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Consumer preferences, and willingness to pay for safe pork products in rural Kenya

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Abstract

Designing interventions to support the safe development of rapidly growing livestock value chains in sub-Saharan Africa requires a clear understanding of consumer demands. This study aimed to determine purchase patterns, consumers' preferences, and willingness to pay for safe pork attributes; specifically, the presence of a veterinary inspection stamp and the cleanliness of the butchery.

A discrete choice experiment-based survey was used to investigate the purchasing behavior of 401 pork consumers: 253 buying raw pork for household consumption, and 148 buying cooked pork for out-of-home consumption. The study findings indicate that the average quantity of pork purchased by consumers was approximately 0.4 Kg per transaction, with the majority of consumers making several purchases per week.

The average price per Kg of pork was KES 310 (Approx. 2.60 USD) at the time of the study. Data from the choice experiment showed that consumers were willing to pay a price premium of KES 245 (Approx. 2.1 USD) and KES 164 (Approx. 1.4 USD) per Kg for evidence of better veterinary meat inspection and higher butchery hygiene respectively; further, these were the two most important attributes they considered while making a pork purchase decision.

These findings highlight the potential to leverage consumers' willingness to pay to improve the food safety within pork value chains in this context. Investing to increase consumer awareness on food safety issues should be considered to generate an effective market demand, especially in rural areas with relatively lower literacy levels.

Keywords: Food safety; Government regulation; Rural population; choice experiment; Consumer behavior

1. Introduction

The Food and Agriculture Organization projects a 155% increase in demand for pork in African countries between 2000 and 2030 (FAO, 2011) and in Kenya, a 268% increase in demand for pork is anticipated between 2010 and 2050 (FAO, 2017). While this presents a great opportunity for improved livelihoods and food security especially for the rural poor, most supply chains lack the requisite public health infrastructure to handle such a burst in production without resulting in frequent and intense foodborne disease (FBD) outbreaks.

The World Health Organization estimated that in 2010, 33 key food safety hazards caused between 420 – 960 million cases of foodborne diseases and 310,000 – 600,000 deaths globally (WHO, 2015). This accounted for 33 million disability-adjusted life years, with a disproportionately higher burden observed in low-resource settings, leading to further impoverishment through debt and foregone incomes (WHO, 2015). Jaffee et al., (2018) quantified the productivity losses attributable to FBDs in sub-Saharan Africa (SSA) at approximately US$ 16.7 billion in 2016. In Kenya, economic losses attributable to FBDs are equivalent to 1.14% of the national GDP (Hoffman & Baral, 2019). FBDs associated with rapidly growing meat value chains are therefore likely to unravel any economic gains generated by the increase in demand (Li et al., 2019).

The majority of sub-Saharan African governments struggle with implementing food safety regulations, mainly due to resource constraints and the diverse nature of the food systems that require regulation (Grace, 2015; Jaffee et al., 2018). To design solutions that augment direct public regulation, a thorough understanding of consumer habits and preferences is required as these greatly influence the nature of value chains—consumers not only determine the quantities but also the quality of what is produced (Alonso et al., 2020; FAO, 2014; Jaffee et al., 2018).

Consumer preferences and willingness to pay (WTP) studies are usually conducted to guide

public and private firms on pricing strategies and/or new product development (Breidert, 2006).

Further, WTP provides a means to quantify the value consumers derive from a product or certain

product attributes; specifically, how consumers perceive the value of various products /attributes

(Breidert, 2006; Louviere et al., 2010). Consumer preference and WTP studies have largely been

applied in food safety research to assess the market viability of voluntary food safety standards

to complement the mandatory baseline government regulations, mostly in developed countries

and emerging markets in Asia. In SSA countries, the focus has been on urban consumers with

very little information on rural consumers[1], therefore leading to insufficient representation

(Jabbar et al., 2010; Lai et al., 2018; Ortega et al., 2011; Ortega & Tschirley, 2017; Thi Nguyen

et al., 2019; Wu et al., 2015; Xu et al., 2019; Zhang et al., 2012).

Rural western Kenya is one of the leading pig production regions in the country with pork

becoming a popular choice of meat amongst consumers in that area, as well as a source of supply

for more distant urban sites (FAO, 2012; Kagira et al., 2010a; Murungi et al., 2021). Because of

the potential within this value chain, several studies have characterized the production practices

and public health risks at the farms (Kagira et al., 2010a, 2010b; Mutua et al., 2012; Thomas et

al., 2013), described the public health standards at the slaughterhouses (Cook et al., 2017), and

outlined the pork marketing dynamics at the retail level (Levy et al., 2014). Kenyan laws require

that all livestock intended for human consumption should be slaughtered in a registered slaughter

facility in the presence of a certified government meat inspector. Upon confirmation of the

absence of pathogenic microorganisms or any other injurious factors to consumers, carcasses

deemed fit for human consumption are subsequently affixed with the official food-grade

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[1] According to the World Bank data for 2021, 72% of the population of Kenya were living rural areas (World Bank, 2022 - https://data.worldbank.org/indicator/SP.RUR.TOTL.ZS?locations=KE).

veterinary stamp of approval (Government of Kenya, 2012a). Additionally, the law requires that all food vending outlets should observe hygiene and safety measures (Government of Kenya 2002; 2012b).

