HONEY QUALITY AND QUALITY PERCEPTION BY CONSUMERS ALONG THE VALUE CHAIN IN NORTHERN UGANDA

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DECLARATION

I, **Woor Sylivia** declare that, to the best of my knowledge and understanding, the work contained in this dissertation is my original work and has never been submitted to any other university or institution for any award of a degree.

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APPROVAL

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DEDICATION

I dedicate this work to my dearest husband Andrew Waaswa and my lovely daughter Maria Mudoko Waaswa.

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ABBREVIATIONS AND ACRONYMS

AGFI	Adjusted Goodness of Fit Index
AMOS	Analysis of Moment Structure
AOAC	Association of Official Analytical Chemists
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
COVID-19	Corona Virus Disease 2019
DN	Diastase Number
EFA	Exploratory Factor Analysis
ETC	Et cetera
EU	European Union
FAO	Food and Agriculture Organization
FA	Free Acidity
GFI	Goodness of Fit Index
GUREC	Gulu University Research Ethic Committee
HMF	Hydroxymethylfurfural
IFI	Incremental Fit Index
KG	Kilogram
KMO	Kaiser-Meyer-Olkin test
MC	Moisture Content
NGOs	Non-Governmental Organizations
RAMSEA	Root Mean Square Error of Approximation
RUFORUM	Regional University Forum for Capacity Building in Agriculture
SEM	Structural Equation Modeling
SPSS	Statistical Package for Social Sciences
TLI	Tucker-Lewis index
UNBS	Uganda National Bureau of Standards
WIS	Water Insoluble Solids
WHO	World Health Organization

OPERATIONAL DEFINITIONS

Amudat	Amudat District is a district in Northern Uganda. In this study, Amudat district will mean the Northeast Drylands agroecology
Lira	Lira district will mean the North-Eastern savannah grasslands agroecology
Arua	Arua district will mean the North-Western savannah grasslands agroecology

ABSTRACT

Honey is the most known and vital bee product produced extensively because it possesses numerous benefits. A significant number of honey value chain actors have emerged in Northern Uganda. However, limited information exists on the honey quality at these value chain nodes. It is also unknown how consumers perceive the quality of this honey. The study used experimental design to examine the quality of honey at the different value chain nodes and cross-sectional survey designs to determine the consumers' perception of honey quality and the honey quality attributes that mainly influence consumers' purchase decisions. A total of 185 consumers were considered for the survey, and 70 honey samples collected from the different value chain actors across different agro-ecologies in Northern Uganda had their physicochemical properties analyzed. Data were collected using structured questionnaires and laboratory analysis. Data was analyzed using SPSS version 25, AMOS version 23, and GEN STAT version 13. The results showed that honey quality deterioration occurred at processor and retailer nodes. Results also showed that honey from Amudat was superior in quality, and diastase number was the only limiting factor to Northern Uganda honey. Labeling, packaging, color, origin, and price significantly influenced consumer perception of honey quality. Purity, viscosity, color, and price also greatly influenced consumer's purchase decisions. The study concluded that Diastase Number was the major limiting factor to Northern Uganda honey and that processor and retailer nodes are the exact node where quality deterioration occurs. Labeling, packaging, color, and origin positively and significantly influenced consumers' perception while price had a significant negative influence on consumers' perception of honey quality. This study recommends mandatory inspections and quality testing at all nodes if the good honey quality is to be maintained.

Keywords: *Honey, perception, purchase decisions, value chain actors, quality, physicochemical characteristics.*

CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

The practice of bee-keeping has increased in the past years (Bunde & Kibet, 2016) and its considered one of the most familiar agricultural activities gaining fame globally (Topal *et al.*, 2021). Beekeeping has the ability to increase people's income, has minimum input requirements, and requires less startup capital hence suitable for both the high and low resource farmers (Amulen *et al.,* 2019; Devkota, 2020). Mudzengi *et al.* (2020) reported that beekeeping provides ecological services through pollination, thus facilitating plant reproduction and food availability. Bees also produce significant products like honey, bee wax, propolis, royal jelly, bee venom queen bees, and larvae. Among these, honey is the most popular bee product produced and consumed extensively (El Sohaimy *et al.,* 2015). This is due to its ability to serve numerous nutritional, medicinal, industrial and economic benefits (Amulen *et al*., 2017; Shugaba, 2012).

World honey production is projected to be 1.8 million tons per annum, with Africa producing around 189 thousand tons of honey per annum which accounts for about 10% of the world production (FAOSTAT, 2021). In East Africa, the practice of beekeeping is increasing rapidly, for example; production increased from 106 thousand tons in 2017 to 112 thousand tons in 2018 (FAOSTAT 2021). This was mainly due to increased government and Non-Governmental Organizations (NGOs) intervention through donations to boost the apiculture sector (Akullu & Mwesigwa, 2021). Despite all these interventions, nationally and regionally honey production is still low below the required production levels and yet its domestic demand exceeds the available supply (Amulen *et al*., 2017).

Correspondingly, Uganda produces only one percent of its predictable production potential of 500 thousand tons of honey annually (Amulen *et al*., 2019). Previous studies [Amulen *et al.* (2019); Mesele (2021)], show that Uganda has been unsuccessful in meeting her expected export supply potential to the European Union markets (EU) while sustaining its national need. This is due to low domestic production levels in terms of quantity produced, production of poor-quality honey that cannot meet the required international and national standards, absence of quality requirement knowledge among the different value chain actors, and weak bee-keeping adoption rates (Amulen *et al.*, 2019). These quality parameters are diastase number (DN), free acidity (FA), Hydroxymethylfurfural (HMF), moisture content (MC), water insoluble solids (WIS), ash, pH and Electrical Conductivity (Codex Alimentarius Commission, 2014).

The quality standards of honey are a major significant aspect considered in the markets in order to compete favorably, get the best price and ensure safety wellbeing of the consumers (Kugonza & Nabakabya, 2008). Similarly, Agyekum *et al,* (2015) noted that quality of a product has a significant influence on consumers perception of the product, and they purchase decision when making purchase. However, Kugonza and Nabakabya (2008) reported that the problem of honey quality deterioration is prominent along the value chain pathway in Uganda, occurring directly from the producer, processors, retailers, and consumers. Deterioration is attributed to overheating during extraction, adulteration and poor hygiene during storage, handling, processing, and marketing (Mohammed, 2020; Kugonza & Nabakabya, 2008; Nwoko. *et al.*, 2017). Adulteration can involve addition of low priced artificial sweet materials like sugars and sugar syrups or adulterating high quality honey with cheap poor quality honey (Ferreiro-González *et al.*, 2018; Guelpa *et al.*, 2017). Another common dangerous practice is hiding the botanical and geographical origin of the honey (Olawode *et al.*, 2018). Reason being consumers significantly

consider the issue of the place of origin during honey purchase because they believe that geographical origin, climatic conditions and the plant species from which bees obtain nectar greatly impacts on the honey quality (Polak-Śliwińska & Tańska, 2021).

Even though many studies have shown that the problem of honey quality standard deterioration is prominent along the value chain in Uganda, Limited research has been carried out to confirm the exact node in the honey value chain pathway where quality deterioration is more prominent, the important honey quality attributes consumers consider when making purchase decisions and consumers' perception of honey quality. Yet considering the essential nutritional and health benefits associated with eating honey, it is vital to understand the quality features of honey produced and marketed by the different honey value chain actors. This is because honey consumption can have negative or positive effects depending on how the quality parameters are handled at different value chain nodes (Bobis *et al*., 2020). Additionally, Lee *et al*, (2021) also testified an increase in consumer awareness level and health consciousness of the products they consume. This prompted the inception of this study.

1.2 Statement of the Problem

Honey demand and consumption is steadily growing every day in Uganda Mushonga *et al.* (2019), due to its ability to serve numerous benefits (Amulen *et al*., 2017; Shugaba, 2012). Despite this increase in demand, the country's production potential for good quality honey is still low estimated at only 5 thousand metric tons per year and this is far below its estimated production potential of 500 thousand metric tons per annum (Amulen *et al.,* 2019). This is due to low domestic production levels, production of poor-quality honey that cannot meet the required international and national standards (Kugonza & Nabakabya, 2008). Furthermore, the high

prevalence of poor quality honey is exacerbated by the absence of quality related knowledge amongst the different value chain actors (Amulen *et al.,* 2019).

The several studies (Kizilaslan & Kizilaslan, 2007; Kugonza & Nabakabya, 2008) that have evaluated the factors that affect the honey quality along the value chain like handling practices, processing and marketing to find whether the honey meets the national and international standards. Kalanzi *et al.* (2015) also reported that honey value chain actors are responsible for quality deterioration resulting in increased honey rejection rates. However, all the previous studies showed insufficient information on the exact node within the value chain where quality deterioration mostly occurs. Additionally, besides perception being considered a significant factor that determines acceptability of a given commodity Fibri & Frøst (2019), there is inadequate information on the consumers' perception of honey quality availed to them. Therefore, this leaves a knowledge gap that this study sought to narrow by determining the exact node along the value chain where quality deterioration occurs. This study further provided information on consumers' perception of the honey quality availed to them.

1.3 General Objectives

To determine honey quality and its quality perception by consumers along the value chain in Northern Uganda.

1.4 Specific Objectives

1. To assess the quality of honey at different value chain nodes
2. To determine the most important honey quality attributes considered by consumers when making purchasing decisions.
3. To ascertain consumers' perception of the honey quality

1.5 Research Questions

1. Does the quality of honey along the value chain node meet the required standards?
2. What are the most relevant honey quality attributes considered consumers by when making purchase decisions?
3. What are the honey consumers perception of the honey quality in the market?

1.6 Scope of the Study

This study was conducted in Northern Uganda in the areas of Amudat, Lira, Arua and Gulu and it focused on determining the quality of honey at different value chain nodes and consumers' perceptions of the honey quality. It aimed at establishing the exact node within the value chain where honey quality deterioration occurs and the adulterants at each node. The data collection was done between August and October 2022 because honey harvesting is done in this period.

1.7 Conceptual Framework

This study conceptualized that within the honey value chain, many factors interact to determine the quality of honey produced and marketed. These factors include production factors used like, type, and number of beehives, honey handling practices used like the type of equipment used, method of harvesting, storage, processing, packaging, and labeling. As well as value chain actors' knowledge, and awareness of honey quality requirements, and their perception of quality. For example (Ndyomugyenyi, 2015; Kugonza & Nabakabya, 2008) found that shortage of knowledge and skills on better quality honey production, lack of better quality equipment, poor harvesting, processing and storage techniques used and absence of adequate extension services were the major constraints to better quality honey production. According to Ndyomugyenyi (2015), most farmers harvest honey by burning grass and putting wet leaves above it in order to

produce smoke which reduces the superiority of honey as the ash and smoke contaminates the honey while the heat denatures the active essential enzymes in the honey. Furthermore, Tadesse *et al*. (2021) also found that poor extension services and lack of knowledge on how to obtain better quality bee products, in-availability of better bee keeping equipment and poor honey storage facilities were a major threat to good quality honey production. Therefore, it is grounded on these earlier study findings that this study is conceptualized.

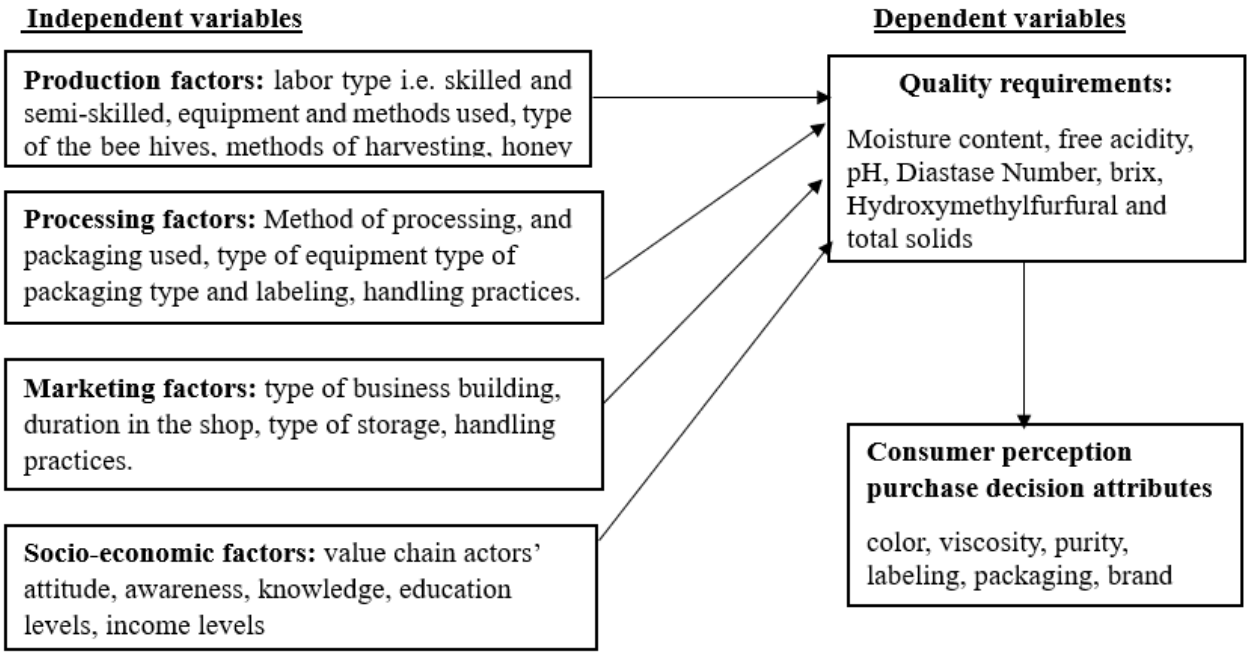


Figure 1: Conceptual framework

Source: Own Conceptualization

1.8 Significance of the study

Honey quality and its quality perception by consumers are significant because consumers' satisfaction rotates around these two. Therefore, an investigation that generates knowledge and recommendations on their improvement will inform policy makers' decisions on the honey production requirements that may create enabling environment for the value chain actors for

increased production with emphasis on quality and value addition to meet the national and international standards. By evaluating consumer perceptions, this study inexorably assesses honey consumers' needs and demands related to good quality honey. Therefore, this research will avail information on the consumers' expectations and perceptions of honey quality. This may help honey value chain actors to revise their honey production and handling techniques to meet the consumers' demands and ensure they are in line with quality requirements of the national and international regulatory bodies. The study findings will be helpful to honey value chain actors in marketing. Importantly, the research will help honey value chain actors to understand factors influencing consumer purchase decisions when making honey choices. Knowledge obtained on aspects impacting consumer purchase decision of honey in general will serve as a guideline for development of policies intended to capitalize on understanding of consumer buying decision to improve performance of value chain actors in the honey business.

CHAPTER TWO: LITERATURE REVIEW

2.1 Honey Quality

Pure natural honey is sticky and viscous, containing carbohydrates, mainly glucose and fructose, water, proteins, minerals, small quantities of amino acids, enzymes, vitamins, and phenolic anti-oxidants (Asaduzzaman *et al.*, 2015; Shugaba, 2012). All these elements have valuable nutritional and medicinal properties (Abraha Aregawi, 2020; Mesele, 2021). Value chain actors place their highest priority on honey quality when setting prices; Hence, throughout marketing, acceptability and readiness to pay are based on the product's quality and physicochemical properties (Mesele, 2021). In quality control of honey, several parameters (physicochemical characteristics) such as moisture content, hydroxymethylfurfural, diastase number, water insoluble solids, free acidity are important (Mesele, 2021; Pasias *et al.*, 2017). Honey is only considered of good quality when these quality parameters meet the recommended limits set by the national (Uganda National Bureau of Standards [UNBS]) and the International (codex) regulatory bodies (Codex Alimentarius Commission, 2014; UNBS, 2019) as shown in (Table 1)

Table 1: Recommended Honey quality standards by (UNBS) and CODEX

Quality standard body	**Quality parameter**						
	Moisture content (%)	Total soluble solids (%)	pH	Free acidity ($meq.kg^{-1}$)	HMF ($mg.kg^{-1}$)	Diastase Number (°Gothe)	Brix (%)
UNBS	≤ 22	≥83	<5.6	≤ 50	≤ 80	≥ 3	65g/100g
FAO and WHO	≤ 21	≥83		≤ 50	≤ 80	≥ 3	65g/100g

Source: Adopted from; UNBS, (2019) and Codex, (2014); HMF = Hydroxymethylfurfural, UNBS, FAO, and WHO=Food and Agriculture Organization and World Health Organization, respectively.

2.1.1 Moisture Content

Moisture content (MC), which means the quantity of water in honey Semra *et al.* (2020) is a significant parameter that influences honey viscosity, crystallization, flavor, color, density, degree of maturity, shelf life, stability, and resistance against degeneration due to fermentation (Mouhoubi-Tafinine *et al*. 2018). According to Osuagwu & Oyerinde (2020) and Semra et al. (2020), moisture content has a significant impacts on the viscosity, flavor, palatability, color, shelf-life, density, specific gravity, refractive index, optical properties of honey and the crystallization ability of honey. The MC varies according to the bee type, floral sources, honey collecting period, the level of maturity in the hive, season, temperature, relative humidity of the hive and the surrounding, ecological factors and climatic conditions of the area (Da Silva *et al.,* 2016; Sereia *et al*., 2017).

According to Shugaba (2012), honey with high MC is prone to quicker fermentation, crystallization, and yeast proliferation within a shorter period during storage. While lower MC lengthens the shelf life of honey and protects it against osmophilic bacterial activities and fermentation (Osuagwu & Oyerinde, 2020). Furthermore, Amariei *et al*. (2020), reported that processing the honey reduces the MC to safer limits thus decreasing its chances of fermenting and crystallizing during storage. Thus MC is a good quality measure for determining honey's stability and resistance to spoilage by yeast fermentation (Erez *et al*., 2015). According to Thrasyvoulou *et al.* (2018), the maximum MC for honey should not exceed 20%. Because honey with MC above this maximum, is susceptible to fermentation.

2.1.2 Free Acidity

Free acidity of honey is the quantity of all free acids expressed in milliequivalents /Kg of honey (Mesele, 2021). Generally, all honey is acidic as a result of the availability and effect of organic acids like citric acid, gluconic acid, succinic, malic, butyric, lactic, formic, acetic, and pyroglutamic acids (Puścion-Jakubik *et al.*, 2020). These account for the honey's taste, flavor, and steadiness against microbial spoilage (Yohannes et al., 2019). According to Sereia *et al.* (2017), the free acidity of honey should not exceed 50 milliequivalents acid per 1000g. This is because excess free acidity value of more than 50mEq/1000g signifies the occurrence of fermentation of the sugars (Sajid *et al*., 2020).

2.1.3 Hydroxymethylfurfural (HMF)

The HMF is a product of Maillard reaction formed during the decomposition of reducing sugars in honey under acidic conditions under high temperature, prolonged storage period, and poor processing methods (Mesele, 2021). HMF is an important parameter primarily essential in evaluating the freshness and purity of honey (Sajid *et al*., 2020). It is usually lacking in newly reaped honey, but its intensity increases with increased storage duration (Mouhoubi-Tafinine *et al.*, 2018). A high value of HMF is an indicator of honey adulteration with inverted syrups, overheating during extraction, and prolonged storage (Osuagwu & Oyerinde, 2020). According to Da Silva *et al.* (2016), additional aspects that affect the HMF level of honey include pH, total acidity, mineral content, quantity, the form of reducing sugars, presence of organic acids, moisture content, and the floral source. Codex Alimentarius Commission (2014), documented that the HMF value of blended or processed honey should not exceed a maximum of 40mg/kg

except for countries or regions in the tropics where a maximum HMF value of 80 mg/kg needs to be maintained.

2.1.4 Diastase Number

Enzymes present in honey are majorly proteins of complex structure that are accountable for explicit chemical reactions Escuredo & Carmen Seijo (2019) that are introduced into the honey by the bees either from plants or their secretions (Al-rubaie & Al-fekaiki, 2022).

The availability of these enzymes in honey has a significant assistance in the manufacture of honey though may not possess any nutritional value vital to humans (Olaitan *et al.*, 2007). Diastase is among the most significant enzymes naturally present in honey and is accountable for the conversion of starch to sugars (Pasias *et al*., 2017). Its availability in honey is dependent on floral and geographical origin of the bees (Da Silva *et al.*, 2016). This enzyme is sensitive to heat; hence, diastase number is a good indicator of overheating, extreme temperatures, storage length, and preservation level (Kugonza & Nabakabya, 2008). The amount of enzymes present in the honey depends on the age of the bees, nectar collection period, physiological period of the colony, the quantity of nectar flow and its sugar content, and pollen consumption (Matović *et al*., 2018). According to Matović *et al.* (2018) and Codex Alimentarius Commission (2014), the amount of diastase number in honey after processing and blending should not exceed a minimum of 8 Schade units, and for honey with a less natural enzyme content not lower than 3 Schade Units.

2.1.5 Brix

Brix also known as Total Soluble Solids is the degree of sugar concentration in honey (Albu *et al.*, 2021)**.** The brix in honey include mainly sucrose, other sugars, organic acids and minerals (Nordin *et al*., 2018). The brix value shows the association between water and sugar

concentration in a substance Nordin *et al*. (2018) in that the brix content is directly proportional to the moisture content of honey and it generally decrease with an increase in honey moisture content (Batu *et al*., 2014). The brix content of honey varies depending on honeys' level of maturity, storage conditions, and level of adulteration of the honey (Yeboue *et al.*, 2021; Batu *et al.*, 2014). According to Batu *et al.* (2014), brix value is an important criteria for honey quality assessment especially during its marketability and storage whereby honey possessing higher brix value and low moisture content has a higher shelf life and can be stored for a longer period without fermenting hence regarded to be of high quality.

2.1.6 pH

Honey is generally acidic, and its normal pH ranges of between 3.2 and 4.5 are as a result of availability of organic acid specifically gluconic acid, and inorganic ions like phosphates and chlorides (Nordin *et al*., 2018). Its acidity defers basing mainly on its floral origin (Majewska *et al*., 2019). Honey's pH has a significant impact on its texture, steadiness and shelf-life and is of great importance especially during its extraction and storage (Mouhoubi-Tafinine *et al.*, 2018). low pH (high acidic), of 3.2-4.5 hinders the availability and development of microorganisms, lengthens honey's shelf life, improves the taste of honey when consumed, improves on the honey's compatible with many other food products in terms of pH and acidity, and denotes the presence of high mineral content (Majewska *et al.*, 2019; Mesele, 2021; Speer & Schreyack, 2015). However, according to Kugonza and Nabakabya (2008) and Mesele (2021), excessive honey acidity is not advised because it results in sour, off-taste, and runny texture. This high acidity is also due to fermentation, which produces alcohol and then acetic acid as a result of this fermentation. In summary, having clear knowledge on the pH/organic acids of different honey

types is essential in detecting and suggesting the honey types' sources, their taste, and their preservation capacity (Mesele, 2021).

