CONSUMERS' PERCEPTIONS AND WILLINGNESS TO PAY FOR HONEY QUALITY ATTRIBUTES IN NYANDARUA COUNTY, KENYA

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DECLARATION

This thesis is my original work and has not been submitted for award of a degree in any other University.

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DEDICATION

To my mum Sarafina Nungari and siblings John Mwangi, Carol Wambui, Burton Macharia and Phyllis Wanjiru. Special dedication to uncle Robert Mbuthia and my grandmother Martha Wanjiku Macharia.

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TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS AND ABBREVIATIONS

ASTGS : Agricultural Sector Transformation and Growth Strategy

CE : Choice Experiment

CIDP : County Integrated Development Plan

EAS : East African Standards

FAO : Food and Agriculture Organization of the United Nations

FGD : Focus Group Discussion

IIA : Independent from Irrelevant Alternatives

KEBS : Kenya Bureau of Standards

KII : Key Informant Interview

KALRO : Kenya Agricultural and Livestock Research Organization

KNBS : Kenya National Bureau of Statistics

KHC : Kenya Honey Council

PCA : Principal Component Analysis

MNL : Multinomial Logit

MWTP : Marginal Willingness to Pay

NMK : National Museums of Kenya

OLS : Ordinary Least Squares

RP : Revealed Preference

RPL : Random Parameter Logit

RUT : Random Utility Theory

SP : Stated Preference

SDG : Sustainable Development Goal

SSA : Sub-Saharan Africa

TPB : Theory of Planned Behavior

WTP : Willingness to Pay

ABSTRACT

Low honey quality is among the major challenges facing the honey sector and consumers are keen on quality attributes of honey when purchasing the commodity. Despite the interventions of planting bee flora to ensure honey quality, limited empirical information exists on consumers' perceptions and willingness to pay for honey quality attributes. The current study assessed consumers' perceptions and willingness to pay for honey quality attributes in Nyandarua County, Kenya. Primary data was collected from a cross-sectional survey through a multi-stage sampling procedure from 252 honey consumers. To assess consumer's perceptions for honey quality attributes, the study employed a principal component analysis (PCA) to generate perception indices that were used in multiple linear regression. A quantitative experimental research design; choice experiment (CE) based on a D-optimal design was used. The choice experiment data was analyzed using random parameter logit (RPL) model to evaluate consumers' willingness to pay for honey quality attributes. The PCA identified origin, bee flora, color and viscosity as key attributes that would inform consumers' purchase decisions. Gender, education, income, bee flora source awareness, place of purchase and prior information significantly influenced consumers' perceptions of honey quality attributes while price had a negative influence. Results from the RPL model revealed that consumers had a positive preference for bee flora source, origin labelling, joint certification, viscosity and colour of honey. Preference heterogeneity across various attributes was observed. Consumers were willing to pay the highest premium prices between Ksh 58 and Ksh 109 for bee flora source, origin labelling, joint certification, viscosity and colour of honey. These findings are important in informing improvement of honey quality in Kenya and the rest of the world. Interventions by county governments in Kenya should be geared towards supporting the establishment of bee flora in order to ensure honey quality and build consumer confidence. County

government should ensure honey sold is labelled with its origin as origin attribute was perceived to be important to consumers.

CHAPTER ONE: INTRODUCTION

1.1 Background Information

Apiculture is a part of livestock sector and it plays a key role in enhancing economic growth, food security, biodiversity conservation and community livelihoods. This is because it serves as a foreign exchange earner for many countries (Buba, 2013) and source of employment as well as generating and diversifying the income of subsistence small holder farmers mainly the landless (Getachew *et al.,*2014). Bees pollinate crops and natural vegetation thus enhancing food production and plant regeneration (Oladimeji, 2014; Martins, 2014). Therefore , sufficient food and achievement of global Sustainable Development Goals (SDGs) can be realized with proper management of natural resources particularly bee flora and water resources which are important for bee sustainability (Oladimeji and Abdulsalam, 2014).

Honey is one of the most beneficial products from apiculture, due to its medicinal, nutritional and industrial use. It is also an important product in the international market where it is a foreign exchange earner for many countries (Buba, 2013; Agboola *et al*., 2021). Honey consumption, provides significant amount of energy, it can also be used as a remedy for cough and sore throat (Pasupuleti *et al.,* 2017). In addition, honey has been used to increase body immunity especially during the Covid 19 pandemic era where the honey business survived and even increased its market ,hence it has the potential to be a good source of income (Indriani *et al.*, 2022).

Global honey consumption has increased over the years due to increase in the world population and preference towards natural foods by an increasing number of consumers (García, 2018). The net global honey demand has increased at a rate of 19,504 tons per year since 2010 (FAOSTAT,

2018). Therefore, with the world growing population and the increase in demand for healthy and natural products, many countries are not able to meet their increasing demand for honey with local production and need to import increasing volumes of honey from exporting countries.

In Sub-Saharan Africa (SSA), demand for sustainable high quality products is increasing and African beekeepers are motivated to embrace practices that are better adapted to climate change (Kelelew *et al.,* 2019). Honey production in SSA is only 9.8 percent of world's honey and the exports are less than the imports. In addition, the household honey consumption is estimated at 38.31 percent per annum (FAO, 2015). Ethiopia is the largest honey producer due to diverse sources of bee forage and the household honey consumption is estimated at 10 kg per annum (Miklyaev *et al.,* 2014). Most honey is produced using traditional beehives which produces less than 10 kg of honey per hive per year (Kelelew *et al*., 2019) . Honey is, therefore, a product with unmet demand in Sub-Saharan Africa and the wider global market.

In Kenya, beekeeping is practiced in Arid and Semi-arid areas (ASALS) and traditional hives (log hives) dominate most of the beekeeping areas. There are 1,440,640 estimated beehives in Kenya, of which the majority are traditional fixed comb, and mostly hollow log hives. However, a few modern hives (Kenya Top Bar hives, Box hives and Langstroth) are found in some apiaries. The use of modern hives has improved honey production and handling as opposed to traditional hives(Carroll & Kinsella, 2013). While there are no official estimates for the number of beekeepers in Kenya, arguably there are around 144,000, mostly small-scale beekeepers based on an average of ten hives per beekeeper. This equates with just three percent of the farm households in Kenya (Carroll & Kinsella, 2013). Being a rural enterprise, beekeeping contributes significantly to

improved livelihoods of most rural communities in Kenya (Belay *et al.,* 2015). In addition, the honey industry provides employment to urban residents in pharmaceutical, herbal, brewing and supplying of packaging materials. In Kenya, honey produced is sold locally supplemented by imports from Australia in order to meet the increasing local demand (Juma *et al.,* 2016). Beekeepers usually sell honey through different channels. The longest channel involves local traders through the middlemen to honey processing firms and then to retail outlets mainly in urban areas (Juma *et al.,* 2016). Therefore, it contributes to household income, employment creation, food security, access to markets and environmental conservation. However, this sector faces several challenges such as low capacity building, low honey quality, technology adoption and honey adulteration. Moreover, honey production has declined in Kenya due to declining bee colonies as a result of climate change (Republic of Kenya, 2013).

The national honey consumption level in Kenya, is about 38,000 metric tonnes but the country is only able to produce 20,000 metric tonnes and about 18,000 metric tonnes of honey is imported to bridge the gap of the standard annual national consumption level (KNBS, 2019). This is attributed to the Kenya's unrealized potential. The production potential for honey in Kenya is estimated at 100,000 metric tonnes per year and only 20 percent of this has been tapped with most of the production coming from arid and semi-arid areas (Republic of Kenya, 2013). In addition, Kenya has been exporting honey to the European Union market until the year 2006 when it was unable to meet the export requirements of quality standard. Since December 2014, Kenya Honey Council (KHC) has been attempting to put up quality standard measures, as specified in the East African Standard (EAS) , as well as in the Codex Alimentarius standards for honey and in the European

Union directive for honey, so as to see it listed again to exporting honey to the European Union market (Meutchieye *et al.,* 2016).

The challenges which are facing the honey sector in Kenya arises from the impact of climate change such as shortage of bee flora. In addition, continuous use of synthetic pesticides on floral sources such as flowering plants, has led to low quality honey which affects consumers' purchasing intentions. In response to these challenges, the National Museums of Kenya (NMK) together with Kenya Agricultural and Livestock Research Organization (KALRO), have supported beekeepers in Nyandarua County to establish climate smart bee flora which are organic in order to ensure that throughout the year not only have bee flora but can also determine what kind of flora one would want the bees to feed on hence determining the quality of the honey.

Establishing bee flora means planting specific flora which are within the reach of the beekeeper so that bees do not have to go far in search of nectar such as visiting the plants nectar which have been sprayed with insecticides. Bees can feed up to radius of 3km but if they have sufficient pasture nearby, they do not have to go far and by doing this, it affects the quality of the honey and one can actually dictate the quality of honey that will make it get a better market. Consumers are keen on honey characteristics when purchasing the commodity. These honey characteristics are aroma, taste and trust regarding the purity (Ismaiel *et al.,* 2014). They value quality honey which is a determinant of price and marketing. In addition, honey quality remains the most critical factor that influences consumers' purchasing intentions on honey related product. According to Belay *et al.* (2015) flora source influences the color and taste of the honey and consumers have heterogeneous

preferences for colour as well as taste. There are some consumers in Kenya who will pay a higher price for quality as shown by Australian imports (Mutisya ,2011).

Therefore, bee flora source is important since honey quality characteristics/ attributes are based on floral source hence planting bee flora will help in promoting quality honey as well as ensure health safety of the consumers and this will help to improve consumers' confidence. Honey quality attributes is a combination of attributes or characteristics of honey that have significance in determining the degree of acceptability of that honey to the consumer. Bee flora is also important since bees might collect pollen that might be toxic hence causing allergy to some consumers (Yeow *et al.,* 2013).

1.2 Statement of the research problem

Consumers value quality honey which is the main variable in price determination and marketing (Shahnawaz *et al.,*2013; Mesele, 2021). However, shortage of bee flora and continuous use of synthetic pesticides on floral sources such as flowering plants, has led to low quality honey which affects consumers' purchasing intentions (Mugo, 2015 ; Meutchieye *et al.,*2016; Wakgari and Yigezu, 2021). In the face of these challenges, various strategies including planting bee flora to ensure honey is produced organically have played a key role in improving honey quality. However, these strategies have rarely been evaluated from a consumer perspective even if consumers are the final customers of the value chain. Thus, limited empirical information exists on consumers' perceptions and WTP for honey quality attributes.

Previous studies on consumer perceptions (Brščić *et al.,* 2017; Blanc *et al.,* 2021) mainly focused on perception but did not consider contextual factors, while others only used descriptive statistics which cannot explain consumer perceptions in an integrated manner. Studies (Maina *et al.,* 2018 ;Okello *et al.,* 2021) that used an econometric model for perceptions , only focused on farmers perceptions and did not include price/cost as a key driver of perception. Further, there is limited evidence on consumer perceptions. Studies on WTP (Pambo *et al.,* 2017; Otieno and Nyikal, 2017; Ceschi *et al.,* 2018; Otieno and Oluoch, 2019; Otieno, 2020; Otieno and Ogutu, 2020; Ahmed *et al.,* 2020) have focused on other products attributes rather than honey. Further, the few existing studies on honey (Juma *et al.,* 2016; Vapa-Tankosić *et al.,* 2020) have majorly focused on geographical indication label and did not explicitly consider color and bee flora label attributes which are important quality cues. This is despite the fact that such information allows possible improvement in honey quality. The concept of bee flora label as a quality attribute is relatively new and has not been widely studied. Further, (Vapa-Tankosić *et al.,* 2020) only used descriptive statistics, which is not sufficient to model preferences since consumers have heterogenous preferences.

1.3 Purpose and objectives of the study

The purpose of this study was to examine consumers' perceptions and willingness to pay for honey quality attributes in Nyandarua County, Kenya. The specific objectives of this study were:

1. To assess factors influencing consumers' perceptions of honey quality attributes.
2. To evaluate consumers' willingness to pay for honey quality attributes.

1.4 Hypotheses

1. Socio-economic and market related factors do not influence consumers' perceptions of honey quality attributes.

2. Consumers' are not willing to pay for honey quality attributes.

1.5 Justification

Promoting honey quality is important in ensuring consumers' health and building consumer confidence. Providing information on honey quality attributes, which are mostly demanded by various consumers, will be used to strengthen the economic position of honey producers and other agencies in the value chain. This will Contribute to Agricultural Sector Transformation and Growth Strategy (ASTGS) anchor 1 on increasing small holders' income, SDG 1 on ending poverty and SDG 2 on zero hunger. Identifying the reasons behind the various decisions made which is basic to meeting consumers' satisfaction will help in realization of SDG 12 on sustainable consumption as well as contributes to Strategic Objective No. 6 of the Codex Alimentarius standards to protect consumer's health.

The National Beekeeping Policy in Kenya endeavors to promote honey quality in order to build consumer confidence. The findings established here from consumer preference and willingness to pay for various quality attributes provide avenues through which such a policy mandate can be achieved. It is also useful in identifying the reasons behind the various decisions made which is basic to meeting consumers' satisfaction. The findings will provide a basis to develop production and marketing positioning strategies as well as develop policies which are related to honey quality.

At the County level, the study informs the critical review of the Nyandarua County integrated development plan (CIDP) 2023-2027 sector priorities and strategies on enhancing quality and safety of food products in collaboration with the Kenya Bureau of Standards (KEBS) which regulates honey quality. The study is timely as the County government in the study area seek to develop and implement strategies towards improving the honey sub-sector thus enhancing economic growth in the County.

This study will inform stakeholders such as producers and marketer to develop marketing plans and strategies in order to increase supply for quality honey and reduce competition for honey imports. Further, it will also help actors in the honey value chain in making an appropriate pricing and promotional plans and strategies for honey and give insights on interventions needed to promote quality honey. This study will inform actors such as traders and marketers on capacity building thus ensuring quality honey. The results will identify various preference for honey among consumers which will provide insights that are important for sustainable honey consumption. This study thus, contributes to the growing literature on WTP for honey quality attributes by offering insights on rural consumer preference for bee flora label and other honey quality attributes.