One of the unifying conclusions from the aforementioned studies is that this value chain is vulnerable to numerous public health hazards, mainly due to the inadequate enforcement of the food safety regulations because of insufficient government resources, resulting in the sale of uninspected pork (Cook et al., 2017; Thomas et al., 2017; Wilson et al., 2020). Currently, there are no data on the purchasing behavior of consumers, their preferences, and WTP for safe pork in rural western Kenya. This is a critical issue, as consumers play a substantial role in the value chain, and understanding their demands for pork in terms of both quantity and quality is essential.

The objectives of this study were therefore to: (1) describe purchase patterns, and (2) determine the preferences and WTP for food safety for pork consumers[2] in rural western Kenya, allowing us to quantify pork consumers' value assigned to current indicators of food safety -i.e., veterinary stamp of inspection and butchery hygiene. The findings are useful contributions to guide the design of interventions that promote efficient compliance with current food safety regulations among key value chain stakeholders in rural areas.

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[2] The terms used in this study, namely "participants," "respondents," "consumers," and "customers," all refer to individuals who are pork consumers within rural western Kenya, constituting the target population under investigation. The variation in terminology throughout the article serves to enhance clarity for the reader within specific contexts."

2. Materials and Methods

2.1. Study design

The study area—Matayos sub-county— is located in Busia County, western Kenya within the Lake Victoria ecosystem, a region with the highest rural human and livestock population densities in East Africa (Falzon et al., 2019). Busia County borders Uganda to the West, Lake Victoria to the Southwest, Kakamega to the East, and Bungoma to the North, and is further sub-divided into seven sub-counties. Matayos sub-county was selected purposively as it is representative of a consumer population that has an increasing demand for pork within a rural economy where pig production is expanding (Kagira et al., 2010a).

To achieve the research objectives, a cross-sectional study design was utilized. The sample size was determined using Cochran's formula, employing a 95% confidence interval and 5% margin of error, assuming a 50% willingness among consumers to pay for safe pork products (Dohoo et al., 2003). With assistance from veterinary and public health officials, a comprehensive list of all pork retail outlets in the study area was compiled. At the time of the study, there were a total of 74 such outlets in the study area. Matayos sub-county comprises five administrative wards. Due to logistical limitations, ten butcheries per ward were randomly selected from the list provided. Guided by the calculated sample size requirements, proportional allocation of respondents per ward was determined based on each ward's total butchery population relative to the sub-county's overall butchery count (Dohoo et al., 2003). Additionally, prior consultations with pork retailers revealed that 63% of their sales were to consumers who proceed to prepare it in their households (hereby referred to as 'household consumers') and 37% to consumers who eat pork at local

restaurants referred to as 'pork joints' (hereby referred to as 'pork joint consumers') in 2019[3].

Therefore, the sampled respondents were also proportionally allocated based on whether they

were household or pork joint consumers. The study comprised 401 pork consumers, of which

253 were "household consumers" and 148 were "pork-joint" consumers, referred to as the

respondents.

2.2. Discrete Choice Experiment

Choice data were collected using a discrete choice experiment (DCE); this is a quantitative

research technique that involves asking individuals to state their preference over hypothetical

alternative products. Each alternative is described by at least two attributes (Hensher et al.,

2015). In a DCE, individuals are asked to choose the alternative they prefer most thus enabling

the estimation of individuals' trade-offs between attributes and their relative importance.

Furthermore, respondents' WTP for any individual attribute can be estimated if the set of

attributes used to describe the alternative products includes the attribute price (Louviere et al.,

2010; Klaiman et al., 2017).

2.2.1. Selection of choice attributes and levels

Existing literature in the study area revealed that pork is sometimes sold to consumers without

undergoing the requisite veterinary inspection, thus lacking the veterinary stamp of approval

(Cook et al., 2017; Government of Kenya, 2012a; Thomas et al., 2017). The authors, therefore,

considered the veterinary stamp as an attribute of interest to enable the quantitative assessment of

the importance that pork consumers in this area attach to veterinary inspection (Helter &

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[3] These figures are based on prior work involving a cross-sectional survey conducted in 2019 within the larger Busia County, which encompasses the study area (Matayos). This survey entailed the mapping and quantification of pork product flows concerning food safety risks within the pork value chain. The corresponding manuscript is currently under preparation.

Boehler, 2016; Mangham et al., 2009). Additionally, three focus group discussions (FGDs) with pork consumers in the study area were conducted to identify other attributes that are important to them when buying pork, and to identify reasonable price levels for the experiment (FGD guide in Supplementary material 1). FGD participants were chosen based on their proximity to the main town center, with one FGD conducted within, one near, and one far from the center. To recruit participants, pork retailers in the respective areas were requested to provide a list of customers who frequently purchased pork from them. Invitations were then extended to those customers who agreed to participate, resulting in the formation of the FGDs[4]. The FGDs were conducted in Kiswahili, the language that all participants understood. These were moderated and documented to achieve a collective agreement regarding various responses. The same researcher moderated all FGDs, to ensure consistency in approach.

