 2015). EC values are important for the differentiation of honeys of different floral origins (Terrab *et al.*, 2002) as honeydew, blossom honey and also for the characterization of unifloral honey (Chefrour *et al.*, 2009). Honeys with EC values higher than 0.8 mS/cm are classified as honeydew honey while those with values lower than 0.8 mS/cm are classified as blossom honey or blends of blossom with honeydew honey (Bogdanov, 2007). Also, slight difference in temperature is known to cause a large change in EC values (Szczęsna, & Rybak-Chmielewska, 2004) suggesting that honey samples recording high EC values, could be affected by other sources other than nectar blossoms. This could therefore be due to exposure of samples to temperature probably during harvesting and handling of honey.

Implications of Non-Compliance to Quality along Honey Value Chain

The physico-chemical qualities already discussed have implications for quality control in the domestic and international honey markets (Krell, 1996), as compliance with quality standards may facilitate market access.

Two factors, water content and HMF levels mainly affected the honey samples analysed in this study. Eight honey samples with water levels above 20% were designated as industrial honey or bakers' honey. This means they are limited to use in processed foods, e.g. baked products, confectionery and many preserved products but not for direct consumption (Bradbear, 2009). 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 prior to analysis. The fact that it cuts across all the four districts suggests 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 (Adjaloo *et al.*, 2017). 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 solar extractors and 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.

One honey sample recorded a high HMF level and was classified as IH. Apart from the fact that Hydroxymethylfurfural (HMF) formation increases with increasing heat application to honey, high HMF levels have been reported in freshly harvested honey as well (Muli, *et al.*, 2007). This results must be confirmed through further analysis of honey samples in order to conclude abuse of heat by producers. This is also due to the fact all sixteen honey samples were within the standards set for Diastase activity, which is another marker for honey freshness, indicating the freshness of the honey samples in spite of containing high levels of water.

Implications of Honey Quality for the Market

The physico-chemical qualities already discussed have implications for quality control in the both the domestic and international honey markets (Krell, 1996), as compliance with quality standards may facilitate market access.

Two factors, water content and HMF levels mainly affected the honey samples analysed in this study. High water content in the majority of the honey samples is indicative of poor handling of honey during processing. The fact that it cuts across all the four districts is more worrying, since this is one of the criteria that determines the quality of honey, and thus the possibility of selling the honey on the world market (Technologies and practices for small agricultural producers, teca.fao.org). Samples with water levels above 20% were designated as industrial honeys, which means they have a quality fit for use in processed foods, e.g. as sweetener, but not for direct consumption.

HMF value for one sample was higher than the accepted value suggesting poor handling of that sample in terms of exposure to high temperatures. The sample with HMF value above 80% was designated as industrial honey and not for direct consumption. The results indicate that there are challenges along the production chain of processing and handling of these honeys by producers. This could be as a result of harvesting non-ripe or non-sealed honey combs, harvesting under high humid climate and thereby exposing honey to atmospheric moisture. It could also be during transportation, extraction or draining, where the honey is not well covered and exposed to moisture. Or better still exposure to high temperatures during processing.

Honey analysis (physicochemical, microbial and botanical origin) enables producers to characterise honeys into their precise quality levels and this enhances its marketability (Aronne, Buonanno, & De Micco, 2008). The honeys with high water content will have short shelf life due to early fermentation which will give bad odour and demand their removal off the shelf. Those with high HMF suggest possible exposure to high temperatures during processing and/or bad storage practices. High free acidity can be indicative of fermentation of sugars into organic acids which will have negative impact on authentication of honey (Nanda, Sarkar, Sharma, & Bawa, 2003). These conditions will therefore affect the marketability of these honeys both home and abroad.

These challenges test the export readiness of honey producers in Ghana. To take advantage of the opportunities for export, firstly, beekeepers will have to pay critical attention to the maturity of honey, the time of harvesting and proper handling of honeys before and after harvesting. Critical attention must also be paid to mode and place storage in order to avoid exposure to unfavourable conditions. This will enhance the quality of the honeys and potential for the domestic and export market.

In order to achieve this, there will be a need for capacity building among beekeepers, associations and public agencies. Inferences from beekeeper interviews show that, the state is not involved in the beekeeping subsector in Ghana save for the benevolence of conservation oriented non-governmental organisations that trained few beekeepers who are then asked to train others in their districts. These further training exercise usually gets stalled due to lack of finances. These beekeepers must therefore be brought on board and trained with current technologies in the beekeeping sector in order to secure quality honeys in future for the country and export.

CONCLUSION

This study adds new knowledge to the physicochemical characterization of honey from the Volta Region of Ghana, which is important for GI labelling and honey commercialization. Six honey samples out of the 16 was wholesome for consumption as table honey per the EU and the Ghana standards. Ten honey samples did not comply with national and international requirements with respect to moisture content, HMF, Acidity and Electrical conductivity, hence were limited for use only as industrial honey.

High moisture content and HMF mainly affected all samples designated as industrial honeys. High moisture content in honey if not checked will cause honey shelf life as a result of honey fermentation and affect both local and international markets.

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. It points towards mishandling of honey at various stages from harvesting to processing and storage, and thus calls for capacity building along the production, processing, packaging and storage activities. Taking into account that the Volta Region is known for high quality honey, similar quality constraints are could be found throughout the Ghanaian honey sector if the situation is same across the Regions.