1.6 Organization of the study

This thesis is organized in a paper format and has six chapters outlined as follows. Chapter one provides background information, statement of the research problem, objectives and study hypotheses, rationale for the study and the organization of the thesis. Chapter two provides a review of relevant literature in perceptions and willingness to pay, application of theories underpinning the objectives of the study and the various analytical approaches used. Chapter three provides materials and methods used to achieve first and second objective. Chapter four provides insights into the achievement of the first objective. The second paper outlined in the succeeding chapter five is based on the second objective. Finally, a general discussion, conclusions, recommendations for policy and recommendations for further research are presented in chapter six.

CHAPTER TWO: LITERATURE REVIEW

2.1 Theoretical Background

2.1.1 Assessing consumer perceptions

The Theory of Planned Behavior (TPB is the most popular theory which has been used to describe individual's perceptions (Maina *et al.,*2018; Okello *et al.,*2021).The TPB postulates that individual's intentions to perform a behavior is informed by their attitudes towards a behaviour, subjective norms and perceived behavioral control (Ajzen, 1991). Consumers attitudes and behavior towards quality attributes of honey determines whether they will be willing to pay for the honey or not. Attitudes and perceptions are used interchangeably because of the similarity in the measurement techniques used when evaluating these two techniques.

Behavioral intention is a result of attitude towards a behaviour which is an outcome of subjective norms and behavioral control (Kalafatis *et al.,*1999). Perceived behavioral control refers to people's perception on the ease or difficulty of performing a certain behavior (Ajzen, 1991).This means that consumers perceive how their satisfaction will be met depending on the quality of honey. Subjective norm is the decision to take or reject a good and it is based on normative beliefs of people who are highly regarded by the respondent and their opinions on whether to do the action (Ajzen, 1991 ; Kalafatis *et al.,*1999). Subjective and perceived behavior are influenced by; beliefs which are concerned with presence or absence of opportunities and resource, referent beliefs which regards to the communication of the issue of reference with people who are close to the individual (Mathieson, 1991; Ajzen, 1991).

The framework in Figure 2.1 shows that the subjective norms, attitudes and perceived behavioral control inform the intention and the decision to purchase honey (the behavior).
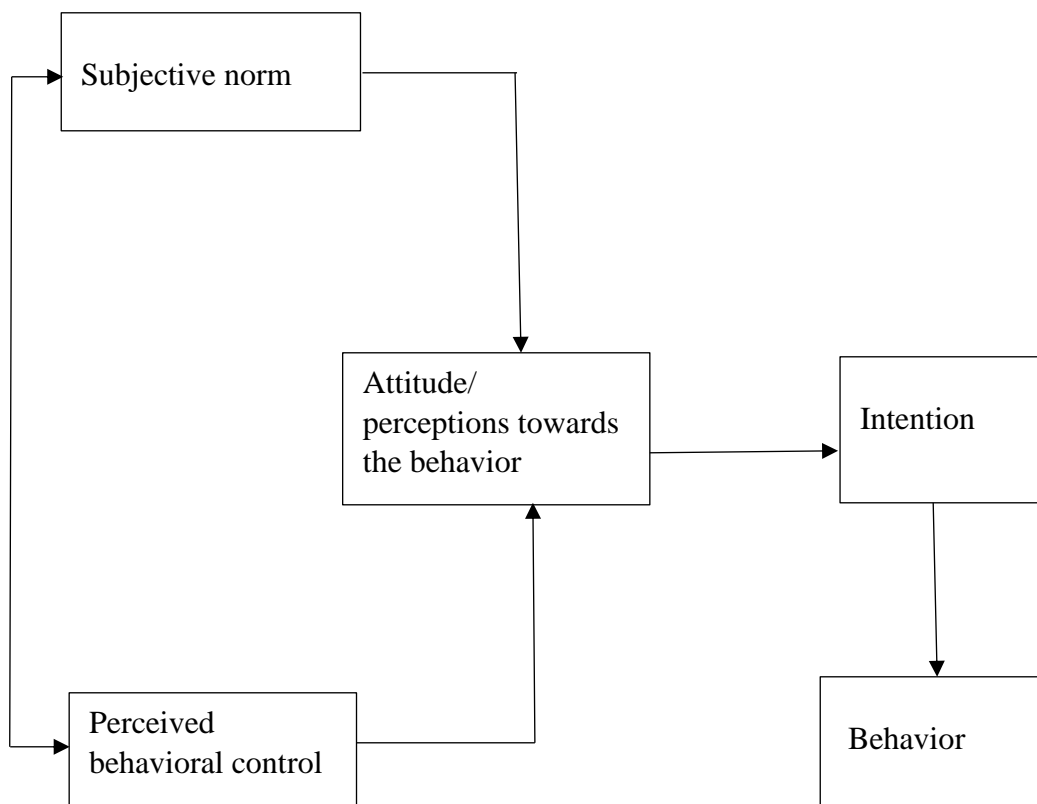
Figure 2.1: Theory of planned behavior (Ajzen, 1991)

This theory has been applied in different contexts to understand producers' perception of geographical indications for agri-food products in semi-arid regions (Maina *et al.,* 2018) and farmers' perceptions of insect based feeds (Okello *et al.,* 2021). This study considers TPB to be the most appropriate theory as it pursues the role played by perceptions in determining consumers' intention to use and purchase honey.

2.1.2 Assessing consumer preference and willingness to pay

Assessment of consumer preference and WTP is anchored on Lancaster Consumer theory (Lancaster, 1966) which is consistent with Random Utility Theory (RUT) . Lancaster consumer theory postulates that ,consumer utility is derived from the attributes of honey rather than honey itself (McFadden and Zarembka, 1974; Louviere *et al.,* 2000). From the literature, consumer utility is not derived from the good but from the attributes that the good have either used as a single attribute or in combination to produce the desired utility. Therefore, different consumers can derive different levels of utility from the same good.

Random utility theory postulates that, since consumers are rational, they chose the choice alternative that maximized their utility (McFadden, 1973). This theory also assumes that, while the consumer knows his preferences with certainty and does not consider them stochastic, the analyst is not able to observe all the components and hence treats the unobserved as random (Hanley *et al.*, 2002). For example; since utility is unobserved, consumers choose what they prefer and what they do not is influenced by random factors. This means that consumers have both observable and unobservable characteristics which influences their choice of utility maximizing alternatives (Louviere *et al.,* 2000). The observable characteristics are the honey attributes that a consumer can visibly identify and assess to make a purchasing decision and the unobservable characteristics include factors such as motivation and ability and are captured by the stochastic error term. This means that, it is impossible to predict with certainty the alternative that the consumer will choose. However, it is possible to express the probability that the perceived value related with a specific choice is greater than other available choice alternatives (Luce, 1959).

2.2 Review of related empirical literature

2.2.1 Empirical literature on perceptions from past studies

The majority of perception studies have used descriptive and exploratory factor analysis to characterize perceptions of orange fleshed sweet potato (Owuor *et al.,* 2022), perception on health and medical benefits (Brščić *et al.,* 2017) as well as those related to food safety (Savelli *et al.,* 2019). Blanc *et al.*(2021) used descriptive analysis to characterize consumer perceptions on honey quality attributes for Italian consumers but failed to proceed with regression analysis. Studies that have used an econometric model with intrinsic variables like perceptions are quite limited due to difficulties in measuring individuals' intrinsic characteristics and interpreting the regression results (Jensen and Mørkbak, 2013 ;Maina *et al.,* 2018 ;Okello *et al.,* 2021). Most studies have used binary logit probability regression due to the ease of classifying perceptions as either positive or negative based on a particular threshold.

There are few studies that have retained the continuous nature of the perception indices and proceeded with regression analysis without subjecting the perception index to any threshold. For instance; Okello *et al.*(2021) assessed factors influencing farmers' perceptions of commercial insect based feed for sustainable livestock production in Kenya. However, the current study extends this application but in a different context by looking at factors influencing consumers' perceptions of honey quality attributes. Further, this study included unique drivers given this context. This study used multiple linear regressions method which have been identified as the suitable framework for this analysis because the perception indices generated are usually uncorrelated hence eliminating multicollinearity problems. This study contributes to literature by combining a linear reduction technique with multiple linear regression to estimate consumers' perceptions on honey quality attributes. Using ordinary least square(OLS) regression (Greene,

2012), this study aims to identify the explanatory variables that are unique in predicting each dimension of consumers' perceptions.

2.2.2 Empirical literature on preference from past studies

The stated and revealed preference are the methods used in estimating WTP for marketed and non-marketed goods (Adamowicz *et al.,* 1998). These are Stated preference (SP) and Revealed preference (RP) methods. The stated preference (SP) method is used when the good does not exist in the market or a pretest because it is hypothetical, whereas in revealed preference (RP) method, preferences are revealed directly through the actions of purchasers and sellers, which create the product price. It is the indirect methods and it involves valuation of existing goods in the market by analyzing the real behavior of consumers. (Adamowicz *et al.,* 1998).

The common SP methods include choice experiment (CE) and contingent valuation method (CVM). In CVM, individuals are asked the highest amount of money they would be willing to pay directly. Due to this it is sensitive to biases in implementation and design of the survey (Adamowicz *et al.,* 1998). Some studies used CVM to analyze consumers' WTP. For instance ,Nandi et al., (2017) used CVM to analyze consumer WTP for organic fruits in India and similarly with Mawia et al (2018) who used CVM to analyze consumer acceptance of chicken meat reared on IBF in Kenya.

CE approach which is a stated preference method was employed in the current study as the most suitable method, since establishing bee flora to improve honey quality is a new concept of which there's limited application in Kenya hence, its evaluation can only be done through a non-market approach. In CE a product is valued in relation to its attributes and their levels.

The CE is a stated preference method which is used to assess products which are not completely traded in the market and revealed preference methods cannot be used to evaluate them (Louviere *et al.,* 2000).The CE method is also a survey method where individuals take choices across products with varying attributes (Louviere *et al.,* 2010). CE is able to estimate trade-offs among choice alternatives. CE is able to produce values for a series of products (Boxall *et al.,* 1996).In CE a product is valued in relation to its attributes and their levels. CE approach which is a stated preference method was employed in the current study as the most suitable method, since establishing bee flora to improve honey quality is a new concept of which there's limited application in Kenya hence its evaluation can only be done through a non-market approach. This method is based on the random utility theory, which stipulates that , given a choice task involving alternatives combinations of attributes of honey, a rational consumer, would choose the choice alternative that maximize their utility (McFadden, 1973). Since utility is unobserved, the satisfaction derived by the consumer can be inferred from the value represented by the choice made (Hanley *et al.*, 2002).

There is a growing literature on consumer preferences and WTP for attributes of different commodities. Recent studies which have applied CE method to analyze farmers and consumer preferences and WTP are; (Pambo *et al.,* 2017; Otieno and Nyikal, 2017; Ceschi *et al.,* 2018; Otieno and Oluoch, 2019; Mwololo *et al.,* 2019; Otieno, 2020; Otieno and Ogutu, 2020; Okello, 2022 ;Owuor *et al.,* 2022).

These studies focused on different product attributes, for instance, preferences for attributes related to vitamin A-fortified sugar in Kenya (Pambo *et al.,* 2017), preferences for safety and quality attributes of artisanal fruit juices in Kenya (Otieno and Nyikal, 2017), WTP for apple attributes in Italy (Ceschi *et al.,* 2018), local stakeholder's preferences for attributes of foreign land lease design

in Kenya (Otieno and Oluoch, 2019), WTP for attributes of fair-trade goat meat in Kenya (Otieno, 2020), WTP for welfare attributes of chicken in Kenya (Otieno and Ogutu, 2020) and preference and WTP for enriched snack product traits in Ethiopia (Ahmed *et al.,* 2020).

These studies also differed in econometric modelling in their analysis. Random parameter logit model (RPL) was the main model as it was used by (Pambo *et al.,* 2017; Otieno and Nyikal, 2017;Otieno and Oluoch, 2019; Otieno, 2020 ;Otieno and Ogutu, 2020). Multinomial Logit model (MNL) used by Ceschi *et al.,* (2018) regardless of the limitation of the model of independence from irrelevant alternatives (IIA) were the main models. Ahmed *et al.,* (2020) used Generalized Multinomial Logit (G-MNL).

Sayeed *et al.* (2021) used conditional logit model in analyzing consumer WTP for mud crabs in Southeast Asian Counties e.g. Senegal and concluded that country of origin is important to consumer. Moreover, consumers prefer to eat mud crabs from Sri Lanka and are willing to pay higher than those from Cambodian or Indonesian. The author used conditional logit model for analysis which assumes a homogenous preference for consumers resulting in bias estimates. This model also requires the Independence of Irrelevant Alternatives (IIA) condition which is a restrictive assumption to make for studies that use observable data since in real life, there might be unobservable product attributes in the product choices that will make some alternatives closer substitutes than others. To address these problems, the current study used RPL which is able to account for preference heterogeneity.

Otieno and Ogutu, (2020) used random parameter logit model in analyzing consumers' WTP for chicken attributes in Kenya. The study found that consumers were willing to pay for use of certified

transportation, welfare labeling and humanely slaughtered chicken. Suffice to note here, the preference pattern for honey attributes is bound to differ from chicken attributes due to variations in targeted consumer segments. Therefore, the current study focused on honey attributes.