Based on the data from the focus groups, seven pork attributes were identified: i.e., presence of a veterinary stamp of inspection, butchery hygiene, fat content, good customer service, the freshness of the pork, distance to the butchery from home, and trust in the butcher. Asking respondents to choose from pork alternatives described in terms of seven attributes would have been cognitively overwhelming (Hensher et al., 2015). The final selection of attributes for inclusion was determined based on the FGD findings and the authors' judgement, considering the sociodemographic characteristics of the study area, especially the literacy levels (Helter & Boehler, 2016; Mangham et al., 2009). Furthermore, during the Focus Group Discussion (FGD) exercise, it became evident that the concept of trustworthiness intersected with the notion of a veterinary stamp, as one of the definitions of trustworthiness encompassed retailers who

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[4] While self-selection bias stemming from individuals who were unable or declined to participate could have potentially influenced the findings, the authors believed that due to the distinct nature of the three separate FGDs, each involving 10-11 participants, its impact on this study's findings would be limited, in contrast to the effect it might exert on a survey.

guaranteed the sale of pork that had undergone inspection. Additionally, the definitions provided for excellent customer service were characterized by subjectivity and variability, posing challenges for enumerators in accurately describing them during the experiment without potentially influencing the choice responses (Helter & Boehler, 2016; Mangham et al., 2009). Consequently, the three most salient, visually identifiable attributes across the three FGDs, namely a veterinary stamp of meat inspection, butchery hygiene, and fat content, were considered, as obtained from a ranking exercise that was part of the group discussion (Table 1). Price was then included as an attribute to facilitate the derivation of WTP from the non-price attributes. (Breidert, 2006). The decision on price levels to include in the choice experiment was arrived at through an exercise where participants were asked to vote for different price levels ranging between 5 -20% of the current price per Kg. The attributes and their levels are described in Table 2.

In Kenya, meat inspection is confirmed by the presence of a certification stamp by certified government meat inspectors. This attribute was therefore represented using two levels: the presence or absence of a stamp. Butchery hygiene was represented using two levels: a hygienic butchery or an unhygienic butchery. Divergent views regarding pork fat content preferences were reported by FGD participants. Consequently, three levels representing this attribute, namely low fat, medium fat, and high fat content, were designated based on the extent of marbling and thickness of subcutaneous fat in the pork leg/ham. Finally, price levels ranged from KES 300 to KES 390 per kg[5].

Table 1: Ranked attributes from focus group discussion (FGD) exercise

Ranking	FGD 1 (11 participants)	FGD 2 (11 participants)	FGD 3 (10 participants)

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[5] The average exchange rate in 2019: 1 USD = 102 KES.

1	Veterinary stamp	Veterinary stamp	Veterinary stamp
2	Hygiene	Hygiene	Hygiene
3	Freshness	Good customer service	Trustworthiness
4	Medium fat content	Medium fat content	Good customer service
5	Low-fat pork	Freshness	Medium fat content
6	Good customer service		

Table 2: Pork attributes and attribute levels in the choice experiment

Product attribute	Attribute level
1. Veterinary stamp	Veterinary stamp
	No veterinary stamp
2. Butchery hygiene	Hygienic butchery
	Unhygienic butchery
3. Fat content	Low-fat
	Medium fat
	High fat
4. Price/kg	KES 300
	KES 330
	KES 360
	KES 390

2.2.2. Experimental design

A full factorial design using the identified attributes and their levels would have resulted in 48 different profiles (2 veterinary stamp ×2 butchery hygiene ×3 fat content ×4 price levels). These would have further translated to 17,296 choice cards - based on the mathematical combination, c(48,3). These are logistically prohibitive to run and would have imposed a high cognitive burden on the respondents (Hensher et al., 2015). The optimal number of choice cards for the experiment was determined based on the formula suggested by Hensher et al. (2015), which recommends the minimum number of choice cards to be equal to [Number of parameters to estimate/ (number of alternatives -1)]. Using the "%ChoicEff Macro" of SAS software (version 9.2), eight choice sets were designed following the principles of orthogonality, level balance, minimal overlap, and utility balance (Kuhfeld, 2010) (full choice experiment attached in

supplementary materials 2 and 3). This had a high D-efficiency of 96.15%, A-efficiency of 92.31%, and a G-efficiency of 93.93%. These efficiencies are measurements of how good an experimental design is, based on the average of the eigenvalues of the variance matrix. A-efficiency focuses on optimizing the design within a given sample size, D-efficiency aims to minimize the sample size required to achieve a target level of efficiency, and G-efficiency aims to optimize the design for heterogeneous populations - the ideal efficiencies should be as close to 100 as possible (Kuhfeld, 2010).

Each choice-set had three hypothetical alternatives and an opt-out option to simulate a realistic shopping experience as closely as possible (Figure 1).

Finally, the tool was piloted with 17 respondents buying pork from the butcheries in the study area to ensure that the wording and pictorial representation of the attributes were clearly understood and made necessary adjustments.

2.3. Data collection

The typical pork outlet within the study area comprises a raw pork sales point situated at the front of the building, while the back portion of the establishment serves as a restaurant where pork is prepared and served to customers. Five enumerators, who had received training on the research objectives and the technique for collecting data through discrete choice experiments, dispersed across the randomly selected pork outlets in each location. They conducted face-to-face interviews using a structured questionnaire uploaded on an ODK ® app with both household and pork joint customers daily until the target number of respondents for each type of consumer in each location was achieved before proceeding to the next. To reduce bias and ensure randomness, every other pork consumer presenting at the pork retail outlets was interviewed.