2.2 Important Honey Quality Attributes that Influence Consumer Purchase Decisions

Consumer purchase decisions are the numerous decision-making processes individuals indulge in and the activities they under take to ensure their needs and wants are fulfilled while purchasing goods or services (Pradhan, 2018). According to Rumagit *et al.* (2022), consumers' purchasing decisions encompass the procedures involved when they (consumers) choose, purchase, utilize, or dispose-off products, services, ideas, and experiences to fully meet their desires and wants. A customer purchasing decision is a process that starts earlier than the product is bought and an impact subsequently, triggering the final decisions made. Consumers usually undergo five stages of decision-making while preparing to make purchase decisions for any good: problem or need recognition, information search, alternative evaluation, outlet selection and purchase, and finally post-purchase evaluation stages where they assess the level of satisfaction they have received (Teeny *et al.,* 2021; Tsimonis, 2014).

However, for regularly purchased and used commodities, a consumer may not consider the entire process from beginning to the final stage (Parities, 2012) and honey is among these frequently consumed products. According to Panda *et al.* (2022), consumers' purchase decisions are influenced by various factors, one of which is mainly product-related factors/ features. Product features are intrinsic characteristics of a product that consumers use to judge the products' capacity to satisfy their desires, needs, and wants through utilizing the product to evaluate their satisfaction levels (Morar, 2013). Consumers usually assign much importance to these features because they are used as a basis for assessing the worthiness and superiority of the good in relation to the benefits that they (consumers) obtain from it. Hence, consumers use these

product-related attributes as important quality indicators when making critical decisions during the purchasing process (Panda *et al*., 2022).

Quality is the total sum of value chain actors' evaluation of all attributes of an object that creates consumer satisfaction (Wicks & Roethlein, 2009). Barrett *et al*. (2010) define quality as the level of excellency or value of a product that distinguishes one product from another. Phan *et al*. (2020) segmented quality into several groups: safety, nutritional value, packaging, processing, color and appearance, flavor, viscosity, organoleptic perception, taste, safety, nutritional value, clear labeling, ingredients, price, packaging, brand reputation, convenience, consistency, origin, ethical considerations, and environmental concerns are the distinguishing qualities of honey that consumers use to evaluate its novelty during purchase (Codex Alimentarius Commission, 2014; Oliveira *et al.,* 2020).

Similarly, Yeow *et al.* (2013) and Żak (2017) discovered that price, taste, country of origin, type of honey, consistency, color, fragrance, shape, and brand significantly influence consumer decisions made during honey purchase. Like other foods, honey is marketed based on these composite quality attributes Ismaiel *et al.* (2014), which are majorly considered by consumers when making food purchase decisions (Ghorbani & Khajehroshanaee, 2009).

The price refers to the sum total that a consumer reimburses for a product or the values that consumers pay for the satisfaction obtained after consuming a product or service (Roman *et al.*, 2013). According to Yeow *et al.* (2013), pricing is the computation of service charged according to its worth that the clients are willing to pay. According to Diaz and Cataluña (2011), the prominence of price as a consumption stimulus has a vital position it plays in price management since it influences how prices are perceived and treasured and impacts consumer purchase decisions. Therefore, pricing is unquestionably a significant factor influencing consumers'

decisions when purchasing honey and its related products (Yeow *et al*., 2013; Roman *et al.*, 2013; Żak, 2017). Hence a significant attribute inducing consumer decisions and willingness to purchase honey (Roman *et al*., 2013). However, there is no clear evidence indicating the level of importance consumers accord to price during purchase compared with other quality parameters that this study seeks to establish.

Packaging is a combination of physical and tangible artifact(s) that continuously undertakes the roles of conserving, shielding, and directing on the use, handling, and conveying formal & informal information about a product (De Lange *et al*., 2013). Hence, packaging is always essential during the product's transportation, sale, and utilization. Since in most cases, ‘’consumers buy products basing on their visual observations’’ or procure products which meet their aesthetic expectations. It is therefore vital to offer products which are well packaged in beautiful and attractive packages (Roman *et al*., 2013). Packaging is an important attribute that is considered widely by many consumers because when deciding to purchase honey, consumers concentrate primarily on the different label information on the packages (Żak, 2017).

Labels are intrinsic elements of product packaging because they not only play a visual role but also provide relevant information (verbal elements) about the product that the consumers use when making purchase decisions (Adam & Ali, 2014). Among these vital information often considered by honey consumers are origin, nutritional composition, and certification (Mirosa *et al*., 2021). According to Roman *et al.* (2013), the unique source of the honey and its certification strongly influence consumers’ purchase decisions. Consumers are found to assign much value to foods of local origin and are willing even to pay more. To consumers, the issue of the place of origin is significant because they believe that the geographical origin and climatic conditions as well as the plant types from which the bees obtain nectar greatly impact the quality of honey

(Khaoula et al., 2019). Therefore, considering the effects of packaging and the graphic influence of labels and its capacity to initiate consumer buying decisions, it can be deduced that packaging, labeling, and artistic design can act as a major influential factor during honey purchase on which decision-making is based (Al-Samarraie et al., 2019; Roman et al., 2013). However, this study needed to confirm this assertion with empirical data in the proposed context it investigated.

Brand which refers to a name, design, symbol, or other feature that differentiates one product from another (Zhang, 2010). Many elite consumers consider it an important criterion when making purchase decisions (Yuan & Xiao, 2021). Brands usually to smoothers numerous purchase decisions and provides assurance to consumers as they relate their past, present, and forthcoming decisions, experiences, satisfactions, and knowledge (Dennhardt, 2014; Kim *et al.*, 2008). Considering the information they are provided with concerning the products, brand reputation always plays an essential key role in the marketing sector by building long-term brand equity, hence a key when making sales and decision-making processes (Yeow *et al*., 2013). Thus, it could be concluded that brand is an important parameter influencing consumer purchase decisions for honey. However, compared to other parameters, the value consumers accord to it needed to be ascertained with empirical data.

Other factors influencing consumer purchase decisions when buying honey are color, viscosity, and purity, though to a lesser extent because consumers do not tend to pay much attention to them when making honey purchase decisions (Oliveira *et al.*, 2020; Purnomo *et al*., 2021). Most consumers prefer bright colored honey since they consider it more hygienic with fewer impurities (Brščić *et al*., 2017). Furthermore, because most honey consumers have for long consumed contaminated honey, they are worried of the quality and purity of the honey they buy and eat (Nabwire, 2016). Because of this, honey consumers are eager to pay much more for pure

honey that is organically produced and having its origin source indicated (Nabwire, 2016) because they believe pure honey is healthier and tasty hence suitable to be utilized as medicine (Oliveira *et al.*, 2020).

2.3 Consumers' Perception of Honey Quality

Consumer concerns for food safety have primarily been driven by awareness and health consciousness worldwide (Petrescu *et al*., 2020). In terms of perceived attributes, Symmank (2019) found that consumers tend to rely on the intrinsic qualities of food products. The most significant honey feature that influence consumer perception are color, viscosity, taste, price, packaging, branding, and labeling (Nabwire, 2016; Petrescu *et al.*, 2020) because they can physically be observed by the consumers using the naked eyes or other body sense organs. Having a clear understanding of the impact of these food quality attributes on consumers perception of quality is significant since they are a critical factor in price determination, willingness to pay, and acceptability of the product (Van Rijswijk & Frewer, 2008).

Color is the most attractive appearance attribute most consumers perceive to be significant (Brščić *et al*., 2017). It is also the leading influential factor of price and consumer acceptability in the market (Mouhoubi-Tafinine *et al.,* 2018). The color of honey differs from colorless to dark brown, and it's dependent on the plant botanical source, ash content, storage duration, and or temperature (Da Silva *et al.*, 2016). According to Archilia *et al*. (2021) and Aroucha *et al*. (2019), most consumers prefer light colored honey. This is because light colored honey is perceived to be fresh, clean, and of good quality since honey tends to darken when heated at high temperatures and with increased length of storage as a result of Maillard reaction (Archilia *et al*., 2021).

Viscosity which means resistance against flow is the greatest critical property of most fluid foods (Blok *et al*., 2020). It is instrumental in determining the quality attribute of most food products that influence consumers' perception of the products (Fellows, 2017). According to Juma *et al.* (2016), viscosity is a feature that indicates the level of consistency, concentration, and the dilution level of the honey. It is dependent on temperature, water quantity, and chemical constitution of honey and has a powerful impact on honey's physicochemical and sensory properties (Singh & Singh, 2018). Viscosity can be described as very watery, watery, normal viscosity, viscous, very viscous, and crystalline (Marcazzan *et al*., 2018). According to Juma *et al*. (2016), viscous honey is perceived as good for medicinal purposes, whereas loose honey is perceived as suitable for consumption. On a similar note, Marcazzan *et al.* (2018) noted that consumers preferred drinks or honey, which are viscous, and concluded that thickness is the main driving force in consumer decision-making. Contrarily, Kabbani *et al*. (2011) noted that some consumers perceived liquid honey to be of good quality and preferred it because it is easier to handle, consume and detect any impurities.

Packaging is essential when deciding on a commodity's purchase (Ghorbani *et al*., 2009). It plays many vital roles, for example, protecting the goods from the harsh environment, providing essential information to customers, and most importantly, "acting as a salesman on shelf by attracting customers" (Bou-Mitri *et al*., 2021). The most essential packaging materials or container features are labels containing the brands, manufacturing and expiry dates, country of origin, and floral sources of the honey (Nabwire, 2016). Based on these, Batt & Liu (2012) reported a positive perception for products with distinctive packaging, labels, brands and product origin.

Considering origin and where honey is bought from, consumers prefer unprocessed honey from local producers since they perceive it as safer and free from adulteration that occurs during processing (Pocol & Bolboacă, 2013). Similarly, Nabwire (2016) reported that customers anticipated organic foods of native origin to be safer and securer for consumption, and as a result, their demand for these native foods escalated due to high consumer awareness of the foods they consumed. Additionally, according to Khaoula *et al*. (2019), consumers significantly consider the issue of place of origin because they believe that the geographical origin and climatic conditions as well as the plant type from which the bees obtain nectar greatly impacts on the quality of honey (Polak-Śliwińska & Tańska, 2021).

Price assists in identifying how income interacts with other attribute, it is used as a measure for willingness to pay for other quality attributes (Lee *et al*., 2004). According to Pocol and Bolboacă (2013), honey is perceived as an expensive or luxury product by the unemployed and less educated people hence looked at as a conclusive factor when buying honey (Henryks *et al*., 2014). On a similar note, Batt and Liu (2012) discovered that during purchase of honey, price is still the most dominant factor customers consider in decision making.

However, despite all these, the factors that affect consumers' perception of honey quality presented to them is still unknown in Northern Uganda. Therefore, this study aimed to confirm with empirical evidence most significant factor customers consider when making honey purchase decisions.

CHAPTER THREE: MATERIALS AND METHODS

3.1 Study Area

This study was conducted in three major honey producing districts of Arua, Lira and Amudat. The three districts are in different Agro-ecological zones of Northwestern-and Northeastern savannah grasslands, and Northeast Drylands, respectively, in Northern Uganda. Arua, Lira, and Amudat are located at coordinates 3°01'12.47"N 30° 54' 39.78" E, 2°14'59.64"N 32°52'59.49"E and 1° 56' 59.99"N 34° 56' 59.99"E respectively. These districts were chosen because they are among the highest honey producing districts with many small honey traders associations and well-established processing facilities, for example, an ultra-sound modern factory for processing bee products established in 2003 in Arua district by Bee Natural Products (Akullu & Mwesigwa, 2021; Lynch *et al*., 2014).

3.1 Methodology for Assessment of Honey Quality Along the Value Chain

3.1.1 Study Design

A survey and collection of honey samples from three value chain nodes spread across three agroecologies was carried out followed by laboratory analysis of seven honey quality parameters. Laboratory and statistical analysis were essential in this research as they provided an opportunity to point out the exact node within the value chain where quality deterioration mostly occurs.

3.1.2 Sample Size Determination

The sample size (n) was determined using the equation described by Cochran (1977) as.

$$n = \frac{Z^2 Pq}{e^2}$$

Where, n represents the minimum sample size.

Z is confidence level at 95% (standard value of 1.96)

P = the variability in proportion of the population (estimated percentage of honey consumers in Gulu, Lira and Arua district) = 95%, this is assumed following the suggestion of Israel (2013).

e = Margin of error at 5% (standard value of 0.05) and q = weighting variable computed as (1-P).

Cochran (1977) formula was applied to get the honey value chain actors because it is suitable for use in sample size determination where the sampling frame is unknow (Thompson & Wu, 2020)

Using the formula above,

Equation 1: Sample Size Determination

$$n = \frac{(1.96)^2 * 0.95(0.05)}{(0.05^2)} = 72 \text{ respondents}$$

3.1.3 Sampling procedures

To determine the physico-chemical properties of honey, 70 honey samples each weighing 500g were purposively collected from every node along the honey value chain for laboratory analysis. Of these, 30 were from farmers (beekeepers) (10 from each district of Arua [(North-Western savannah grasslands), Lira (North-Eastern savannah grasslands), and Amudat (Northeast Drylands)], 10 from processors (5 from each of the two districts of Arua, and Lira), and 30 from retailers (15 from each of the two districts of Arua, and Lira) and at the retail level, honey samples were obtained from different retail businesses, including supermarkets (5 samples), roadside vending (5 samples), and general merchandise (5 samples). These honey value chain

actors were purposively selected because they are actively involved in the honey production process and thus their activities have a direct effect on the quality of honey they deal with. Snowball sampling technique also followed to get more value chain actors. The honey samples were filled in precleaned dry plastic containers of 500g capacity and packed in cold boxes then transported to Gulu University Faculty of Agriculture laboratory. The samples were then stored at room temperature awaiting quality parameters analysis. The experiments were run in triplicate during laboratory analysis to ensure accuracy.

3.1.4 Laboratory Analysis

The honey samples collected were used to determine quality parameters like diastase number (DA), pH, free acidity (FA), Hydroxymethylfurfural (HMF), moisture content (MC), total solids, and Brix (Codex Alimentarius Commission, 2014), and the procedures followed were in accordance with those described by the Association of Official Analytical Chemists (AOAC) in 1995.

3.1.4.1 Determination of pH

The pH of the honey was determined using digital pH meter (pH 920 model) which was calibrated at pH 3.0, 7.0 and 9.0. Ten grams of honey sample was dissolved in 75 ml of distilled water in 250 ml beaker and made up to the 100 ml mark. The solution was then stirred using a magnetic stirrer model MS400. The pH electrode was immersed in the solution and the stable pH value recorded immediately.

3.1.4.2 Determination of Free Acidity

Free acidity was determined by volumetric method as used by previous studies [Fuentes Molina *et al*., (2020); Kugonza & Nabakabya, (2008)]. During the experiment, 10 g of honey weighed

using an analytical balance was dissolved in 75 mL of distilled water in a beaker of 250ml capacity to form a homogeneous solution; 5 drops of alcoholic solution of phenolphthalein indicator were added and the solution titrated with 0.1 M sodium hydroxide (NaOH) to pH 8.30 to obtain the free acidity value of honey. The titre value was recorded and used to obtain free acidity using the formula in equation 2.

Equation 2: Determination of Free Acidity

$$Free\ Acidity\ in\ milliequivalents/kg\left(\frac{mEq}{kg}\right) = Volume\ of\ 0.1M\ NaOH(ml) \times 10$$

3.1.4.3 Determination of Diastase Number

Diastase number was determined using spectrophotometric method (AOAC 958.09) at 660 nm as specified by the previous studies on honey (Fuentes Molina et al., 2020; Kugonza & Nabakabya, 2008). To carry out this analysis, several solutions including iodine stock solution, iodine solution and starch solution were prepared in accordance to the procedures described by Association of Official Analytical Chemists AOAC (1995) as used by (Sereia et al., 2017). The starch solution was first standardized so as to obtain an absorbance reading in the spectrophotometer range from 0.760 to 660 nm. During the analysis, two grams of honey were weighed in a 50 ml beaker and 5 ml of acetate buffer together with 20 ml distilled water added to dissolve the honey. Three milliliters of sodium chloride solution were added to a 50 ml volumetric flask and the dissolved honey sample was transferred to it. The volume was adjusted to the 50 ml mark. The starch solution was warmed to 40 °C and 5 ml of it were pipetted into 10 ml of water at 40 °C and mixed well. 1 ml of this solution was pipetted into 10 ml of 0.0007 N iodine solution and was then diluted by 35 ml of water and mixed well. The color was then read at 660 nm against a water blank using a spectrophotometer. Ten ml of the honey solution was

pipetted into a 50 ml graduated cylinder and placed in a water bath at 40±0.2 °C with the flask containing the starch solution. After 15 minutes, 5 ml of the starch solution was pipetted into the honey solution, mixed and the stopwatch was started. One ml of the honey starch solution was then mixed with 10 ml iodine solution, and the stop clock started. The absorbance was measured immediately following a 5-minute interval (at the 5^{th}, 10^{th}, 15^{th}, and 20^{th} minutes) at 660 nm by a spectrophotometer. The measurements were continued until absorbance readings of less than 0.235 was reached. The time taken to reach this absorbance of 0.235nm was recorded. The absorbance was plotted against time (minutes) on graph paper. A straight line was drawn through at least three points on the graph to determine the time when the reaction mixture reaches an absorbance of 0.235. The diastase number (DN) was obtained by dividing three hundred by the time in minutes it took to obtain an absorbance reading less than 0.235.

Equation 3: Determination of Diastase Number

$$Diastase\ Number\ (DN) = 300/tx$$

3.1.4.4 Determination of Hydroxymethylfurfural

The hydroxymethylfurfural concentration was determined using Spectrophotometric method (AOAC 980.23) as used by several researchers (Fuentes Molina *et al*., 2020; Gebremariam & Brhane, 2014; Kugonza & Nabakabya, 2008). Five grams of honey were diluted with 25 ml of distilled water prior to transfer into a 250 ml volumetric flask. 0.5 ml Carrez I solution were added followed by 0.5 ml Carrez II solution and then distilled water added up to the 250 ml mark. The solution was filtered using a 0.45 µm filter paper but with the first 10 ml filtrate discarded away. The 5 ml honey was then mixed with 5 ml water. Its absorbance was measured against a reference solution of 5 ml of initial honey solution and 5 ml of 0.2% sodium bisulphite

solution. The absorbance was then measured at 284 nm and 336 nm, and the values expressed in (mg/kg). The HMF was calculated using the formula:

Equation 4: Determination of Hydroxymethylfurfural (HMF)

$$HMF\left(\frac{mg}{kg}\right) of\ honey = ((Abs284 - Abs336) \times 5 \times W$$

Where, Abs *284* = absorbance at 284 nm; Abs336= absorbance at 336 nm; and W= Weight of sample taken.

3.1.4.5 Determination of Moisture Content

Moisture content of the honey samples was determined by using gravimetric method (AOAC 969.38B) as used by Gebremariam and Brhane (2014). Five grams of honey was weighed and placed in a pre-weighed drying crucible. The sample was then dried to a constant weight in a vacuum oven at 105 ^{0}C for four hours. The moisture content of each sample was then calculated as:

Equation 5: Determination of Moisture Content

$$Moisture\ Content\ (\%) = (M1 - M2) \times 100/(M1 - M0)$$

where MO = weight of empty dish; M1 = weight of fresh sample + dish; M2 = weight of dried sample + dish.

3.1.4.6 Determination of Total Solids

The percent total solids of each honey sample were determined using the equation (El-Haskoury et *al.*, 2018):

Equation 6: Determination of Total Solids

$$Total\ Solids\ (\%) = 100 - Percentage\ Moisture\ Content$$

3.1.4.7 Determination of Brix Content

The brix content of each honey sample was determined using a handheld refractometer. Whereby, few drops of the honey sample were mounted onto the main prism of the refractometer. The daylight plate of the refractometer was closed, and the readings checked. The readings were taken by checking the boundary line of blue and white separating the graduated scale. This was then recorded as the percentage brix for sugar concentration (percentage of sucrose content was measured in g/mL of honey).

3.1.5 Data Reliability, Validity, and Quality Control

Samples were purchased, wrapped in foil, packed in cold boxes, and transported to Gulu University Faculty of Agriculture laboratory using public transport. The samples were then stored at room temperature awaiting analysis of their quality parameters. The experiments were done in a clean environment, and samples were labeled appropriately to avoid cross-mixing. The laboratory wastes were disposed off into designated laboratory sinks meant for laboratory waste disposal. Additionally, the experiments were run in triplicate during laboratory analysis, and their means were later calculated. The data was then recorded in prepared data sheets, entered into Microsoft Excel spreadsheets, and then exported to GEN STAT (version 13) for statistical analysis. Prior to data analysis, data cleaning and coding was done to enhance the quality of the data.

3.1.6 Data analysis

Data on the physico-chemical quality properties of honey were analyzed using GEN STAT software (version 13) and (SPSS version 25). All analyses were carried out in triplicates and the data were presented as means ± standard deviations. One way Analysis of Variance (ANOVA)

was used to estimate variation in the physico-chemical properties of honey at different value chain nodes or agroecology. ANOVA was used for analysis because it enables comparing three or more independent data groups. To determine whether there was a statistically significant difference in the mean values of the physicochemical quality characteristics of honey, the Games-Howell post hoc test for multiple comparisons was run since the sample sizes were unbalanced (Midway et al., 2020). Finally, Pearson's correlation analysis at 5% significance level was used to determine the relationship between moisture content and free acidity and hydroxymethylfurfural (HMF) and diastase number. The significance level was fixed at 5% ($P < 0.05$).

3.2 Methodology for Objective Two and Three

3.2.1 Study Design

This study employed a cross-sectional survey design to collect data on honey consumers' socioeconomic characteristics, their purchase and consumption patterns, important quality parameters considered by consumers when making honey purchase decisions and consumers' perception of honey quality.

3.2.2 Sampling Procedure

Purposive sampling technique was employed to select representative samples of the respondents. Purposeful sampling technique permitted the identification and selection of individuals who were knowledgeable about honey, experienced and had consumed honey for a longer period. In the first stage, the three cities of Gulu, Arua and Lira were purposively selected because they are the major cities with a high population of honey consumers and rapidly growing number of supermarkets, grocery shops and honey vendors. In the second stage, purposive sampling was

employed to select the sub-counties (divisions) of Bardege-Layibi division and Laroo-pece division (for Gulu), Arua Central division and Ayivu division (for Arua) and then Lira-East and Lira-West divisions (for Lira city). In the third stage, the participants were also purposively selected targeting majorly honey consumers.