Literature on consumer preference and WTP for safety and quality attributes of honey show that researchers (Wu et *al.,* 2015;Cosmina *et al.,* 2016; Juma *et al.,* 2016; Šánová *et al.,* 2017 ;Vapa-Tankosić *et al.,* 2020) have studied the influence of different extrinsic attributes (examples; price, origin, labelling, packaging and certification) and intrinsic attributes of honey (taste, viscosity and pesticide residues). Two studies (Šánová *et al.,* 2017 ;Kos *et al.,* 2018) show that price is the most important among other attributes such as quality, texture and flavour. Other studies (Wu *et al.,* 2015; Cosmina *et al.,* 2016; Juma *et al.,* 2016; Kopala *et al.,* 2019) found that geographical indication label, local origin of honey is important to consumers. In addition to origin, they found that, organic honey was preferred for which willingness to pay was higher. Similarly, findings from Vapa-Tankosić *et al.* (2020) shows that consumers are willing to pay more for organic honey compared to local honey. These studies used different models for example ;Juma *et al.* (2016) used Random Parameter Logit model which will be adopted in this study since it is able to account for preference heterogeneity. Cosmina *et al.* (2016) used Latent Class model which account for heterogeneous class-specific preference and was used in the context of segmented samples of respondents. Vapa-Tankosić used descriptive statistics (frequencies and percentage) to analyzing consumer WTP for local and organic honey in Serbia. This method does not account for the preference heterogeneity of the consumers resulting in bias estimates.

Although choice experiment has been widely used in analysis of consumer preferences and WTP, this method has not been widely used to assess consumer preferences and WTP for honey attributes. Therefore, choice experiment was adopted in this study as the most suitable stated preference method due to its robustness in estimating WTP values. The only empirical valuation of preferences for honey attributes is that of Juma *et al.*(2016) which focused on awareness and WTP for geographical indication labelling and other quality attributes. The study found that consumers were willing to pay for geographical indication labelling. However, the latter did not include color and bee flora which are important quality cues. The current study included bee flora source and color attributes which were not included in the latter study. This study makes a novel application of CE method to evaluate consumers' preference and WTP for honey quality attributes. The CE method was considered to be the most appropriate approach for this study because concern for bee flora is a relatively new concept in Kenya, with limited awareness.

CHAPTER THREE: METHODOLOGY

3.1 Conceptual Framework

This study illustrates the relationship between consumers' perceptions for honey quality attributes and their WTP for these attributes. This study conceptualized that, socio-economic and market related factors influence perceptions which in turn influence their WTP for honey quality attributes.

These factors are gender, income, education, awareness of bee flora source, place of purchase, prior information and price. Therefore, consumer's decision whether to buy honey or not is directly influenced by; socio-economic factors, market related factors, attitude or intention, purchase behavior, product characteristics, knowledge and awareness. The Lancaster theory of choice postulates that consumer's decision to buy honey is influenced by the attributes of the honey and not the honey itself (Lancaster, 1966). Therefore, this study conceptualized that consumer preference and WTP will be influenced by honey attributes such as bee flora, origin labelling, inspection and certification, viscosity, colour and price. Consumers who are aware of honey produced from established bee flora and have positive perception about the bee flora, they would be willing to pay for the honey and this will lead to increased consumption of quality honey. This is expected to lead to better prices and high income for the beekeepers.

An idea on consumer's perception and willingness to pay for honey attributes can be conceptualized as depicted in Figure 3. 2.
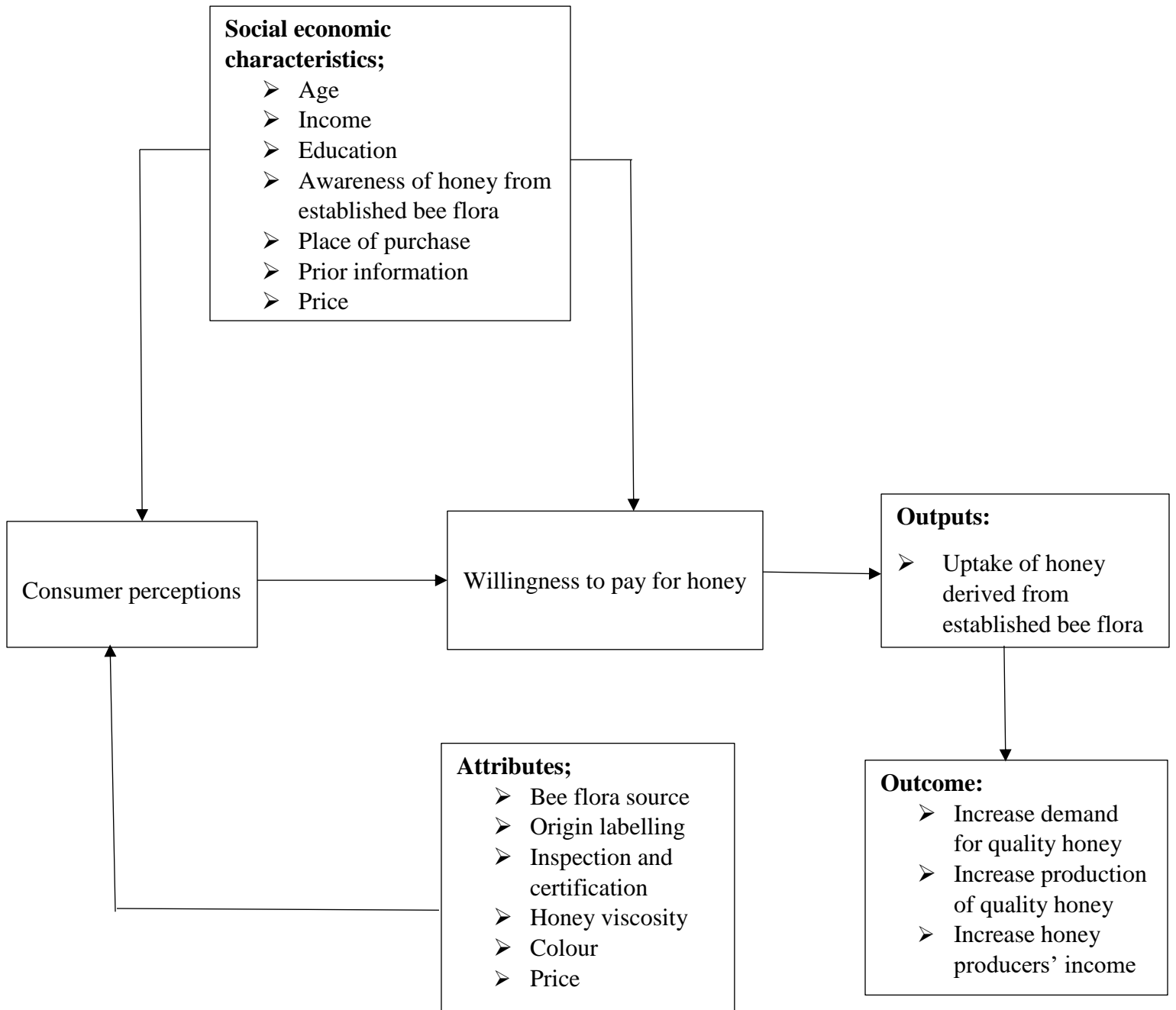
Figure 3.2: Conceptual framework showing factors influencing consumer perceptions and willingness to pay for honey quality attributes

3.2 Research design

The research was experimental based on quantitative and qualitative data from primary data. The primary data was collected through descriptive consumer survey and choice experiment.

3.2.1 Quantitative approach

Consumer surveys were conducted in order to obtain quantitative data on the perceptions. The perceptions were regressed against consumer socio-economic characteristics (Objective 1). Choice experiments were also conducted for each consumer in order to determine their willingness to pay for honey quality attributes (Objective 2).

3.3 Sampling approach

A multi-stage sampling procedure was employed to select consumers. At the first stage, Nyandarua County was purposively selected because the project which aims at promoting honey quality is implemented in the County. Oljorork and Kinangop sub counties were selected. At the second stage, Kinangop and Ol'jororok were purposively selected because they were the projects' sub-counties.

Following Choice Metrics (2009) on sample size determination for optimal CE designs, a minimum sample of 200 consumers was required. Previous studies (Otieno and Oluoch, 2019) used a sample size of 200 respondents for choice -based survey on local stakeholders' preferences for foreign land attributes and the current study adopted this approach and used a sample size of 252 respondents. At the final stage, a systematic random sampling method was used to select every third and fifth household honey consumer and they were interviewed at different consumption points. To select the households, a cross sampling method was employed; that is, a cross "X" was drawn on the village map and every nth household ('n' equals three and five where households

were scattered and densely populated, respectively) along the "X" with a random start was interviewed (Birol et al.,2011). Where the targeted respondent was unavailable or uninterested in participating, the next randomly selected household on the list was chosen to ensure that the desired sample size was realized. Employing sampling proportionate to size criterion,132 respondents were selected from Kinangop and 120 respondents from Ol'jororok. This was in line with the population distribution (KNBS, 2019). Data was collected through face-to-face interviews of consumers using a structured questionnaire and choice experiment design.

3.4 Data collection and analysis

Key informant interviews and focus group discussions were conducted in July 2022. Consumer survey was conducted using semi-structured questionnaires. The study used choice cards for choice experiment data. The data on consumer perception was analyzed using SPSS and STATA version 16.

3.5 Study area

The study was conducted in Nyandarua County which was purposively selected because the project which aims at promoting honey quality is implemented in the County. Oljorork and Kinangop sub counties were selected because they were the projects' sub-counties.
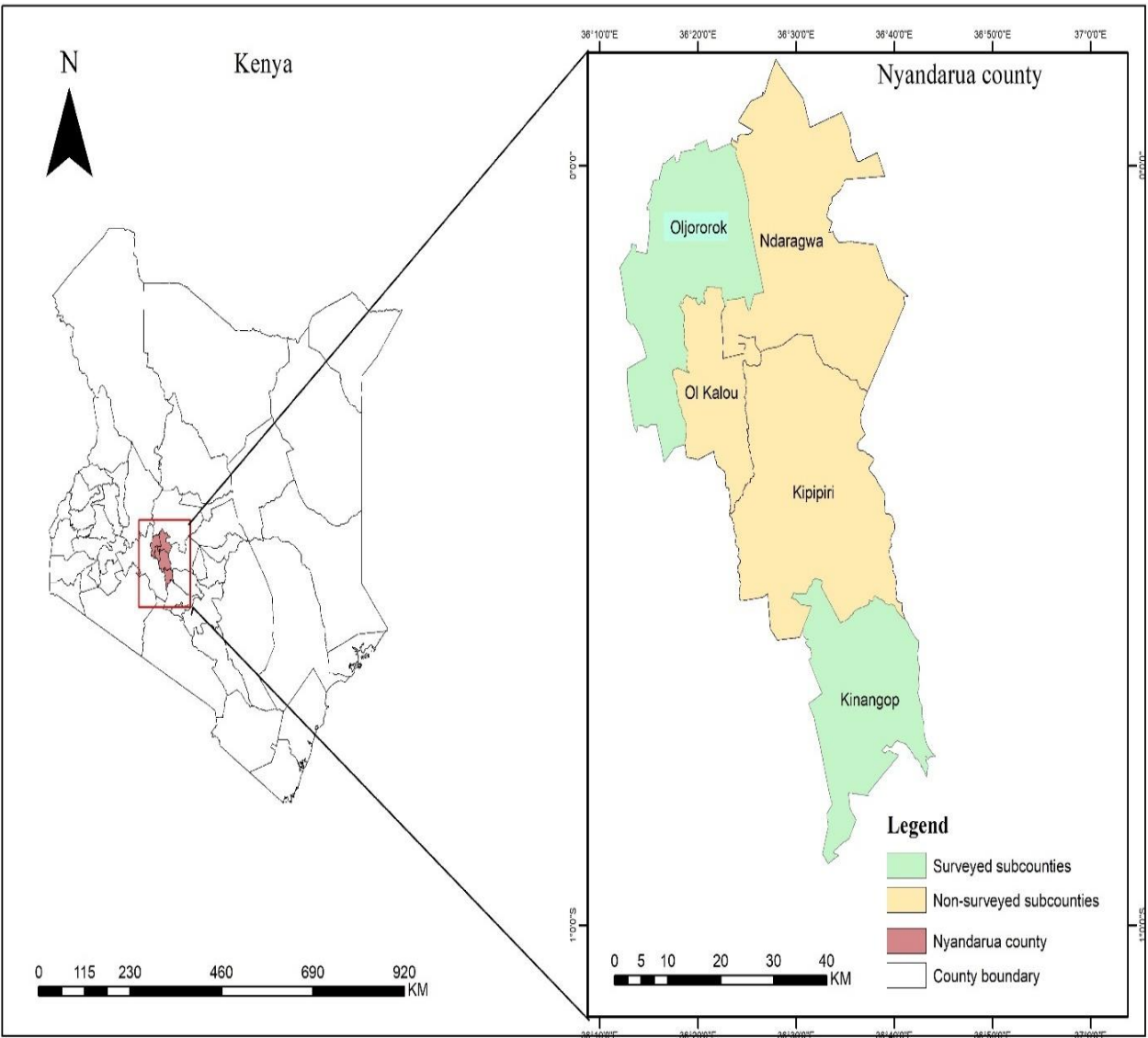
Figure 3.3: Map illustrating the study sites in Nyandarua County, Kenya

CHAPTER FOUR: CONSUMERS' PERCEPTIONS OF HONEY QUALITY ATTRIBUTES IN NYANDARUA COUNTY, KENYA: A MULTIPLE LINEAR REGRESSION APPROACH

 Abstract

Low honey quality is among the major challenges facing the honey sector. What consumers perceive to be quality honey and factors that influence their perceptions remain to be the most critical factors that influence consumers' purchasing intentions on honey. This study evaluated consumer's perceptions of quality attributes of honey and assessed the factors that would influence their perceptions. It employed principal component analysis (PCA) to generate perception indices which were used in multiple regression analysis to determine factors that influence consumers' perceptions. The data was collected from a sample of 252 honey consumers. The PCA identified origin, bee flora, color and viscosity as key intrinsic attributes. Education, income, bee flora source awareness, place of purchase, prior information, and price significantly influenced consumers' perceptions of honey quality attributes. County government should ensure honey sold is labelled with its origin as origin attribute was perceived to be important to consumers. Creating awareness on honey quality is crucial in increasing consumer knowledge about quality honey.