Additionally, the enumerators, while obtaining participation consent, confirmed that a respondent had neither participated in the pilot study nor interviewed more than once during the official data collection period. This took place every Monday to Friday during the peak hours of 10 a.m. to 6:30 p.m. between November 2019 and February 2020.

A total of 401 respondents (253 'household' and 148 'pork joint' consumers) participated in the study and were distributed across the five wards as follows: Burumba (n=76), Mayenje (n=106), Bukhayo west (n=87), Matayos south (n=97), and Busibwabo (n=35). They each responded to the questionnaire which consisted of four sections. The first section covered questions on the consumers' purchase patterns and consumption habits, such as types of meat consumed and frequency of consumption. The second section contained the choice experiment. Before conducting the choice experiments, the attributes included in the study were explained to the respondents using pictorial aids. For each choice set (in total eight choice sets were presented to each respondent), we asked, *"If presented with these options, what would you choose?"* (Figure 1). Furthermore, a 'cheap talk script,' a tool used to reduce the hypothetical bias—the difference between respondents' stated and real choices—was incorporated in the choice experiment as shown below (Lusk, 2003; Penn & Hu, 2018). Each respondent was asked to make the choices as though they were making a real-life purchase decision where they would have to consider their budget constraints.

Cheap talk script for the respondents.

"The experience from previous similar surveys is that people often state a higher willingness to pay than what they would pay for the good in question. For example, in a study that was done before, 80% of people stated that they would pay more for a particular product that was hypothetical (as it will be for you today). When brought to the shops, however, only 43% paid for it because in real situations people consider the limitation of their money considering that they cannot buy other goods they would like if they bought this good. This difference is called a hypothetical bias.

When answering the questions in the following choice tasks, please respond like you would if you were facing these exact choices at the butchery/ pork joint i.e., noting that buying a product means you would have less money available for other purchases."

Figure 1: Example of a choice set in the experiment

After completing the choice experiment, respondents were asked to list the three most important attributes they consider while making a pork purchase decision. In the third section, respondents were asked to suggest ways in which pork retailers in their area could improve. This enabled us to determine their perceptions about pork retail practices in their area. Finally, the fourth section included questions about the respondents' sociodemographic characteristics.

2.4. Data analysis

Data were downloaded from the ODK server into Excel® and later exported to R® software version 4.0.2 for analyses.

2.4.1. Descriptive summaries

Proportions and means were used to provide descriptive summaries on pork purchase and consumption habits, ranking of the attributes considered by consumers while making a pork purchase decision, consumer perceptions about pork retailers, and sociodemographic characteristics. The student's t-test was used to compare the differences in mean purchase amounts and prices between household and 'pork-joint' consumers.

2.4.2. Choice experiment modeling

Choice experiment data were analyzed using the random parameter logit model to determine the consumers' preferences and WTP for the attributes included in this study. Analysis of discrete choice data is mainly based on two theories (Lancsar & Louviere, 2008). Firstly, Lancaster's consumer theory states that individuals derive utility from the attributes that define the product rather than the product as a whole (Lancaster, 1966). Pork in this study is therefore considered as a combination of attributes that include inspection by a government veterinary official, butchery hygiene, fat content, and price. Secondly, the random utility theory (RUT) states that individuals select the alternative that yields the highest utility for them (McFadden, 1974).

According to the RUT, utility comprises an observable/deterministic component and an unobservable/stochastic component. The observable components in this study are the attributes outlined in Table 2. The unobservable components could be the unobserved/ non-included attributes, preference variations, or intrinsic behavioral differences that exist among individuals in the study population (Lancsar & Louviere, 2008).

Given these theories, the utility derived by individual pork consumer *i* from choosing option *j* in choice situation *t* is given by:

$$U_{ijt} = V_{ijt} + \varepsilon_{ijt} \qquad (1)$$

V_{ijt} represents the deterministic observable component of the utility while ε_{ijt} represents the unobservable stochastic component. Assuming that the deterministic component of the utility is linear-in-parameter, equation (1) can be written as:

$$U_{ijt} = \beta X_{ijt} + \varepsilon_{ijt} \qquad (2)$$

where β is a vector of the unknown utility parameters, and X_{ijt} represents the vector of attributes for the jth alternative. The price attribute was coded as a continuous variable while (L-1) dummy variables were generated for each non-price attribute. L is the number of attribute levels. The Lth level of each attribute was not included in the estimation of the choice model to avoid multicollinearity. It also served as the baseline level for the interpretation of the coefficients and WTP values (Akaichi et al., 2020).

Despite being the workhorse model for analyzing discrete choice data, the assumptions of the conditional logit model (i.e., homogeneity of respondents' preferences and the independence of the alternatives included in any choice set) do not generally hold (Hensher *et al*., 2015). To relax the assumption of the independence of irrelevant alternatives within choice sets and allow for the control of the heterogeneity of respondents' preferences and WTP, the random parameter logit (RPL) model was used (Hensher & Greene, 2003). In the RPL, at least one parameter must be specified as random. This implies that each individual is considered to have a unique set of preferences, reflected in the individual parameters β_i. The probability that consumer i chooses alternative j in choice situation t (t = 1,……, T) can therefore be expressed as;

$$L_{ijt}(\beta_i) = \frac{\exp(\beta_i' X_{ijt})}{\sum_{j=1}^{J} \exp(\beta_i' X_{ijt})}$$

In this study, all the estimated parameters are assumed to be random and follow a triangular distribution.