3.2.3 Sample Size Determination

The sample size (n) was determined using the equation described by Cochran (1977) as.

$$n = \frac{Z^2 Pq}{e^2}$$

Where, n represents the minimum sample size.

Z is confidence level at 95% (standard value of 1.96)

P = the variability in proportion of the population (estimated percentage of honey consumers in Gulu, Lira and Arua district) = 86%, this is assumed following the suggestion of Israel (2013).

e = Margin of error at 5% (standard value of 0.05) and q = weighting variable computed as (1-P).

This formula was applied to the honey consumers in the three cities, and the sample size was determined as follows.

Using the formula above,

Equation 7: Sample Size Determination

$$n = \frac{(1.96)^2 * 0.86(0.14)}{(0.05^2)} = 185 \text{ respondents}$$

3.2.4 Data Collection

Semi-structured questionnaires were used to collect data on consumers' honey consumption patterns and purchasing habits, product related factors that consumers consider as important quality indicators when making honey purchase decisions and consumer's perception of honey quality. The questionnaires were pretested on selected honey consumers in Gulu district through face-to-face interviews to ascertain the reliability and validity, consistency, significance, and appropriateness of the designs used. Pre-testing was done to enable the researcher to ascertain whether research assistants and respondents would be able to understand the questions consistently and in a way intended by the researcher (Buschle *et al.*, 2022). The necessary modifications were made to the questionnaires after the pretesting exercise to capture the relevant information related to the study objectives and to allow an orderly flow of the questions for the final administration of the interview guide. The questionnaire was separated into five parts. The first section consisted of questions on the frequency of honey consumption, the quantity of honey bought, motivations to consume honey, and the mode of honey consumption. The second section consisted of questions on the frequency of honey purchase, preferred place of honey purchase, quantity purchased, preferred color, impurities, and type of label information often checked during honey purchase.

The third section of the questionnaire collected data on the influential product-related factors that consumers consider as important quality indicators when making honey purchase decisions (objective two). The selection of the product-related constructs (color, viscosity, purity, labeling, packaging, brand name, certification, price, and origin) was based on existing literature, as well as their relevance to the study context (Khaoula *et al., 2*019). All constructs were gauged on a 5-point Likert scale where (1-strongly disagree, 2-disagree, 3-neutral, 4-agree, 5-strongly agree).

The fourth section assessed consumers' perception of honey quality. The construct used to assess consumer perception of honey quality were color, viscosity, purity, labeling, packaging, brand name, certification, price, and origin. Each of these constructs had several statements portraying it (Appendix 7). The statements were assessed using a five-point Likert scale (1-strongly disagree, 2 -disagree, 3 -neutral, 4 -agree, 5-strongly agree), in which respondents were asked to indicate their level of agreement and disagreement with the statements relating to the stated constructs. The constructs' selection were guided by present literature (Khaoula *et al.,* 2019; Nabwire, 2016; Hameed Taherdoost, 2016) and their significance to the study context.

The fifth part assessed the socio-demographic characteristics of the respondents such as gender marital status, education level, household size, age, employment status, and monthly income levels.

3.2.5 Data Reliability and Validity

The reliability of the questionnaires was tested through a pilot study using beekeepers around Gulu district and internal checks by asking some selected questions in different ways. Validity was further established by having supervisors from Gulu university and experts in the study area (district entomologists and sub-county agricultural officers) look at the instruments to make sure that the questions were exhaustive for the study objectives capturing all aspects of the study. The suitability and clarity of questions was determined by pretesting the questionnaires with other respondents not involved in the study but with related characteristics to the target population.

3.2.6 Data Analysis

Data collected on important honey quality attributes considered when making purchase decisions and consumers' perception of honey quality was coded and edited to ensure completeness, uniformity, and accuracy. Data analysis tools included SPSS version 25 (Statistical Package for

Social Scientists) and AMOS. The information on the socioeconomic characteristics of the respondents was summarized using descriptive statistics (frequencies and percentages).

3.2.6.1 Objective 2 (Determining Important Honey Quality Attributes influential in Purchase Decisions)

The data on the key honey quality factors that customers take into account when making honey purchase decisions were described using descriptive statistics in the form of averages, standard deviation, and pie charts.

3.2.6.2 Ascertaining Consumers' Perception of the Honey Quality

Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) are two steps in the structural equation modeling (SEM) process used to assess the collected data on consumers perception of honey quality. In the first step, exploratory factor analysis (EFA) in SPSS was used to reduce the amount of data, and the best-fitting items for explaining the primary construct were found.

EFA using varimax rotation with Kaiser normalization was conducted on each attribute of consumer perception of honey quality to clarify the factor loadings of the constructs of perception of honey quality as the dependent variable and the constructs of the independent variables (colour, viscosity, packaging, labelling, price, and origin). Due to cross loadings or low factor loadings on the various constructs in an iterative process, certain measurement items were eliminated (Terkes et al., 2019). The EFA results showed that the value of KMO = 0.712 was above the minimum threshold of 0.7 and Bartlett's sphericity test ($\chi^2 = 1846.463$; $P < 0.01$) was significant (Table 2), meaning the assumption of sampling adequacy was met in this study. The EFA results of the dependent variable of perception yielded five items, namely origin, labelling, packaging, colour, and price (Table 2). Cronbach alpha was then calculated for each factor extracted in order to assess the internal consistency of the extracted components. The Cronbach's

Alpha values of all the variables in the constructs of consumer perception were above the minimum threshold of (≥ 0.6), confirming adherence to the assumption of internal consistency.

Table 2: Exploratory factor analysis for consumer perception of honey quality

Items	**Standardized factor loadings**				
	F1 ORG	**F2 LAB**	**F3 PAK**	**F4 COL**	**F5 PRC**
When buying honey, the country of origin is very important to me.	0.651				
When buying honey, it is important that I buy honey of local origin.	0.684				
I think good quality honey should have its area of origin indicated.	0.731				
I personally always prefer to know the origin of the honey I buy.	0.741				
I always choose honey depending on the region (country) of origin.	0.824				
Cronbach Alpha	**0.891**				
When buying honey, I always read the information on the labels.		0.732			
Proper labeling of honey is critical in ensuring food safety.		0.688			
I find it easier to use labeled honey		0.782			
I read labels to be able to differentiate between the different honey brands		0.751			
I think honey labels contain all the information that describes good quality honey		0.611			
Cronbach Alpha		**0.813**			
I believe packaged honey is not safe for consumption®			0.755		
Packaged honey is not convenient to use®			0.587		
I find it difficult to transport packaged honey®			0.624		
I believe labeled honey is not of good quality®			0.553		
I think labeled honey is not safe for consumption®			0.658		
I think indicating the country of origin of honey is not necessary®			0.566		
Cronbach Alpha			**0.729**		
I believe dark colored honey is fresh				0.846	
I prefer dark colored honey to light colored honey				0.861	
I believe dark colored honey has a higher nutritional value				0.778	
Cronbach Alpha				**0.833**	
I think the current market price of honey is generally fair.					0.780
I am satisfied with the current market price of honey					0.760
Cronbach Alpha					**0.611**

*Total variance explained =50.804%. KMO=0.712; Bartlett's tests of sphericity: X^2=1846.463; df=465; p=0.000. F1 = items of Origin (ORG), F2 = items of Labelling (LAB), F3 = items of (PAK), F4 = items *of Colour (COL), F5 = items of Price (PRC)*

Additionally, a confirmatory factor analysis was conducted for the dependent and independent variables that exhibited good-fit. The CFA was conducted in Analysis of Moment Structure (AMOS) to assess how well the observed variables measured the latent constructs in the model. All items with factor loadings less than 0.5 were dropped further, followed by, co-varying the measurement error terms on items of the same independent and dependent variables **(**Appendix 13**).** Subsequently, path analysis was carried out to estimate the structural relationships between the independent and dependent latent variables (Table 14).

3.3 Ethical Approval

Ethical clearance was sought from Gulu University Research Ethics Committee (GUREC). While in the field, permission was obtained from the District Production and Commercial Officer. In addition, permission was also sought from the district entomologists and sub county officers of the selected sub counties of study and from parish and village chairpersons. Prior consent was sought from the respective respondents with an assurance that their information would be reserved confidential using question codes and passwords for the soft copies. Participants were also informed about the aims and the benefits of the study with assurance that the research is only for academic purposes. Informants' data was protected privately using passwords for the case of soft copies and using codes for the case of hard copies. Corona Virus Disease 2019 (COVID-19) Standard Operating Procedures (SOPs) were observed.

CHAPTER FOUR: RESULTS

4.1 Variation in Honey Quality

4.1.1 Variation of Honey Quality within Agroecologies

The results show that agroecology had a significant effect on moisture content, total solids, pH, free acidity, HMF and brix ($P< 0.05$) but not diastase number (Table 3). Additionally, honey quality from all the Agroecological zones met the recommended national and international (Codex Alimentarius Commission, 2014) quality standards (Table 3) except diastase number which was the only limiting factor to the quality of Northern Uganda honey.

The percentage moisture content, free acidity, and hydroxymethylfurfural (HMF) of honey from Amudat were statistically lower than honey from Lira and Arua by at least 2.65%, 17.73 $meq.kg^{-1}$ and 21.44 $meq.kg^{-1}$ respectively. However, the total solids, pH and brix of honey from Amudat were statistically higher than that from Lira and Arua by at least 0.34, 0.45 and 0.69 units respectively. No significant differences were detected on diastase Number (Table 3).

4.1.2 Variation of Honey Quality within the Value Chain Nodes

The mean values of the different honey parameters from three prominent honey value chain nodes are presented in (Table 4).

The results revealed that value chain node had a significant effect on moisture content, total solids, free acidity, HMF, diastase number and brix ($P< 0.05$) but not pH. Additionally, honey from all the value chain nodes met most of the recommended national (UNBS) and international (FAO and WHO) quality standards (Table 4) except diastase number which was the only limiting factor to the quality of honey obtained from processors and retailers.

The percentage moisture content, free acidity, and hydroxymethylfurfural (HMF) of honey from farmers were statistically lower than honey from processors and retailers by at least 1.9%, 6.68 meq.kg^{-1} and 14.23 meq.kg^{-1} respectively. However, the total solids, Diastase number and brix of honey from farmers were statistically higher than that from processors and retailers by at least 1.90, 2.81 and 0.13 units respectively. No significant differences were detected on pH across all the value chain nodes (Table 4).

Table 3: Mean Physico Chemical Properties of Honey by Agroecological zones

Agro-ecology	Sample number (n)	Quality parameters						
		Moisture content (%)	Total solids	pH	Free acidity ($meq.kg^{-1}$)	HMF ($meq.kg^{-1}$)	Diastase Number(°Gothe)	Brix (%)
Amudat	10	13.48 ± 0.85^{a}	86.53 ± 0.85^{a}	4.09 ± 0.15^{a}	27.20 ± 4.02^{a}	24.66 ± 4.63^{a}	2.53 ± 2.00^{a}	79.50 ± 0.71^{a}
Arua	30	16.13 ± 2.40^{b}	83.29 ± 2.40^{b}	4.54 ± 0.18^{b}	44.93 ± 9.91^{b}	48.80 ± 14.21^{b}	1.79 ± 1.37^{a}	78.54 ± 0.91^{b}
Lira	30	16.71 ± 1.84^{b}	83.87 ± 1.84^{b}	3.96 ± 0.30^{a}	46.18 ± 10.80^{b}	46.10 ± 13.18^{b}	3.57 ± 5.30^{a}	$78.81\pm1.22^{a,b}$
$LSD_{0.05}$		0.926	0.926	0.168	4.792	8.06	2.418	0.678
p-values		0.000	0.000	0.000	0.000	0.000	o.177	0.044

Values are means ± are standard deviations. Means and standard deviations within the same parameters(column) with different superscripts letters (a, b, & c) are significantly different at ($P<0.05$), whereas those within the same parameters(column) with the same superscript letters are not statistically significant. HMF= hydroxymethylfurfural . [Amudat represents the Northeast Drylands agroecology, Arua North-Western savannah grasslands agroecology, and Lira represents the North-Eastern savannah grasslands Agro-ecological zone]

Table 4: Mean physico-chemical properties of honey by value chain nodes

Value chain nodes	Sample number (n)	Quality parameters						
		Moisture content (%)	Total solids (%)	pH	Free acidity ($meq.kg^{-1}$)	HMF ($mg.kg^{-1}$)	Diastase Number(°Gothe)	Brix (%)
Farmers	60	15.64 ± 2.22^{a}	84.36 ± 2.22^{a}	4.21 ± 0.27^{a}	39.25 ± 7.68^{a}	34.51 ± 11.79^{a}	5.16 ± 9.09^{b}	79.02 ± 1.17^{a}
Processors	10	17.54 ± 2.0^{b}	82.46 ± 2.01^{b}	4.20 ± 0.39^{a}	$41.17\pm13.6^{a,b}$	48.74 ± 11.45^{b}	2.13 ± 1.37^{a}	78.89 ± 0.80^{b}
Retailer	60	15.84 ± 2.21^{a}	84.16 ± 2.21^{a}	4.24 ± 0.43^{a}	45.93 ± 9.88^{b}	54.39 ± 11.7^{b}	2.35 ± 1.688^{c}	78.53 ± 1.00^{c}
$LSD_{0.05}$		1.00	1.00	0.1675	5.254	6.399	2.384	0.6938
p-values		0.003	0.003	0.847	0.024	0.000	0.068	0.200

Values are means ± are standard deviations. Means and standard deviations within the same parameters(column) with different superscript letters (a, b, & c) are significantly different at ($P<0.05$), whereas those within the same parameters(column) with the same superscript letters are not statistically significant. HMF= hydroxymethylfurfural

A correlational analysis (Figure 2) showed a very weak positive (r = 0.19) correlation between moisture content and free acidity.

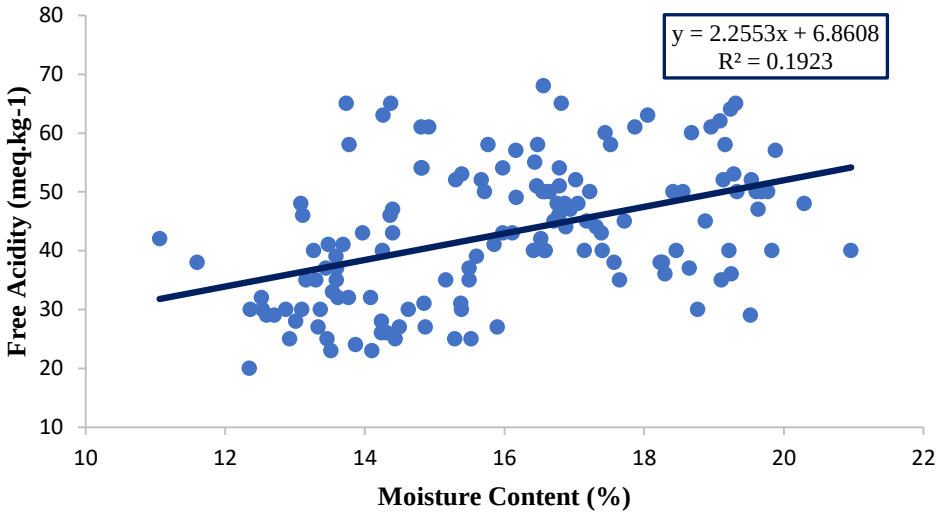


Figure 2: Correlational analysis between FA and MC in different agro-ecologies and nodes

4.2 Social-Demographic Characteristics of Honey Consumers

Many (53%) of the consumers were females, (59%) were married and were between (25-34) years (Table 5).

Table 5: Socio-demographic characteristics of honey consumers

Variables	Categories	Overall N (%) N=182
Gender	Male	85 (47)
	Female	97 (53)
Marital status	Single	51 (28)
	Married	108 (59)
	Divorced	13 (7)
	Widowed	10 (6)
Education level	Primary	26 (14)
	Secondary	73 (40)
	Tertiary	69 (38)
	None	14 (8)
Household size	≤ 5 (Small)	106 (58)
	6 – 8 (Average)	48 (26)
	≥ 9 (Large)	28 (15)
Age	> 24	28 (15)
	25-34	78 (43)
	35-44	47 (26)
	45-54	20 (11)
	> 55	9 (5)
Employment status	Employed	65 (36)
	Self employed	74 (41)
	Unemployed	43(24)
Monthly Income (UGX)	<100,000	28 (15)
	100,000-500,000	107 (59)
	600,000-1,000,000	23 (13)
	>1,000,000	5 (3)
	Not indicated	19 (10)

Source: Field survey (2022); Number of respondents = 182, The values in the parentheses represent the percentages.

Many of the respondents (92%) had acquired formal education, with 40% and 38% having attained secondary, and tertiary education level respectively, and at least 14% had primary level. Over half of the consumers lived in small households of (≤ 5) and the largest percentage (59%) was employed and received a monthly income of Ugandan shillings 100,000-500,000.

4.2.2 Honey Consumption Patterns

The results show that majority (37%) of the consumers bought honey on a monthly basis and prefered to buy mainly 1kg and 500g packages of honey. Consumers were mainly motivated to

consume honey for healthy reasons as medicine (32%), for nutriotional benefits (29%), sugar substitute (13%) and to keep a healthy life style (13%) (Table 6).

Table 6: Honey Consumption Patterns

Variable	Category	Frequency	Percentage
Honey purchase	Daily	24	13.2
	Weekly	36	19.8
	Fortnight	22	12.1
	Monthly	67	36.8
	Twice a year	18	9.9
	Once a year	15	8.2
	Total	**182**	**100**
Quantity bought	250g	26	14.3
	500g	43	23.4
	1kg	68	37.4
	1.5kg	10	5.5
	2kg	17	9.3
	3kg	3	1.6
	4kg	5	2.7
	Total	**182**	**100**

Variable	Category (factors)	Response		Percent of cases
		N	Percent	
Motivation factors to consume	Medicinal value	134	31.5	73.6
	Nutritional benefits	122	28.7	67
	Keep a healthy lifestyle	54	12.7	29.7
	Religious and customary reasons	3	0.7	1.6
	habit	27	6.4	14.8
	Sugar substitute	56	13.2	30.8
	Food additive	18	4.2	9.9
	Cosmetic additive	7	1.6	3.8
	I do not know	4	0.9	2.2
Mode of consumption/use	Spread	76	23.7	42.7
	Sweeter	117	36.4	65.7
	Baking	32	10	18
	Medical purpose	87	27.1	48.9
	Preservative	9	2.8	5.1

4.2.3 Honey Purchase Habits

During honey purchase, majority (61%) of the consumers bought their honey from market stalls, supermarkets, direct from farmers, and or processors. Most of them (89%) always considered checking for impurities in honey before purchasing and they mainly looked for ash particles, insect parts and larvae, grass, and soil particles. Majority (47%) of the consumers preferred dark colored honey when making purchase (Table 7).

Table 7: Consumers Honey Purchase Habits

Variable	**Category(factors)**	**Response**		**Percent of cases**
		N	**Percent**	
Place of purchase	Farmers	81	19.6	44.5
	Processors	64	15.5	35.2
	Supermarket	82	19.9	45.1
	General merchandise	35	8.5	19.2
	Market stalls	87	21.1	47.8
	Roadside vendors	49	11.9	26.9
	Own hive	15	3.6	8.2
Impurity checks		**Frequency**		**Percentage**
	Yes	161		88.5
	No	21		11.5
	Total	**182**		**100**
Variable	**Category(factors)**	**Response**		**Percent of cases**
		N	**Percent**	
Kind of impurities checked	Insect parts	98	17.9	60.9
	Insect larvae	84	15.3	52.2
	Ash/ smoke particles	118	21.5	73.3
	Sand/soil particles	94	17.2	58.4
	Grass particles	96	17.5	59.6
	Mammalian hair	29	5.3	18
	Microbial contaminants	29	5.3	18
Preferred color during purchase	**Number of times**	**Frequency**		**percentage**
	Colorless	20		11
	Yellow	14		7.7
	Light brown	62		34.1
	Dark brown	86		47.3

4.3 Important Honey Quality Attributes Considered when Making Purchasing Decisions

When consumers were requested to give the degree of importance they accorded to different attributes they most often considered when deciding to purchase honey, it was found that purity (4.47±0.79) was the most critical quality attribute that strongly influenced consumer purchase intention (Table 8).

Table 8: Important Quality Attributes Considered When Making Purchasing Decisions

Factors	Mean (SE)	Std. Deviation
Color	4.14 (0.07)	0.99
Viscosity	4.16 (0.07)	0.95
Purity	4.47 (0.06)	0.79
Labeling	3.35 (0.09)	1.22
Packaging	3.98 (0.08)	1.07
Brand name	3.23 (0.09)	1.27
Certification	3.74 (0.09)	1.28
Price	4.06 (0.07)	0.91
Origin	3.98 (0.09)	1.26

Std. Deviation=Standard deviation; items in parathesis = standard error (SE)

Similarly, viscosity (4.16±0.95), color (4.14±0.99), and price (4.06±0.91) also had a great influence on the consumer purchase decision.

4.3.1 Consumer Frequency of Reading Labels

Considering labeling as one of the parameters when making purchase decisions, (42%) of the consumer preferred reading label information before making purchases whereas 27% never read (Figure 3).

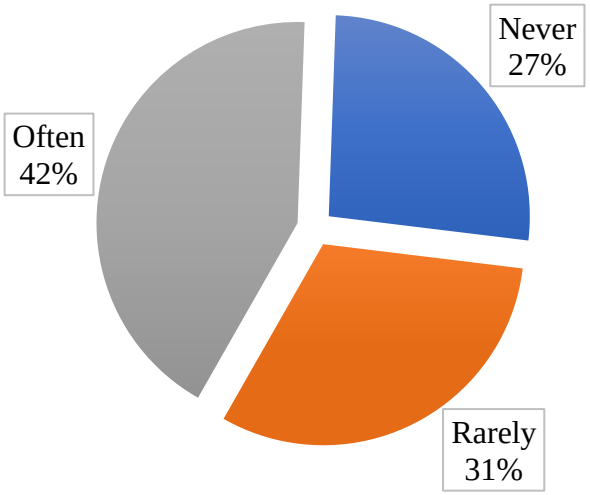


Figure 3: Consumer frequency of reading labels

4.3.2 Preferred Label Information

Majority of the consumers looked for manufacturing (75%) and expiry (80%) date of the honey products before buying. Additionally, about (50%) of consumers considered origin and nutritional information to be important.