Keywords: honey quality attributes; multiple regressions; perceptions; principal component analysis

4.1 Introduction

Honey is one of the most beneficial products from apiculture, due to its medicinal, nutritional and industrial use. It is also an important product in the international market where it is a foreign exchange earner for many countries (Buba, 2013; Agboola *et al.,* 2021). Honey consumption provides significant amount of energy, it can also be used as a remedy for cough and sore throat (Pasupuleti *et al.,* 2017). In addition, honey has been used to increase body immunity especially during the Covid 19 pandemic era where the honey business survived and even increased its market ,hence it has the potential to be a good source of income(Indriani *et al.,* 2022).

Honey quality remains to be the most critical factor that influences consumers' purchasing intentions on honey related product (Yeow *et al.,* 2013). Honey characteristics such as color, taste and aroma influence its perceived quality and consumers are keen on honey characteristics when purchasing the commodity (Ismaiel *et al.*, 2014). However, there is a dearth of empirical insights into what consumers perceive to be quality honey and factors that influence their perceptions in developing country. In developed countries, there is vast literature on consumer perceptions on honey attributes; for instance, honey attributes related to health and medical benefits (Brščić *et al.,* 2017) as well as those related to environmental sustainability (Jensen and Mørkbak, 2013). However, the analysis of consumer perceptions on honey quality attributes related to food safety attributes is very limited, especially in a developing country like Kenya. Understanding consumer perceptions on honey quality attributes and factors that influence their perceptions is crucial since consumers make decisions based on what they perceive.

The current study used PCA to analyze consumer perceptions of honey quality attributes in Kenya and assessed factors that influenced consumer perceptions using multiple linear regression model. Multiple linear regression allows an in-depth exploration of the factors to consider when advising the government, consumers, honey producers, research institutions and other stakeholders on the honey quality attributes. Understanding consumers' perceptions is important to marketers and traders to develop marketing plans and strategies in order to increase supply for quality honey.

4.2   Methodology

4.2.1 Theoretical considerations

Assessment of consumer perceptions is grounded on the theory of planned behaviour. This theory postulates that individual's intentions to perform a behavior is informed by their attitudes towards a behaviour, subjective norms and perceived behavioral control (Ajzen, 1991). Behavioral intention is a result of attitude towards a behaviour which is an outcome of subjective norms and behavioral control (Kalafatis *et al.,* 1999). Perceived behavioral control refers to people's perception on the ease or difficulty of performing a certain behavior (Ajzen, 1991). This means that consumers perceive how their satisfaction will be met depending on the quality of honey. Subjective norm is the decision to take or reject a good and it is based on normative beliefs of people who are highly regarded by the respondent and their opinions on whether to do the action (Ajzen, 1991 ; Kalafatis *et al.,* 1999). According to the theory, perceived behaviour can influence actions indirectly, and hence be used to predict the actual decisions the individual would take (Ajzen, 1991).

4.2.2 Analytical framework

4.2.2.1 The principal component analysis method

The PCA method was applied to generate factors with strong patterns explaining consumer's perceptions of honey quality attributes. PCA is a key tool in consumption analysis, since it minimizes the number of variables which are correlated by building a linear combination of variable which are uncorrelated which maximize the total variance explained. Relevant information is extracted from large data and the dimensionality of the data set is reduced by providing new and meaningful variables. The use of PCA was validated through the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy where a value of at least 0.6 was preferred (Kaiser, 1974). Components with eigen values of at least one were retained based on the Kaiser criterion (Kaiser, 1960). Further, the component loadings were subjected to an orthogonal varimax rotation which produces uncorrelated factor scores for ease of interpretation. Perception statements with factor loading above 0.5 were retained for use in composing perception indices.

4.2.2.2 Estimation of Multiple Linear Regression Model

The perception indices computed using PCA were used as dependent variables in a multiple regression analysis to estimate the factors influencing consumers' perceptions of honey quality attributes in Nyandarua County, Kenya. The indices consisted of three consumer honey quality component indices (both intrinsic and extrinsic attributes of honey) derived from the factor scores of three key honey quality perception components (origin, bee flora, color and viscosity as key intrinsic attributes) while independent variables were the consumers characteristics and market related factors.

Following Greene, (2012 ,Ordinary Least Squares is specified as follows;

$$Y_n = X_k \beta_k + \varepsilon \qquad\qquad (4.1)$$

where Y_n is the nth factor score, β_k is the vector of the estimated parameters; X_k is the vector of consumer characteristics such as gender, years of formal education, income, awareness of bee flora source and market related factors such as; place of purchase, prior information and price while ε is the random term which accounts for errors in measurement. Multiple regression is an extension of linear regression which analyses the correlation between more than one explanatory variable. Depending on the nature of dependent variable which was continuous, the study qualifies the use of OLS. The OLS estimates are best, linear and unbiased estimators with minimum variance (Greene, 2012). Further model adequacy checks and validation were done to ascertain the appropriateness of the model as seen in the appendix.

Past studies have applied perception indices as dependent variable in multiple regression analysis to understand perceptions. For instance; Cieslinski (2019) evaluated factors influencing consumer perception and acceptance of stevia-sweetened ice cream beyond intrinsic cues using OLS. Other studies such as Maina *et al.*(2018) evaluated perception of geographical indications as a product diversification tool for agri-food products in semi-arid regions of Kenya using factor analysis and OLS. Whereas factor analysis reveals latent variables representing consumers' perceptions of honey quality attributes, the OLS permits in-depth exploration of the factors to consider when advising governments, consumers, honey producers, research institutions and other stakeholders on honey value chain.

4.2.3 Data sources and sampling procedure

A multi-stage sampling procedure was employed to select consumers. At the first stage, Nyandarua County was purposively selected because the project which aims at promoting honey quality is implemented in the County. At the second stage, Kinangop and Ol'jororok were purposively selected because they were the projects' sub-counties.

A total of 252 honey consumers who are responsible for making decision on honey purchase and consumption in their households were interviewed; 132 from Nyandarua South and 120 from Nyandarua West in line with the population distribution (KNBS, 2019). Finally, at the third stage, systematic random sampling method was used to select every third person and they were interviewed at different points in the consumption chain. Data was collected using five-point likert scale questions and analyzed using SPSS 22 and STATA 16 software.

4.2.4 Measurements of independent variables

The consumers' characteristics which were included in an OLS regression model as predictors for consumers' perceptions of honey quality attributes are in Table 4.1. Variables capturing gender, awareness, frequency of honey consumption, place of purchase, prior information and were measured as dummy variables. Age, income, education and price were measured as continuous variables.

Table 4. 1:Description and measurement of the independent variables used in the linear regression model

Variable	Description	Measurement	Expected signs
Age	Age of the household head	Years	-
Gender	Sex of the household head	Male=1; Female=0	+/-
Education	Number of years of complete schooling of the household	Years	+
Income	Average monthly income of the household	Kenya Shillings	+
Bee flora source Awareness	Awareness of honey that is produced from established bee flora	Yes=1; No=0	+
Place of purchase	Buys honey from the beekeepers	Yes=1; No=0	+
Prior information	Respondent seeks honey information prior	Yes=1; No=0	+
Price	The price of 500g of honey bought by consumers	Continuous	-

Age of consumers was hypothesized to have a negative influence on consumers' perceptions of honey quality attributes. This implies that younger consumers are more likely to have favorable perceptions on quality attributes since information has gone digital in Kenya due to technological advancement so that even food advertisers seek new avenues so as to keep track with the changing times. Internet options and mobile phone usage have provided the medium for the new advertisement opportunities that mostly targets technologically advanced consumers. The younger consumers get favor in these new avenues which may explain their favorable perceptions.

The education level of the household head was measured as the number of schooling years of the respondent. As hypothesized, education level was expected to positively influence consumers' perceptions since educated consumers' have an increased capacity to source information regarding honey quality. Awareness is important in promoting honey quality information. Seeking prior information before purchase increases providence of honey quality information. Additionally, Juma *et al.* (2016) found that seeking prior information before purchase influenced awareness of geographical indicators in honey. Place of purchase/ honey source is important as it increases consumer confidence and influenced its perceived quality (Ismaiel *et al.*,2014). Price is hypothesized to be negative due to rationality of consumers.

4.3 Results and Discussion

4.3.1 Descriptive Results

Consumers' socio-economic characteristics are presented in Table 4.2. More respondents were male about (67.8 percent) with 11 years of completed formal schooling on average indicating that the respondents did not complete high school and no college or university education. The age of the respondent was 40 years on average. Sixty percent were aware of honey produced from established bee flora while 53.9 percent bought honey from the beekeepers.

Table 4. 2:Characteristics of honey consumers in Nyandarua County, Kenya

Variable	Mean and percentages
Average age of the respondent (Years)	40.4(13.4)
Average years of schooling (Years)	11.5(3.1)
Household size (Numbers)	4.4(3.4)
Average household income (Kshs)	34829 (27944)
Gender of the respondent (Percent Male)	67.83
Occupation (Formal employment)	85.66
Awareness (Percent Yes)	60.5
Place of purchase (Percent Beekeepers)	53.88
Frequency of consumption (Percent Twice)	33.7
Prior information (Percent Yes)	67.83

* Standard deviations are in parentheses (for continuous variables).

4.3.2 Principal components of consumers' perceptions of honey quality attributes and their associated factor loadings

Respondents were asked to rate their level of agreement on a five-point Likert scale ranging from 1 (strongly disagree) to 5(strongly agree) in a questionnaire which included 13 perception statements. These 13 perception statements are shown in Table 4.3. The PCA was used to reduce the statements and group them into three broad honey quality perception attributes which retained 5, 4, 4 factors respectively as shown in Table 4.3. The statements were based on honey quality indicators such as, viscosity, color, local origin and bee flora source which determines the quality of honey. From the PCA results the KMO test of sampling adequacy was 0.756 which is within the recommended threshold of 0.6 to 1 (Kaiser, 1974). The Bartlett's test of sphericity was significant at a 1 percent level, implying that the items in each group had significant relationship. Further, the Cronbach's alpha, a measure of internal consistency, for each factor score was above

0.5 hence the perception statements were reliable for PCA. Based on the Kaiser criterion (Kaiser, 1974), cumulatively, the retained factors explained about 53.5 percent of the variation.

The first component on origin, embraces those variables linked to the local origin of honey with exception of when Iam buying honey, its high quality is more important to me than price. This component explains the maximum variation of about 32 percent with five items showing factor loadings above the threshold of 0.5 for retention of statements. Consumers agreed with statements such as, "When Iam buying honey, it is important that honey is from local producer", "I prefer honey from beekeepers since I know the source", "Honey bought from beekeepers is better than honey bought from a supermarket", "When Iam buying honey, the County of origin is more important to me" and "When Iam buying honey, its high quality is more important to me than price".

Table 4. 3: Factor loadings of perception statements of honey quality attributes after varimax rotation

Perception Statements	Rotated components		
	Origin	**Bee flora**	**Color and viscosity as key intrinsic attributes**
When Iam buying honey, it is important that honey is from local origin	**0.934**	0.076	0.190
I prefer honey from beekeepers since I know the source	**0.922**	0.050	0.101
Honey bought from beekeepers is better than honey bought from a supermarket	**0.920**	0.039	-0.084
When Iam buying honey, the County of origin is more important to me	**0.847**	0.094	-0.009
When Iam buying honey, its high quality is more important to me than price	**0.711**	0.086	0.016
Planting bee flora will help to improve honey quality	0.383	**0.798**	0.014
Viscosity is determined by the bee flora	0.035	**0.722**	-0.017
Color is determined by the bee flora	-0.083	**0.610**	0.080
Taste is determined by the bee flora	0.243	**0.548**	0.180
Viscosity determines honey quality	0.260	0.017	**0.762**
Color determines honey quality	0.178	0.016	**0.787**
Honey should be thick in viscosity for it to be quality	0.256	-0.070	**0.691**
Dark colored honey is of better quality than light colored honey	-0.064	0.120	**0.519**
Eigen values	6.121	2.153	1.484
Variance explained (%)	32.11	12.48	8.88
Cumulative variance explained (%)	32.11	48.58	53.47
Cronbach's alpha	0.886	0.721	0.703

Notes: Cronbach's alpha = 0.779; Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy = 0.756; Bartlett's test of sphericity: Chi-square (df) = 1636.74.

Source: Survey Data (2022).

The second component bee flora involves consumer acceptance of interventions of planting bee flora as a confirmation of honey quality. This component recorded four statements with factor loadings above 0.5 and explained 12 percent of the cumulative variation. The third component involves the intrinsic attributes of the honey which can be described as the color and viscosity as key intrinsic attributes. This component explained 9 percent of the cumulative variation and recorded four statements with factor loadings above the 0.5 threshold. It was common for consumers to indicate that "Viscosity determines honey quality", "Color determines honey quality", "Honey should be thick in viscosity for it to be quality" and "Dark colored honey is of better quality than light colored honey".

4.3.3 Factors influencing consumers' perceptions of honey quality attributes

The multiple linear regression analysis results are presented in Table 4.4. The adjusted R-squared values, which measure goodness of fit, were low (18 percent to 29percent) but within the range of similar studies. For instance, Okello *et al.* (2021) reported values of as low 2 percent for linear regression models of survey data. According to Greene (2012) , it is not unusual to observe low goodness-of-fit in regression analysis using cross-sectional data and in behavioral studies. This is mainly due to heterogeneity in individuals' attitudes, actions and behaviors. All the models were significant. The model diagnostic tests were performed to ascertain the absence of correlations among the factor scores and to further justify the use of individual linear regressions.