The results from the RPL revealed a significantly heterogeneous population. To investigate the factors driving this heterogeneity, a Latent Class Model (LCM), which classifies consumer behavior into discrete classes based on factors unobserved by the analyst, was estimated (Greene & Hensher, 2003; Keane & Wasi, 2012). The Akaike and Bayesian Information Criterion indicated that three classes were the most appropriate. However, the results of the LCM failed to identify the source of heterogeneity. As a result, the RPL was re-estimated for known sub-sets of the population; i) by purchase type (household versus pork joint), ii) by gender (male versus female), and iii) by income levels (low-, middle- and high-income, as well as low- and high-income). The complete combinatorial Poe test was used to assess for statistically significant differences between the estimates from these models (Poe et al., 2005). The RPL model, however, failed to converge when applied to the income level subsets of the data.

The use of discrete choice models enables the researcher to obtain information on consumers' preferences (i.e., marginal utilities). It also allows the derivation of measures designed to determine the amount of money individuals are willing to give up to obtain some benefit from the non-price attributes of the product (e.g., 'Veterinary stamp,' 'Clean butchery'). Such measures are referred to as measures of WTP (Hensher *et al.*, 2015). The most commonly used approach to calculate consumers' WTP consists of computing the ratio of two estimated parameters, holding all else constant. WTP is commonly expressed as the negative ratio of the

non-price attribute coefficient (e.g., 'Veterinary stamp') to the price coefficient (Louviere *et al.*, 2010; Hensher *et al.*, 2015):

$$WTP_{non-price\ attribute} = -\frac{\beta_{non\ price\ attribute}}{\beta_{price}}$$

The calculated value represents respondents' marginal WTP. The standard error of consumers' WTP was computed using the delta method (Cox, 2005). In this study, the attributes' levels considered in the estimation of the RPL model were all coded as dummies. Therefore, the calculated WTP value represented the respondents' marginal WTP for the attribute level considered in the estimation relative to the baseline level (e.g., WTP for the level 'Veterinary stamp' relative to the level 'No stamp').

3. Results
3.1. Consumer and household characteristics

Table 3 presents summaries of sociodemographic characteristics.

Table 3: Consumers' sociodemographic characteristics (N=401)

Variable	Percentage/number
Purchase type (%)	
Pork joint consumers	36.9
Household consumers	63.1
Gender	
Household consumers (%)	
Male	56.5
Female	43.5
Pork joint consumers (%)	
Male	89.9
Female	10.1
Average age (Years ±SD, min, median, max)	32.9 (±10.6, 17, 31, 70)
Average household size (±SD, min, median, max)	4.6 (±2.4 ,1, 4,15)
Households with children below five years of age (%)	49.4
Occupation (%)	
Unemployed	14.2
Salaried employment	15.2
Casual labor	17.2
Self-employed	42.9
Student	10.2
Retired with pension	0.2
Education level (%)	
None	5.7
Primary school	42.5
Secondary school	34.4
Tertiary education	17.4
Household monthly income KES (%)	
Less than 15,000 (Approx. 147 USD)	69.6
15,001 – 45,000 (Approx 147 – 441 USD)	24.7

More than 45,000 (Approx. 441 USD)	5.7
Ever been ill after consuming pork (%)	
No	87.5
Yes	12.5
Relevant information sources (%)	
Radio	62.3
Television	54.5
Internet	30.4
Friends	9.0
Newspaper	8.3
Other sources	1.5
Are you the one who usually makes decisions about meat purchases? (%)	
Yes	
No	76.1
	23.9

The average age of the respondents was thirty-three, and almost half of them had children below five years of age (Table 3). Only 17.4% of the respondents had accessed education beyond the secondary school level and the majority (69%) earned less than KES 15,000 per month (approx. 147 USD in 2019). Most of the respondents (76.1%) stated that they are the ones who make decisions about meat purchases. Of those who indicated that they do not, 8.3% were females who had their husbands decide, 47.9% were males who had their wives decide, 24% and 13.5% stated that the decisions were made by their father and mother respectively, while 3.1% indicated that their siblings held that responsibility. Nearly 12% of the respondents reported having been ill after consuming pork.

3.2. Meat purchase and consumption habits

Results of the respondents' purchase and consumption patterns are provided in Table 4.