CONFLICTS OF INTERESTS

There is no conflicts of interest among the authors

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CHAPTER SEVEN

Assessment of Consumer knowledge of GIs and other Food Quality Standards labels in Ghana

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ABSTRACT

A geographical indication (GI) is a label or sign that differentiates one product from another, on the basis of known unique characteristics linked to the geographical origin and communicate same to prospective buyers. Ghana is developing a GI regime to promote unique products. This study presents findings of a first-hand investigation assessing the knowledge of GIs and use of food label information in Ghana. 206 consumers in Accra, were surveyed using structured questionnaire.

Results showed that the sample was gender biased, (52.9%) were females, were recorded, the age group between 18 -25 years forming majority (83%). In terms of level of education, primary/basic and other forms of training other than secondary and tertiary education formed (48.5%) followed by tertiary education (28.6%). Most consumers read food labels (81.6%) to check manufacture and expiry dates. The logos of the Food and Drugs Authority, FDA and the Ghana Standards Authority, GSA were popular among consumers especially those within the age group of 18-25: FDA (X^2 (4) = 23.972, Pr = 0.000) and GSA (X^2 (4) = 18.962, Pr = 0.001). Females were more familiar with the FDA logo (X^2 (1) = 4.996, Pr = 0.025). It was also

observed that the Ghanaian consumer had very little knowledge about the GI concept as majority (89.3%) responded no.

Keywords: Consumer awareness, food label, GI concept, familiar food quality certifications, Ghana

INTRODUCTION

Geographical Indications (GIs) identify a good as originating in a territory, a region or locality in that territory, where a given quality, reputation or other characteristic of the good is essentially attributable to its geographical origin (World Intellectual Property Organization, WIPO, 2013). Inferring from the GI definition by WIPO, a GI could be a label or sign that can differentiate one product from another, on the basis of its genuine unique characteristics and geographical origin and communicates same to prospective buyers. Over the years, consumers have repeatedly indicated the need for information on food products in order to make rational choices in the food market (Glanz *et al.*, 1989). A label acts as a source of information to consumers about a particular food item and dietary intake (Dimara & Skuras, 2005) and provides a window through which consumers could make responsible food choices (Jill Davies & Smith, 2004). Studies have shown that consumer knowledge and awareness of the link between diet and health has increased (Bardaji *et al.*, 2009). This knowledge has led to increased demand for healthier, safer, and more environmentally friendly food products, which has influenced the rise in the use of food labelling (Loureiro, & McCluskey, 2000).

Research into consumer studies have also observed that other factors like the level of education, geographic residence, age, gender, and knowledge of labels also influence consumer behaviour towards a particular food quality label (Xu, *et al.*, 2012). A label is partly the packaging of a product (Héroux, Laroche, & McGown, 1988) which is also an important communication channel for consumers and is a key factor influencing consumers' purchasing decision (Silayoi & Speece, 2004). Consumers' opinion on a particular product could be developed through information on the product (in this case by food labels, mass media, relatives and friends) (Smith *et al.*, 2012). According to Xu *et al.*, (2012) educated consumers are more informed and aware of the information contained in Eco-labels hence is well appreciated and preferred. The Eco-label and organic labels for instance identify with environmentally preferable products based on an environmental-impact assessment of the product compared to other products in the same category. This includes the production process, use, and disposal of the product (Blend & van Ravenswaay, 1999) an information that influences consumers' purchasing decisions for the product (Jaffry, Pickering, Ghulam, Whitmarsh, & Wattage, 2004).

The use of geographical names (which were associated with unique products from a particular area) has been one of the earliest form of food labelling. Consumers are becoming increasingly interested with the place and/or special means of production in relation to the food they purchase (Ilbery & Kneafsey, 1998). For example in Rome, olive oil from Baetica were acclaimed for its uniqueness (Blázquez, 1992). Also, wines of Bordeaux and Porto, the cheeses of Parma and Roquefort, and the hams of Parma and Bayonne, are other food products connected with geographic names due to distinct agro-ecological conditions, typical animal breeds, plant varieties, unique human capital and traditions (Josling, 2006). Studies on reading food labels by consumers around the world are not conclusive. Some countries seem to use information on labels while others do not use much of labels. For instance, consumers in the United States of America (65%), Portugal (64%), Canada (61%), New Zealand (61%), Spain (60%), South Africa (59%), Norway (57%), and Mexico (56%) are among developed countries known to understand nutrition labels (Mahgoub, Lesoli, & Gobotswang, 2007). Meanwhile, observations in other European countries say the opposite. For example, reading of labels among Croatian consumers is said to be low and does not play an important role during food purchase (Ranilovic & Baric, 2011). Similar scenarios are reported for countries like France, The United Kingdom, Germany and the Netherlands (Ranilovic & Baric, 2011). Furthermore, while it is reported in Malawi, that over 73% of consumers do not understand the numerical information and terminology used in labelling (Kasapila & Shawa, 2011), over 59% of consumers in Lesotho are said to read food labels (Mahgoub, Lesoli, & Gobotswang, 2007). In Botswana, large proportion of consumers were reported to be aware of information on food labels (Themba, & Tanjo, 2013). However, the story could be a bit different in Ghana.

Azila-Gbettor, Avorgah, & Adigbo, (2013) in exploring consumer knowledge and usage of label information in the Ho Municipality of Ghana, observed that reading of labels was generally low among Ghanaians. This study feeds into an overall plan of developing a GI honey in Ghana. Promoting GIs could have a critical role to play socially, economically and culturally. It may help nurture and strengthen key skills and traditions, support and develop entire communities (Sharma, & Kulhari, 2015). In order to achieve this, the Ghanaian consumer will need to appreciate the GI concept in terms the information it communicates about a particular product to inform purchasing decision. It is therefore important to know if (1) the behaviour of consumers towards reading food labels; (2), what information they look for on food labels; (3), which certifying agencies are they familiar with; and (4), whether the consumers in Ghana aware of the GI concept. The aim of this study was therefore to assess cconsumer knowledge on food quality standards labels and GIs in Ghana, through ssurveys of consumers who shop at the Accra Central Mall and students at the University of Ghana. This information will eventually influence the overall GI policy framework for Ghana in the direction of relating to consumers, since the uniqueness of any GI will be in the label.