Generally, education, income, bee flora source awareness, place of purchase and prior information positively and significantly influenced consumers' perceptions of honey attributes at least at the 5 percent level while price negatively influenced perceptions. The origin aspect of quality attributes such as when Iam buying honey, it is important that honey is from local origin and I prefer honey

from beekeepers since I know the source were perceived to be more important to consumers who had higher income. This means that a percentage increase in consumer's income, increased perception on origin by 45.6 percent. This can be attributed to the fact that honey labelled with its local origin is expensive and can only be afforded by people with high income since they have the buying power. Consumers who bought honey from beekeepers perceived local origin index to be important than those who did not buy from beekeepers. This shows that increase in the number of consumers who bought honey from beekeepers, increased perception on origin by 43.6 percent. This implies that consumers have confidence with honey bought from beekeepers relative to other places of purchase.

Consumers who sought prior information before purchase had favorable perception about the origin than their counterparts who never sought prior information before purchase. This shows that increase in the number of consumers who sought prior information on honey quality before purchase, increased perception on origin by 49.1 percent. This finding is supported by Juma *et al.* (2016) who found that seeking prior information influenced awareness of geographical indicators in honey. Price increase resulted in unfavorable perception on origin. This shows that, a unit increase in price reduced perception on origin by 0.1 percent. This implies that, since consumers are rational, increase in price could deter them from preferring local honey.

Table 4. 4: Multiple regression estimates of the factors influencing consumers' perceptions of honey quality attributes

Regression Parameter Estimates

Explanatory Variables	Origin	Bee flora	Color and viscosity as key intrinsic attribute
Age (Years)	0.15(0.05)	-0.001(0.005)	0.001(0.005)
Gender (Male)	0.294(0.131)	0.192(0.136)	-0.064(0.130)
Education (Years)	0.331(0.141)	-0.167(0.126)	0.276(0.134) **
Income (Continuous)	0.456(0.16 1) ***	0.153(0.069) **	0.395(0.122)
Bee flora source Awareness (Yes)	0.588(0.133)	0.281(0.136) **	0.483(0.154) ***
Place of purchase (Beekeepers)	0.436(0.125) ***	0.367(0.132) ***	0.117(0.126)
Prior information (Yes)	0.491(0.115) ***	0.270(0.136) **	0.291(0.134) ***
Price (Continuous)	-0.001(0.001) **	0.003(0.002)	-0.003(0.002)
Constant	-1(0.269)	0.146(0.286)	-0.416(0.284)
Adjusted R-squared	0.290	0.221	0.191
Prob>F	0.000	0.000	0.000
Observations (n)	252		

Notes: ***, ** and * denote statistical significance of variables and models at 1%, 5% and 10% levels, respectively. Robust standard errors are presented in parentheses.

Source: Survey Data (2022)

The bee flora aspects of honey quality were perceived to be more important by consumers with high income. This result shows that a percent increase in income, increases perception on bee flora in improving honey quality by 15.3 percent. This implies that, the income would allow them to purchase honey from established bee flora. Consumers who were aware of honey produced from established bee flora perceived this aspect to be more important than their counterparts who were not aware. Consumers who bought honey from beekeepers and sought prior information before purchase perceived this aspect to be important than those who did not. This shows that increase in the number of consumers who bought honey from beekeepers, increased perception on bee flora in improving honey quality by 36.7 percent. This is consistent with Ismaiel *et al.* (2014) who found that honey source influenced its perceived quality.

Finally, color and viscosity as key intrinsic attributes aspects were more important to consumers who were aware of honey produced from established bee flora than their counterparts who were not aware. The more educated consumers, perceived the quality of honey aspect to be important than their less educated counterparts. This indicates that increase in the consumers' years of education, increased perception on the intrinsic attributes of the honey such as color and viscosity by 27.6 percent. This implies that high literacy facilitates the search, access and comprehension of existing and new information. Intrinsic attributes aspect was also important to consumers who sought prior honey information before purchase.

4.4 Conclusion and policy recommendations

The first objective assessed the factors influencing consumers' perceptions on honey quality attributes. Using principal component analysis technique, perception data revealed that honey purchasing decisions are informed by various elements including the origin, bee flora, color and viscosity as key intrinsic attributes. This implies that consumers focus on diverse elements of honey quality attributes beyond the external purchase of honey in supermarkets, honey outlets and from the beekeepers. Further interactions identified socio-economic and market-related factors that influence the perceptions. Consumers who are educated, have higher income, are aware of honey produced from established bee flora, buy honey from beekeepers, sought prior honey information before purchase and use honey for medicinal purposes consider the various elements of honey quality to be important.

The study, therefore, rejects the null hypothesis and conclude that socio-economic and market related factors influence consumers' perceptions of honey quality attributes.

Based on the results, several policy recommendations can be drawn from this study. The origin component was perceived to be more important by consumers and therefore, the government should ensure honey sold is labelled with its origin. Given that perceptions are based on exposure to knowledge, the study recommends that policy interventions by county governments in Kenya should be geared towards increasing consumers' knowledge to evaluate honey quality through training on honey quality. This will ensure that consumers are aware of what they are taking and they should be able to know quality honey and what level of quality because they are the one who

create a demand pull of quality honey. Capacity build everyone along the honey value chain to
ensure quality honey.

CHAPTER FIVE: WILLINGNESS TO PAY FOR HONEY QUALITY ATTRIBUTES IN NYANDARUA COUNTY, KENYA: A CHOICE EXPERIMENT APPROACH

Abstract

Low honey quality is one of the major challenges facing the honey sector. Despite the interventions of planting bee flora to ensure honey quality, limited empirical information exists on consumers' preferences and willingness to pay for honey quality features. This study assessed consumers' preferences and estimated willingness to pay for these attributes in Nyandarua County, Kenya. Further, inclusion of bee flora is a useful contribution to empirical literature. Random Parameter Logit model was used to analyze choice experiment data from 252 honey consumers. The empirical results showed that consumers had a positive preference for bee flora source, origin labelling, joint certification, continuous viscosity and dark brown color of honey. Preference heterogeneity across various attributes was observed. Consumers were willing to pay the highest premium for honey viscosity. The results of this study will help in developing marketing positioning strategies for honey as well as develop policies which are related to honey quality.

Keywords: Honey quality attributes; choice experiment; bee flora source; preference heterogeneity; random parameter logit; Kenya

5.1 Introduction

Honey value chain is important to the livelihoods of many producers, consumers and other stakeholders in developing countries like Kenya. It is also an important product in the international market where it is a foreign exchange earner for many countries (Buba, 2013; Agboola *et al.,* 2021). In Kenya, the production potential for honey is estimated at100,000 metric tonnes per year and only 20 percent of this has been tapped with most of the production coming from arid and semi-arid areas in Kenya (RoK, 2013). The honey demand has increased during and after the Covid 19 era since it was proven to increase the body immunity. With increase in population and preference towards natural foods by an increasing number of consumers García (2018), the honey demand has also increased considerably. The national honey consumption level is about 38,000 metric tonnes and about 18,000 metric tonnes of honey is imported to bridge the gap of the standard annual national consumption level since the country is only able to produce 20,000 metric tonnes of honey (KNBS, 2019). In addition, as the demand for honey increases, the honey sector will be an important driver of economic growth and a pathway out of poverty in Kenya.

Low honey quality is one of the major challenges facing the honey sector. Consumers use a wide range of parameters to judge honey quality such as aroma, taste, trust regarding the purity and honey source (Ismaiel *et al.,* 2014) . A recent intervention to promote honey quality by Kenya Agricultural and Livestock Research Organization (KALRO) involved sensitizing beekeepers to establish bee flora. However, this has rarely been evaluated from a consumer perspective since consumers are the final customers of the value chain.

Establishing organic bee flora means planting specific flora which are within the reach of the beekeeper so that bees do not have to go far in search of nectar. Bees can feed up to radius of 3km

but if they have sufficient forage nearby, they do not have to go far and by doing this, it affects the quality of the honey and one can actually dictate the quality of honey that will make it get a better market. Further, consumers are keen on honey characteristics when purchasing the commodity and they value quality honey which is a determinant of price and marketing. According to Belay *et al.* (2015) flora source influences the color and taste of the honey and consumers have heterogeneous preferences for color as well as taste. There are some consumers in Kenya who will pay a higher price for quality as shown by Australian imports (Mutisya ,2011). Therefore, bee flora is important since honey quality characteristics/ attributes are based on floral source hence planting bee flora will help in promoting quality honey as well as ensure health safety of the consumers and this will help to improve consumers' confidence. Establishing bee flora is also important since bees might collect pollen that might be toxic hence causing allergy to some consumers (Yeow *et al.,* 2013).

There is vast research on consumer preference and willingness to pay (WTP) for quality attributes in various foods; for example, preferences for attributes related to vitamin A-fortified sugar in Kenya (Pambo *et al.,* 2017) , preferences for safety and quality attributes of artisanal fruit juices in Kenya (Otieno and Nyikal, 2017), WTP for apple attributes in Italy (Ceschi *et al.,* 2018), local stakeholder's preferences for land attributes in Kenya (Otieno and Oluoch, 2019), WTP for attributes of fair-trade goat meat in Kenya (Otieno, 2020), WTP for welfare attributes of chicken in Kenya (Otieno and Ogutu, 2020) and preference and WTP for enriched snack product traits in Ethiopia (Ahmed *et al.,* 2020). However, empirical research on consumer preference and willingness to pay for honey quality attributes is limited. One exception is a study by Juma *et al.* (2016) on consumer WTP for honey attributes. The study mainly focused on geographical indicators and failed to capture consumer preferences in an integrated manner since it omitted

important attributes like color and bee flora label which are critical in influencing consumers' purchase decisions. Therefore, limited empirical information exist on consumer WTP for honey quality attributes.

The current study used a choice experiment design to estimate consumers' WTP for each attribute and identified factors that govern heterogeneity in attribute preference. Further, the concept of bee flora source as a quality attribute is relatively new and has not been widely studied. In addition, understanding consumer willingness to pay for honey attributes will help producers to develop niche market strategies that will target the consumer.

5.2 Methodology

5.2.1 Choice modelling framework

Choice modelling theoretical framework is based on Lancaster Consumer theory (Lancaster, 1966) and it is consistent with random utility theory (McFadden and Zarembka, 1974 ;Louviere *et al.,* 2000; Hanley *et al.,* 2001). Consumer theory, defines utility as the satisfaction that a consumer derives from the attributes of a good unlike the good as a whole (McFadden and Zarembka, 1974; Louviere *et al.,* 2000). From the literature consumer utility is not derived from the good but from the attributes that the good have either used as a single attribute or in combination to produce the desired utility. Therefore, different consumers can derive different levels of utility from the same good.

Random utility theory stipulates that since consumers are rational, they chose the choice alternative that maximized their utility (McFadden, 1973). This theory also assumes that, while the consumer

knows his preferences with certainty and does not consider them stochastic, the analyst is not able to observe all the components and hence treats the unobserved as random (Hanley *et al.*, 2002). For example; since utility is unobserved, consumers choose what they prefer and what they do not is influenced by random factors. This means that consumers have both observable and unobservable characteristics which influences their choice of utility maximizing alternatives (Louviere *et al.,* 2000). The observable characteristics are the honey attributes that a consumer can visibly identify and assess to make a purchasing decision and the unobservable characteristics include factors such as motivation and ability and are captured by the stochastic error term. Consumers were presented with different choice alternatives and chose that alternative which they expected to derive maximum utility as stipulated by RUT.

5.2.2 Data sources and sampling methods

A multi-stage sampling procedure was employed to select consumers. At the first stage, Nyandarua County was purposively selected because the project which aims at promoting honey quality is implemented in the County. Oljorork and Kinangop sub counties were selected. At the second stage, Kinangop and Ol'jororok were purposively selected because they were the project's sub counties.

Following Choice Metrics (2009) on sample size determination for optimal CE designs, a minimum sample of 200 consumers was required. Previous studies (Otieno and Oluoch, 2019) used a sample size of 200 respondents for choice -based survey on local stakeholders' preferences for foreign land attributes and the current study adopted this approach and used a sample size of 252 respondents. Therefore, at the final stage, a systematic random sampling method was used to select every third household honey consumer and they were interviewed at different consumption

points. Employing sampling proportionate to size criterion,132 respondents were selected from Kinangop and 120 respondents from Ol'jororok. This was in line with the population distribution (KNBS, 2019). Data was collected through face-to-face interviews of consumers using a structured questionnaire and choice experiment design.

5.2.3 Choice experiment design

The CE design involved various steps; the first step involved identification of both intrinsic and extrinsic attributes through literature review. The second step was validation of attributes and their levels through key informant interviews and focus group discussions. The expert consulted include honey experts from National Beekeeping Institute (NBI). As suggested by Bateman *et al.* (2002) two focus group discussions (FGDs) each with 12 randomly selected consumers was used to validate the attributes identified and the attribute levels for which were included in the design. The randomly selected consumers, represented different gender, age groups and income levels in each session in order to understand the contextual relevance of the attributes and their levels.

The aim of these consultations was to identify compulsory and voluntary (optional) attributes. The compulsory attributes are those features which are necessary in building confidence for honey consumers by providing a regulatory framework. For instance, the codex standards governing bee honey essential composition, hygiene, quality factors, contaminants and analysis of honey. Voluntary (optional) attributes are the ones that go into CE design and they provide options for consumers to make their preferences. Voluntary attributes are usually classified as marketing and search attributes. The search attributes considered in this study were viscosity and color, while the marketing attributes were inspection and certification, labelling and price. These attributes and their levels are shown in Table 5.1.

Bee flora source, origin labelling, viscosity and color attributes were set at two levels while inspection and certification and price were set at three levels. Bee flora source is important since honey quality characteristics are based on floral source hence planting bee flora will ensure health safety of the consumers and this will help to improve consumers' confidence. Origin labelling attribute is necessary as it influences consumer purchase of food (Juma *et al.*, 2016). Inspection and certification is important because the institutions that handles inspection of honey are important in assuring consumer confidence in the efficacy of the process. Honey viscosity is the most important determinant of honey quality (Warui *et al.,* 2014). Colour is an important visual perceptual property of honey quality.