Table 4: Consumers' meat purchase and consumption patterns (N=401)

Variables[*]	Household consumers (253)	Pork joint consumers (148)	Pooled (401)

Average daily pork purchase amount (Kg)	0.44 (0.33)	0.43 (0.32)	0.44 (0.33)
Average pork purchase price (KES/kg)	310 (10.0)	309 (9.9)	310 (10.01)
Pork consumption frequencies (%)			
Daily	5.1	14.9	8.7
Few times/ week	68.0	62.2	65.8
Once/week	15.0	11.5	13.7
Few times/month	6.7	3.4	5.5
Once/ month	2.8	3.4	3.0
Occasionally	2.4	4.7	3.2
Other types of meat consumed apart from pork (%)			
Beef	95.3	77.7	88.8
Goat	63.6	56.1	60.8
Fish	90.5	64.2	80.8
Chicken	88.9	52.0	75.3
Most frequently consumed type of meat (%)			
Pork	58.5	62.8	60.1
Beef	21.3	16.9	19.7
Fish	15.4	10.8	13.7
Goat	3.2	8.8	5.2
Chicken	4.0	2.7	3.5
Exclusive pork consumers (%)	16.6	23.0	19.0

[*]Note: Standard Deviation in brackets

The average purchase amounts per day for both household and pork joint consumers were not significantly different. Interestingly, even with the value addition of cooking, the selling price of cooked pork did not differ significantly from that of raw pork sold to household consumers. Nevertheless, most of the pork joint consumers (98.6%) indicated that they buy other foods alongside pork; 99.3% bought 'ugali' (maize meal, a Kenyan starch staple), 84.2% bought local cooked vegetables and 47.3% bought 'kachumbari,' a local tomato and onion salad.

Slightly over two-thirds of the consumers (65.8%) ate pork more than once a week. Although they indicated that they also consume other types of meat, most of the sampled consumers ranked pork as their most frequently consumed type of meat. There is a potential bias, however, since we were specifically targeting consumers at cooked pork joints and butcheries.

3.3. Ranking of attributes consumers consider while making a pork purchase decision and their perceptions about pork sold within their locality

Most respondents, based on the questionnaire responses, ranked butchery hygiene as the first and second most important attribute (i.e., 48.1% and 34.2% respectively). This was followed by the presence of a veterinary inspection stamp where 31.2% and 20.3% of the respondents stated this as their first and second most important attribute, respectively. Most consumers ranked medium fat content (26.2%) and affordability/price (16.8%) as their third most important attributes.

Consumer perceptions about pork sold to them were derived from responses to whether they believed that pork butchers in their area could make any improvements. About an eighth of the respondents (12.5%) stated that they were satisfied with the status quo and could therefore not suggest any improvements. Most respondents listed butchery hygiene (75.8%) and meat inspection (36.4%) as one of the areas that need improvement in their local butcheries. These were followed by an improvement in customer services (13.2%) and the provision of fresh pork (11.2%). (Tables attached in supplementary material 4).

3.4. Consumer preferences and willingness to pay for pork safety.

Tables 5, 6, and 7 display the preference estimates as well as the WTP values estimated using the random parameter logit model.

Table 5: Preference estimates from the Random Parameter Logit model (N=401)

Variables	Mean effects	Standard deviation
None [a]	-2.710***	6.40***
	(1.013)	(0.403)
Veterinary meat inspection stamp	2.974***	4.217***
	(0.178)	(0.282)

Hygiene	1.990***	2.783***
	(0.128)	(0.245)
Medium fat content	1.406***	1.522***
	(0.111)	(0.165)
Low fat content	0.970***	1.747***
	(0.119)	(0.158)
Price	-0.012***	0.008***
	(0.001)	(0.002)
Number of respondents	401	
Number of observations	12,832	

SE in parentheses. *, **, and *** indicate significance at 10%, 5% and 1% significance levels, respectively.

[a] Represents the coefficient corresponding to the opt-out option

The negative coefficient associated with the opt-out choice shows that the respondents preferred to select a buying choice rather than the opt-out option in the majority of the choice sets (Table 5). The price coefficient is also negative and significant, indicating that a price increase significantly reduced the utility and consequently the probability of a consumer choosing a more expensive option, all other things being equal. The estimated coefficients for all pork attributes were positive and significantly different from zero at the 1% level. According to this, the sampled respondents significantly preferred to buy pork with a veterinary stamp of inspection compared to one that did not and pork from a clean butchery instead of an unhygienic one. They were also more likely to choose pork with medium or low-fat content than pork with high fat content. Interestingly, the results also show that respondents' preferences for pork with medium-fat content are higher than their preferences for pork with low-fat content. Additionally, the results displayed in Table 5 also show that all estimated standard deviations are statistically significant, indicating a strong heterogeneity in the respondents' preferences.

Table 6: Marginal willingness to pay estimates from the random parameter logit model

Attributes	**KES/kg of pork**

Veterinary stamp	245.46***
Hygienic Butchery	164.24***
Low-fat	80.05***
Medium fat	116.06***

*** indicates significance at 1% significance level

Table 6 presents the average maximum prices per Kg of pork that the respondents were willing to pay for the attribute levels "Veterinary stamp", "Hygienic Butchery", "Low-fat", and "Medium fat" in addition to their WTP for pork with the baseline levels "No stamp", "Unhygienic butchery", "High fat", and "High fat", respectively. Pork consumers were willing to pay a premium of KES 245.46 for pork that had a veterinary stamp of inspection compared to pork that did not. They were also willing to pay KES 164.24 more for pork from a hygienic butchery compared to pork from an unhygienic one. Respondents were also found to be willing to pay KES 116.06 more for medium-fat pork, and KES 80.05 more for low-fat pork compared to pork with high fat content.