METHODOLOGY

Study Site

The consumer survey was conducted in the Greater Accra Regional capital, Accra in September, 2016 with shoppers at the Accra shopping mall and students at the University of Ghana campus, Legon (Fig.10). These sites were chosen based on the following reasons. Firstly, the Accra Shopping Mall is the largest, busiest and centrally located shopping centre, where the upper and middle class Ghanaian consumers could easily be located hence suitable for this study. Secondly, the University of Ghana was selected to include undergraduate students who belong to the knowledge group of the young Ghanaian population. These segments of society usually have the purchasing power and also care about the products they buy in the supermarkets. It was therefore necessary to find out what affect their food choices, food label reading habits and knowledge of GIs as part of the development program.

Sample Selection

This study set out to locate consumers right at the shopping malls undergoing shopping activities, in order to make real meaning of whether or not they read the labels on the food items they were buying, what information they were looking for, if they are familiar with standards logos on the market and if they knew anything about GIs at all. This intention was however not possible due to policy issues with the management of the mall. It was only possible to engage consumers outside the shopping mall. Therefore, consumers could only be located as they hurried towards their vehicles.

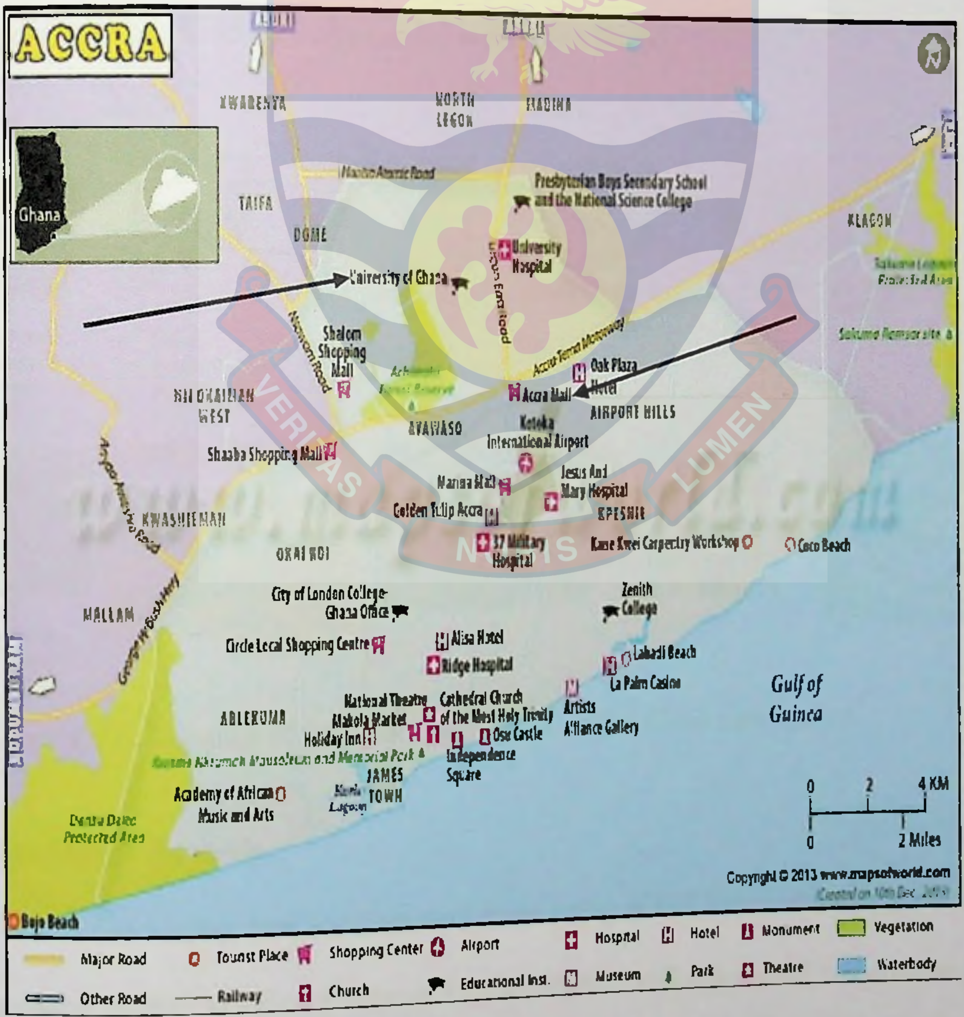

Figure. 10. Map of Accra showing the Accra shopping mall and the University of Ghana, Legon directed by black arrows. (Source: www.mapsofworld.com).

Data Collection

The survey started by gathering demographic information of respondents namely: gender; social status; nationality and level of education of the respondents. In assessing quality food standard labels, consumers were presented with an array of famous coloured standard logos (Fig. 11) to select from.

Prospective consumers were purposefully spotted and approached. Permission sorted for a face-to-face interview using a questionnaire. Such fixed locations, especially the shopping malls are known to provide information for food products as retail outlets (Shine *et al*., (1997). After each interview, respondents were offered a $0.5 gift pen in exchange for their participation. In all 206 consumers were interviewed.