Table 5. 1:Description of honey quality attributes used in the CE design

Attribute	Description of the attributes	Attribute levels
Bee floral source	Indication of whether honey is produced organically from established bee flora or not.	Yes; No
Origin labelling	Indication of information about the place where the honey is produced	Yes; No
Inspection and Certification	Which institution should do inspection and certification of honey quality and safety?	Public agency e.g. KEBs; Private agency e.g. Kenya Consumer Organization; Joint inspection by public and private institutions
Honey viscosity	Flow of honey	Continuous; Breaking
Color	Color of the honey	Dark brown; Light brown
Price	Price of 500grams of honey (Kshs)*	350;400;450

*Note: * At the time of survey USD$1 was equal to Kshs 120.29*

Finally, price was included to allow computation of trade-offs between honey quality attributes and money. The current prices of honey in the market was used to determine the appropriate levels for the CE design. The average price of 500g of honey from various honey consumption outlets is (Kshs 350) which was used as the base price level. As in other previous CE studies (Juma *et al.,* 2016 ;Otieno and Ogutu, 2020) a uniform interval was adopted for the price attribute to make sure there is proper scaling of the WTP estimates.

The CE design was generated by a two-step procedure using Ngene software (Choice Metrics , 2009). At the first stage, a fractional orthogonal design was generated from the six attributes and

this was used in a pilot survey of 36 respondents. The information gathered from this stage was analyzed to obtain prior parameters. At the second stage, the priors were used to generate a D-optimal CE design which was used in the main survey. This design enables estimation of parameters with low standard errors from a smaller sample (Bliemer and Rose, 2010). The design had a high D-optimality, D-efficiency measure of 80 percent and a good utility balance, a B-estimate of 76 percent, which surpasses the minimum threshold measure of utility balance, which is a B-estimate of 70 percent. This shows there was a very limited likelihood of dominance by any alternative in the choice situations. Furthermore, the CE design generated had an A-efficiency measure of 82 percent, indicating that the variance matrix could yield reliable estimates (Huber and Zwerina, 1996).

The efficient design had 24 choice sets which were randomly blocked into six profiles each with four choice tasks. Consumers were randomly assigned to one of the six sets. Each choice task consisted of two alternatives (A and B) and an opt-out alternative (C). Inclusion of an opt-out option or status quo (neither A or B) was in line with the completeness axiom of choice to accommodate consumers who would not wish to choose either of the honey alternative presented, or those who preferred combinations not fully captured by the design. The opt-out alternative help to reduce over-estimation of the WTP estimates which is reported in comparative studies between CE and CVM (Danyliv *et al.,* 2012). During the survey, respondents were asked to consider only the attributes presented in the choice tasks and to treat each choice task independently. One of the choice tasks presented to the respondents is illustrated in Table 5.2

Table 5. 2:Example of choice design presented to consumers

	Honey option A	Honey option B	Status quo
Bee flora source	Yes	No	
Origin labelling	No	Yes	
Inspection and certification	Private	Joint	
Viscosity	Breaking	Continuous	
Color	Dark brown	Light brown	
Price	350	400	
Which one would you prefer?			

5.2.4 Description of variables used in the RPL model

The consumer characteristics which were used in RPL model as interaction variables for heterogeneity analysis are presented in Table 5.3. Variables capturing gender and presence of an elderly person were measured as dummy variables. Education and income were measured as categorical variables. Education levels included primary, secondary, college and university levels while income category included; high, middle and low-income levels. These variables are important since consumers with different socio-economic variables such as education and income levels may derive different marginal utilities from the same attributes.

Table 5. 3:Description and measurement of the socio-economic variables used in the RPL Model

Variable	Description	Measurement	Hypothesized signs
Gender	Sex of the household head	Male=1; Female=0	+/-
Education level	Consumer education category	Education levels	+
Income	Consumer income category	Income levels	+
Age	Presence of an elderly person	Yes=1; No=0	+

5.2.5 Data analysis

The CE data on consumer preference and WTP for honey quality attributes was analyzed using Random Parameter Logit (RPL) model following (Revelt and Train, 1998). RPL has several advantages. First, it captures unobserved heterogeneity. Second, it relaxes the assumption of independence of irrelevant alternatives by making the choice alternatives to be chosen, not to be independent. Following Revelt and Train (1998), the utility that consumer i obtains from alternative j in time period t or choice situation is given by:

$$U_{ijt=}\beta'_i X_{ijt} + y' Z_{it} + \varepsilon_{ijt} \tag{5.1}$$

where β_i is a vector of individual random specific utility parameters (i.e. coefficient vector of unobserved variables for each consumer and varies in the population), X_{ijt} is a vector of observed variables representing honey attributes, γ are consumer parameters which are fixed for all the consumers in the choice set (e.g. price attribute), ε_{ijt} is unobserved random term (result in unobserved heterogeneity) and is assumed to be independent and identically distributed (IID).

Therefore, the probability that consumer i chose alternative j among m alternatives in a choice situation t, conditional on β_i', takes the following specification;

$$L_{ijt}(\beta_i) = \frac{\exp(X_{ijt}\,\beta_i' + \gamma'z_{it})}{\sum_{j=1}^{m}\exp(X_{ijt}\,\beta_i' + \gamma'z_{it})} \qquad (5.2)$$

where β_i' is a vector of unobserved parameters, X_{ijt} is a vector of variables representing honey attributes, m represents the total set of alternatives. Conditional on β_i' the probability of consumer $i's$ observed sequence of choices is the product of standard logits. Suppose β_i' which is the consumers' taste, do not vary across choice situations for one consumer in repeated choice tasks, but they vary over all consumers, the probability can be written as:

$$S_i(\beta_i) = \prod_{t} L_{ijt}(\beta_i) \qquad (5.3)$$

Since β_i is unknown it is integrated out in order to get unconditional choice probability. The unconditional probability of the sequence of choices that consumer i made is given as:

$$P_i(\theta) = \int S_i\,(\beta_i)f(\beta_i|\theta)d\beta_i \qquad (5.4)$$

There are two important concepts of parameters in this equation. The coefficient vector β_i which are the parameters relating to consumer i, (parameters specific to consumer i) and they represent consumer's tastes, and it varies among consumers, and θ which is the mean and covariance of β_i or the parameters describing the distribution of the consumer-specific estimates. The aim of this model was to estimate the θ which is done through choice probability simulation, since Equation 4 which is an integral does not have a closed mathematical form and hence cannot be computed

analytically hence we approximate the probability through simulation and maximize the simulated log-likelihood function. The simulated probabilities were inserted in the log-likelihood function. The log-likelihood function is written as:

$$LL(\theta) = \sum_i \ln P_i(\theta) \tag{5.5}$$

$P_i \theta$ is approximated by a summing all the randomly selected values of β_i. For any value of the parameters θ selected, a value of β_i is drawn from its distribution, and $S_i(\beta_i)$, i.e. the product of standard MNL models, is calculated. These calculations were repeated for numerous draws and the average of the $S_i(\beta_i)$ was viewed as the approximate choice probability, as shown in equation 6 below:

$$SP_i(\theta) = \left(\frac{1}{R}\right) \sum_{r=1}^{R} S_i\left(\beta_i^{r/\theta}\right) \tag{5.6}$$

where R is the number of draws of β_i, $\beta_i^{r/\theta}$ is the rth draw from $f(\beta_i|\theta)$ and SP_i is the simulated probability of consumer i's sequence of choices. As suggested by Train, (2003), standard Halton draws were used in the simulation instead of random draws to increase accuracy of estimation. Up to 100 Halton draws were used in the simulations. The simulated log-likelihood function is:

$$SLL(\theta) = \sum_i \ln\left(SP_i(\theta)\right) \tag{5.7}$$

The estimated parameters are those that maximizes the $SLL(\theta)$. WTP for each attribute is the monetary value that the consumer were willing to pay for an attribute.

Price being one of the honey attributes in the explanatory variables ,trade-offs between the honey attributes and money i.e. consumers' marginal WTP, for each of the other non-price attribute levels were calculated following (Hanemann, 1984) as follows:

$$WTP = -1 * \left(\frac{\beta_k}{\beta_p}\right) \tag{5.8}$$

whereby β_k is the coefficient which is estimated for honey attribute level in the choice set and β_p is the marginal utility of the attribute of price. The marginal WTP (implicit price) for a discrete change in an attribute gives a measure of the relative importance that consumers attach to that attribute within the design. Following Train and Weeks (2005), the current study directly estimated the WTP in a WTP space. This approach involves deriving the WTP estimates directly by reformulating the mixed logit model. It produces more realistic WTP estimates than the conventional method. The model was estimated using maximum simulated likelihood procedure in STATA 16.0 econometric software which utilized 100 Halton draws for the simulations.

5.3 Results and discussion

5.3.1 Respondents' characteristics and honey consumption

More respondents were male about (67.8 percent) with secondary education level and 11 years of completed formal schooling on average as shown in Table 5.4. This corroborates with national statistics, which show that in Kenya, about 84 percent of the population have completed primary education (KIPPRA, 2018).The average age of the respondent was 40years, this shows that they are in economically active age bracket, hence an important segment of honey consuming population. This is in line with Selmi *et al.*(2020) that honey consumers in Kota Bengkulu are

young adults between 21- 45years .The average household had four family members who consume on average 1kg of honey per month.

Table 5. 4:Respondents' characteristics, honey purchase and consumption behaviour

Variable	Statistic (n = 252)
Average age of respondent (Years)	40.4 (13.4)
Average Years of schooling completed (Years)	11.5(3.1)
Average household monthly income (Kshs)	34829 (27944)
Average household size (Numbers)	4.4 (3.4)
Average volume of honey consumed (Kgs per Month)	1.2 (1.0)
Gender of respondent (Percent Male)	67.8
Place of honey purchase (Percent)	
Beekeepers	53.88
Hawkers	20.54
Supermarket	14.34
Kiosk	7.55
Roadside	3.49
Heard of honey produced from established bee flora before (Percent Yes)	60.5
Have consume honey from established bee flora (Percent Yes)	41.5
Frequency of consuming honey per day (Percent Once)	46.9
Frequency of consuming honey per day (Percent Twice)	33.7
Usually read quality labels while buying honey (Percent Nearly always)	12.4
Usually read quality labels while buying honey (Percent Never)	39.2

* Standard deviations are in parentheses (for continuous variables)

The average household income was Kshs 34,829 which is higher than the minimum wage of Kshs13,572 (KNBS, 2019).This implies that respondents were able to afford honey which is quite expensive and even pay for honey attributes. This is in line with Garcia-Yi (2015) that as income increase , people's WTP for yellow peppers grown without pesticides also increase. About 53.38 percent of consumers, bought honey from the beekeepers, while 20.54 percent, 14.34 percent ,7.55

percent and 3.49 percent purchased from hawkers, supermarket, kiosk and roadside respectively. The results show that 46.9 percent of the respondents consume honey at least once per day while 33.7 percent consume twice per day. About 67.5 percent respondents reported of being aware of honey produced from established bee flora and 41.5 percent of the respondents have consumed it. About 39.2 percent of the respondents never read quality label while buying honey.

5.3.2 Preferences for honey quality attributes

Table 5.5 contains the simulated likelihood estimates of the RPL model for different choices. All the honey attributes were specified as random variables with normal distribution, apart from price, which was specified as fixed (Train, 2009).The coefficient for price is significant with the negative sign as expected. The magnitude of parameter coefficients showed how strongly respondents valued the attributes.

The RPL model was highly significant (ρ- value<0.0001) and exhibited a good explanatory power with pseudo- R^2 of 0.34, which is within the recommended range for discrete choice models. Domenich and McFadden (1975) noted that in discrete choice models, a pseudo-R^2 in the range of 20 percent –40 percent is robust. Further, the RPL model shows an improvement from the starting log-likelihood value of -726.187 in the multinomial logit (MNL) model to -536.346 in RPL model.

Table 5. 5: RPL estimates for honey quality attributes

Variable	Coefficient	Standard errors	p-value
Bee flora source	0.229***	0.080	0.008
Origin labelling	0.386***	0.117	0.001
Private certification	-0.554***	0.161	0.001
Joint certification	0.214**	0.098	0.020
Viscosity	0.727***	0.136	0.000
Colour	0.169**	0.088	0.056
Price	-0.015***	0.002	0.000
Standard deviations of parameter distributions			
SdBee flora source	0.818***	0.288	0.005
SdOrigin labelling	0.554**	0.258	0.032
SdPrivate certification	0.397	0.452	0.380
SdJoint certification	0.860***	0.215	0.000
Sd Viscosity	0.856***	0.215	0.000
Sd Colour	0.739***	0.227	0.001
No of respondents	252		
No of observations	3,024		
Log-likelihood	-536.34607		
Pseudo-R^2	0.34		
$\chi 2$ (ρ- value)	628.4(0.000)		

Note: ***, **, * represent statistically significant at 1%, 5% and 10% level respectively.

From the results, consumers had a positive preference for bee flora source attribute and this may be attributed to consumers' awareness of the health risks and would be interested in a product's mode of production (Ngigi *et al.,* 2010). Indeed, this result corroborates those of Warui *et al.(*2014) that shows all honey consumers and producers perceive floral/nectar sources as the major factor that influence the quality of honey. The results also indicated that consumers had positive preferences for origin labelling. This is consistent with (Wu *et al.,* 2015 ;Juma *et al.,* 2016) who found that food and honey labels are important in helping consumers to correctly match with the

products. Origin labeling is crucial in avoiding quality honey being offered lower prices in a heterogeneous market setting like unadulterated honey.

The negative and significant coefficient for private inspection indicates that, consumers lack confidence in private inspection of honey quality and safety. This result contradicts Otieno and Nyikal (2017) where it was noted that consumers had a positive preference for private inspection of artisanal fruit juice. Suffice to note here, the preference pattern for honey attributes is bound to differ from artisanal fruit juice due to variations in targeted consumer segments.