Table 7: Willingness to pay value comparison by gender and purchase type

Purchase type			Gender		
Attributes	Household	Pork joint	Attributes	Female	Male
Stamp***	64.97	171.42	Stamp***	261.95	132.53
Hygiene***	54.57	113.01	Hygiene***	240.58	84.67
Medium	36.69	60.83	Medium***	296.02	47.09
Low-fat	22.07	38.09	Low-fat***	218.59	81.35

*, **, and *** indicate that the difference is statistically different from zero at 10%, 5%, and 1%, respectively. The statistical significance was assessed using the Poe test.

Results from Table 7 highlight the WTP differences in the two predetermined sample sub-sets. Cooked pork consumers were willing to pay premiums that were almost thrice as much for the veterinary stamp of inspection and almost twice as much for butchery hygiene compared to those of household consumers. Comparisons by gender reveal that females had significantly higher WTP values for all the attributes considered in the study compared to their male counterparts.

The most outstanding difference was in the WTP values for pork with medium fat content, which

were six times higher compared to men.

4. Discussion and conclusion

The primary objective of this study was to examine the purchasing patterns of pork consumers in rural western Kenya and to determine their preferences and willingness to pay for safe pork. The study participants were found to purchase relatively small quantities of pork each time – they however made frequent purchases, indicating a consistent consumption pattern.

The results also showed that the surveyed pork consumers significantly value veterinary meat inspection and butchery hygiene. These are consistent with findings from other low and middle-income countries, including Kenya, regarding preferences and willingness to pay for safe animal source food products (Heilmann et al., 2015; Jabbar et al., 2010; Owusu-Sekyere et al., 2014; Udomkun et al., 2018). This affirms that indeed, consumers in developing countries are increasingly becoming aware of the importance of food safety and are therefore demanding safer products (Jabbar et al., 2010) As urbanization and incomes increase, this is expected to be an upward trend (Jabbar et al., 2010; Ortega & Tschirley, 2017).

With regards to fat content, the average consumer in this study reveals a stronger preference for pork with medium fat content, followed by low-fat pork. Pork with high fat content was least preferred. Consumers in Uganda also had similar preferences, claiming that fatty pork was unhealthy and that very low-fat pork could indicate that a pig was diseased and would also probably need more oil while cooking (Roesel et al., 2019). In Eswatini, pork consumers preferred low-fat, tender, and juicy pork (Ndwandwe & Weng, 2017). Jabbar & Admassu (2010) in Ethiopia found varying preferences for beef fat content depending on the purpose for which the meat was used. Mincemeat was preferred tender and low-fat while moderately fatty meat was preferred for frying. The distaste for fatty pork could be because of the controversially debated

fact that excessive consumption of fatty acids from meat is generally associated with increased risk of heart disease (Heileson, 2020; Vissers et al., 2019).

Even though the results indicated an overall interest in food safety, the consumers exhibited significant heterogeneity in their preferences and their WTP values. Heterogenous responses to safety attributes have been found in previous studies as well (Liu et al., 2019, 2020; Ortega et al., 2011; Owusu-Sekyere et al., 2014; Wongprawmas & Canavari, 2017). Identifying the source of heterogeneity enables policymakers to develop interventions specifically tailored to the needs of the different consumer segments. For pork joint consumers, WTP values for the veterinary stamp were almost three times as high as those of household consumers. WTP values for hygiene as well as pork with medium fat content or low-fat pork among pork joint consumers were approximately twice as high as compared to the household consumers. This could be because when eating out, consumers avoid restaurants that may expose them to food poisoning and therefore consciously or sub-consciously place higher value on food safety indicators (Knight et al., 2009; Worsfold, 2006). Conversely, household consumers tend to have more control over how they prepare their meals ensuring they are well-cooked, observe hygiene and would know what to do with a less than ideal piece of meat e.g., if too fatty (Roesel et al., 2019). Additionally, comparison by gender showed that female consumers had approximately twice as high WTP values for the veterinary stamp, thrice as high WTP values for hygiene and low-fat pork and WTP values for pork with medium fat content that were almost six times higher compared to their male counterparts. These findings are similar to other studies that have shown that females display higher preference for, and are willing to pay more than men, to be assured of healthy and safe food (Alphonce et al., 2014; Alphonce & Alfnes, 2012; Owusu-Sekyere et al., 2014). This could be because females tend to have greater nutritional knowledge than men and

focus more on the medium-long term household well-being while making food purchases (Cavaliere et al., 2015). They also bear the main responsibility of guaranteeing food safety and quality for their households (Sudershan et al., 2009). Unfortunately, this study was unable to analyze differences in WTP values across different household income levels, indicating the need for further studies in this area.

Ascertaining the signals consumers rely on for food safety assurance is a key component in managing food safety (Owusu-Sekyere et al., 2014). Most DCE-based studies in food safety mainly focus on assessing the viability of introducing new attributes such as food safety labels or inclusion of traceability information (Lai et al., 2018; Liu et al., 2019, 2020; Mørkbak et al., 2011; Ortega et al., 2011; Owusu-Sekyere et al., 2014). This study differs from previous ones by evaluating the significance of existing food safety features for rural Kenyan pork consumers. The results clearly indicate that rural pork consumers in western Kenya value food safety and are willing to invest a premium for assurance of meat inspection by a certified government official and hygiene. This therefore indicates that there is an opportunity to explore consumer-dependent food safety interventions in the pork value chain in rural western Kenya. Although we focused on one rural locality in the country, we are confident that the findings are generalizable for similar rural settings in SSA.