Figure 11: Samples of food standard labels on the Ghanaian market

Statistical Analysis

Data entry and analysis was done using SPSS Inc. computer package version 20 and MS Excel version 15. Descriptive and inferential statistics were created and used to define and explain the results. A Chi Square (X^2) statistic was performed as appropriate to assess whether distributions of categorical variables differ from each other. An assessment of whether the two paired observations were independent was done using the Pearson's chi-squared test. Statistical significance level was set at 0.05.

RESULTS

Socio-demographic Statistics of the Sample

Results showed that the sample was gender sensitive (female = 52.9) with the age group 18 -25 years forming majority (83%). In terms of level of education, the greater number falls within those who had primary/basic and all forms of training other than secondary and tertiary education forming (48.5%) followed by tertiary education (28.6%).

Table 8

Socio-demographic Characteristics of Consumers

Variable	Indicator	Percentage (%)
Age	Less than 18	6.3
	18 -25	83
	26 - 35	7.8
	36 -50	2.4
	50 and above	0.5
Total		100
Gender	Male	42.2
	Female	52.9
	Non Response	4.9
Total		100
Level of Education	No Education	0.5
	Primary & other form of education	48.5
	Secondary	17
	Tertiary students	28.6
	Non Response	5.4
Total		100

Source: Field survey, Besah-Adanu, (2016)

Food Label Reading Habit Assessment

Majority of the respondents (81.6%) have a habit of reading food labels hen purchasing (Fig. 12).

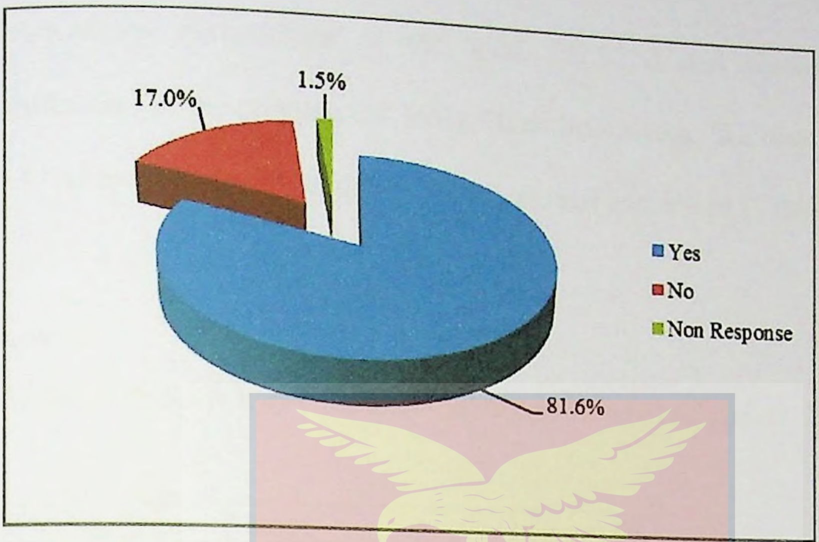

Figure 12: Consumer label reading habit assessment results.

Table 9

Relationship between Demographic Factors and Food label Reading Habit

Variables		Yes (%)	No (%)	Pearson's X^2 (df)
Compositional Factors				
Gender				
	Male	69	18	
	Female	91	16	X^2 (1) = 1.092 , Pr = 0.296, Cramer's = 0.075
Age	Less than 18	11	2	
	18 - 25	138	30	
	26 - 35	13	3	X^2 (4) = 1.352 , Pr = 0.853, Cramer's = 0.082
	36 -50	5	0	
	50 and above	1	0	
Education	No Education	1	0	
	Primary / Other form of Education	80	17	X^2 (3) = 1.443, Pr = 0.696, Cramer's = 0.087
	Secondary	31	4	
	Tertiary	47	12	

Source: Field survey, Besah-Adanu, (2016)

Reasons why Consumers Read Food Labels

The most important reason why consumers read food labels is to check Date label (manufacture and expiry dates) which forms (37.52%). This if followed by composition of the food, (27.57%) and authenticate the certification of the product, (21.76%). Other information like direction of use (1.32%) and country of origin (1.98%) were least considered (Table 10).

Table 10

The Main Reasons Why Ghanaian Consumers Read Food Labels

Why do you read label	Percent (%)
To learn food composition	27.57
For manufacturing and expiring date	37.52
To ensure food is certified	21.76
Direction for use	1.32
Country of origin	1.98
Non Response	9.85
Total	100.0

Source: Field survey, Besah-Adanu, (2016)

Table 11

Relationship between Demographic Factors and Reasons for Reading Food Labels

Variables		To learn food composition	For manufacturing and expiring date	To ensure food is certified	Direction for use	Country of origin	Pearson's X^2 (df)
Gender	Male	13	26	16	0	3	X^2 (4) = 7.778, Pr = 0.100, Cramer's = 0.239
	Female	27	32	17	2	0	
Age	Less than18	2	2	1	1	0	X^2 (16) = 24.711, Pr = 0.075, Cramer's = 0.209
	18 - 25	40	49	25	1	2	
	26 - 35	1	4	7	0	1	
	36 -50	0	3	1	0	0	
	50 and above	0	1	0	0	0	
Education	Primary/ Other form of Education	26	31	16	0	0	X^2 (8) = 21.052, Pr = 0.007, Cramer's = 0.278
	Secondary	7	11	5	2	0	
	Tertiary	7	15	13	0	3	