Consumers preferred joint certification (both public and private certification) to the public certification which is the current status quo. This could be attributed to the current limitations by KEBS, since even though honey users find and use mark of quality as an important indicator of honey quality; there are still issues of poor packaging, honey adulteration and pesticide residue even for those found in supermarkets. Despite this, majority of consumers have adopted in buying honey directly from beekeepers. However, such honey may not be safe since it is not certified, and there is also loss of revenues by the government through avoided taxes. Therefore, these findings are relevant in overcoming the certification problem in that, the stakeholders may adopt joint certification.

Consumers also revealed positive preference for continuous honey viscosity (flows continuously) to the one that has a breaking viscosity. These results are similar to (Warui *et al.,* 2014 ;Juma *et al.*, 2016) who found that honey viscosity is an important quality cue to all honey consumers and producers. Dark brown color was more preferred to light brown color. The coefficient for price is

negative and significant as expected, this means that as the price of honey increases, the purchasing power of consumers is reduced and rational consumers will reduce their purchases or seek for substitutes if the utility obtained is less than what they are paying for. Further, the negative and significant coefficient of price allows computation of the consumers' WTP for the honey quality attributes.

The standard deviations of all the random coefficients, except for private certification are statistically significant indicating that honey consumers in Nyandarua have heterogeneous preferences for all the attributes considered. The implication is that the preferences for these attributes are influenced by other factors not included in the model. The preference-heterogeneity observed confirms suitability of the RPL model in the analysis. The estimated means and standard deviations of the normally distributed parameters also show the probability distribution of the population in terms of whether they placed a positive or negative value on a particular attribute.

5.3.3 Heterogeneity in honey attributes preferences

The standard deviations in Table 5.5 suggested preference heterogeneity for honey quality attributes, which indicates that consumers did not attach equal weights to different attributes. To explore the sources of this heterogeneity, socioeconomic characteristics were introduced into the models as interactions. This was done by re-estimating the model, including the interaction terms between the socioeconomic characteristics and selected attributes, accounting for correlations and multicollinearity. Results are presented in Table 5.6.

Table 5. 6:Sources of preference heterogeneity

Variable	Structural parameters		SD of the parameter distribution	
	Coefficient	SE	Coefficient	SE
Bee flora source	0.409***	0.125	0.606	0.281
Origin labelling	0.641**	0.099	0.029	0.511
Private certification	-0.612***	0.181	0.461	0.475
Joint certification	0.392**	0.098	-0.747**	0.364
Viscosity	0.704***	0.135	1.047***	0.257
Colour	0.327**	0.201	0.761	0.236
Price	-0.000***	0.000	0.000	0.000
Heterogeneity analysis				
Origin labelling *income	0.080	0.000	-0.000	0.000
Color*gender	0.427**	0.048	0.683**	0.356
Origin labelling*educ	0.014**	0.005	-0.023**	0.007
Bee flora source*elderly	0.331**	0.145	0.613**	0.283
No of respondents	252			
No of observations	3,024			
Log-likelihood	-536.34607			
Pseudo-R2	0.34			
χ 2 (ρ-value)	728.4(0.0001)			

Note: ***, **, * represent statistically significant at 1%, 5% and 10% level respectively. SE stands for standard errors;

SD stands for standard deviations.

The interaction between gender of the respondent and the dark brown colour shifts the preference for dark brown colour of honey by 43 percent, among the household. Male consumers were more likely to have strong preferences for dark brown color compared to female counterparts. An interaction between the presence of an elderly person (above 50 years old) and bee flora attribute shows that elderly people are more likely to have strong preferences for bee flora source. This implies that old people worry more for food safety because they are more prone to other old age diseases such as blood pressure and diabetes, and the purity of what they consume may improve

their health (Prasad *et al.,* 2012). Consumers with high level of education were more likely to have strong preferences for origin labelling. This is consistent with literature that more learned persons have positive preferences for traceability labels (Seetisarn and Chiaravutthi, 2011).

This study identified gender of the household, education as well as having an elderly person in the household as significant sources of preference heterogeneity in consumers' preferences for three attributes (dark colour, origin labelling and bee flora source). However, the derived standard deviations of parameter distributions for joint certification and continuous viscosity, are still highly statistically significant. This indicate that the heterogeneity in the preferences for these attributes is caused by factors other than the socioeconomic characteristics included in the model.

5.3.4 Willingness to pay for honey quality attributes

The mean values of the parameters in Table 5.6, were used to estimate consumers' marginal willingness to pay (WTP) for different honey quality attributes. WTP estimates are the derivation of the marginal rate of substitution between significant attributes and significant purchase prices, measuring implicit prices of possible trade-offs across traits conditioned on the choices made by an individual (Hensher and Greene, 2003) . Table 5.7 shows the WTP matrix estimated in the WTP space.

Table 5. 7:Willingness to pay (WTP) estimates for honey quality attributes (Kshs)

Variable	WTP (at 95 percent CI)	p-value
Bee flora source	58.29***	0.002
	(41.703 to 125.873)	
Origin labelling	60.161***	0.001
	(47.715 to 198.61)	
Private certification	-108.421***	0.000
	(-64.418 to 7.42)	
Joint certification	45.002**	0.011
	(10.395 to 79.609)	
Viscosity	109.443***	0.000
	(67.969 to 150.917)	
Colour	40.397***	0.004
	(23.370 to 89.164)	

Note: ***, **, * represent statistically significant at 1%, 5% and 10% level respectively.

Consumers were willing to pay Kshs 60 per 500g of honey for origin labelling; Kshs 109 for continuous viscosity; Kshs 58 for bee flora source; Kshs 45 for joint certification and Kshs 40 for dark brown color. However, consumers were demanding for a discount of Kshs 108 to accept certification by private institutions. This shows that they lacked confidence in private inspection of honey. Compared to the current price per 500grams of honey, the WTP estimates show that consumers would pay a premium of 15percent for bee flora label. They would also pay 25percent for origin labelling. These results are similar to Juma *et al.* (2016) who found that consumers were willing to pay a premium for geographical labelling. Consumers were also willing to pay a premium of 10 percent for joint certification, 27 percent for continuous viscosity and 11 percent for dark brown color. Often, color preferences is largely related to household consumption preferences, however, consumers may have a perception that dark brown colored honey is of better quality. The negative and significant sign for the coefficient on private certification implies that

consumers were demanding for a 27 percent discount to accept certification by private institutions. This is consistent with Owuor et al. (2022) who found that consumers were not willing to pay for private inspection of orange fleshed sweet potatoes. Results also show that consumers were willing to pay more for continuous viscosity compared to all the other attributes.

5.3.5 Conclusions and policy recommendations

The results showed that consumers would be willing to pay premiums for honey that is; produced organically from established bee flora; labeled as where it comes from; inspection and certification is done by joint (both private and public) institutions; has continuous viscosity and dark brown in color which indicates different minerals in honey. The most valued attribute was honey viscosity, followed by origin labelling, bee flora source, joint certification and dark brown color. Therefore, the design of honey quality should include these features to increase its acceptability. However, consumers were demanding for a discount for inspection and certification by private institutions. Further analysis showed that the source of preference heterogeneity was explained by gender, education level and presence of an elderly person. Consumers' willingness to pay for the attributes was consistent with their preferences. The null hypothesis is therefore rejected, and the study concludes that consumers are willing to pay for honey quality attributes.

Based on the results, several policy implications can be drawn from this study. First, honey producers should be sensitized on planting bee flora for the bees as this will ensure production of quality honey and build consumer confidence. Second, the origin labelling of honey is necessary as a means of identification and creating trust in quality calls for consultations between quality regulators and honey producers on the appropriate standard logos to use for honey quality. Since

consumers preferred public-private inspection and lacked confidence in private institutions, it would be rational to address the weaknesses in the private institutions that lead to distrust of these institutions. This would help in implementation of public-private inspection and sharing of value chain responsibilities for greater accountability in inspection and certification of honey quality. This partnership would ensure the pricing of honey is within the affordable range by consumers. Capacity build everyone along the honey value chain.

Effective enforcement and monitoring to ensure compliance with the attributes that consumers desire will require participation by the government, Consumer Federation of Kenya and the media. The results of this study, provide insights into how consumers value different honey quality attributes. Policy makers would need to consider these results during implementation of interventions in honey value chain. Hence, these recommendations should serve as a starting point in incorporating honey aspects to ensure that honey value chains are responsive to the needs of the society.

CHAPTER SIX: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Summary

The thesis sought to assess perceptions and willingness to pay of quality attributes of honey that would inform consumers' decision to purchase honey. Explicitly, the study sought to (i) assess factors influencing consumers' perceptions of honey quality attributes; (ii) evaluate consumers' willingness to pay for honey quality attributes. The PCA identified origin, bee flora, color and viscosity as key intrinsic attributes as the important indicators that inform consumers' decision to purchase honey. To assess factors influencing consumers' perceptions of honey quality attributes, the study used multiple linear regression. Results from multiple linear regression shows that education, income, bee flora source awareness, place of purchase and prior information positively and significantly influenced consumers' perceptions of honey attributes while price negatively influenced perceptions.

The origin aspect of quality attributes was perceived to be important to consumers who had high income, bought honey from beekeepers and sought prior information before purchase. Price had a negative influence. The origin of honey aspect highlights a particular appeal for honey labelled with its origin. The bee flora aspects was influenced by consumers who had high income, were aware of honey produced from established bee flora, bought honey from beekeepers and those who sought honey prior information before purchase. The bee flora aspect shows consumers' acceptance of interventions of planting bee flora as a confirmation of honey quality. The color and viscosity as key intrinsic attributes aspects was influenced by consumers with high education level, are aware of honey produced from established bee flora and those who sought prior information before purchase.

To evaluate consumers' willingness to pay (WTP) for honey quality attributes, this study used choice experiment design method to elicit consumers' preferred attributes and random parameter logit (RPL) model was employed to analyse WTP values. Preference heterogeneity was observed for three attributes; bee flora source, origin labelling and dark brown color which confirmed the use of the RPL model. Consumers were willing to pay for bee flora source, origin labelling, joint inspection and certification, continuous viscosity and dark brown color of honey, however, they were demanding for a discount for private inspection and certification of honey. Bee flora source is an indication that honey is produced from established bee flora which is a confirmation of quality honey. The origin labelling informs the consumer where the honey is coming from. Inspection and certification was important in assuring consumer confidence in handling and inspection of honey. Color and viscosity as intrinsic attributes allow consumer flexibility on what they desire as the quality cue. Therefore, this study provides insights into how consumers value different honey quality attributes.

6.2 Conclusions

The study concludes that most consumers were aware of honey that is produced organically from established bee flora. The study also identified origin, bee flora, color and viscosity as key intrinsic attributes which inform consumers' decision to purchase honey. The origin aspect was perceived to be more important by consumers and explained maximum variation. Empirical evidence showed that consumers' perceptions were highly influenced by education, income, bee flora source awareness, place of purchase, prior information and price.

The study further concludes that, all consumers were willing to pay premiums for honey that is; produced from established bee flora; labeled as where it comes from; inspection and certification is done by joint (both private and public) institutions; has continuous viscosity and dark brown in color which indicates different minerals in honey. The most valued attribute was honey viscosity, followed by origin labelling, bee flora source, joint certification and dark brown color. However, consumers were demanding for a discount for inspection and certification by private institutions. Further analysis showed that the sources of preference heterogeneity was explained by gender, education level and presence of an elderly person. Consumers' willingness to pay for the attributes was consistent with their preferences.

6.3 Recommendations for policy

Consumers' preferences signify what they would like to have as quality honey. This calls for collaborations between various stakeholders in the honey value chain to incorporate the identified attributes in the existing guidelines for honey in order to ensure sustainable consumption of honey. The origin of honey was perceived to be important, therefore the county government should increase incentives for local production. Consumers were willing to pay for bee flora source and therefore, the county government and development partners should support the establishment of bee flora in order to ensure honey quality and build consumer confidence. Bee flora label should be included in the packaging and quality standards.

Based on the findings, the study also recommends the need for joint inspection and certification of honey which will improve consumers' confidence in honey. Regulatory agencies such as Kenya Bureau of Standards and consumer protection agencies such as Consumer Federation of Kenya should collaborate and ensure the honey that is produced meets the required quality standards and

that labelling is done to provide information on the origin of honey to consumers. Since consumers were not WTP for private certification, it would be rational to address the weaknesses of the initiatives in the private institutions.

6.4 Recommendations for further research

The current study was hypothetical in nature. Therefore, further studies should provide more insights through evaluation of actual honey samples by presenting the real honey to consumers. This study focused on consumers since consumers are the final customers of the honey value chain, further research should look at honey markets and preferences of other value chain actors especially honey producers who provide quality honey, traders and processors for effective compliance with attributes that consumer desires.

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Appendix 1: Consumer Survey Questionnaire

ANALYSIS OF CONSUMER'S PERCEPTIONS AND WILLINGNESS TO PAY FOR HONEY QUALITY ATTRIBUTES IN KENYA.

June 2022

Introduction

(Before commencement of the survey read the consent form to the consumers to make them understand the purpose of the survey and get their consent to go on with the administration of the questionnaire.)

Thank you for the opportunity to speak with you. This research survey is being conducted under the collaboration of the University of Nairobi, Department of Agricultural Economics and Kenya Agricultural and Livestock Research Organization (KALRO) for academic and research purposes. The purpose of this study is to understand honey consumers' perceptions and preferences for characteristics of honey. Respondents for this survey should be household head honey consumers who are at least 18 years old.

The survey will cover 450 respondents and you have been selected to participate in the interview. The information provided will be treated with a high sense of confidentiality. Your name will not appear in any data or report that is made publicly available and the information you provide will be used solely for academic and research purposes to help improve honey quality. The interview will take approximately 30mins. I now request your permission to begin the interview.

Screening questions:

1. Do you or your household normally consume honey?

[1 = Yes, 0 = No].

2. Are you one of the primary food (honey) shoppers in your household?

[1 = Yes, 0 = No].