Table 9: Preferred label information during honey purchase

Variable	Category(factors)	Response		Percent of cases
		N	Percent	
Label information looked for	Certification	69	13.1	51.5
	Brand name	62	11.8	46.3
	Nutritional information	69	13.1	51.5
	Expiry date	107	20.4	79.9
	Storage information	52	9.9	38.8
	Place of origin	66	12.6	49.3
	Manufacturing date	100	19	74.6

4.3.3 Segmentation of Honey Consumers

4.3.3.1 Segmentation by Level of Education

Often, customers with different education levels consider different parameters when making purchase decisions. Purity and color of honey proved to be the most essential parameters for all consumers except non-educated consumers. However, color ($P < 0.01$), purity ($P < 0.01$), viscosity ($P < 0.05$), and origin ($P < 0.1$), were statistically significant among the different education groups (Table 10).

Table 10: Segmenting Consumer According to Education Level

	Educated						Non educated			
	Primary (N=26)		Secondary (N =73)		Tertiary (N =69)		None (N = 14)			
Factors	**Mean**	**Std. Dev**	**Mean**	**Std. Dev**	**Mean**	**Std. Dev**	**Mean**	**Std. Dev**	**F Value**	**Sig**
Color	4.31	0.84	4.36	0.77	4.06	0.98	3.07	1.54	7.783***	0.000
Viscosity	4.27	0.96	4.23	0.89	4.17	0.92	3.50	1.60	2.597**	0.054
Purity	4.35	0.94	4.53	0.50	4.59	0.83	3.79	1.19	4.699***	0.003
Labeling	2.96	1.15	3.48	1.13	3.45	1.30	2.93	1.27	1.888	0.133
Packaging	3.54	1.27	4.00	1.05	4.10	1.05	4.14	0.77	1.900	0.131
Brand name	2.73	1.25	3.25	1.24	3.46	1.23	2.93	1.44	2.439	0.66
Certification	3.15	1.38	3.81	1.25	3.93	1.22	3.57	1.28	2.538*	0.058
Price	3.92	0.93	4.05	0.83	4.16	0.93	3.86	1.10	0.707	0.549
Origin	3.81	1.41	4.22	1.15	3.70	1.31	3.92	1.14	1.553	0.203

N= honey consumer, χ^2 denotes Pearson's chi-squared test; *** Represents 1% significance level; **Represents 5% significance level; *Represents 10% significance level; Std. Dev= standard deviation

4.3.3.2 Segmentation by Employment Status

From the results obtained, both the employed and unemployed consumers had similar preferences when making purchase decisions where they focused mostly on the honey purity (4.50), viscosity (4.14), color (4.13), and price (4.01). However, only honey label was a statistically significant ($p = 0.1$) parameter among the groups (Table 11).

Table 11: Consumer Segmentation According to Employment Status

Factors	Employed (N = 139)		Unemployed (N = 43)		χ^2	sig
	Means	Std. Deviation	Mean	Std. Deviation		
Color	4.13	0.97	4.16	1.07	1.806	0.771
Viscosity	4.14	0.97	4.21	0.86	2.399	0.663
Purity	4.50	0.76	4.37	0.90	3.437	0.487
Labeling	3.30	1.25	3.53	1.12	7.568*	0.109
Packaging	3.96	1.10	4.07	0.99	1.836	0.766
Brand name	3.26	1.29	3.14	1.21	1.810	0.771
Certification	3.77	1.29	3.65	1.23	1.734	0.784
Price	4.01	0.92	4.21	0.83	3.116	0.539
Origin	3.99	1.24	3.93	1.32	0.655	0.957

N= honey consumer, χ^2 denotes Pearson's chi-squared test; *** Represents 1% significance level; **Represents 5% significance level; *Represents 10% significance level; Std. Dev= standard deviation

4.3.3.3 Comparison of Purchase Decisions According to Customers' Age Groups

Nearly all the age groups highly considered purity when deciding to buy honey though there was no statistically significant difference amongst the age groups. Furthermore, the youth preferred color and viscosity, the adults mostly focused primarily on price and viscosity, elders focused on packaging, origin, color and purity. Brand name had the least influence on the purchase decision for all the age groups. While color, viscosity, packaging, certification, labelling, and brand name were statistically significant among the age groups (Table 12).

Table 12: Consumer Segmentation According to Age Groups

Factors	Youth (N= 06)		Adults (N= 67)		Elderly (N = 9)		F Value	Sig
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev		
Color	4.31	0.72	3.87	1.24	4.11	1.27	4.311**	0.015
Viscosity	4.27	0.75	3.93	1.20	4.56	0.53	3.711**	0.026
Purity	4.47	0.72	4.52	0.88	4.11	0.93	1.072	0.344
Labeling	3.65	1.11	2.91	1.26	3.11	1.67	8.374***	0.000
Packaging	4.13	1.01	3.70	1.17	4.33	0.50	3.921**	0.022
Brand name	3.44	1.21	2.99	1.33	2.56	1.01	4.146**	0.017
Certification	3.96	1.21	3.44	1.34	3.33	1.12	3.944**	0.021
Price	3.98	0.82	4.21	1.02	3.89	0.78	1.478	0.231
Origin	4.06	1.24	3.84	1.25	4.11	1.63	0.684	0.506

N= honey consumer, χ^2 denotes Pearson's chi-squared test; *** Represents 1% significance level; **Represents 5% significance level; *Represents 10% significance level; Std. Dev= standard deviation

4.3.3.4 Comparison of Purchase Decisions According to Customers' Gender

Often, consumers of different gender have different quality parameters they consider when deciding to buy honey. However, our results, show that all the consumers have almost similar preferences where they mostly consider purity, color, viscosity, price, and origin when making purchase decisions and concentrated less on labeling and the brand name. A chi square test of association showed no statistically significant difference in the level of preference between the two gender groups (Table 13).

Table 13: Consumer Segmentation According to According to Gender

Factors	Male (N=85)		Female = (N= 97)		χ^2	Sig
	Mean	Std. Dev	Mean	Std. Dev		
Color	4.22	0.94	4.06	1.03	3.600	0.463
Viscosity	4.12	1.02	4.20	0.89	2.282	0.684
Purity	4.52	0.72	4.43	0.85	5.831	0.212
Labeling	3.47	1.14	3.25	1.28	2.612	0.625
Packaging	4.01	1.05	3.96	1.10	3.011	0.556
Brand name	3.38	1.22	3.10	1.30	5.049	0.282
Certification	3.85	1.31	3.65	1.24	4.896	0.298
Price	4.11	0.86	4.02	0.95	5.538	0.236
Origin	4.05	1.26	3.92	1.26	4.882	0.300

N= honey consumer, χ^2 denotes Pearson's chi-squared test; *** Represents 1% significance level; **Represents 5% significance level; *Represents 10% significance level; Std. Dev= standard deviation

4.4 Consumer Perception of Honey Quality

Results of the confirmatory factor analysis presented in (Appendix 12) showed the following fit indices; the chi-square (χ^2) at 265.877, degree of freedom (df) at 182, p-value at 0.000, the ratio of chi-square to degrees of freedom (χ^2/df) at 1.461 was below the acceptable maximum threshold of ≤ 3. The GFI at 0.880 was within the acceptable minimum value of ≥ 0.90, and the AGFI at 0.848 was within the specified range of ≥ 0.80 (Hooper, Coughlan & Mullen, 2008; Mun, Jackson, Park, & Probst, 2006). The IFI at 0.926, the TLI at 0.912 and the CFI at 0.924 all were far more than the recommended target value of ≥ 0.9 (Hu & Bentler, 1999), these satisfied the recommended baseline values, while the RMSEA at (0.05) was far less than the recommended maximum value of 0.08. The findings conformed to acceptable model fit as articulated by Hu & Bentler (2009). Having met all acceptable limits in this study, we therefore concluded that the data on honey quality exhibited model fit in explaining consumer perception of honey quality.

The results in (Table 14) illustrate that perception was positively and significantly influenced by labelling (P < 0.01), packaging (P < 0.01), colour (P < 0.01), and origin (P < 0.01). However, price had a negative but significant (P < 0.01) influence on consumer perception of honey quality.

Table 14: Hypothesis testing of consumer perception of honey quality

		Path coefficients		
Hypothesis	**Regression Path**	**Estimate, β (S.E)**	**t-value**	**Results**
H1a	PERC→LAB	0.628 (0.112)	5.610***	Supported
H1b	PERC →PAK	0.251 (0.089)	2.806***	Supported
H1c	PERC →COL	0.394 (0.094)	4.197***	Supported
H1d	PERC →PRC	-0.538 (0.97)	-5.521***	Supported
H1e	PERC →ORG	0.403 (0.085)	4.758***	Supported

*Key: PERC = Perception, ORG=Origin, LAB = Labelling, PAK = Packaging, COL = Colour, and PRC = Price. *** significant at 0.01.* χ^2 = 265.877, df = 182, P < 0.01, χ^2/df = 1.461 and RMSEA = 0.08

CHAPTER FIVE: DISCUSSION OF RESULTS

5.1 Assessment of Honey Quality at Different Agroecologies and Value Chain Nodes

The results (Table 3 and 4) show that all the honey met the recommended national and international standards as required by UNBS (2019) and Codex Alimentarius Commission (2014) respectively except for diastase number which was the major limiting factor. These indicate good honey quality, due to proper maturity, use of better harvesting techniques, adequate processing using better techniques, and freshness of the honey hence good for human consumption.

However, across the agroecologies, honey from Amudat was more superior in quality as it had lower mean percentage moisture content, pH, free acidity, hydroxymethylfurfural (HMF), and high total solids and honey Brix (total sugars). The excellent quality (low moisture content, free acidity, and pH as well as high total solid levels and Brix) could be attributed to the fact that Amudat is found in a drier agroecology (semi desert) receiving very little rainfall and this could have affected moisture content of the original plants from which nectar was obtained as well as the humidity levels in the hives. Also, the fact that the honey was mature at the time of harvest, had just been freshly harvested and stored for a short period might have contributed to the excellent quality. This could have eventually resulted in low free acidity and pH of the honey due to absence of fermentation that results from high honey moisture content implying that the honey could be stored for longer periods without developing off tastes due to increased acidity as a result of excessive fermentation. This claim commensurate with past studies Erez *et al.* (2015) and Machado *et al.* (2018) who found moisture content of honey to vary with geographical location, climatic conditions, the moisture content of the original plant, amount of humidity inside the hive, and these could explain the variation in moisture content within the three regions

hence variation in quality. Similarly, the low moisture content could have resulted into high total solids level and Brix hence very sweet honey with a natural taste and of superior quality. According to Batu *et al.* (2014), high brix value is an important criterion for assessing the quality of honey, especially during storage and marketing and according to Shamsudin *et al.* (2019) the Brix content ratio is inversely correlated to the moisture content of honey hence as Brix value reduces, the moisture content also raises. Therefore, this implies that honey with high Brix content can be stored for a long period without fermenting and becoming harmful to human health on consumption.

Furthermore, regarding good quality, the HMF of the honey was within the recommended standards of ≤ 80 meq.kg^{-1} for honey from tropical regions hence fit for human consumption. This could indicate that the honey was fresh, had not stayed for a very long time, or was not subjected to extreme temperatures during harvesting, processing, and storage. Furthermore, the fact that honey sample from Amudat were obtained directly from farmers indicates that they were still fresh and had not been stored for long. This claim is in agreement with Mesele (2021), who found that the low HMF of East African honey was because it was freshly harvested, collected directly from the farmers, and not heat treated. According to Machado *et al*. (2018) HMF is a parameter that indicates whether freshness lacks or exists in minute quantities in fresh honey. But its concentration steadily increases with increased storage length heating of the honey (Moniruzzaman *et al.*, 2012). This therefore implies that Amudat honey was of superior quality and can be stored for longer periods without developing contaminants that are harmful to human health.

However, across the value chain nodes, honey from farmers was more superior in quality than from other nodes. This is because it had very low mean percentage moisture content, pH, free

acidity, HMF, and high total solids, honey Brix (total sugars) and diastase number. The good honey quality could be attributed to the fact that the farmers had freshly harvested ripe honey, stored under suitable conditions for shorter periods and not diluted with any liquid and thus it could stay for longer periods without fermentation that results from excessive moisture or without having increased HMF levels due to prolonged storage. Additionally, farmers used better honey harvesting techniques, did not process their honey, and did not subject it to extreme temperatures during harvesting, processing, and storage. This might have contributed to the low HMF and high diastase numbers. This claim is in agreement with Mesele (2021) who found that low HMF in honey was because the honey samples used were freshly harvested and were collected straight from the farmers. Additionally, the honey had not been processed and stored for longer periods at extreme temperatures (Mesele 2021). number standards, whereas across the value chain nodes only honey from the farmers met the required standards. Failure of honey from retailors and processors to meet the required diastase number.

Diastase number was the only limiting factor to the quality of Northern Uganda honey whereby across agro-ecologies, only Lira honey met the required diastase standards could be due to low diastase enzyme concentration in the honey. Diastase enzymes are denatured by higher temperatures during honey harvesting, industrial honey processing or by boiling, poor storage conditions of the honey at higher temperatures and adulteration of the honey with artificial sugars or direct feeding of bees on artificial sugars. This claim agrees with Mesele (2021) who reported that low diastase number in East African honey was due excessive heating during processing that denatured the diastase enzyme, adulteration by directly adding artificial sugars to the honey, or feeding bees on artificial sugars, and prolonged storage period. According to Czipa *et al.* (2019), and Tosun and Keles (2021) addition of sugar syrups to pure honey gradually

reduced diastase number due to absence of diastase number in the sucrose syrup which inhibited enzyme activities.

It is therefore important to note that better quality honey that is safe for human consumption presented to consumers at both the local and on international markets will stimulate both local and international trade. And this will enable honey value chain actors achieve better prices in return.

5.2 Important Honey Quality Attributes Considered When Making Purchasing Decisions

This study's findings (Table 8) revealed that when making honey purchase decisions, consumers most importantly considered purity, viscosity, color, and price.

Consumers' consideration of purity as an important quality attribute before making honey purchase could be because they are highly conscious of the dangers of food contamination that could be hazardous to their health. This suggestion is in line Dickson-Spillmann *et al*. (2011) who reported that consumer consumption and purchase choices are motivated by purity because they are highly concerned about the dangers of contaminated foods. In this study, most consumers (88.5%) considered checking for impurities, and they highly concentrated on dirt particles, insects and their parts, and microbial contaminants. This finding is similar to that of Röhr *et al.* (2005) who found that consumers highly perceived hygiene, sterility, and purity in the form of absence of filth materials and molds.

Honey viscosity was the second most important honey attribute consumers used to judge quality. This could be due to consumers considering thick honey as unadulterated, natural and free from the effects of industrial processing. This is in line with Di Vita *et al*. (2021) and Marcazzan *et al.* (2018), who found honey viscosity to be an essential quality attribute highly considered during

handling, storage, purchase and consumption and this strongly influenced honey's acceptance in the market. Similarly, color was an important quality attribute that informed consumers' buying decisions. This could be because it attracts customers' attention since it is used as a sign of quality informs of purity, freshness, degree of processing, storage and adulteration. This finding corresponds with that of Barrett *et al*. (2010), who found that consumers usually use color as an indicator of freshness and flavor. And to honey consumers, if the color is not appropriate as expected, it indicates loss of freshness or absence of ripeness, which shuns them from buying (Barrett *et al.*, 2010). Furthermore, price's qualification as an important quality attribute that influenced consumers' honey purchasing decisions could be because consumers assumed highly priced honey to be of high quality, indicating that honey consumers are highly price conscious. This is in agreement with Lee and Chen-Yu (2018**),** who found that consumers usually associate price with product quality, whereby a highly perceived price reflects high quality and vice versa. Similarly, Wu *et al.* (2012) reported that price increased consumers' perceived product quality, raising their willingness to pay and purchase intentions.

This study found that educated consumers mainly focused on purity, color, viscosity, and price when making honey purchase decisions. This could be because purity, color, and viscosity inform consumers about the existence of adulterants, and impurities and to the educated consumers with the knowledge of filtrate and residuals, this is an indicator of quality. While educated consumers like quality and healthy food products, they also attach value to money, which may explain why price influenced their purchase decisions. These claims are supported by Kearney *et al.* (2000), as cited in Gyau *et al*. (2014), who reported that subjects of a greater educational level and socioeconomic status are the most likely to regard "healthy eating" as an essential influence on food choice. Gyau *et al*. (2014) added that educated people seem to be more exposed to diet and health information and can better understand and process it. On the

other hand, non-educated consumers mainly focused on packaging, origin, and price. This could be because these non-educated consumers may not see beyond the beauty of the packaging material, and they are so rigid to buy honey from people and localities they don't know since the fear of the unknown always limits them. Additionally, most non-educated consumers are unemployed with low incomes, which drives them to go for low-priced honey. These assertions are consistent with Loureiro and Hine (2001), as cited in Gyau *et al*. (2014), who found price/ income and education to influence purchase of food products. They further concur with Nguyen *et al.* (2020) who reported packaging as the first communication with consumers and found that it elicited emotional responses and motivated consumers to purchase a product.

The employed and unemployed consumers had similar preferences when making purchase decisions and mainly focused on the honey purity, viscosity, and color. This could be because all these quality attributes can be visibly seen, and any compromise equally affects the health of both the employed and unemployed consumers. This is in line with Popescu & Guresoaie, (2019) who reported that both the employed and unemployed consumers considered these honey attributes as essential indicators of healthy honey which everyone prioritizes regardless of their employment status. Furthermore, labeling was found to significantly influence honey purchase between both consumer groups. This could be because labels are one of the main sources of information regarding the honey ingredients, source, and usage. These results are consistent with Popescu and Guresoaie (2019) who found a certain percentage of employed and unemployed consumers relying on jar labels, magazines, and journals as their primary sources of information about honey. It is generally expected that as people obtain more formal education and employment, their level of general awareness rises. As a result, even in the absence of food origin labeling, these consumers will typically possess the necessary knowledge about important issues pertaining to food production and composition (Juma *et al.*, 2016).

This study found that the youths' honey purchasing decisions were mainly influenced by color and viscosity. This could be because the youths think color indicates freshness and are also attracted to bright colored foods. This finding aligns with previous studies Pappalardo *et al*. (2020) where young consumers' consumption decisions were driven by their desire to test colored and viscous drinks. This finding agrees with Brščić *et al.* (2017), who found honey choice drivers among young consumers related to health, and the youths regarded viscous and colored honey as unadulterated and free of impurities. Blanc *et al.* (2021) added that young consumers are becoming more health-conscious, and this informs their food choices. On the other hand, adults' honey purchasing decisions was primarily based on price and viscosity. This could be due to their declining income and increased responsibility that shun them from highly priced food items. They are also prone to diseases that drive them to buy less viscous honey that is easily consumed and digested. This suggestion is supported by Nascimento *et al.* (2022) and Testa *et al.* (2019), who found that financial variables have an essential role in consumers' choices, and according to Hamilton & Thompson, (2018), these financial constraints limit consumers' choices for the numerous products and services they desire. Additionally, Brun *et al.* (2020), found viscosity to be an important variable among consumers over 40 years of age, and not a significant attribute among young Slovakian honey consumers. These adult consumers prefer liquid honey because it is easier to handle, consume and detect any impurities (Kabbani *et al*.,2011).

Furthermore, the honey purchasing decisions of the elderly was influenced by packaging, origin, color and purity. This could be because the elderly have a strong attachment to their native backgrounds, which explains their consideration of origin as a measure of honey quality. Additionally, given their declining health conditions, they consider light colored and pure honey to be medicinal and free from contaminations hence safer for consumption. These claims are

backed by Juma *et al.* (2016), who reported that older consumers have more choosy diets and generally avoid foods mixed with chemicals; they are more health conscious and would be expected to go for foods whose source they are certain. Brun *et al.* (2020) added that older people prefer local products more due to their roots with the territory.

Though, none of the honey quality attributes significantly influenced different consumers' purchasing decisions based on gender, both genders considered honey purity, color, viscosity, price and origin when making purchase decisions. This could be because these attributes are the major visible honey quality attributes which attract consumers from a distance. This finding is similar with that of several previous studies for example, Di Vita *et al.* (2021) reported that the female gender, is positively correlated to local honey. Gyau *et al.* (2014) added that differences in preferences are explained by the difference in the income and education level attained by different genders. Additionally, Irianto (2015) and Pelletier *et al.* (2013) found a greater preference of the female gender towards organic food products and attitude towards health aspects. Similarly, Ványi *et al.* (2011) found price to be the most important criterion for both women and men. As well, flavor and color of the honey were more important for women than men. Relatedly, Ványi *al*. (2011)'s study on the two types of viscous soymilks and their consumption by gender found viscosity was the most liked attribute for both soymilks.

5.3 Determination of Consumer Perception of Honey Quality

Understanding the different honey quality attributes that influence consumer perception of honey quality is essential for policy makers and value chain actors as it can assist in designing appropriate strategies for improving the marketability of honey (Kassa *et al.*, 2017). This study revealed that labeling, packaging, color, price, and origin are significant honey quality attributes influencing consumer perception of honey quality. This could be because labels contain and

communicate crucial product information like the type of ingredients used, product usage, expected life span, nutritional and storage information, origin, brand name, among others. These findings are consistent with those of Jeddi and Zaiem (2010), who found that labels contain reliable product identifiers that provide information about their quality and when properly analyzed and understood by consumers, they significantly improve marketing communication. Furthermore, positive and significant influence of packaging on consumer perception of honey quality could be because it protects the product from external environmental effects and ensures convenience during transportation and use. This is in line with Dangelico and Vocalelli (2017) and Batt and Liu (2012), who found packaging as an essential marketing tool that enhances sales by providing relevant information about the product and supports the product's branding.

Similarly, the positive and significant influence of color on consumers, perception of honey quality could be because it attracts customers' attention since it acts as a sign of quality and freshness. This argument is consistent with Kovaevi (2019), who discovered a favorable effect of brighter colors on customer perception and concluded that people are more drawn to brighter colors. This is relevant to the honey used in this study because it was a variety of colors, including colorless, yellow, light brown, and dark brown. The study's findings showed that 47.3% and 34.1% percent of consumers, respectively, preferred dark brown and light brown colored honey. Furthermore, origin’s positive and significant impact on consumer perception of honey quality could be because consumers considered local honey as original, untampered with, pure, and nutritious, imposing no health hazards to the consumers. This finding is consistent with Province *et al*. (2019), who found that consumers preferred to buy local honey because they wanted to support their local economy.