Table 12

Quality Food Standard Logos Familiar to Consumers

Food standards and Logos	Count	Percentage (%)
Food and Drugs Authority	168	44.9
Ghana Standard Authority	144	38.5
Organic Farmer	7	1.9
Fairtrade	9	2.4
UK Organic Food	4	1.1
Codex	7	1.9
Certified Sustainable Seasoned Food	17	4.5
Better farming, Better future	11	2.9
Certified Wildlife Food	4	1.1
Rainforest Alliance Certified	3	0.8
Total	374	100

Table 13

Relationship between Age and Familiar Food Labels in Ghana

Variables		Age					Pearson's X^2 (df)
		Less than 18	18 - 25	26 - 35	36 - 50	50 and above	
FDA	Yes	8	149	9	2	0	X^2 (4) = 23.972, Pr = 0.000, Cramer's = 0.341
	No	5	22	7	3	1	
GSA	Yes	6	130	6	2	0	X^2 (4) = 18.962, Pr = 0.001, Cramer's = 0.303
	No	7	41	10	3	1	
OF	Yes	1	6	0	0	0	X^2 (4) = 1.511, Pr = 0.825, Cramer's = 0.086
	No	12	165	16	5	5	
Fairtrade	Yes	1	8	0	0	0	X^2 (4) = 1.388, Pr = 0.846, Cramer's = 0.082
	No	12	163	16	5	1	
UKOFG	Yes	0	4	0	0	0	X^2 (4) = 0.835, Pr = 0.934, Cramer's = 0.064
	No	13	167	16	5	1	
CAIFS	Yes	1	6	0	0	0	X^2 (4) = 1.511, Pr = 0.825, Cramer's = 0.086
	No	12	165	16	5	1	
CSSF	Yes	1	15	1	0	0	X^2 (4) = 0.691, Pr = 0.952, Cramer's = 0.058
	No	12	156	15	5	1	
RC	Yes	1	10	0	0	0	X^2 (4) = 1.471, Pr = 0.832, Cramer's = 0.084
	No	12	161	16	5	1	
CWFF	Yes	0	4	0	0	0	X^2 (4) = 0.835, Pr = 0.832, Cramer's = 0.934
	No	13	167	16	5	1	
RAC	Yes	0	3	0	0	0	X^2 (4) = 0.623, Pr = 0.960, Cramer's = 0.055
	No	13	168	16	5	1	

Table 14

Relationship between Gender and Familiar Food Labels in Ghana

Variables		Gender		Pearson's X^2 (df)
		Male	Female	
FDA	Yes	65	95	X^2 (1) = 4.996, Pr = 0.025, Cramer's = 0.160
	No	22	14	
GSA	Yes	58	80	X^2 (1) = 1.051, Pr = 0.305, Cramer's = 0.073
	No	29	29	
OF	Yes	3	4	X^2 () = 0.007, Pr = 0.934, Cramer's = 0.006
	No	84	105	
Fairtrade	Yes	4	5	X^2 (1) = 0.000, Pr = 0.997, Cramer's = 0.000
	No	83	104	
UKOFG	Yes	2	2	X^2 (1) = 0.052, Pr = 0.819, Cramer's = 0.016
	No	85	107	
CAIFS	Yes	3	4	X^2 (1) = 0.007, Pr = 0.934, Cramer's = 0.006
	No	84	105	
CSSF	Yes	8	9	X^2 (1) = 0.054, Pr = 0.817, Cramer's = 0.017
	No	79	100	
RC	Yes	6	5	X^2 (1) = 0.487, Pr = 0.485, Cramer's = 0.050
	No	81	104	
CWFF	Yes	2	2	X^2 (1) = 0.052, Pr = 0.819, Cramer's = 0.016
	No	85	107	
RAC	Yes	2	1	X^2 (1) = 0.613, Pr = 0.434, Cramer's = 0.056
	No	85	108	

Table 15

Relationship between Level of Education and Familiar Food Labels in Ghana

Variables		Level of Education				Pearson's X^2 (df)
		No Education	Pr/Other Form of Edu	Secondary Edu.	Tertiary Edu	
FDA	Yes	1	87	27	45	X^2 (3) = 3.793, Pr = 0.285, Cramer's = 0.139
	No	0	13	8	14	
GSA	Yes	0	75	21	41	X^2 (3) = 5.217, Pr = 0.157, Cramer's = 0.164
	No	1	25	14	18	
OF	Yes	0	4	2	1	X^2 (3) = 1.154, Pr = 0.764, Cramer's = 0.077
	No	1	96	33	58	
Fairtrade	Yes	0	6	2	1	X^2 (3) = 1.723, Pr = 0.632, Cramer's = 0.094
	No	1	94	33	58	
UKOFG	Yes	0	3	1	0	X^2 (3) = 1.818, Pr = 0.611, Cramer's = 0.097
	No	1	97	34	59	
CAIFS	Yes	0	4	2	1	X^2 (3) = 1.154, Pr = 0.764, Cramer's = 0.077
	No	1	96	33	58	
CSSF	Yes	0	8	4	5	X^2 (3) = 0.488, Pr = 0.922, Cramer's = 0.050
	No	1	92	31	54	
RC	Yes	0	6	3	2	X^2 (3) = 1.210, Pr = 0.751, Cramer's = 0.079
	No	1	94	32	57	
CWFF	Yes	0	3	1	0	X^2 (3) = 1.818, Pr = 0.611, Cramer's = 0.097
	No	1	97	34	59	
RAC	Yes	0	2	1	0	X^2 (3) = 1.480, Pr = 0.687, Cramer's = 0.087
	No	1	98	34	59	

Assessment of consumer knowledge on the concept of GIs

In the assessment of consumer knowledge on GIs, majority (89.3%) had not heard about GIs in Ghana (Fig. 13)