A key limitation, which relates to all stated preference WTP methods, is that willingness to pay does not obviously translate to ability to pay (Ahmed et al., 2019; Hoffmann et al., 2019; Kofoworola et al., 2019; Saulo et al., 2008). As of 2009, 45.2% of the Kenyan population lives below the poverty line, majority of whom are found in rural areas; with the proportion in Busia County at 60% (KNBS, 2014; Okwi et al., 2007). Furthermore, the average monthly expenditure for each Kenyan adult is US$34, ranging from US$61 in urban areas to US$22 in rural areas,

with the largest proportion spent on food. Forty-five percent of each dollar goes towards food (Malala, 2018). This could imply that some consumers' purchasing power might not match their willingness to pay, therefore threatening the sustainability of consumer-driven incentives for improving food safety in rural areas (Jaffee et al., 2018). We argue that in such instances, other alternatives that still leverage that desire for safer pork products can be exploited – such as capitalizing on their role as citizens (Alonso et al., 2020; Alphonce et al., 2014). Kenya implemented the devolved system of government in 2013, giving citizens an opportunity to participate in the planning and implementation of development projects within their counties (Kanyinga, 2016). Additionally, the Consumer Protection Act (CPA) was enacted in 2012 with the aim of protecting Kenyan consumers' health, social and economic welfare. It further allows for the establishment of accredited consumer organizations such as the Consumer Federation of Kenya (COFEK) which is an independent body that is committed to consumer protection matters (Cofek, n.d.). This provides the perfect opportunity for the engagement of consumers with governments either directly or through civil society organizations to push for better food safety regulation (Dreyer & Renn, 2009; Fulponi, 2006).

This further highlights the need to invest in increasing consumer awareness about food safety, especially in areas with low literacy levels, to generate effective market demand to sustain consumer-driven interventions (Jaffee et al., 2018; Hoffmann et al., 2019). As found in this study, the use of radio, television and internet could be the best way to reach consumers and enhance their awareness about food safety. Hrynick et al., (2019) also emphasize the need for government regulators working in low-resource settings to view butchers and other key value chain players such as farmers and slaughter-slab owners as allies in ensuring food safety in meat markets. This entails building the capacity of the 'regulated' to enable them to identify and

safeguard food safety indicators as well as give them the space to catch up with the legal requirements in a relaxed and economically feasible manner.

Additionally, as incomes increase, butchers in this study area should be encouraged to embrace other measures that are identified with hygiene such as hygienic packaging and food safety and quality labels. In this population, labels could indicate that pork has been inspected by a certified government meat inspector and that it is from a pig preferably with either medium or low fat. This will enable them to cash in on the premiums that some consumers are willing to pay and possibly result in a positive trickle-down effect on other value chain players. There's need however, to consider the effects of potentially increased prices on demand for pork as retailers invest in improved public health standards in this region; Shibia et al., (2017) highlighted that the different meat products consumed in Kenyan households are potentially strong substitutes. In addition to pork, the surveyed consumers indicated that they also eat beef, fish, and less frequently chicken and goat meat. Additionally, pork is the most affordable type of meat in the study area and the second most consumed type of meat in the region (Fèvre et al., 2017). Further research is needed to establish the effect of increased pork prices on demand for pork vis-à-vis other types of meat (Azar, 2011).

The study also acknowledges the potential limitations in the assessment of preferences and willingness to pay that may arise from the inability to fully incorporate all the attributes in a manner that accurately reflects a real-world scenario. For example, during the focus group discussion, good customer service was ranked highly, but it was not feasible to capture and represent the diverse meanings of good customer service without potentially influencing the choice experiment responses. Furthermore, while the definition of butchery hygiene is also subjective and varies, we had to represent it as either hygienic or unhygienic to reduce the

cognitive burden on respondents. To more precisely quantify the utility derived from food safety, additional studies using non-hypothetical methods, such as experimental auctions, that incorporate more attributes and mimic real purchase situations are required. These need to also creatively consider the impacts of large-scale economic crises that might increase inflation rates and that could negatively impact the economic circumstances of governments and households in developing economies – decreased purchasing power might predispose low-income consumers to make risky food choices.

Author contributions

Cianjo Gichuyia: Conceptualization, methodology, investigation, formal analysis, writing-original draft.

Nadhem Mtimet: Conceptualization, methodology, software, formal analysis, writing- review & editing.

Faical Akaichi: Methodology, software, formal analysis, writing- review & editing.

Lian Thomas: Conceptualization, methodology, writing- review & editing, supervision,

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Eric Fèvre: Funding acquisition, conceptualization, writing- review & editing, supervision.

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Conflict of Interest

The authors declare no conflict of interest.

Ethical approvals

Data from pork consumers were collected after approval by the ILRI Institutional Research Ethics Committee (ref ILRI-IREC2018-13/2). The committee is licensed by the National Commission for Science, Technology, and Innovation (NACOSTI) in Kenya and also approved by the Federal wide Assurance for the Protection of Human Subjects in the USA. Informed and signed consent was obtained from all consumers prior to data collection.

Disclaimer

The views and opinions expressed in this paper are those of the authors and should not be attributed to IFAD, its Member States, or their representatives to its Executive Board. All remaining errors are our own.

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