This study found the price of the honey to have a significant but negative impact on consumers' perceptions of the quality of the honey. This could be because consumers always prefer quality honey with relatively low prices. In the context of this study, over 74% of the consumers were in the low-income category, which may explain price's significant but negative impact on their willingness to purchase honey. These results are in tandem with Juma *et al.* (2016), who found price as being significantly negative and influencing consumers to buy cheap but high-quality honey. Zhao *et al.* (2021) supported this study and found that pricing undoubtedly played a significant influence when a product is already in plenty on the market since price increase will deter customers from purchasing it. Similarly, when Lee and Chen-Yu (2018), and Raghubir (2004) looked into the connection between price cuts and perceived quality, the results showed that there was a bad correlation, which meant that consumers thought that things that were heavily reduced were of inferior quality. Although consumers love inexpensive honey, it should be of great quality because their purchasing power decreases whenever they feel uneasy, especially when they receive an unexpectedly large price discount that other merchants ordinarily do not provide (Raghubir, 2004).

Contrarily to this study, several studies [Palma *et al.* (2016); Suri & Monroe (2003); Zeithaml (1988)] that have attempted to explain how prices affect customers' perceptions have consistently found that consumers' views of quality were positively impacted by pricing. According to these studies, pricing affects how people perceive quality, how much they are willing to give to pay more, and how they trade off perceived quality for quantity. (Palma *et al*., 2016; Suri & Monroe, 2003; Zeithaml, 1988). Perceived sacrifice affects perceived value, which influences purchase intentions. Additionally, Lee and Chen-Yu (2018) concluded that people believe a product is of excellent quality when the price is high. Interestingly, consideration of high prices for honey as a measure of good quality is not uniform across all contexts because (Roy *et al*., 2021) found low

prices to increase purchasing decisions in India for low income earners. Therefore, regarding prices, support of the notion that a product's price can serve as an external gauge of its quality is subjective based on the context.

CHAPTER SIX: SUMMARY, CONCLUSION, AND RECOMMENDATIONS

6.1 Summary

This study sought to determine the honey quality and quality perception along the value chain in Northern Uganda. It sought to determine the exact node along the honey value chain where quality deterioration occurs, provide information on consumers' perception of honey quality present in the markets and ascertain the major honey quality attributes considered by consumers when making deciding to buy honey.

Data were collected from a sample of 255 value chain actors. These included 70 value chain actors (farmers, processors, and retailers) from whom honey samples were obtained for laboratory analysis and 185 consumers from whom survey data was obtained. The laboratory data were obtained through experimental analysis of honey samples, while the survey data were obtained through face-to-face interviews of honey consumers using structured questionnaires. Data were analyzed using SPSS, AMOS, and GENSTAT.

The results revealed that Diastase Number was the major limiting factor to the quality of honey produced and marketed in Northern Uganda. The study further pointed out processor and retailor nodes as the exact nodes within the value chain where quality deterioration mostly occurs. We consequently concluded that much of the honey from Northern Uganda was of good quality however, Amudat honey was superior in quality compared to honey from other regions.

Additionally, results on perception showed that labeling, packaging, color, and origin positively and significantly influenced consumers' perception of honey quality; however, price had a negative and significant influence on consumers' perception of honey quality. Furthermore, the

results indicated that most consumers most importantly considered purity, viscosity, color, and price as important quality attributes when making their honey purchase decisions.

6.2 Conclusion

The findings of this study showed that Diastase number is the major limiting factor to Northern Uganda honey and that processor and retailer nodes are the exact node where quality deterioration occurs. This study confirmed that across agroecological zones, Amudat honey was superior in quality compared to honey from other regions. This enables consumers to be confident and not worry about their health while consuming this honey.

This study concluded that purity, viscosity, and price are the most important honey quality attributes consumers highly consider when purchasing. Therefore, aware of these, value chain actors should consider incorporating these when preparing their honey products in order to capture a greater market share. Furthermore, having segmented consumers according to different demographic groups and discovered their priorities when making honey purchase decisions, it is vital for the value chain actors to have a better understanding of their consumers' needs and wants and highly put them into consideration when preparing their honey products for sale in order to meet the needs of each individual group hence capture a larger market share. In conclusion, policy makers and value chain actors should strive to gain a deeper understanding of consumer needs and wants in order to better understand the various quality attributes that consumers take into account when making purchasing decisions. This will help them develop strategies that will increase the marketability of honey on a global scale.

Honey quality attributes, including labeling, packaging, color, origin, and price, are key attributes that influence consumers' perception of honey quality hence key indicators of honey quality.

Therefore, honey value chain actors should focus more on these attributes and incorporate them when designing and preparing their honey products for sale if they are to be accepted as of good quality by the consumers.

6.3 Recommendations

6.3.1 Policy Recommendation

Aware of the various activities that cause deterioration in honey quality, deliberate effort is required to minimize this deterioration through trainings and encouraging honey value chain actors to adopt the use of better honey harvesting, processing, and storage techniques and equipment. Additionally, the government, concerned NGOs, and knowledgeable stakeholders should sensitize and train honey value chain actors on better honey handling practices and provide them with support inform of inputs like capital and modern beekeeping equipment. Furthermore, the government, NGOs, and honey regulatory bodies need to sensitize other regions and encourage them to emulate what value chain actors in the Amudat region do to produce superior quality honey.

Honey quality testing laboratories should be established in localities near the values chain actors coupled with mandated inspection and quality testing by quality regulatory organizations, such as the National Bureau of Standards, to enable them to quickly establish the quality of their honey before circulating it in the market to consumers. These should also consider sensitizing the value chain actors on honey quality assurance and its numerous benefits as a way of ensuring that honey is brought to consumers with little or no change and alteration in its quality.

Through market segmentation, there is also a need to develop specific honey marketing strategies based on consumer socio-economic characteristics.

Marketers need to base their marketing strategies on research information on the quality attributes that most significantly influence consumers' honey perception and purchase decisions.

6.3.2 Recommendation for Further Studies

The study mainly focused on honey quality, focusing on the effect of value chain node and agroecologies on honey quality (physicochemical properties). Future studies should focus mainly on the influence of agroecologies and associated activities on the amount of agrochemical residues in honey.

This study only looked at honey as a bee product. In order to have a better understanding of the influences of agro-ecological zones and handling procedures at different value chain nodes on the quality of other bee products, it is advised that comparative research be carried out on other bee products.

Future studies could now compare both rural and urban areas and ascertain any potential differences in their opinions of key honey quality attributes they consider during purchase and perception of honey quality. The study, however, only focused on honey consumers in and around central business districts of Gulu, Arua, and Lira cities, leaving out the rural areas.

Future studies could also segment consumers according to their geographical locations (urban and rural) consumers so as to establish which quality parameters they consider best when making honey purchase decisions.

REFERENCES

Abraha Aregawi, H. (2020). Determinant Factors Influencing Honey Consumption Trends in Mekelle City, Tigray, Ethiopia. *European Business & Management*, *6*(5), 105. https://doi.org/10.11648/j.ebm.20200605.11

Adam, M. A., & Ali, K. (2014). Impact of Visual Packaging Elements of Packaged Milk on Consumers Buying Behavior. *Interdisciplinary Journal of Contemporary Research in Business*, *5*(11), 1–45. https://doi.org/261988154

Agyekum, C. K., Haifeng, H., Agyeiwaa, A., Agyekum, C. K., Haifeng, H., & Agyeiwaa, A. (2015). Consumer Perception of Product Quality. *Microeconomics and Macroeconomics*, *3*(2), 25–29. https://doi.org/10.5923/j.m2economics.20150302.01

Akalın, H., Bayram, M., & Anlı, R. E. (2017). Determination of some individual phenolic compounds and antioxidant capacity of mead produced from different types of honey. *Journal of the Institute of Brewing*, *123*(1), 167–174. https://doi.org/10.1002/jib.396

Akullu, P., & Mwesigwa, D. (2021). Embracing bee-keeping technology to enhance smart farming: evidence from Lira city, mid-north Uganda. *International Journal of Interdisciplinary Research and Innovations*, *9*(2), 114–123. https://ir.lirauni.ac.ug/handle/123456789/278

Al-rubaie, W. K., & Al-fekaiki, D. F. (2022). Enzymes Activity Study Of Multiple Types Of Iraqi. *Journal of Pharmaceutical Negative Results*, *13*(2), 255–260. https://doi.org/10.47750/pnr.2022.13.S02.36

Al-Samarraie, H., Eldenfria, A., Dodoo, J. E., Alzahrani, A. I., & Alalwan, N. (2019). Packaging

design elements and consumers' decision to buy from the Web: A cause and effect decision-making model. *Color Research and Application*, *44*(6), 993–1005. https://doi.org/10.1002/col.22427

Albu, A., Radu-Rusu, C. G., Pop, I. M., Frunza, G., & Nacu, G. (2021). Quality assessment of raw honey issued from Eastern Romania. *Agriculture (Switzerland)*, *11*(3). https://doi.org/10.3390/agriculture11030247

Amariei, S., Norocel, L., & Scripcă, L. A. (2020). An innovative method for preventing honey crystallization. *Innovative Food Science and Emerging Technologies*, *66*(January), 102481. https://doi.org/10.1016/j.ifset.2020.102481

Amulen, D. R., D'Haese, M., Ahikiriza, E., Agea, J. G., Jacobs, F. J., DeGraaf, D. C., Smagghe, G., & Cross, P. (2017). The buzz about bees and poverty alleviation: Identifying drivers and barriers of beekeeping in sub-Saharan Africa. *PLoS ONE*, *12*(2), 1–14. https://doi.org/10.1371/journal.pone.0172820

Amulen, D. R., D'Haese, M., D'Haene, E., Acai, J. O., Agea, J. G., Smagghe, G., & Cross, P. (2019). Estimating the potential of beekeeping to alleviate household poverty in rural Uganda. *PLoS ONE*, *14*(3), 1–19. https://doi.org/10.1371/journal.pone.0214113

Archilia, M. D., Neto, A. A. L., Marcucci, M. C., Alonso, R. C. B., de Camargo, T. C., Camargo, R. C., & Sawaya, A. C. H. F. (2021). Characterization of Brazilian monofloral and polyfloral honey by UHPLC-MS and classic physical-chemical analyses. *Journal of Apicultural Research*, *0*(0), 1–12. https://doi.org/10.1080/00218839.2021.1886747

Aroucha, E., Silva, M., Leite, R., Santos, F., & Oliveira, V. (2019). Physicochemical, Antioxidants and Sensorials Properties of Melipona subnitida Honey after Dehumidifying. *J*

Food Process Technol, *10*(3), 781. https://doi.org/10.4172/2157-7110.1000781

Asaduzzaman, M., Rahman, M. S., Munira, S., Rahman, M. M., Islam, M., Hasan, M., Siddique, M. A. H., Biswas, S., Khan, M. H., Rahman, M., & Islam, M. A. (2015). Analysis of Biochemical Composition of Honey and its Anti-Oxidant, Phytochemical and Anti-Bacterial Properties. *Biomedical and Pharmaceutical Reseach*, *4*(4), 69–81. https://doi.org/281212647

Barrett, D. M., Beaulieu, J. C., & Shewfelt, R. (2010). Color, flavor, texture, and nutritional quality of fresh-cut fruits and vegetables: Desirable levels, instrumental and sensory measurement, and the effects of processing. *Critical Reviews in Food Science and Nutrition*, *50*(5), 369–389. https://doi.org/10.1080/10408391003626322

Batt, P. J., & Liu, A. (2012). Consumer behaviour towards honey products in Western Australia. *British Food Journal*, *114*(2), 285–297. https://doi.org/10.1108/00070701211202449

Batu, A., Aydoğmuş, R. E., Bayrambaş, K., Eroğlu, A., Karakavuk, E., & Eroğlu, Z. (2014a). Changes in Brix, pH and total antioxidants and polyphenols of various honeys stored in different temperatures. *Journal of Food, Agriculture and Environment*, *12*(2), 281–285.

Batu, A., Aydoğmuş, R. E., Bayrambaş, K., Eroğlu, A., Karakavuk, E., & Eroğlu, Z. (2014b). Changes in Brix, pH and total antioxidants and polyphenols of various honeys stored in different temperatures. *Journal of Food, Agriculture and Environment*, *12*(2), 281–285. https://doi.org/262774167

Blanc, S., Zanchini, R., Di Vita, G., & Brun, F. (2021). The role of intrinsic and extrinsic characteristics of honey for Italian millennial consumers. *British Food Journal*, *123*(6), 2183–2198. https://doi.org/10.1108/BFJ-07-2020-0622

Blok, A. E., Bolhuis, D. P., & Stieger, M. (2020). Contributions of viscosity and friction properties to oral and haptic texture perception of iced coffees. In *Food and Function* (Vol. 11, Issue 7, pp. 6446–6457). https://doi.org/10.1039/d0fo01109f

Bobis, O., Moise, A. R., Ballesteros, I., Reyes, E. S., Durán, S. S., Sánchez-Sánchez, J., Cruz-Quintana, S., Giampieri, F., Battino, M., & Alvarez-Suarez, J. M. (2020). Eucalyptus honey: Quality parameters, chemical composition and health-promoting properties. *Food Chemistry*, *325*(December 2019), 126870. https://doi.org/10.1016/j.foodchem.2020.126870

Bou-Mitri, C., Abdessater, M., Zgheib, H., & Akiki, Z. (2021). Food packaging design and consumer perception of the product quality, safety, healthiness and preference. *Nutrition and Food Science*, *51*(1), 71–86. https://doi.org/10.1108/NFS-02-2020-0039

Brščić, K., Šugar, T., & Poljuha, D. (2017). An empirical examination of consumer preferences for honey in Croatia. *Applied Economics*, *49*(58), 5877–5889. https://doi.org/10.1080/00036846.2017.1352079

Brun, F., Zanchini, R., Mosso, A., & Di Vita, G. (2020). Testing consumer propensity towards novel optional quality terms: An explorative assessment of "mountain" labelled honey. *AIMS Agriculture and Food*, *5*(2), 190–203. https://doi.org/10.3934/AGRFOOD.2020.2.190

Bunde, A. O., & Kibet, K. (2016). Socio-Economic Factors Influencing Adoption of Modern Bee Keeping Technologies in Baringo County, Kenya. *International Journal of Science and Research (IJSR)*, *5*(6), 960–969. https://doi.org/10.21275/v5i6.nov164195

Buschle, C., Reiter, H., & Bethmann, A. (2022). The qualitative pretest interview for questionnaire development: outline of programme and practice. *Quality and Quantity*, *56*(2), 823–842. https://doi.org/10.1007/s11135-021-01156-0

Charity Nabwire Juma, David Jakinda Otieno, Willis Oluoch-Kosura, Amos Gyau, and J. A. O. (2016). A survey of consumer perceptions and preferences for geographical indication and quality attributes of honey in Kenya. *Journal of Gender, Agriculture and Food Security*, *1*(3), 1–22.

Codex Alimentarius Commission. (2014). Codex Alimentarius : Food Additives. *Journal of Chemical Information and Modeling*, *53*(9), 1689–1699. https://sis.binus.ac.id/2016/12/15/pasar-monopoli/

Czipa, N., Phillips, C. J. C., & Kovács, B. (2019). Composition of acacia honeys following processing, storage and adulteration. *Journal of Food Science and Technology*, *56*(3), 1245–1255. https://doi.org/10.1007/s13197-019-03587-y

Da Silva, P. M., Gauche, C., Gonzaga, L. V., Costa, A. C. O., & Fett, R. (2016). Honey: Chemical composition, stability and authenticity. *Food Chemistry*, *196*, 309–323. https://doi.org/10.1016/j.foodchem.2015.09.051

Dangelico, R. M., & Vocalelli, D. (2017). "Green Marketing": An analysis of definitions, strategy steps, and tools through a systematic review of the literature. *Journal of Cleaner Production*, *165*, 1263–1279. https://doi.org/10.1016/j.jclepro.2017.07.184

de Lange, J., Luttikhuis, E. O., ten Klooster, R., & Lutters, E. (2013). *Towards Integrating Sustainability in the Development of Product/Packaging Combinations*. 855–864. https://doi.org/10.1007/978-3-642-30817-8_84

Dennhardt, S. (2014). User-generated content and its impact on branding: How users and communities create and manage brands in social media. *User-Generated Content and Its Impact on Branding: How Users and Communities Create and Manage Brands in Social*

Media, 1–129. https://doi.org/10.1007/978-3-658-02350-8

Development, R. (2016). *Ndyomugyenyi , E . K ., Odel , I . and Okeng , K . (2015). Assessing honey production value chain in Lira Sub-county , Lira District ... January 2015*.

Devkota, K. (2020). Beekeeping: Sustainable Livelihoods and Agriculture Production in Nepal. *Modern Beekeeping - Bases for Sustainable Production*, 1–11. https://doi.org/10.5772/intechopen.90707

Di Vita, G., Pippinato, L., Blanc, S., Zanchini, R., Mosso, A., & Brun, F. (2021). Understanding the Role of Purchasing Predictors in the Consumer's Preferences for PDO Labelled Honey. *Journal of Food Products Marketing*, *27*(1), 42–56. https://doi.org/10.1080/10454446.2021.1884161

Diaz, I. M. R., & Cataluña, F. J. R. (2011). Antecedents of the importance of price in purchase decisions. *RAE Revista de Administracao de Empresas*, *51*(4), 370–381. https://doi.org/10.1590/s0034-75902011000400005

Dickson-Spillmann, M., Siegrist, M., & Keller, C. (2011). Attitudes toward chemicals are associated with preference for natural food. *Food Quality and Preference*, *22*(1), 149–156. https://doi.org/10.1016/j.foodqual.2010.09.001

Economics, R., & State, O. (2017). *Consumers ' Preference for Honey and its Attributes in Ibadan North Local Government Area of Oyo State , Nigeria*. *22*(2), 126–130.

El-Haskoury, R., Kriaa, W., Lyoussi, B., & Makni, M. (2018). Ceratonia siliqua honeys from Morocco: Physicochemical properties, mineral contents, and antioxidant activities. *Journal of Food and Drug Analysis*, *26*(1), 67–73. https://doi.org/10.1016/j.jfda.2016.11.016

El Sohaimy, S. A., Masry, S. H. D., & Shehata, M. G. (2015). Physicochemical characteristics of honey from different origins. *Annals of Agricultural Sciences*, *60*(2), 279–287. https://doi.org/10.1016/j.aoas.2015.10.015

EREZ, M. E., KARABACAK, O., KAYCİ, L., FİDAN, M., & KAYA, Y. (2015). Characterization of Multifloral Honeys of Pervari Region with Different Properties. *Türkiye Tarımsal Araştırmalar Dergisi*, *2*(1), 40. https://doi.org/10.19159/tutad.20031

Escuredo, O., & Carmen Seijo, M. (2019). Honey: Chemical composition, stability and authenticity. *Foods*, *8*(11), 3–5. https://doi.org/10.3390/foods8110577

FAOSTAT_data_9-21-2021. (n.d.).

FAOSTAT_data_9-21-2021 (2). (n.d.).

Fellows, P. J. (2017). Properties of food and principles of processing. In *Food Processing Technology* (Issue 2015). https://doi.org/10.1016/b978-0-08-100522-4.00001-8

Ferreiro-González, M., Espada-Bellido, E., Guillén-Cueto, L., Palma, M., Barroso, C. G., & Barbero, G. F. (2018). Rapid quantification of honey adulteration by visible-near infrared spectroscopy combined with chemometrics. *Talanta*, *188*, 288–292. https://doi.org/10.1016/j.talanta.2018.05.095

Fibri, D. L. N., & Frøst, M. B. (2019). Consumer perception of original and modernised traditional foods of Indonesia. *Appetite*, *133*(July 2017), 61–69. https://doi.org/10.1016/j.appet.2018.10.026

Fuentes Molina, O., Alizadeh, K., Bucarey, S. A., Castaneza Zúñiga, E., & Vásquez-Quitral, P. (2020). Analysis of organic molecules, physicochemical parameters, and pollen as

indicators for authenticity, botanical origin, type and quality of honey samples examined. *International Journal of Food Properties*, *23*(1), 2242–2256. https://doi.org/10.1080/10942912.2020.1850775

Gebremariam, T., & Brhane, G. (2014). Determination of quality and adulteration effects of honey from adigrat and its surrounding areas. *International Journal of Technology Enhancements and Emerging Engineering Research*, *2*(10), 71–76. https://doi.org/2347-4289

Ghorbani, M., & Khajehroshanaee, N. (2009). The study of qualitative factors influencing on honey consumers demand: Application of hedonic pricing model in Khorasan Razavi Province. *Journal of Applied Sciences*, *9*(8), 1597–1600. https://doi.org/10.3923/jas.2009.1597.1600

Guelpa, A., Marini, F., du Plessis, A., Slabbert, R., & Manley, M. (2017). Verification of authenticity and fraud detection in South African honey using NIR spectroscopy. *Food Control*, *73*, 1388–1396. https://doi.org/10.1016/j.foodcont.2016.11.002

Gyau, A., Akalakou, C., Degrande, A., & Biloso, A. (2014). Determinants of Consumer Preferences for Honey in the Democratic Republic of Congo. *Journal of Food Products Marketing*, *20*(5), 476–490. https://doi.org/10.1080/10454446.2013.807405

Hamilton, R. W., & Thompson, D. V. (2018). How Financial Constraints In fl uence Consumer Behavior : An Integrative Framework. *Journal of Consumer Psychology*, *October*, 1–21. https://doi.org/10.1002/jcpy.1074

Henryks, J., Cooksey, R., & Wright, V. (2014). Organic Food at the Point of Purchase: Understanding Inconsistency in Consumer Choice Patterns. *Journal of Food Products*

Marketing, *20*(5), 452–475. https://doi.org/10.1080/10454446.2013.838529

Hooper, D., Coughlan, J., & Mullen, M. (2008). *Structural Equation Modelling : Guidelines for Determining Model Fit.*

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis : Conventional criteria versus new alternatives. Structural Equation Modeling. *A Multidisciplinary Journal*, *6*(1), 1–55. https://doi.org/10.1080/10705519909540118

Irianto, H. (2015). Consumers' Attitude and Intention towards Organic Food Purchase: An Extension of Theory of Planned Behavior in Gender Perspective. *International Journal of Management Economics and Social Sciences*, *4*(1), 17–31. https://doi.org/hdl.handle.net/10419/107961 Standard-Nutzungsbedingungen:

Ismaiel, S., Kahtani, S. Al, Adgaba, N., Al-ghamdi, A. A., & Zulail, A. (2014). *Factors That Affect Consumption Patterns and Market Demands for Honey in the Kingdom of Saudi Arabia*. *September*, 1725–1737.