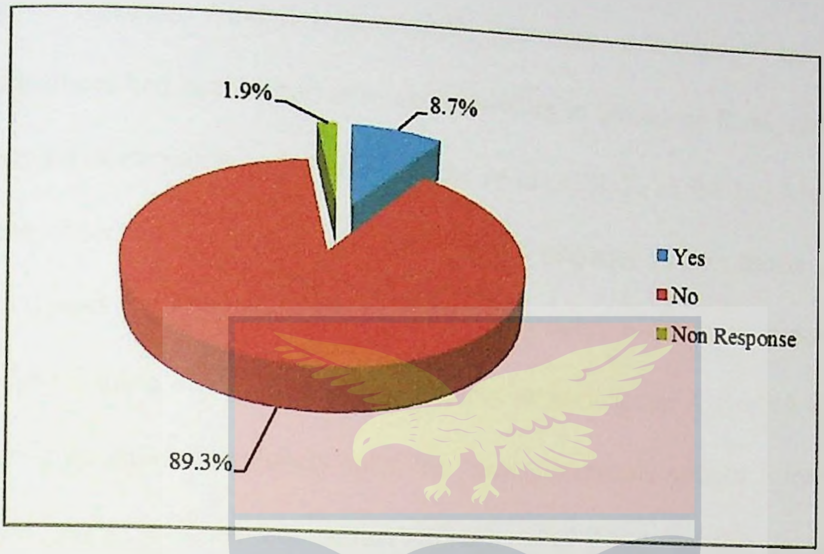

Figure 13: Consumer Knowledge Assessment on the GI Concept.

DISCUSSIONS

This study assessed consumer knowledge of GIs and other food quality standards labels in Ghana. This was necessary towards the development of GIs in Ghana. Many of the consumers responded to reading food labels prior to purchasing. The habit of reading food labels enable consumers to evaluate food products (Bublitz, 2010) and make right choices regarding diet (Miri Sharf, Gary, Hanna, Iris & Chen, 2012). This result is comparable to consumers in countries like the United States of America, Portugal, Canada, New Zealand, South Africa and Norway, who are known to read food labels (Mahgoub, Lesoli, & Gobotswang, 2007). However, it contrasts with reports in the United Kingdom, Germany and the Netherlands where majority claimed they never read a food label (Ranilovic & Baric 2011). The results also contrasts with reports in Ghana by (Azila-Gbettor *et al.*, 2013) where label reading habit was low. Increase in reading food labels by consumers in this study could suggest increased awareness of the link between food and health as reported by (Bardaji *et al.*, 2009)

Reading food labels mainly for date information by Ghanaian consumers had been reported in earlier studies in Ghana by Rose, (2012) in the Kumasi Metropolis and Azila-Gbettor *et al.*, (2013) in the Ho Municipality. This observation by Washi, (2012), where majority of the consumers in the UAE read labels for manufacture and expiry dates as the most important issue before finding out details of food content or packaging. A studies in Scotland also mentioned date labels were the most commonly sought information on food labels by Scottish consumers (Tessier *et al*, 2000). In their studies, expiry date was also commonly used by consumers as an indication of freshness, shelf life and food safety across a range of foods by Sabbe *et al.*, (2009).

Ghanaian consumers are most familiar with two main quality standard logos; the (FDA) Food and Drugs Authority and (GSA) Ghana Standards Authority logos. There were statistical difference between age and familiarization of the FDA and GSA logos as well as gender and FDA logo. This suggests the two standard logos are popular within the Ghanaian populace and could imply that whether or not a food product was certified by these authorities was important to consumers and could influence their purchasing decisions. Food certification play a key role in purchasing decision of consumers. For instance, in the Greek market a number of quality certifications are available to a consumer as he or she makes a decision to buy a product (Botonaki, Polymeros, Tsakiridou, & Mattas 2006). This has led to a positive relationship between willingness to pay and organic certification in

Greece (Fotopoulos & Krysatallis, 2003). Also, studies have shown that Italian consumers are willing to pay a premium for organically certified food products free from pesticides (Boccaletti & Nardella, 2000).

On the basis of education, high level of education has been observed to influence label reading as reported by Rose, (2012) and (Xu, *et al.*, 2012). That observation was however different in this study. Consumers within the lower grade of education (in this case primary and other forms of training) rather than of secondary or tertiary orientation had a compelling reason to read food labels (p = 0.007) than those with higher levels of education (Table 11).

Familiarity to the logos of the two main quality standard agencies in Ghana (FDA and GSA) were pronounced among consumers within the age group 18-25 than the other age groups at probabilities of (Pr = 0.000 and Pr = 0.001) respectively (Table 13). This could probably be due to the fact that the youth group actively follow public discourse in recent years by these agencies as the influx of counterfeit and fake products on the Ghanaian market is on the ascendency. For instance, the case of palm oil adulteration as reported by researchers Ayodele, (2010) and Amoako-Mensah, (2017). Other platforms include Ghana Broadcasting Corporation, GBC, (2017), Myjoyonline (2015), Ghana News Agency GNA (2016), All Africa (2008) and Ghana web (2015).

Familiarity with these logos was also gender sensitive. Females were more familiar with the FDA logo (p= 0.025) than males (Table 14). Again the sensitive issues of fake food products could account for this as these group are usually involved in food matters in the home than males. Also women are usually tipped to read food labels more (Rasberry, Chaney, Housman, Misra, & Miller, 2007) and use the information than men (Su, *et al.*, 2015).