Respondents that answer YES to both questions should proceed with the survey. Those answering NO should **exit** from the survey

NOTE; all answers are correct as they express consumers opinion from his/her use of honey

Section A: General Information

A/1   Name of Respondent……………………………………………….........

A/2   Phone number of respondents: _____

A/3   Are you a household head? Yes.................No.....................................

A/4   If, NO. How are you related to the Household Head……………?

A/5   County: [_____] 1 =Nyandarua

A/6   Sub-county: _____

A7   Ward: _____

A/8   Location: _____ A/9 Sub-location: _____

A/10   Village: _____

A/11   GPS Reading: Latitude-(N/S): _____   Longitude (E): _____   A/7

           Altitude: _____ (metres above sea level)

Section B: Honey purchase and consumption behaviour

1. Does your household consume honey regularly? ……………. [1=YES 0=NO]

2. If NO what is the reason? (1=Not Available, 2=Poor quality,4=expensive, 5=Allergic 6=don't trust the producers 6=other, specify…………………………………….)

3. What could be your motivation to consume honey? [1= To keep a healthy lifestyle ,2= For medicinal value 3= Religious and customary reasons ,4= I don't Know 5= other, specify…………...]

4. What is the main use of honey you normally buy? (1=Spread, 2=sweetener, 3=Baking, 4=Medical, 5=preservative, 6=baby use ,7=other (specify) ……………….

5. How many times a day do you use honey? (1=once 2=twice 3=thrice 4=other specify……………………)

6. What are the major doubts/issues you have encountered in the honey that you consume?

(1=Crystallization 2=pesticide residues 3=fake or adulterated honey 4= Packaging 5=other (specify)……………….)

7. How much honey has your household consumed per month over the last one year?............(kilograms)

8. Where do you buy your honey 1=Supermarket, 2= Beekeeper, 3= Hawker, 4=kiosk 5= roadside 6=market 7=other (specify)………………………

9.How much do you pay for 500g of honey……………? (Kshs)

Section C: Consumers' perceptions on the honey quality attributes

10. Have you ever heard about honey that is produced from established bee flora? [1 = Yes, 0 = No]

Skip Q11 if the response to Q10 is No.

11 (i) If YES, what was your main source of information? (Through 1= Meeting/Seminars, 2= Friend, 3=Observation, 4= Radio, 5= Television, 6= Newspaper, 7= Internet options e.g. face-book, twitter, 8= Other (Specify)…………………………….)

(ii)If YES have you consumed honey it? (*Hint: Honey from established bee flora*) [1 = Yes, 0 = No]

If the response to Q11(ii) is Yes skip Q12

(iii) If NO what is the main reason?.....................................

12. What do you think is the effect of the honey that is produced from established bee flora on honey quality?...(1=It will improve the honey quality,2=It will not help to improve honey quality, 3=I don't know)

13.Please give your opinion on your perceptions on quality attributes of honey on a scale of 1 to 5(whereby 1= Strongly Disagree,5=Strongly Agree).

Statement	1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree
Food safety and quality	
Honey should be thick in viscosity for it to be quality.	
Dark colored honey is of better quality than bright colored honey	
I prefer honey from beekeepers since i know the source	
Honey bought from beekeepers is better than honey bought from a supermarket	
Color determine quality of honey	
Color is determined by the bee flora	
Viscosity determines honey quality	
Viscosity is determined by the bee flora	
Improving honey quality is critical to ensuring food safety	
Honey must be of high quality and confirmed by authorized institutions	
I think there's too much surrogate(false) honey in the market	
When I'm buying honey, the county of origin is more important to me	
I do not believe in the validity of honey in Kenya	
I consider the current quality standards of honey to be inadequate	
Planting bee flora near the bee hives will contribute to quality honey	
Managing bees in bee houses will contribute to quality honey	
I consume honey because it is safe for my health	
The quality of honey is more important to me than price	
Iam satisfied with the quality of honey from open apiary and will never consume honey from closed apiary	
I choose honey depending on the county of origin	
When I'm buying honey it's important that honey is from local producers	
The higher the price the higher honey quality	

Section D: Consumers' Preferences

14. Which brand of honey do you prefer the most and why? Brand (1= Mwingi, 2= Kitui 3= Baringo, 4=Kajiado 5= Nyandarua, 6= Other...)

Reason..

15(a) Have you ever tasted honey from Kajiado and Nyandarua [Yes=1,

No=0]

(b) If No, why? [1=Is it because you don't believe there's honey ,2=It does not taste good, 3=Other

specify……………………………………………………………………]

16. If you get honey from Kajiado and Nyandarua, which one would you prefer? (1=Kajiado

honey, 2=Nyandarua honey,3= Other specify……….)

Reason...

17. Which honey would you prefer depending on the production system (1=Honey produced from

open apiary,2=Honey produced from closed apiary)

Reason…………………………………………………………………………………………

…...

18. Which honey would you prefer depending on the hive type [1=Honey produced from log

hive;2= Honey produced from improved hives (Langstroth and KTBH); 3=Honey produced from

modified hives;4=Other, specify]

19. Please indicate your preferred features of honey below.

(i)Honey source[1=local2=imported] …………………………………………………
(ii)Imported and Local brand used List……………………………………………………
 (iii)Climate of production [1= semi-arid areas 2=Highlands] ………………………
(iv)Color [1=Light brown   2=Dark brown] ………………………………………………
(v)Viscosity [1= Continuous 2=Breaking] …………………………………………………
(vi) Production type [1=organic 2=non-organic] ………………………………………...
(vii) Honey form [1=processed 2=unprocessed] …………………………………………
(viii) Region of production in Kenya List……………………………………………………
20. How important are the following factors as indicators of honey quality during purchase

	1= Not very important 2= Not important 3=Neutral 4= important 5=Very important
County/area of origin	
Price	
Colour	
Taste	
Texture	
Honey Viscosity	
Bee flora source	
Production system	
Packaging	
Labelling	
Organic honey	
Certification indicator	
Mark of quality	
Brand name	
Storage instruction	
Expiry date	
Nutritional information	

21. How often do you read honey quality labels when purchasing honey?

(1=Never, 2=Rarely, 3=Occasionally,4=Often,5 =Always)

22. Do you normally seek prior information regarding any of the aspects on the above

question before making honey purchase decisions? _____ [1=YES 0=NO]

If yes, where do you normally seek information……………….

Section F: Choice Experiment

Suppose the honey industry in Kenya were to be reformed (redesigned) and your opinion is consulted on how the product needs to be developed. You are required to choose the best combination of voluntary features/attributes that should be considered in the new honey

Attributes	Description of attributes	Attribute levels
Bee flora	Indication of whether honey is produced from established bee flora or not.	Yes; No
Origin labelling	Indication of information about the place where the honey is produced	Yes; No
Inspection and Certification	Which institution should do inspection and certification of honey quality and safety?	Public agency e.g. KEBs; Private agency e.g. Kenya Consumer Organization; Joint inspection by public and private institutions
Honey viscosity	flow of honey	Continuous; Breaking
Color	Color of the honey	Dark brown; Light brown
Price	Price of 500grams of honey in Kenya Shillings	350;400;450

I would like to show different honey type scenarios and their options that can be made by combining the above attributes and their levels. You are requested to compare them carefully and indicate which one you prefer.

Profile 1

Scenario 1

	Honey option A	**Honey option B**	**Status quo**
Bee flora	No	No	
Origin labelling	No	No	
Inspection and certification	Joint	Private	
Viscosity	Breaking	Breaking	
Color	Light brown	Light brown	
Price	450	350	
Which one would you prefer?			

Scenario 2

	Honey option A	**Honey option B**	**Status quo**
Bee flora	Yes	Yes	
Origin labelling	Yes	No	
Inspection and certification	Private	Joint	
Viscosity	Continuous	Breaking	
Color	Light brown	Dark brown	
Price	350	450	
Which one would you prefer?			

Scenario 3

	Honey option A	Honey option B	Status quo
Bee flora	No	Yes	
Origin labelling	Yes	Yes	
Inspection and certification	Public	Private	
Viscosity	Breaking	Continuous	
Color	Light brown	Light brown	
Price	400	400	
Which one would you prefer?			

Scenario 4

	Honey option A	Honey option B	Status quo
Bee flora	Yes	No	
Origin labelling	Yes	Yes	
Inspection and certification	Joint	Public	
Viscosity	Breaking	Breaking	
Color	Dark brown	Dark brown	
Price	450	450	
Which one would you prefer?			

Scenario 5

	Honey option A	Honey option B	Status quo
Bee flora	Yes	No	
Origin labelling	No	No	
Inspection and certification	Public	Public	
Viscosity	Continuous	Continuous	
Color	Dark brown	Light brown	
Price	350	400	
Which one would you prefer?			

Scenario6

	Honey option A	Honey option B	Status quo
Bee flora	No	Yes	
Origin labelling	No	Yes	
Inspection and certification	Private	Joint	
Viscosity	Continuous	Continuous	
Color	Dark brown	Dark brown	
Price	400	350	
Which one would you prefer?			

Validation questions on choice experiment responses

23. How sure are you about the choices you made in the honey options (types)? [1= Very sure, 0= Not sure] ………………………………………………………………………………………….

24. Were you considering and comparing all attributes before you made a choice? [1= Yes, 0= No]

25. Were there specific attributes you were looking for in each choice option before you made each decision? [1= Yes, 0= No]. If yes, list the selected attributes; ……………………………………………………………………………………………………

26. Were there specific attributes that you ignored in each choice option before you made your choices? [1= Yes, 0= No]. If yes, list the selected attributes; ………………………………………………………………………………………………….

27. Is there any other factor that influenced your responses to the choice experiment questions besides the information given? [1= Yes, 0= No] If yes, please specify …………………………………………………………………………………………………

SECTION G: CONSUMER CHARACTERISTICS AND DEMOGRAPHICS

28. Indicate how the statements below best describe you and your household;

	1=(Never) 2=(Rarely) 3 = (Not sure) 4 = (Often) 5 = (Always)
Read newspaper/magazine articles on food safety	
Listen to radio discussion programmes about food safety	
Watch television/cable programmes on food safety	
Pay more to ensure safe food is purchased	

29. Marital status of the respondent: [0=never married, 1=married,2=divorced, 3= Widowed]

30. Please indicate your age in years ……………………...

31. Please indicate your occupation [1= Farmer; 2 = civil servant; 3 = trader; 4 = Boda-boda operator; 5= Building and construction; 6 = other, specify…………………………………]

32. Gender of the respondent: [1= Female, 0= Male]

33. Excluding yourself, how many members of your household are in the following age groups?

		Males	**Females**
(i)	Pre-school children – less than 5 years		
(ii)	School children - 5 -18 years		
(iii)	Youth 18-35years		
(iv)	Adults - 16-50 years		
(v)	Elderly - Above 50 years		

34. Please indicate your highest level of education attained

	Education Category	**Tick Category**	**Years of completed schooling**
(i)	Primary School		
(ii)	High / Secondary School		
(iii)	Some College or Diploma		
(iv)	Bachelor Degree		
(v)	other, specify		

35. What is your approximate household monthly income?

Income Category (KSHS)	**Tick Category**	**Gross Household Income**
Less than 10,000		
10,001 – 20,000		
20,001 – 40,000		
40,001 – 75,000		
75,001 – 100,000		
100,001 – 200,000		
Above 200,000		

Thank you for your participation.

Approved by (supervisor name) ……………………………. Signature: ....Date…………

Appendix 2: Model diagnostics of Variance inflation factor for OLS

	VIF	1/VIF
Age	1.446	.691
Educ	1.38	.725
Household size	1.338	.747
Occupation	1.247	.802
Income level	1.166	.858
Gender	1.075	.93
Prior information	1.073	.932
Awareness	1.066	.938
Honey source	1.049	.954
Frequency of consumption	1.022	.978
Mean VIF	1.186	.

Notes: If VIF <10, there is no multicollinearity

Source: Survey Data (2022)

Appendix 3: Heteroscedasticity test

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

Ho: Constant variance

Variables: fitted values of Overall Index

chi2(1)   =   2.62

Prob > chi2 =   0.1052

Appendix 4: NGENE choice experiment design syntax

a) Orthogonal design for preliminary survey

Design

; alts = alt1, alt2

; rows = 36

; block = 6

; orth = sim

; model:

U(alt1) =b0+b1*x1[0,1] +b2*x2[0,1] +b3*x3[0,1,2] +b4*x4[0,1] +b5*x5[0,1] +b6*x6[0,1,2]/

U(alt2) = b1*x1 +b2*x2 +b3*x3 +b4*x4 +b5*x5 +b6*x6$

Attributes are listed in this order:

X1 = Bee flora label

X2 = Origin labelling

X3 = Inspection and certification

X4 = Viscosity

X5 = Color

X6 = Price

b) Efficient design for final survey

Design

; alts = alt1, alt2

; rows = 24

; block = 6

; eff = (mnl,d)

; model:

U(alt1) =b1[0.28] *x1[0,1] +b2[0.35] *x2[0,1,2] +b3[0.81] *x3[0,1] +b4[0.3] *x4[0,1] +b5[0.36] *x5[0,1,2] +b6[-0.02] *x6[0,1,2]/

U(alt2) = b * x1 + b2 * x2 + b3 * x3 + b4 * x4 + b5 * x5 + b6 * x6$

Appendix 5: Mixed logit/random parameter logit and willingness to pay syntax in STATA

global Y "choice"

global X2 "price"

global X1 "bfyes olyes certprv certjnt viscont dakbrwn"

global X3 "Agedrk orgeduc"

gen obsid= respondent*10^2+ scenario

gen cons=1 if alternative==3& choice==1

mixlogit $Y $X2 cons, group(obsid) id(consumerid) rand ($X3 $X1) nrep (100)

mixlogitwtp $Y, group(obsid) id (consumerid) price (price) rand($X1) nrep (100)

gen Agedrk= age* dakbrwn

display "pseudo R2=" (e(ll_0)-e(ll))/e(ll_0)