Israel, G. D. (2013). *Determining Sample Size 1*. *November 1992*, 1–5.

Juma, C. N., Otieno, D. J., Oluoch-Kosura, W., Gyau, A., & Oduol, J. A. (2016). A survey of consumer perceptions and preferences for geographical indication and quality attributes of honey in Kenya. *5th International Conference of the African Association of Agricultural Economists*, 10 p. https://econpapers.repec.org/paper/agsaaae16/246915.htm

Kabbani, D., Sepulcre, F., & Wedekind, J. (2011). Ultrasound-assisted liquefaction of rosemary honey: Influence on rheology and crystal content. *Journal of Food Engineering*, *107*(2), 173–178. https://doi.org/10.1016/j.jfoodeng.2011.06.027

Kalanzi, F., Nansereko, S., Buyinza, J., Kiwuso, P., Turinayo, Y., Mwanja, C., Niyibizi, G., Ongerep, S., Sekatuba, J., Mujuni, D., & Ajijur Rahman, S. (2015). Socio-economic analysis of beekeeping enterprise in communities adjacent to Kalinzu forest, Western Uganda. *International Journal of Research on Land-Use Sustainability*, *2*(1), 81–90. https://doi.org/10.13140/RG.2.1.2647.4329

Kassa, T., Gonche, G., Amenay, A., Tarekegn, K., Girma, G., & Assefa, A. (2017). Value Chain Analysis of Honey in Kaffa and Sheka Zones of SNNPR, Ethiopia. *International Journal of Research in Agricultural Sciences*, *4*(3), 142–148. https://doi.org/322819796

Khaoula, B., Zineb, N., Zakaria, A., Abdelmajid, S., Asmae, C., & Abderrazak, K. (2019a). Consumption, preferences and habits of purchasing consumers of honey in Morocco. *Journal of Hygienic Engineering and Design*, *28*(64), 61–65.

Khaoula, B., Zineb, N., Zakaria, A., Abdelmajid, S., Asmae, C., & Abderrazak, K. (2019b). Consumption, preferences and habits of purchasing consumers of honey in Morocco. *Journal of Hygienic Engineering and Design*, *28*(64), 61–65. https://doi.org/658.89:638.16(64)

Kim, D. J., Ferrin, D. L., & Rao, H. R. (2008). A trust-based consumer decision-making model in electronic commerce: The role of trust, perceived risk, and their antecedents. *Decision Support Systems*, *44*(2), 544–564. https://doi.org/10.1016/j.dss.2007.07.001

Kizilaslan, H., & Kizilaslan, N. (2007). Factors Affecting Honey Production in Apiculture in Turkey. *Journal of Applied Sciences*, *3*(10), 983–987. https://doi.org/228624870

Kugonza, D. R., & Nabakabya, D. (2008a). Honey Quality as Affected by Handling, Processing and Marketing Channels in Uganda. *Tropicultura*, *26*(2), 113–118.

Kugonza, D. R., & Nabakabya, D. (2008b). Honey Quality as Affected by Handling, Processing and Marketing Channels in Uganda. *Tropicultura*, *26*(2), 113–118. https://doi.org/45266297

Lee, J. D., Repkine, A., Hwang, S. W., & Kim, T. Y. (2004). Estimating consumers' willingness to pay for individual quality attributes with DEA. *Journal of the Operational Research Society*, *55*(10), 1064–1070. https://doi.org/10.1057/palgrave.jors.2601797

Lee, J. E., & Chen-Yu, J. H. (2018). Effects of price discount on consumers' perceptions of savings, quality, and value for apparel products: mediating effect of price discount affect. *Fashion and Textiles*, *5*(1). https://doi.org/10.1186/s40691-018-0128-2

Lee, S., Kim, N., Hwang, J., & Moon, J. (2021). A Study on Determinants of the Willingness to Pay for Native Honey: Focusing on Knowledge of and Experience with Honey and Attitude toward Health. *Agricultural Economics*, *2*(1), 1–22. https://doi.org/10.14771/AIM.12.2.1

Lynch, M., Mabaya, E., Bussiere, E., & Willigerd, M. (2014). Bee natural Uganda: Unlocking the potential of smallholder farmers in the West Nile. *International Food and Agribusiness Management Review*, *17*(SPECIALISSUEB), 57–61. https://doi.org/10.22004/ag.econ.179490

Machado De-Melo, A. A., Almeida-Muradian, L. B. de, Sancho, M. T., & Pascual-Maté, A. (2018). Composición y propiedades de la miel de Apis mellifera: una revisión. *Journal of Apicultural Research*, *57*(1), 5–37. https://doi.org/10.1080/00218839.2017.1338444

Majewska, E., Drużyńska, B., & Wołosiak, R. (2019). Determination of the botanical origin of honeybee honeys based on the analysis of their selected physicochemical parameters coupled with chemometric assays. *Food Science and Biotechnology*, *28*(5), 1307–1314. https://doi.org/10.1007/s10068-019-00598-5

Marcazzan, G. L., Mucignat-Caretta, C., Marina Marchese, C., & Piana, M. L. (2018). Una revisión de los métodos para el análisis sensorial de la miel. *Journal of Apicultural Research*, *57*(1), 75–87. https://doi.org/10.1080/00218839.2017.1357940

Matović, K., Ćirić, J., Kaljević, V., Nedić, N., Jevtić, G., Vasković, N., & Baltić, M. (2018). Physicochemical parameters and microbiological status of honey produced in an urban environment in Serbia. *Environmental Science and Pollution Research*, *25*(14), 14148–14157. https://doi.org/10.1007/s11356-018-1659-1

McGuirk, P. M., & O'Neill, P. (2005). Using Questionnaires in Qualitative Human Geography. *Qualitative Research Methods in Human Geography*, 147–162.

Mesele, T. L. (2021). Review on physico-chemical properties of honey in Eastern Africa. *Journal of Apicultural Research*, *60*(1), 33–45. https://doi.org/10.1080/00218839.2020.1754566

Midway, S., Robertson, M., Flinn, S., & Kaller, M. (2020). Comparing multiple comparisons: practical guidance for choosing the best multiple comparisons test. *PeerJ*, *8*, 1–26. https://doi.org/10.7717/peerj.10387

Mirosa, M., Liu, Y., & Bremer, P. (2021). Chinese consumers' perceptions of food safety cues and maximising the effectiveness of food safety communications. *British Food Journal*, *123*(1), 261–278. https://doi.org/10.1108/BFJ-09-2019-0694

Mohammed, M. E. A. (2020). Factors Affecting the Physicochemical Properties and Chemical Composition of Bee's Honey. *Food Reviews International*, *00*(00), 1–12. https://doi.org/10.1080/87559129.2020.1810701

Moniruzzaman, M., Benhanifia, M., Sulaiman, S. A., Gan, S. H., & Centre, H. G. (2012). Physicochemical and Antioxidant Properties of Algerian Honey. *Molecules*, *17*(4), 11199–11215. https://doi.org/10.3390/molecules170911199

Morar, D. D. (2013). An overview of the consumer value literature – perceived value, desired value. *6th Edition of the International Conference "Marketing - from Information to Decision," November 2013*, 169–186. https://doi.org/271585009

Mouhoubi-Tafinine, Z., Ouchemoukh, S., Bachir Bey, M., Louaileche, H., & Tamendjari, A. (2018a). Effect of storage on hydroxymethylfurfural (HMF) and color of some Algerian honey. *International Food Research Journal*, *25*(3), 1044–1050. https://doi.org/326800473

Mouhoubi-Tafinine, Z., Ouchemoukh, S., Bachir Bey, M., Louaileche, H., & Tamendjari, A. (2018b). Effect of storage on hydroxymethylfurfural (HMF) and color of some Algerian honey. *International Food Research Journal*, *25*(3), 1044–1050.

Mudzengi, C., Kapembeza, C. S., Dahwa, E., Taderera, L., Moyana, S., & Zimondi, M. (2020). Ecological Benefits of Apiculture on Savanna Rangelands. *Bee World*, *97*(1), 17–20. https://doi.org/10.1080/0005772x.2019.1701797

Mun, Y. Y., Jackson, J. D., Park, J. S., & Probst, J. C. (2006). Understanding information technology acceptance by individual professionals : Toward an integrative view. *Information & Management 43*, *43*(3), 350–363. https://doi.org/10.1016/j.im.2005.08.006

Mushonga, B., Hategekimana, L., Habarugira, G., Kandiwa, E., Samkange, A., & Ernest Segwagwe, B. V. (2019). Characterization of the Beekeeping Value Chain: Challenges, Perceptions, Limitations, and Opportunities for Beekeepers in Kayonza District, Rwanda. *Advances in Agriculture*, *2019*, 1–9. https://doi.org/10.1155/2019/5982931

Nabwire, E. J. . (2016a). *Economic Analysis of Consumers' Awareness and Willingness To Pay for Geographical Indicators and Other Quality Attributes of Honey in Kenya* (Issue November) [University of Nairobi November]. https://www.iprsonline.org/resources/docs/Rangnekar - GI - Blue 4.pdf

Nabwire, E. J. . (2016b). *Economic Analysis of Consumers' Awareness and Willingness To Pay for Geographical Indicators and Other Quality Attributes of Honey in Kenya*. *November*, 121. https://www.iprsonline.org/resources/docs/Rangnekar - GI - Blue 4.pdf

Nascimento, A. G. M., Toledo, B. S., Guimarães, J. T., Ramos, G. L. P. A., da Cunha, D. T., Pimentel, T. C., Cruz, A. G., Freitas, M. Q., Esmerino, E. A., & Máralém, E. T. (2022). The impact of packaging design on the perceived quality of honey by Brazilian consumers. *Food Research International*, *151*(110887), 1–9. https://doi.org/10.1016/j.foodres.2021.110887

Nguyen, A. T., Parker, L., Brennan, L., & Lockrey, S. (2020). A consumer definition of eco-friendly packaging. *Journal of Cleaner Production*, *252*(2020). https://doi.org/10.1016/j.jclepro.2019.119792

Nordin, A., Sainik, N. Q. A. V., Chowdhury, S. R., Saim, A. Bin, & Idrus, R. B. H. (2018). Physicochemical properties of stingless bee honey from around the globe: A comprehensive review. *Journal of Food Composition and Analysis*, *73*, 91–102. https://doi.org/10.1016/j.jfca.2018.06.002

Nwoko., C. I. ., Nkwoada., A. ., E.O, U., & Njoku., A. (2017). Characterization of Selected Honey in South-East Nigeria: Theoretical Translation. *International Journal of Environment, Agriculture and Biotechnology*, *2*(2), 695–700. https://doi.org/10.22161/ijeab/2.2.16

Olaitan, P. B., Adeleke, O. E., & Ola, I. O. (2007). Honey: A reservoir for microorganisms and an inhibitory agent for microbes. *African Health Sciences*, *7*(3), 159–165. https://doi.org/10.5555/afhs.2007.7.3.159

Olawode, E. O., Tandlich, R., & Cambray, G. (2018). 1H-NMR profiling and chemometric analysis of selected honeys from South Africa, Zambia, and Slovakia. *Molecules*, *23*(3). https://doi.org/10.3390/molecules23030578

Oliveira Neto, W. M. de, Paiva, R. D. N., & Novais, J. S. de. (2020). "Honey is Good for Health": Patterns of honey purchasing and consumption in Lower Amazon. *CBR - Consumer Behavior Review*, *4*(3), 324. https://doi.org/10.51359/2526-7884.2020.247470

Osuagwu OS, Oyerinde AA, O. A. and O. A. (2020). Comparative Studies of the Physicochemical Properties and Mineral Elements of Honey Produced in the Guinea Savannah Zones of Nigeria. *Biomedical Journal of Scientific & Technical Research*, *24*(5). https://doi.org/10.26717/bjstr.2020.24.004105

Panda, D., Masani, S., & Dasgupta, T. (2022). Packaging-influenced-purchase decision segment the bottom of the pyramid consumer marketplace? Evidence from West Bengal, India. *Asia Pacific Management Review*, *27*(2), 145–153. https://doi.org/10.1016/j.apmrv.2021.06.004

Parities, P. P. (2012). Consumer goods and services. In *Eurostat-OECD Methodological Manual on Purchasing Power Parities (2012 Edition)*. https://doi.org/10.1787/9789264189232-8-en

Pasias, I. N., Kiriakou, I. K., & Proestos, C. (2017). HMF and diastase activity in honeys: A fully validated approach and a chemometric analysis for identification of honey freshness and adulteration. *Food Chemistry*, *229*, 425–431. https://doi.org/10.1016/j.foodchem.2017.02.084

Pelletier, J. E., Laska, M. N., Neumark-Sztainer, D., & Story, M. (2013). Positive attitudes toward organic, local, and sustainable foods are associated with higher dietary quality among young adults. *Journal of the Academy of Nutrition and Dietetics*, *113*(1), 127–132. https://doi.org/10.1016/j.jand.2012.08.021.Positive

Petrescu, D. C., Vermeir, I., & Petrescu-Mag, R. M. (2020). Consumer understanding of food quality, healthiness, and environmental impact: A cross-national perspective. *International Journal of Environmental Research and Public Health*, *17*(1). https://doi.org/10.3390/ijerph17010169

Phan, T., Bremer, P., & Mirosa, M. (2020). Vietnamese consumers' preferences for functional milk powder attributes: A segmentation-based conjoint study with educated consumers. *Sustainability (Switzerland)*, *12*(13). https://doi.org/10.3390/su12135258

Pocol, C. B., & Bolboacă, S. D. (2013). Perceptions and trends related to the consumption of honey: A case study of North-West Romania. *International Journal of Consumer Studies*, *37*(6), 642–649. https://doi.org/10.1111/ijcs.12046

Polak-Śliwińska, M., & Tańska, M. (2021). Conventional and organic honeys as a source of water- and ethanol-soluble molecules with nutritional and antioxidant characteristics. *Molecules*, *26*(12). https://doi.org/10.3390/molecules26123746

Popescu, A., & Guresoaie, I. (2019). Consumer's behaviour towards honey purchase - a case study in Romania. *Scientific Papers Series - Management, Economic Engineering in Agriculture and Rural Development*, *19*(1), 451–469. https://doi.org/2285/3952

Pradhan, S. (2018). Role of CSR in the consumer decision making process – The case of India. *Social Responsibility Journal*, *14*(1), 138–158. https://doi.org/10.1108/SRJ-06-2016-0109

Purnomo, D., Bunyamin, A., Gunawan, W., Faizah, N. A., Danuwidjaja, T. G., Rohman, L. N., & Annisa, R. (2021). Motivation, purpose, and purchasing frequency of honey consumption in West Java. *IOP Conference Series: Earth and Environmental Science*, *948*(1). https://doi.org/10.1088/1755-1315/948/1/012070

Puścion-Jakubik, A., Borawska, M. H., & Socha, K. (2020). Modern methods for assessing the quality of Bee Honey and botanical origin identification. *Foods*, *9*(8), 1–21. https://doi.org/10.3390/foods9081028

Röhr, A., Lüddecke, K., Drusch, S., Müller, M. J., & Alvensleben, R. V. (2005). Food quality and safety - Consumer perception and public health concern. *Food Control*, *16*(8 SPEC. ISS.), 649–655. https://doi.org/10.1016/j.foodcont.2004.06.001

Roman, A., Popiela-Pleban, E., Kozak, M., & Roman, K. (2013). Factors influencing consumer behavior relating to the purchase of honey part 2. Product quality and packaging. *Journal of Apicultural Science*, *57*(2), 175–185. https://doi.org/10.2478/jas-2013-0027

Roy, G., Debnath, R., Mitra, P. S., & Shrivastava, A. K. (2021). Analytical study of low-income consumers' purchase behaviour for developing marketing strategy. *International Journal of System Assurance Engineering and Management*, *12*(5), 895–909. https://doi.org/10.1007/s13198-021-01143-6

Rumagit, M. C. N., Sharma, A., Angelle, A., Mui, D., Kee, H., Ke, A., Nik, C., Bin Bachotan, A., Bian, S., & Pelealu, C. (2022). Universitas Negeri Manado 1,8 Jln Raya Tondano. *International Journal of Accounting & Finance in Asia Pasific (IJAFAP)*, *5*(1), 7. https://doi.org/10.32535/ijafap.v5i1.141

Sajid, M., Yamin, M., Asad, F., Yaqub, S., Ahmad, S., Mubarik, M. A. M. S., Ahmad, B.,

Ahmad, W., & Qamer, S. (2020). Comparative study of physio-chemical analysis of fresh and branded honeys from Pakistan. *Saudi Journal of Biological Sciences*, *27*(1), 173–176. https://doi.org/10.1016/j.sjbs.2019.06.014

Semra, G., Çakıcı, N., Mehmeto, S., Atmaca, H., Demir, T., Atmaca, F., Fazıl, G., & Arıg, M. (2020). Physicochemical Quality Characteristics of Southeastern Anatolia Honey , Turkey. *International Journal of Analytical Chemistry*, *20*(20), 1–6. https://doi.org/10.1155/2020/8810029

Sereia, M. J., Março, P. H., Perdoncini, M. R. G., Parpinelli, R. S., de Lima, E. G., & Anjo, F. A. (2017a). Techniques for the Evaluation of Physicochemical Quality and Bioactive Compounds in Honey. *Honey Analysis*. https://doi.org/10.5772/66839

Sereia, M. J., Março, P. H., Perdoncini, M. R. G., Parpinelli, R. S., de Lima, E. G., & Anjo, F. A. (2017b). Techniques for the Evaluation of Physicochemical Quality and Bioactive Compounds in Honey. *Honey Analysis*. https://doi.org/10.5772/66839

Shamsudin, S., Selamat, J., Sanny, M., & R, S. B. A. (2019). A Comparative Characterization of Physicochemical and Antioxidants Properties of Processed Heterotrigona itama Honey from Di ff erent Origins. *Molecules*, *3898*(24), 1–20. https://doi.org/10.3390/molecules24213898

Shugaba, A. (2012). Analysis of Biochemical Composition of Honey Samples from North-East Nigeria. *Biochemistry & Analytical Biochemistry*, *2*(3). https://doi.org/10.4172/2161-1009.1000139

Singh, I., & Singh, S. (2018). Honey moisture reduction and its quality. *Journal of Food Science and Technology*, *55*(10), 3861–3871. https://doi.org/10.1007/s13197-018-3341-5

Symmank, C. (2019). Extrinsic and intrinsic food product attributes in consumer and sensory research: literature review and quantification of the findings. *Management Review Quarterly*, *69*(1), 39–74. https://doi.org/10.1007/s11301-018-0146-6

Tadesse, B., Tilahun, Y., Woyamo, W., & Bayu, M. (2021). Heliyon Factors in fl uencing organic honey production level and marketing : evidence from southwest Ethiopia. *Heliyon*, *7*(September), e07975. https://doi.org/10.1016/j.heliyon.2021.e07975

Taherdoost, H. (2016). Sampling Methods in Research Methodology ; How to Choose a Sampling Technique for Research Hamed Taherdoost To cite this version : HAL Id : hal-02546796 Sampling Methods in Research Methodology ; How to Choose a Sampling Technique for. *International Journal of Academic Research in Management (IJARM)*, *5*(2), 18–27.

Terkes, N., Celik, F., & Bektas, H. (2019). Determination of nursing students' attitudes towards the use of technology. *Japan Journal of Nursing Science*, *16*(1), 17–24. https://doi.org/10.1111/jjns.12207

Testa, R., Asciuto, A., Schifani, G., Schimmenti, E., & Migliore, G. (2019). Quality determinants and effect of therapeutic properties in honey consumption. An exploratory study on italian consumers. *Agriculture (Switzerland)*, *9*(8), 1–12. https://doi.org/10.3390/agriculture9080174

Thompson, M. E., & Wu, C. (2020). ICSA Book Series in Statistics Sampling Theory and Practice: Sampling Theory and Practice. In *Springer Nature Switzerland AG*. http://www.springer.com/series/13402

Thrasyvoulou, A., Tananaki, C., Goras, G., Karazafiris, E., Dimou, M., Liolios, V., Kanelis, D.,

& Gounari, S. (2018). Legislación de criterios y normas de miel. *Journal of Apicultural Research*, *57*(1), 88–96. https://doi.org/10.1080/00218839.2017.1411181

Topal, E., Adamchuk, L., Negri, I., Kösoğlu, M., Papa, G., Dârjan, M. S., Cornea-cipcigan, M., & Mărgăoan, R. (2021). Traces of honeybees, api-tourism and beekeeping: From past to present. *Sustainability (Switzerland)*, *13*(21). https://doi.org/10.3390/su132111659

Tosun, M., & Keles, F. (2021). Investigation methods for detecting honey samples adulterated with sucrose syrup. *Journal of Food Composition and Analysis*, *101*(April), 103941. https://doi.org/10.1016/j.jfca.2021.103941

UNBS. (2019). *PU*. *1*(1).

Van Rijswijk, W., & Frewer, L. J. (2008). Consumer perceptions of food quality and safety and their relation to traceability. *British Food Journal*, *110*(10), 1034–1046. https://doi.org/10.1108/00070700810906642

Ványi, G. Á., Csapó, Z., & Kárpáti, L. (2011). Evaluation of consumers' honey purchase habits in Hungary. *Journal of Food Products Marketing*, *17*(2–3), 227–240. https://doi.org/10.1080/10454446.2011.548293

Wicks, A. M., & Roethlein, C. J. (2009). Journal of Business & Economic Studies, Vol. 15, No. 1, Spring 2009 A Satisfaction-Based Definition of Quality Angela M. Wicks, Bryant University Christopher J. Roethlein, Bryant University. *Journal of Business & Economic Studies*, *15*(1), 82–98.