In terms of knowledge about the concept of geographical indications, over 89% of the respondents confirmed to have no knowledge at all of the concept. This is not surprising as the concept of GIs is relatively new in Ghana. This result is independent of educational background. This suggest that more work has to be done in order to educate the general public on the concept of GIs and how it connotes quality and genuineness in food products, as well as its overall benefits in communicating same to consumers, producers and the country as a whole.

CONCLUSIONS

This study aimed at assessing four main objectives among the Ghanaian consumer which include the habit of reading food labels, why they read food labels, which quality standard logos they were familiar with as well as the awareness of GI concept.

The results suggest most consumers in this study read food labels and they do so to check the manufacture and expiry date of products. Consumers with lowest grade of education were more concerned of date label than highly educated ones. The youth and females were familiar with the FDA and GSA logos.

The findings also showed that majority of Ghanaians have very low knowledge and understanding of the concept of GIs. In conclusion, the development of GI in Ghana may not suffer too much set back. The GI is a label and since many consumers are interested in reading food labels, they can be communicated with through the GI as a tool on the relevant information on the food. However, a deliberate campaign effort is needed to educate the general public which should particularly emphasize those characteristics of GI food products that can relate to their interests and ethical preferences, for example, reputation, unique sensory characteristics and environmental attributes.

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CHAPTER EIGHT

SUMMARY ON THE DEVELOPMENT OF GI HONEY IN GHANA, GENERAL CONCLUSIONS AND RECOMMENDATIONS.

Summary on Developing a GI Honey in Ghana

Presence of Local Producer Organization

The study site currently has a vibrant beekeeper organization compared with other producing Regions in the country from local communities through to the Region. Such organizations are key to production with respect to common code of practice.

Availability of a GI law

Ghana currently has a GI law, (Act 659) since 2003 though yet to be operational.

Reputation for honey quality per international standards

Five honey samples from the Volta Region met international quality status though more work needs to be done.

Relevant State Institutions

Registrar General's Department is currently responsible for the registration of GIs but currently has no document on how to operationalize the main registration process. Currently the law is undergoing a review to allow for smooth operation.

The Ghana Standards Authority also allows for labelling honey with its geographical origin if could be proved as such. However, the state agency lacks capacity for thorough analysis to that effect. There is also no deliberate national policy for the development, promotion and protection of GIs in Ghana.

Link of Honey to Origin

The current study linked the honey samples to its origin in terms of botany and geography. This notwithstanding, there is the need for expanded work on the botanical origins of honeys to enhance characterization as a GI. All honeys likely to be designated as uni floral could be further investigated for proper linkage to origins.

GI Knowledge among Ghanaians

Currently knowledge on the GI concept is almost absent among Ghanaians the study showed consumers read food labels. It is necessary for the public to understand GIs and what benefits they could benefit from it as consumers.

In conclusion, it is currently not possible to register any GI product or honey in Ghana. It would only be possible until the law is finally reviewed, capacity of state institutions are fully built, the consumer public well educated on the concept, national policy for GI development, and finally, training producers along the value chains to produce according to agreed formulations in terms of GI products.

GENERAL CONCLUSIONS

At the end of the investigations into the analysis of the Volta Region honey as a GI product in Ghana, the following general conclusions were observed.

1. Key elements and storylines that best describe GI honeys have been identified
2. Both botanical and geographical origin of honey samples in this study were linked to the study site
3. Production quality per international standards evaluated for samples and strengths and weaknesses identified
4. Current state of GI laws and State institutions in Ghana have been assessed as not usable in the current circumstance to register any GI product yet
5. Level of consumer knowledge on labels and GI concept assessed as in adequate

GENERAL RECOMMENDATIONS

Developing a GI honey in Ghana could be possible, however:

1. There's the need for a national policy regime towards GI products development, protection and promotion in Ghana
2. Thorough training for potential GI honey producers to conform with all standards of production in a common code of practice regime

3. Further expanded study for establishing the real link of honeys to their origins including other regions in Ghana.

4. Deliberate GI education for Consumers in Ghana to appreciate and be willing to pay for a GIs

5. The establishment of regulations to fully implement the GI regime in Ghana is urgently needed.

APPENDIX A

Table 16

Detailed Factors on Registered EU GI Honeys Reviewed for GI Framework

GI Honey	Country	Registration	Summary of elements
Mel Do Alentejo	Portugal	1996	Description of the agricultural product -type of product -description of the product -physico-chemical characteristics -specific production steps -specific steps for packaging -specific steps for labelling Concise definition of geographical area Link with the geographical area -Natural link -Human link -Product specificity -Causal link between geographical area and product quality characteristics
Miel De La Alcarria	Spain	1996	Description of the agricultural product -type of product -description of the product -physico-chemical characteristics -specific production steps -specific steps for packaging -specific steps for labelling Concise definition of geographical area Link with the geographical area -Natural link -Human link -Product specificity -Causal link between geographical area and product quality characteristics
Mele Di Corsica	France	2000	Description of the agricultural product -type of product -description of the product -physico-chemical characteristics -specific production steps -specific steps for packaging -specific steps for labelling Concise definition of geographical area Link with the geographical area -Natural link -Human link

			-Product specificity -Causal link between geographical area and product quality characteristics National requirements
Miel De Granada'	Madrid	2004	Description of the agricultural product -type of product -description of the product -physico-chemical characteristics -specific production steps -specific steps for packaging -specific steps for labelling Concise definition of geographical area Link with the geographical area -Natural link -Human link -Product specificity -Causal link between geographical area and product quality characteristics National requirements

Table 16 Cont....

Miel D'Alsace	France	2005	Description of the agricultural product -type of product -description of the product -physico-chemical characteristics -specific production steps -specific steps for packaging -specific steps for labelling Concise definition of geographical area Link with the geographical area -Natural link -Human link -Product specificity -Causal link between geographical area and product quality characteristics
Miel De Sapin Des Vosges	France	2005	Description of the agricultural product -type of product -description of the product -physico-chemical characteristics -specific production steps -specific steps for packaging -specific steps for labelling Concise definition of geographical area Link with the geographical area -Natural link -Human link -Product specificity -Causal link between geographical area and product quality characteristics National requirements
Miel De Galicia	Spain	2007	Description of the agricultural product -type of product -description of the product -physico-chemical characteristics -specific production steps -specific steps for packaging -specific steps for labelling Concise definition of geographical area Link with the geographical area -Natural link -Human link -Product specificity -Causal link between geographical area and product quality characteristics National requirements
Miód Wrzosowy Z	Poland	2008	Description of the agricultural product -type of product -description of the product

Borów Dolnośląskich			physico-chemical characteristics -specific steps for packaging -specific steps for labelling Concise definition of geographical area Link with the geographical area -Natural link -Human link -Product specificity -Causal link between geographical area and product quality characteristics

Table 16 Cont....

Podkarpacki Miód Spadziowy	Poland	2010	Description of the agricultural product -type of product -description of the product -physico-chemical characteristics -specific production steps -specific steps for packaging -specific steps for labelling Concise definition of geographical area Link with the geographical area -Natural link -Human link -Product specificity -Pollen characteristics -Causal link between geographical area and product quality characteristics
Miód Kurpiowski	Poland	2010	Description of the agricultural product -type of product -description of the product -physico-chemical characteristics -specific production steps -specific steps for packaging -specific steps for labelling Concise definition of geographical area Link with the geographical area -Natural link -Human link -Product specificity -Pollen characteristics -Causal link between geographical area and product quality characteristics
Miód Drahimski	Poland	2011	Description of the agricultural product -type of product -description of the product -physico-chemical characteristics -specific production steps -specific steps for packaging -specific steps for labelling Concise definition of geographical area Link with the geographical area -Natural link -Human link -Product specificity -Pollen characteristics -Causal link between geographical area and product quality

			characteristics
Miele Delle Dolomiti Bellunesi	Italy	2011	Description of the agricultural product -type of product -description of the product -physico-chemical characteristics -specific production steps -specific steps for packaging -specific steps for labelling Concise definition of geographical area Link with the geographical area -Natural link -Human link -Product specificity -Pollen characteristics -Causal link between geographical area and product quality characteristics

Table 16 Cont....

Kočevski Gozdni Med	Slovenia	2011	Description of the agricultural product -type of product -description of the product -physico-chemical characteristics -specific production steps -specific steps for packaging -specific steps for labelling Concise definition of geographical area Link with the geographical area -Natural link -Human link -Product specificity -Pollen characteristics -Causal link between geographical area and product quality characteristics
Miód z Sejneńszczyzny	Poland And Lithuania	2012	Description of the agricultural product -type of product -description of the product -physico-chemical characteristics -specific production steps -specific steps for packaging -specific steps for labelling Concise definition of geographical area Link with the geographical area -Natural link -Human link -Product specificity -Pollen characteristics -Causal link between geographical area and product quality characteristics
Slovenski Med	Slovenia	2013	Description of the agricultural product -type of product -description of the product -physico-chemical characteristics -specific production steps -specific steps for packaging -specific steps for labelling Concise definition of geographical area Link with the geographical area -Natural link -Human link -Product specificity -Pollen characteristics -Causal link between geographical area and product quality characteristics

Miele Varesino	Italy	2013	Description of the agricultural product -type of product -description of the product -physico-chemical characteristics -specific production steps -specific steps for packaging -specific steps for labelling Concise definition of geographical area Link with the geographical area -Natural link -Human link -Product specificity -Pollen characteristics -Causal link between geographical area and product quality characteristics

Table 16 Cont....

Miel De Tenerife	Spain	2013	Description of the agricultural product -type of product -description of the product -physico-chemical characteristics -specific production steps -specific steps for packaging -specific steps for labelling Concise definition of geographical area Link with the geographical area -Natural link -Human link -Product specificity -Pollen characteristics -Causal link between geographical area and product quality Characteristics
Miele Varesino	Italy	2013	Description of the agricultural product -type of product -description of the product -physico-chemical characteristics -specific production steps -specific steps for packaging -specific steps for labelling Concise definition of geographical area Link with the geographical area -Natural link -Human link -Product specificity -Pollen characteristics -Causal link between geographical area and product quality characteristics
KRAŠKI MED'	Slovenia	2013	Description of the agricultural product -type of product -description of the product -physico-chemical characteristics -specific production steps -specific steps for packaging -specific steps for labelling Concise definition of geographical area Link with the geographical area -Natural link -Human link -Product specificity -Pollen characteristics -Causal link between geographical area and product quality characteristics
Miel Des Cévennes	France	2015	Description of the agricultural product -type of product -description of the product -physico-chemical characteristics

			-specific production steps -specific steps for packaging -specific steps for labelling Concise definition of geographical area Link with the geographical area -Natural link -Human link -Product specificity -Pollen characteristics -Causal link between geographical area and product quality characteristics
Miel De Liébana	Spain	2016	Description of the agricultural product -type of product -description of the product -physico-chemical characteristics -specific production steps -specific steps for packaging -specific steps for labelling Concise definition of geographical area Link with the geographical area -Natural link -Human link -Product specificity -Pollen characteristics -Causal link between geographical area and product quality characteristics

Source: (http://ec.europa.eu/agriculture/quality/door/).