Wu, W. Y., Lu, H. Y., Wu, Y. Y., & Fu, C. S. (2012). The effects of product scarcity and consumers' need for uniqueness on purchase intention. *International Journal of Consumer*

Studies, *36*(3), 263–274. https://doi.org/10.1111/j.1470-6431.2011.01000.x

Yeboue, A. K., Roger, M., Kabran, G., Sorokina, A. E., Adou, A. D., & Kouassi, C. K. (2021). Physical , physicochemical and nutritional profile of honey produced in nine localities in Côte d ' Ivoire. *International Journal of Biological and Chemical Sciences*, *15*(2), 846–859. https://doi.org/10.4314/ijbcs.v15i2.34

Yeow, S. H. C., Chin, S. T. S., Yeow, J. A., & Tan, K. S. (2013a). Consumer purchase intentions and honey related products. *Entrepreneurship Vision 2020: Innovation, Development Sustainability, and Economic Growth - Proceedings of the 20th International Business Information Management Association Conference, IBIMA 2013*, *1*, 332–345. https://doi.org/10.5171/2013.197440

Yeow, S. H. C., Chin, S. T. S., Yeow, J. A., & Tan, K. S. (2013b). Consumer purchase intentions and honey related products. *Entrepreneurship Vision 2020: Innovation, Development Sustainability, and Economic Growth - Proceedings of the 20th International Business Information Management Association Conference, IBIMA 2013*, *1*(May 2014), 332–345. https://doi.org/10.5171/2013.197440

Yohannes, W., Chandravanshi, B. S., & Moges, G. (2019). *Assessment of trace metals and physicochemical parameters of commercially available honey in Ethiopia*. *4*(2), 91–101. https://doi.org/10.31221/osf.io/5vb6a

Yuan, X., & Xiao, Y. (2021). Cognition, value perception and purchase intention of organic food-evidence from China's organic milk market. *Sustainability (Switzerland)*, *13*(2), 1–15. https://doi.org/10.3390/su13020910

Żak, N. (2017). Honey market in the opinion of young consumers. In *Rynek miodów w opinii*

młodych konsumentów. (Vol. 1, Issue 1, pp. 424–438). https://ucc.idm.oclc.org/login?URL=http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=122883748&site=ehost-live

Zhang, E. M. (2010). Understanding the Acceptance of Mobile SMS Advertising among Young Chinese Consumers. *Psychology & Marketing*, *30*(6), 461–469. https://doi.org/10.1002/mar

APPENDICES

Appendix 1: Ethical Approval

GULU UNIVERSITY

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RESEARCH ETHICS COMMITTEE

30/09/2022

To: Sylivia Woor

Gulu University
+256787762471

Type: Initial Review

Re: GUREC-2022-235: Determination of Quality Requirements and Perception of Honey Value Chain Actors., Three, 2022-08-29

I am pleased to inform you that at the **83rd** convened meeting on **19/05/2022**, the Gulu University REC, committee meeting, etc voted to approve the above referenced application.
Approval of the research is for the period of **30/09/2022** to **30/09/2023.**

As Principal Investigator of the research, you are responsible for fulfilling the following requirements of approval:

1. All co-investigators must be kept informed of the status of the research.
2. Changes, amendments, and addenda to the protocol or the consent form must be submitted to the REC for re-review and approval **prior** to the activation of the changes.
3. Reports of unanticipated problems involving risks to participants or any new information which could change the risk benefit: ratio must be submitted to the REC.
4. Only approved consent forms are to be used in the enrollment of participants. All consent forms signed by participants and/or witnesses should be retained on file. The REC may conduct audits of all study records, and consent documentation may be part of such audits.
5. Continuing review application must be submitted to the REC **eight weeks** prior to the expiration date of **30/09/2023** in order to continue the study beyond the approved period. Failure to submit a continuing review application in a timely fashion may result in suspension or termination of the study.
6. The REC application number assigned to the research should be cited in any correspondence with the REC of record.
7. You are required to register the research protocol with the Uganda National Council for Science and Technology (UNCST) for final clearance to undertake the study in Uganda.

The following is the list of all documents approved in this application by Gulu University REC:

GULU UNIVERSITY
INSTITUTIONAL REVIEW COMMITTEE
APPROVED UNTIL
★ 30 SEP 2023 ★
FACULTY OF MEDICINE
P. O. Box 166, Gulu

No.	Document Title	Language	Version Number	Version Date
1	Protocol	English	Three	2022-08-29
2	Informed Consent forms	English	Three	2022-08-29
3	Informed Consent forms	lugbari	Three	2022-08-29
4	Informed Consent forms	Langi	Three	2022-08-29
5	Data collection tools	English	two	2022-08-05

GULU UNIVERSITY
INSTITUTIONAL REVIEW COMMITTEE
APPROVED UNTIL
30 SEP 2023
FACULTY OF MEDICINE
P. O. Box 166, Gulu

Yours Sincerely

Julaina A. Obika (PhD)
For: Gulu University REC

Appendix 2: Informed Consent Document (English Version)

VERSION 3

Informed consent form

Title of the study: Determinants of quality and quantity requirements of honey along the value chain in Arua and Lira districts in Uganda

Investigator: Woor Sylivia

Institution: Gulu University

Introduction:

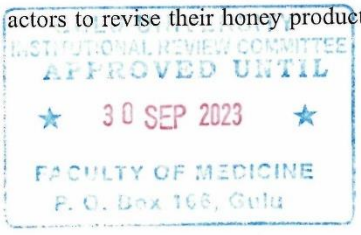
My name is Woor Sylivia, a student pursuing Master of science in Animal Production and Marketing at Gulu University. I am researching on the **" Determinants of quality and quantity requirements of honey along the value chain in Arua and Lira districts in Uganda. "** The study is disclosed to you in this informed consent, after which any questions you may have are answered. Having decided to participate in the study, you must sign a consent form, which you will be given a copy to keep.

Sponsors of the research:

This study is sponsored by MasterCard Foundation and Regional Universities' Forum for Capacity Building in Agriculture (RUFORUM).

Purpose:

The study seeks to **determine the quality of honey produced and marketed at different honey value chain nodes and value chain actors' honey quality and quantity requirements during purchase and their perception of honey quality**. knowledge generated will inform policy makers' decisions on the honey production requirements that may create an enabling environment for the value chain actors for increased honey production with emphasis on quality and value addition so that it can meet national and international standards. This study will also avail information on the consumers' expectations as well as perception of honey quality. This may help honey values chain actors to revise their honey production and handling techniques to meet the



consumers' demands and ensure they are in line with quality requirements of the national and international regulatory bodies

Procedures:

Participation in this study will involve filling in a questionnaire with the research team (principle researcher and the research assisstants.

Who will participate in the study?

You have been chosen to participate in this study because you are among the honey value chain actors; beekeepers, processors, retailers or consumers in Northern Uganda. The interview will last for about 30 minutes. Approximately 300 participants will take part in the study.

Risks/discomforts:

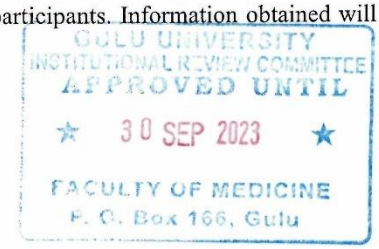
There is no foreseeable risk of harm or discomfort that will arise from your participation in this study. The only risk or discomfort will be the inconvenience in terms of time spent during the interview.

Benefits:

Value chain actors will benefit from my immediate advice as I interract with them during the data collection process. Additionally, more benefits will be availed after a report has been compiled by the researcher on which concerned bodies will react appropriately. The research participants will get feedback on the findings and progress of the study. Also, any new information that affects the study participants (including incidental findings) will be made available to research participants.

Confidentiality:

This research is exclusively for academic purposes and is being conducted as a requirement for the completion of my studies. Your identity will not be revealed to any one as we shall only use codes to identify participants. Information obtained will only be accessible by the research team. Soft



copies of the data will be protected by password and hard copy files will be kept under lock and key only accessible and known to the principal investigator.

Alternatives:

Your participation is voluntary and feel free to leave at any time even after starting on the questionnaire.

Cost:

There will be no cost incurred because of participating in this study.

Compensation:

You will be compensated for your participation in the study with a bar of blue soap.

Questions:

If you have any questions related to the study, or your rights as a research participant, you can contact the principal investigator, Woor Sylivia on +256787762471 or via email on sylviawoor@gmail.com

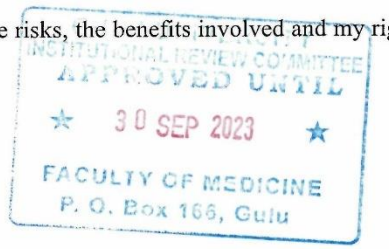
Statement of voluntariness:

Participation in the research study is voluntary and you may join on your own free will. You have a right to withdraw from the study at any time without penalty.

If you have any issues about your rights and participation in the study, please contact the Chairperson, Gulu University Research Ethics Committee, Dr. Gerald Obai Tel: No., 0772305621; email: lekobai@yahoo.com/lekobai@gmail.com; or the Uganda National Council for Science and Technology, on plot 6 Kimera Road, Ntinda, Kampala on Tel 0414705500.

Statement of consent

The research team (research assistant and the principle investigator) has described to me what will be done, the risks, the benefits involved and my rights as a participant in this study. I understand

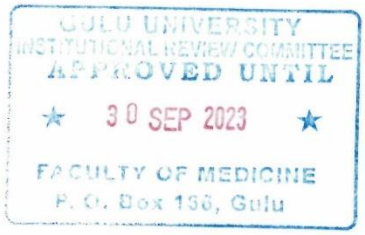


that my decision to participate in this study will not affect me. In the use of this information, my identity will be concealed. I am aware that I may withdraw at any time. I understand that by signing this form, I do not waive any of my legal rights but merely indicate that I have been informed about the research study in which I am voluntarily agreeing to participate. I will be provided with a copy of this form.

Name .....Signature/thumbprint of participant.....date.....

Name..... Signature of witness.....Date.....

Name.....Signature of interviewer.....Date:.....



Appendix 3: Informed Consent Document (Langi Version)

Version 3

INFORMED CONSENT DOCUMENT IN LANGI

Nying Ikweda: Me neno ngo amite aber pi cilo amoo kic kede neno ajoo _alubere kede yore me yubu moo kic

Won ikweda(s): Woor Sylivia

Kakwan (s) GULU UNIVERSITY

Nyute:

Amoti baa,

An nyinga Sylivia Woor, atin kwan me Gulu University ijyange me dongo lobo me kin paco kede biacara ame tye idul me pur kede kan orumu waa. Nenno jami ame mite me atima me nenno ber akic kede tam ajoo ikom kic iyi Lira kede Arua distrik ame tye tung malu me Uganda kan.

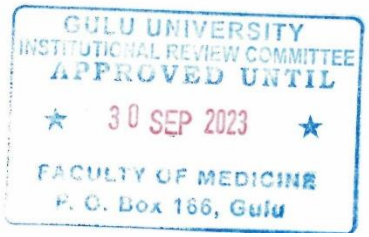
Ikweda man tye pii cobo miti me pwonyere kede konyo joo atye atimo ikweda man nyang magoba ango opur nwongo ipitu punu kede me nyang yore me gwoko punu mene aber aloo ame opur myero tii kede me kelo magoba adit iyi lira kede Arua distrik.

Pimono, yin otye oyeri me bedo ikin joo ame amiyo tam gi ikom ikweda ma kede dang amito miyi ngeyo ni, tam onyo ngecoro kiken ayin ibinu miyu binu bede me imung ame ngatoro kiken pe bino ngeyo ni ngec man oya iboti

Obanga binu miyi gum ka ibinu jalu caw ni me gamo apeny wa ame openyi kede

Ngnec acegocego akwo joo ame oculu pi ikweda man

Ikeweda man jo ame oculu pire obedo dul ame olwongo ni, Mastercard RUFORUM karacel kede Tagdev Gulu University



Icwil me kwan man:

Kwan man tye me neno ka pitu punu kelo lim icing opur kede yore aber mene ame opur myro tii kede me gwoko punu wek kel lim icingi i Lira kede Arua distrik. Ikweda man binno bedo me kony bot jo atimo ikweda ikop ikom pur kede joo aogo myeka me pur. Ikweda man bino kelo agam bot opur iyore me pitu punu akelo lim abup icing opur ame bino konyo opur me goyo myeka ikare me pitu punu

Yore ame atic kede:

Tici iyi ikweda man bino bedo me gamo apeny kun ipongo iyi papara ame obino miyi

Joo ame abedo iyii ikweda man:

Yin oyere me bedo iyii ikweda man pien ibedo apur ame gwoko punu apeny ame obino peni kede ni bino bedo pi cawa atitidi

Peki ame yaa ikom ikweda man:

Peko moro ame bino yaa iyi ikweda man pe nikwanyo kono ka cawa nii ame ibino miyo

Ber ikweda man:

Ikweda man bino mede rwom me gwoko punu malu ikin opur man bino medo rwom me lim icao opur kede dang bino nyuti opuryore aber ame myero otii gini kede me gwoko punu ame tye kede magoba



Gwoko imung:

Imung ikom ngat acelacel ame bino miyo tamere pe obino kelo oko kan aler

Onyo:

Itye kede twero me kwero miyo tami ikom ikweda ma ka pe imito bedo bedo iye

cul

Pe tye cul omoro kike ame bino yaa iboti wek ibed ikweda man

Pwoc

Obino miyi pwoc me cabun bar acel bi miyo cawani lkwan man

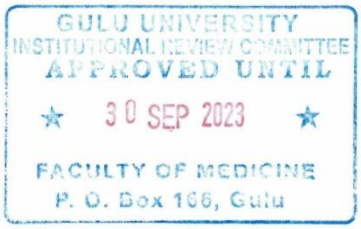
Questions:/ Apeny

Ka itye kede apeny omore kiken akwako ikweda man, itwero goyo cim bot aloo wii ikweda man I nuba cim man Sylivia Woor. +256787762471 onyo itwero cwalo kwena email sylviawoor@gmail.com

Lok akwako kop ikom jale me miyo tami:

Miyo tam ikom ikweda man dic pee iye dong itye agonya me miyo tami onyo pe

Ka itye kede peko moro onyo twero ni oturu ikare me ikweda man itwero miyo ngec bot Adit alo kop me pwonyore kede ikweda I Gulu university, Dr. Gerald Obai Tel: Nama cim., 0772305621; email: lekobai@yahoo.com/lekobai@gmail.com; onyo imi ngec bot Uganda National Council for Science and Technology, ame tye iw plot 6 Kimera Road, Ntinda, Kampala on Tel 0414705500.

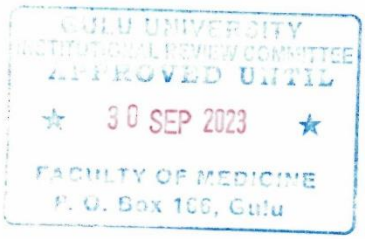


Yeo: ……..Omyia angeo ngo ame bino timere, peko abini yaa iyee, ber ikweda man,kede twero na akwako ikweda man. Anyang aber dong amoko tam ani aye bedo ikin joo ame bino miyo tam gi iyi ikweda man.

Nying ……cing agamkop……ninodwe ……...

Nying……..cing akewedkop ……ninodwe ……

Nying…… cing caden……ninodwe ……



Appendix 4: Informed Consent Document (Lugbraa Version)

Version 3

KOKOBI OTULE EYO ECEZURI

- **EYO DRI – BANI ONILERI:-**
- AFA BANI LELE ONYIRU TU, ANYU TAMBAZURI ESUZU.
- **BA EYO ONIPIRI:** – MA RU – WOOR SYLIVIA- I
- **AMUTI ERINI ENGAZURI** – GULU UNIVERSITY.
- **BANDE ECEZURI** – RU NI -WOOR SYLIVIA -I

SCHOOL-MVA ONITA MASTER OF SCIENCE LAPI ANYAPA EZOZA AZINI CUU NDAZURI, GULU UNIVERSITY –A. MA EYO ONI AFA BANI LELE ONYIRU TU ANYU TAMBAZURI ESUZURI MA DRIA.

- EYO ONILERI BA ESU ENGAZU MIVU, VUTINIA ZITA KA OVU MI BE CI, ECO OMVIZU RA.
- EKILE MINI AIIZU EYO NDE OMVIZU RA RILE, AMA AII MI DRITIZU KOKOBI DRIA, DIKA BANGA KOKOBI DRITIZURI FE MIDRI INDI, TANI MBAZU..

- **AMUTI ROBIA FEPI EYO ONIZURI:**
- AMUTI ROBIA FEPI EYO ONIZU DII MA RU, MASTERCARD FOUNDATION azini REGIONAL UNIVERSITIES FORUM FOR CAPACITY BUILDING IN AGRICULTURE (RUFORUM)

- **ASISILI NIRI:-**
- EYO ONILERI MA ASISILE, AFA BANI LELE ONYIRU TU, ANYU TAMBAZURI ESUZU, UGANDA MA WOKO URULERU RIA.
- EYO ONILERI KA FIRA, ERI NGA NITA AZINI ONDUA FE BA EYO AMAPI DIYI DRI, AFA LELE ANYU TAMBAZU DIYI MA DRIA, ONYIAFA ANGUNI DRIFUPI RA DIYI BAZU, BA LEPI ANYU TAMBAPI DIYI DRI, ANYU OFUZU OMGBO ANGIRISI, WURA BE ALARU, ECOZU CUU UGANDA SI AZINI WUDRIKURU SIRI ESUZU ANI.
- EYO ONILERI VINI NGA ASIBAZA FE 'BA ANYU AYUPI NYAKARU DIYI DRI, FEZU BA ANYU TAMBAPI DIYI NI ONDUA ANYU BAZURI OJAZU, ANYU YINI MA CA 'BA ANYU AYUPI DIYI MA AVIJO-A ANI, VINI NEZU KINI, ANYU YINI MA OVU TROTRO AZITA KARINI AZINI WUDRIKURU NI LELERILE.

- **GERI AYULE EYO ECEZURI:-**
- MINI ECOZU EYO ECEZU, MINGA KOKOBI OFI TUALU AGU EYO ONIPIRI BE.

APPROVED UNTIL
30 SEP 2023

- **A'DINI NGA EYO ECE NI YA?**
- MI OVU PEZARU AGBARI, ADISIKU MI 'BA AZI ANYU TAMBAZU YETASI RI-I, VINI 'BANILELE EYO ONIZU ERI VURI –I.
- EYO ONIZURI NI ACIZU KILILIRU, MA ECO ANYU JEZU EMI VU LITA ALU MA AGANDUA, O'BIZARU OKALAMVU ANYU O'BIZURIA.
- ZITA BANI EYO ONIZU MIVURI ECO SAWA 'DUZU DAKIKA 30.

- 'BA KALAFE 300, YINGA EYO ECE SAWA EYO ONIZURIA NI.

- **EYO ECAPI KUMURU (ASIOTIZARU) DIYI:**
- EYO AZINI BANI ASI DROZU, ECAPI NYOKARU, KANIKU ASIOTIZA FEZU RA NI YO, PELU SAWA AYULE MI OZIZURI-I

- **ORODRI:-**
- MINGA ORODRI ESU EYO ONILERI OTIZU KOKOBI DRIA BO RI MA VUTIA, ENGAZU BA EYO ONIPI DIYI VU, AZINI AMUTI EYO NDE MA ALE NYAPI DIYI NI AZI DEZU BORI MA VUTIA.
- BA EYO ECEPI DIYI NGA OMVITA ESU EYO ONILERI MA DRIA, KANIKU, EYO EFIPI ODIRU, BANI ONILE BORI MA VUTIARI MA DRIA.

- **EYO TAMBAZU NDROZARU:-**
- BA ECONI MI RU ECEZU BA AZINI DRI ALUANI KU.
- EYO DRIA 'BANI ONILE DIYI, BA ONDUORU EYO NDE ONIPI DIYI NGA ESU NI.
- ONDUA O'DIRU BANI AYULE EYO TAMBAZU DIYI BANGA AYU-I DIKA EYO SIZA KOKOBI DRIARI BANGA TINI ECI KOPOLOSI FUNGUA BE.
- EYO ONILERI NGA OVU NDROZARU BA AMBU, AMUTI EYO ONIPIRI MA DRILERU RI DRI ADULE.

- **EYO PEZA BA ALU-ALU NIRI.**
- MI ECONI EYO OMVIZU OKPO-ALIA KU, EKA LE KURIA. AFA AZINI MINI AVI-RA NI YO, EKA TRO OMVI KU RA TI.

- **AJE:-**
- AJE AZINI MINI OFE EYO OMVIZU NIYO.

POS:-
EFE ODUKO POS BAR BLUE SABON MA DRIA MA HENNA-MARI KOSKELA.

- **ZITA:-**
- ZITA KA OVU MI BE CI, EYO ONILERI MA DRIA, KANIKU MIMA DRIWALA EYO ECEZURI MA DRIA, MI ECO WOOR SYLIVIA NI OMVE SIMU NAMBA +256787762471, KANIKU E-MAIL: sylviawoor@gmail.com

GULU UNIVERSITY
INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE
30 SEP 2023

- **EYO ECEZA, MINI MI NGULUPI FEZU CENI:-**
- ERI MI-I, MI NGULUPI FEZU CENI, AMUTI EYO ONIPIRI DRI, MI ECO VINI FIZU EKILE MINI EGALERILE.
- MIMA DRIWALA CI FUZU RA, SAWA MINI PELERIA, PANGA AZINI KOKORU.
- EYO AZINI KA IBI MIMA DRIWALA BE, EYO ONILERI MA DRIA, EFE ODUKO KOME-EI, GULU UNIVERSITY RESEARCH ETHICS COMMITTEE, DR. JERALD OBAI, SIMU NAMBA 0772305621, KANIKU E-MAIL: lekobai@yahoo.com / lekobai@gmail.com KANIKU, UGANDA NATIONAL

COUNCIL FOR SCIENCE AND TECHNOLOGY, PLOT 6 KIMERA ROAD NTINDA KAMPALA, TEL NAMABA 0414705500.

- **EYO NDE MA DRIARI AIZURI:-**

- 'BA EYO ONIPI DIYI ECE MA DRI EYO DRIA BANI LELE MAMA 'YE DI YIRA, EYO KUMURU, ORODRI ALENIA, AZINI DRIWALA EYO OMVIZU DIYI PIE.
- MA ONI KILILIRU EYO PEZA MANI FIZU EYO OMVIZURI NGANI MA EZA GERI AZINISI KU.
- 'BANI EYO MANI OMVILERI AYURIA, RU MANIRI NGANI FU AMVE ALUANI KU.
- MA ONI KILILIRU KINI DRITIZA MA ECO FUZU RA, SAWA DRIA MANI LELERIA.
- DRIWALA MANI OVUPI AZITA PALARI OJANI I KU, ECEZU KINI AZI BANI MA AYUZURI MANI MA NGULUPI FEZU CENI RI-I.
- KOKOBI DRITIZURI BANGA FE MA DRI INDI.

RU MANI..... DRITIZA.....

MBA O'DU .....SIMU NAMBA.....

DISTRICT .....SUB-COUNTY.....

PARISH (MKUNGU)..... VILLAGE (ENYATI).....



Appendix 5: Research Work Plan

	2021					2022											
Months / Activity	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
Proposal writing and Defense																	
Site selection, laboratory selection and designing the study sampling units																	
Application to Gulu University Research Ethical Committee (GUREC)																	
Purchasing of the research materials, equipment, and stationeries.																	
Identifying Research Assistance																	
Data collection and laboratory analysis																	
Data analysis																	
Thesis writing and progress report																	
Letter of intention to submit dissertation																	

Appendix 6: Research Budget

Activity	**Daily Rate (UGX)**	**Quantity**	**No. of Days**	**Total Cost (UGX)**
PILOT STUDY AND QUESTIONNAIRE TESTING				
Transportation (car hire)	200,000	1	1	200,000
Fuel	270,000	1	1	270,000
Training (Enumerators)	15 0,000		1	150,000
Enumerator's facilitation during testing and Piloting	50,000	3 people	1	150,000
Communication (Airtime)	10,000	1	1	10,000
Translation of Questionnaire and Informed Consent	100,000	2 (Lugbra and Langi)		200,000
Printing questionnaires	100	12pages	20questionaires	24,000
Masks	50,000	1 packet		50,000
sanitizer	50,000	1 bottle		50,000
Stationary (Pens, notebooks, clipboard, and clear bags)	50,000			50,000
SUBTOTAL				**1,154,000**
FIELDWORK, DATA COLLECTION AND SAMPLE COLLECTION				
Enumerators' facilitation	50,000	3 people	12	1,800,000
Travel cost (Hired car)	200,000	1	12	2,400,000
Fuel (ten full tanks for the entire period)	270,000	10 full tanks	12	2,700,000
Accommodation while in the Arua and Lira	50,000	1 person	12	600,000
Printing Questionnaires and consent forms	100	12 pages	250copies	300,000
Communication (airtime)	10,000	1	12	100,000
Purchase of mobile data for the choice experiment online survey	20,000	5 tablets	12	100,000
Purchase of honey samples	15,000 @1/2litre	40 samples		600,000
Purchase of packing containers	2,000	40 containers		80,000
Purchase of cold box for carrying honey samples	100,000	1		100,000
mask	50,000	2 packets		100,000
Sanitizer	50,000	2 bottles		100,000
Stationary (Pens, notebooks, clipboard, and clear bags)	100000	(Pens, notebooks, clipboard, and		100,000

		clear bags)		
SUB-TOTAL				**9,080,000**
LABORATORY ANALYSIS OF THE SAMPLES				
Purchase of reagents				
Lab assistance	400,000			400,000
Heavy duty acid proof gloves	15,000	3 packs		45,000
Phenolphthalein indicators	50,000	50g	3	150,000
Sodium hydroxide pellet	50,000@	500g	3	150,000
Hydrochloric acid	55,000	2.5 litres		110,000
Potassium ferrocyanide	25,000	100g	2	50,000
Zinc acetate	100,000	500g	1	100,000
Sodium bisulfite	50,000	500g	2	100,000
Ethanol	200,000	2.5 litres		200,000
Iodine	200,000	500g		200,000
Potassium iodine	200,000	500g		200,000
Sodium chloride	200,000	500g		200,000
Anhydrous starch.	100,000	500g		100,000
Buffer solution	200,000	500ml		200,000
Filter papers (47mm membrane filter. 0.45mm)	210,000	1 packet		210,000
Petri dishes	600 each	500 pieces		300,000
Transport of reagents				150,000
Testing for diastase activity and HMF (light absorbance using spectrometer) Running sample in kampala	500,0000	2 tests		500,000
miscellaneous	500,000			500,000
Subtotal				**3,365,000**
GRAND TOTAL				**14,099,000**

Appendix 7: Questionnaire for survey data collection

A questionnaire on the quality requirements and perception of honey along the value chain

Dear respondent,

I am **Sylivia Woor,** a student of MSc in Animal Production and Marketing at Gulu University. I am carrying out research on the determination of the perception of honey along the value chain. You have been selected purposively to participate in this study because you are one of the consumers of honey that the study targets. This interview will last for about 20 minutes. This research is exclusively for academic purposes and is being conducted as a requirement for the completion of my studies. I appreciate your kind cooperation in completing this questionnaire in advance.

Thank you. Date….……..

Questionnaire code…… District……

Subcounty…… Parish ……

INSTRUCTIONS: TICK OR FILL WHERE NECESSARY

Section A: Honey Consumption Patterns

S/No	Questions	Responses
1	Do you or your household consume honey?	a) = Yes b) = No
2	If yes (in 1) above, what is your frequency of honey consumption?	a) Daily b) Weekly c) Fortnight d) Monthly e) Twice a year f) Once a year
3	In what quantities do you normally buy honey?	a) 250g b) 500g c) 1kg d) 1.5kg e) 2 kg f) 3kg g) 4kg h) 5kg
4	What could be your motivation to consume honey? **(Multiple response)**	a) For medicinal value b) Nutritional benefits c) Keep a healthy Lifestyle d) Religious and customary reasons e) Habit f) Sugar Substitute g) Food Additive h) Cosmetic Additive i) I don't know j) others(specify)…… ……..
5	How do you normally consume honey? **(Multiple response)**	a) =Spread b) =Sweetener c)=Baking d) =Medical

S/No	Questions	Responses
		e) =Preservative f) Others(specify)…….. ……

Section B: Honey purchasing habits

S/No	Questions	Responses
6	How often do you purchase honey?	a) Daily b) Weekly c) Fortnight d) Monthly e) Twice a year f) Once a year
7	Where do you prefer to buy your honey from? **(Multiple response)**	a) Farmers b) Processors c) Supermarkets d) General merchandise shops e) Market stalls f) Roadside vendors g) Own hive h) Others specify……... ……..
8	What quantity of honey do you always purchase?	a) 250g b) 500g c) 1kg d) 1.5Kg e) 2 kg f) 3kg g) 4kg h) 5kg
9	What color of honey do you prefer to buy?	a) Colorless/white b) Yellow c) Light brown d) Dark brown (amber)
10	Do you normally check for impurities in the honey you buy?	(a) =Yes b) = No
11	If yes, in 10 above, what kind of impurities do you often look for? **(Multiple response)**	a) Insect parts b) Insect larvae c) Ash/smoke particles d) Grass particles e) Soil/sand particles f) Mammalian hair g) Microbial contaminants h) others specify……... ……
12	How often do you read labels when purchasing honey?	(a)=Never (b)=Rarely (c) =Often
13	If yes, in (12 above), what information do you look for in the labels? **(Multiple response)**	a) UNBS Certification b) Brand name c) Nutritional information d) Expiry date e) Storage information f) Place of origin g) manufacturing date h) others specify……. ……...

Section C: Honey Purchase Decisions

In this section, we would like to have an understanding of your scores on some product-related factors that you would consider when making decision as important indicators of honey quality during purchase.

14. Please indicate the level of importance of the following factors during honey purchase. Whereby 1= not at all important and 5=very important.

No.	Factor	1= Not at all important	2=Not important	3=Not sure	4=Important	5=Very important
1.	Color					
2	Viscosity					
3	Purity					
4	Labeling					
5	Packaging					
6	Brand name					
7	UNBS Certification					
8	Price					
9	Origin					

Section D: Quality perceptions

Using a 5-point Likert scale of agreement whereby 1 = strongly disagree and 5 = strongly agree, please indicate your thinking of the following statements about the quality of honey you buy?

S/NO	Statements	Responses				
		1=Strongly disagree	2=Disagree	3=Not sure	4=Agree	5=Strongly agree
	Color					
15	I consider color when buying honey					
16	I believe dark colored honey is fresh					
17	I prefer dark colored honey to light colored honey					
18	I believe dark colored honey has a higher nutritional value					
19	I think dark colored honey is not healthy®					

	Viscosity					
20	I prefer to buy thick honey					
21	I believe thick honey is fresh					
22	I believe honey does not crystallize with increased length of storage®					
23	I believe thick honey is of better quality than light honey					
24	I believe that the thickness of honey is influenced by temperature					
25	I think crystallized honey is of poor quality ®.					
26	I believe honey thickness is influenced by the change in weather					
27	I consider crystallized honey impure due to the addition of sugars or adulterants®					
	Packaging					
28	When purchasing honey, I consider product packaging to be highly important					
29	I believe packaged honey is not safe for consumption®					
30	I believe packaged honey is free from contaminants					
31	I believe packaged honey is of lower quality®					
32	Packaged honey has a better appearance					
33	Packaged honey is tastier					
34	Packaged honey is not convenient to use®					
35	I find it easier to handle packaged honey					
36	I find it difficult to transport packaged honey®					
37	I believe packaged honey is easier to store					
	Labeling					
38	When buying honey, I always read the information on the labels					
39	I believe labeled honey is not of good quality®					

40	Proper labeling of honey is critical in ensuring food safety					
41	I find it easier to use labeled honey					
42	I think labeled honey is not safe for consumption®					
43	I read labels to be able to differentiate between the different honey brands					
44	I think labeled honey does not contain all the ingredients and additives added to the honey®					
45	I think honey labels contain all the information that describes good quality honey					
46	I think labels do not contain enough information about the honey product®					
	Price					
47	When I am buying honey, its quality is more important to me than the price®					
48	I think the current market price of honey is generally fair					
49	I think the current market price of honey is too high ®					
50	I am satisfied with the current market price of honey					
51	I do not think that price is a good indicator of good quality honey®					
	Origin					
52	I believe local honey is better than imported honey					
53	When buying honey, the country of origin is very important to me					
54	I am satisfied with the honey sold in our local market					
55	I do not believe our local honey is good for consumption®					

56	When buying honey, it is important that I buy honey of local origin					
57	I think good quality honey should have its area of origin indicated					
58	I personally always prefer to know the origin of the honey I buy					
59	I always choose honey depending on the region (country) of origin					
60	I think indicating the country of origin of honey is not necessary®					
61	I don't believe in the quality of imported honey in the market®					
62	I always consume imported honey®.					
63	The honey I find in the local market is impure®					

Section E: Socio-economic characteristics

S/No	Question	Response
64	Gender	(a)= Male (b)=Female
65	Marital status	a) Single b) Married c) Divorced d) Widowed
66	Level of education	a) Primary b) Secondary c) Tertiary d) None
67	Household size (# of people)	……..
68	Age of the respondent (years)	…….
69	Employment status	a) civil servant b) private employee c) self-Business d) casual laborer e) student f) not employed g) others(specify)…… …….
70	Monthly income	…….

Appendix 8: Questionnaire for honey sample collection

Dear respondent,

I am **Sylivia Woor** a student at Gulu University, Faculty of Agriculture and Environment carrying out research on determination of honey quality in Northern Uganda. You have been selected purposively to participate in this study because you are one of the value chain actors along the honey value chain that the study targets. This research is exclusively for academic purposes and being conducted as a requirement for the completion of my studies. It is not for enforcing the quality control and in case of detection of poor-quality honey, you will only be advised on how to produce and maintain quality honey for human health safety and economic benefits. I appreciate your kind cooperation in completing this questionnaire in advance.

Thank you.

Date……

Name……...Signature of participant……

Contact…….. District……
Sub country……...
Parish…… Village…….

Sample specific information

1	Value chain position	Producer/Bee keeping Honey retailing (supermarket, retail shop, roadside) Processing
2	Sample Code	
3	GPS location	
4	Type of hive	Traditional Kenyan top bar Langstroth
5	Individual/group	
6	Type of vegetation	
7	Storage house	Grass thatched houses Iron sheet houses
8	Storage containers	Jerricans Buckets Containers Bottles Recycled bottles
9	Source of honey	Own hive Beekeepers Middlemen Processors others specify……...
10	Date/month of Harvest	
11	Honey harvesting techniques	Fire Smokers Touches Others specify…….
12	Honey processing technique (only processers)	Boiling Sun heating Pressing Straining Do not process
13	Processing equipment	Honey Centrifuge Extractor Press & straining cloth others specify…….……
14	Date of processing	
15	Date of purchase (only retailer	

Appendix 9: Measures for the Prevention and control of risk of spread of COVID-19

Study Title: Determinants of quality and quantity requirements of honey along the value chain in Arua and Lira districts in Uganda.

Principal Investigator (s): Woor Sylivia

Introduction:

The novel Coronavirus is transmitted from human to human through droplets and direct or close personal contact with an infected individual.

Novel Coronavirus signs of infection include respiratory symptoms, fever, cough, shortness of breath and breathing difficulties. In more severe cases, the infection can cause pneumonia, severe acute respiratory syndrome, kidney failure and even death.

Implementation of the prevention and control measures

In the implementation of the research activities, I the investigator and my research team are committed to ensuring the safety of its research team, research participants and communities where the study will be conducted. The study team undertakes to comply with the Standard Operating Procedures issued by the Ministry of Health, and presidential directives to mitigate against the risk of infection of COVID-19, rapidly detect and effectively respond to any COVID-19 case that may occur in the process of carrying out the study, screening, face covering, physical distancing, and good hand hygiene.

Procedures to be followed during the implementation of the research

Prior to data collection and Training

1. **Health guidance:** There will be training sessions dedicated for COVID-19 sensitization and awareness, to equip the research team with knowledge of signs and symptoms of the COVID-19, and preventive measures such as hand hygiene before placing and removing the mask, as well as storage of the mask, social distancing. The research team will circulate notices, posters, charts on common signs and symptoms of COVID-19 as provided by the Ministry of Health and develop and/or use existing plan for the appropriate referral pathway for identified and/or suspected cases.
2. **Personal Screening:** All researchers, research assistants, research participants and any other individuals engaged in research activities will screen temperature daily for fever. Screening for temperature will be carried out during planning meetings, trainings, community outreach. Any individual found with COVID 19 symptoms will be withdrawn and referred to the COVID – 19 task force for further assessment and management. The withdrawn individual will be allowed to return only if they present a valid certification of their COVID-19 status showing negative result.
3. **Wearing face coverings:** All researchers and research assistants and any other individuals engaged in research activities that require interaction with fellow researchers or research participants or the community members will have to wear a face masks that fully covers the mouth and nose at all times. The study will provide face masks for individuals who do not have.

4. **Physical Distancing:** There will be social distancing during the training, meetings, community outreach of at minimum of 2 metres. During breaks, the team will not be allowed to congregate in common areas.
5. **Good hygiene:** All team members will be required to wash their hands with soap and water or use hand sanitizers before and after entering the training room/ interacting with the participants, and other common areas. Hand washing equipment shall be supplied and made available at all times. All surfaces and equipment used shall be sanitized frequently.

During data collection

1. **Personal Protective Equipment (PPE):** All research assistants involved in tracing of respondents and in in-person interviews and research participants will use PPE including a properly fitted face mask. Enumerators/Researchers and research participants will wash their hands with soap and water or use hand sanitizer prior to the interview. Handshakes and hugging are prohibited. Physical distancing of at least 2 metres in all research related activities shall be observed.
2. **Focus group discussions:** The research team shall carry educational materials on prevention of COVID-19 in a language understood by the participants. These materials shall also have visual images to support understanding. Enumerators/Researchers and research participants will wash hands with soap and water or use hand sanitizer prior to the interview. Screening for temperature will be carried out prior to conducting meetings
3. **Consent Process:** The Researcher /Research assistants will observe social distancing when taking consent (while 2 metres apart) upon arrival to the participant. Enumerators/Researchers and research participants will wash hands with soap and water

or use hand sanitizer prior to the interview. Participant will then be sensitized on covid-19 and presented with preventive measures.

4. **Equipment sanitization:** shared devices used to record or capture data shall be sanitized regularly before and after use.

During Dissemination/Community engagement

1. **Community Engagement:** The research team shall carry educational materials on prevention of COVID-19 in a language understood by the participants. These materials shall also have visual images to support understanding. Enumerators/Researchers and research participants will wash hands with soap and water or use hand sanitizer prior to the interview. Screening for temperature will be carried out prior to conducting community engagements.
5. **Equipment sanitization:** shared devices used during community engagements to shall be sanitized regularly.

The preventive and control measures will continuously be reviewed based on new information and guidelines communicated by the Ministry of Health

Appendix 10: ANOVA results for Honey Quality from three Agro-ecologies [1]

PROPERTIES		Sum of squares	df	Mean sum	F-Value	sig
% Moisture content	Between groups	158.312	2	79.156	19.603	.000
	Within groups	553.196	137	4.038		
	Total	711.508	139			
Total solids	Between groups	158.312	2	79.156	19.603	.000
	Within groups	553.196	137	4.038		
	Total	711.508	139			
pH	Between groups	10.751	2	5.375	99.498	.000
	Within groups	7.401	137	.054		
	Total	18.152	139			
Free acidity	Between groups	5824.505	2	2912.252	30.710	.000
	Within groups	12991.917	137	94.832		
	Total	18816.421	139			
HMF	Between groups	4619.372	2	2309.686	13.871	.000
	Within groups	14486.998	87	166.517		
	Total	19106.370	89			
Diastase Number	Between groups	48.026	2	24.013	1.776	.177
	Within groups	905.643	67	13.517		
	Total	953.669	69			
Brix	Between groups	6.975	2	3.487	3.279	.044
	Within groups	71.248	67	1.063		
	Total	78.223	69			

HMF = Hydroxymethylfurfural; df = Degree of freedom; sig = p-Value

[1] Amudat, Lira and Gulu

Appendix 11: ANOVA results for honey quality obtained from three value chain nodes[2]

PROPERTIES		Sum of squares	df	Mean sum	F-Value	sig
% Moisture content	Between groups	56.580	2	28.290	5.918	.003
	Within groups	654.928	137	4.780		
	Total	711.508	139			
Total solids	Between groups	56.580	2	28.290	5.918	.003
	Within groups	654.928	137	4.780		
	Total	711.508	139			
pH	Between groups	.044	2	.022	.166	.847
	Within groups	18.108	137	.132		
	Total	18.152	139			
Free acidity	Between groups	998.605	2	499.302	3.839	.024
	Within groups	17817.817	137	130.057		
	Total	18816.421	139			
HMF	Between groups	7683.199	2	3841.599	29.258	.000
	Within groups	11423.171	87	131.301		
	Total	19106.370	89			
Diastase number	Between groups	73.541	2	36.771	2.799	.068
	Within groups	880.128	67	13.136		
	Total	953.669	69			
Brix	Between groups	3.669	2	1.835	1.649	.200
	Within groups	74.554	67	1.113		
	Total	78.223	69			

HMF = Hydroxymethylfurfural; df = Degree of freedom; sig = p-Value

Appendix 12: Model fit summary for consumer perception results

$\chi 2$		265.877
df		182
$\chi 2$/df	≤ 3.0	1.461
RMSEA	≤ 0.08	0.050
GFI	≥ 0.90	0.880
AGFI	$\geq 0.90/0.8$	0.848
CFI	≥ 0.90	0.924
IFI	≥ 0.90	0.926
TLI	≥ 0.90	0.912

[2] Farmers, processors, and retailers

Appendix 13: Model fit summary for consumer perception results

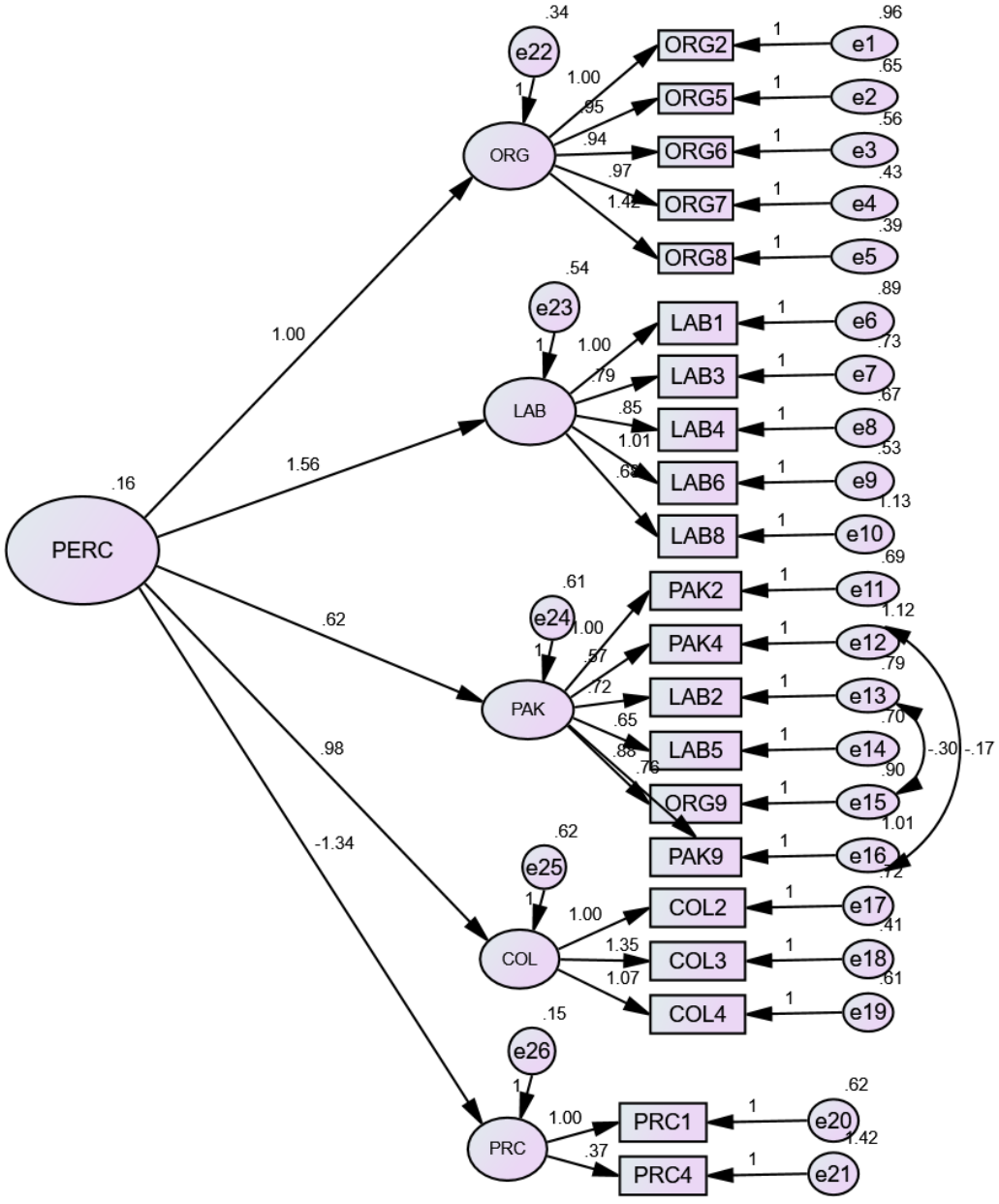


Figure 4: Structural equation model explaining the perceived quality of honey consumers

*Key: PERC = Perception, ORG=Origin, LAB = Labelling, PAK = Packaging, COL = Colour, and PRC = Price. *** significant at 0.01, ** significant at 0.05 and * significant at 0.1*