Global Food Security 20 (2019) 26–36

Contents lists available at ScienceDirect

Global Food Security

journal homepage: www.elsevier.com/locate/gfs

Knowledge, attitudes and practices of pork consumers in Uganda

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ARTICLE INFO

Keywords:
Animal sourced foods
Nutrition
Participatory research
Pork
Smallholder
Uganda

ABSTRACT

Pig production is thriving in Uganda and the demand for pork is increasing, therefore offering potential for increased income from pig production and marketing. The consumers' preferences determine and potentially drive this demand but are largely unknown in the context of Uganda. As part of a multi-disciplinary assessment of smallholder pig value chains we investigated these preferences in one of the four thematic subgroups with 292 smallholder pig farmers. In addition, 79 consumers in Kampala, the main pork market outlet in Uganda, were included. Using participatory methods and considering that pig keepers are also consumers, we describe drivers for and taboos around eating pork, the role of pork in peoples' diets compared to other livestock-derived foods, important attributes when buying pork, the risk of pig feeds competing with human food as well as knowledge, attitudes and practices around pig zoonoses.

1. Introduction

Since the 1990s, pig numbers in Uganda have increased by more than a tenfold (Food and Agriculture Organization of the United Nations FAO, 2018; Ministry of Agriculture; Animal Industry and Fisheries MAAIF/ Uganda Bureau of Statistics UBOS, 2009), the approx. 3.2 million pigs are in the hands of 1.1 million smallholder farmers, many of them women (Ministry of Agriculture Animal Industry and Fisheries MAAIF/ Uganda Bureau of Statistics UBOS, 2009), and up to 70% of all pork is estimated to be consumed in urban and peri-urban areas, mainly through informal road-side butcheries and pork eateries (the so-called 'pork joints') (International Livestock Research Institute, 2011). Per capita consumption of pig meat in Uganda currently ranks highest in East Africa at 3.4 kg per year (Food and Agriculture Organization of the United Nations FAO, 2018). Due to this potential and in a consultative process, the CGIAR Research Program on Livestock (CRP Livestock), led by the International Livestock Research Institute (ILRI), has identified pigs in Uganda as one of nine selected livestock value chains where research for development has high potential and is targeted to make an impact for poor producers and consumers (International Livestock Research Institute, 2018). Until 2012, little was known about how smallholder pig value chains in Uganda operate; where pigs come from, who eats them, constraints and opportunities in producing more and better pork as well as public health risks associated with pig farming and pork consumption. The present study focuses on the consumer node of the supply chain, and aims to describe animal source food consumption, processing and preparation practices to guide qualitative assessment of health and nutrition risks and benefits, especially from pork consumption.

2. Methods

2.1. Integrated assessment of food safety, zoonoses and nutrition

From November 2012 to January 2013, under the umbrella of a multidisciplinary project characterizing constraints and opportunities in smallholder pig value chains in Uganda (Ouma et al., 2015), we carried out qualitative assessments at the producer node to map out the various actors involved in pig rearing (e.g. input and service providers) as well as to identify constraints to and opportunities for improved pig farm productivity and marketing. We conducted participatory rural appraisals (PRA) in 34 villages with about 1200 smallholder pig farmers in Masaka and Mukono districts of the Central region (436,400 pig-owning households, Ministry of Agriculture Animal Industry and Fisheries MAAIF/ Uganda Bureau of Statistics UBOS, 2009), and Kamuli district in the Eastern region (262,300 pig-owning households, Ministry

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https://doi.org/10.1016/j.gfs.2018.12.001
Received 2 August 2018; Accepted 5 December 2018

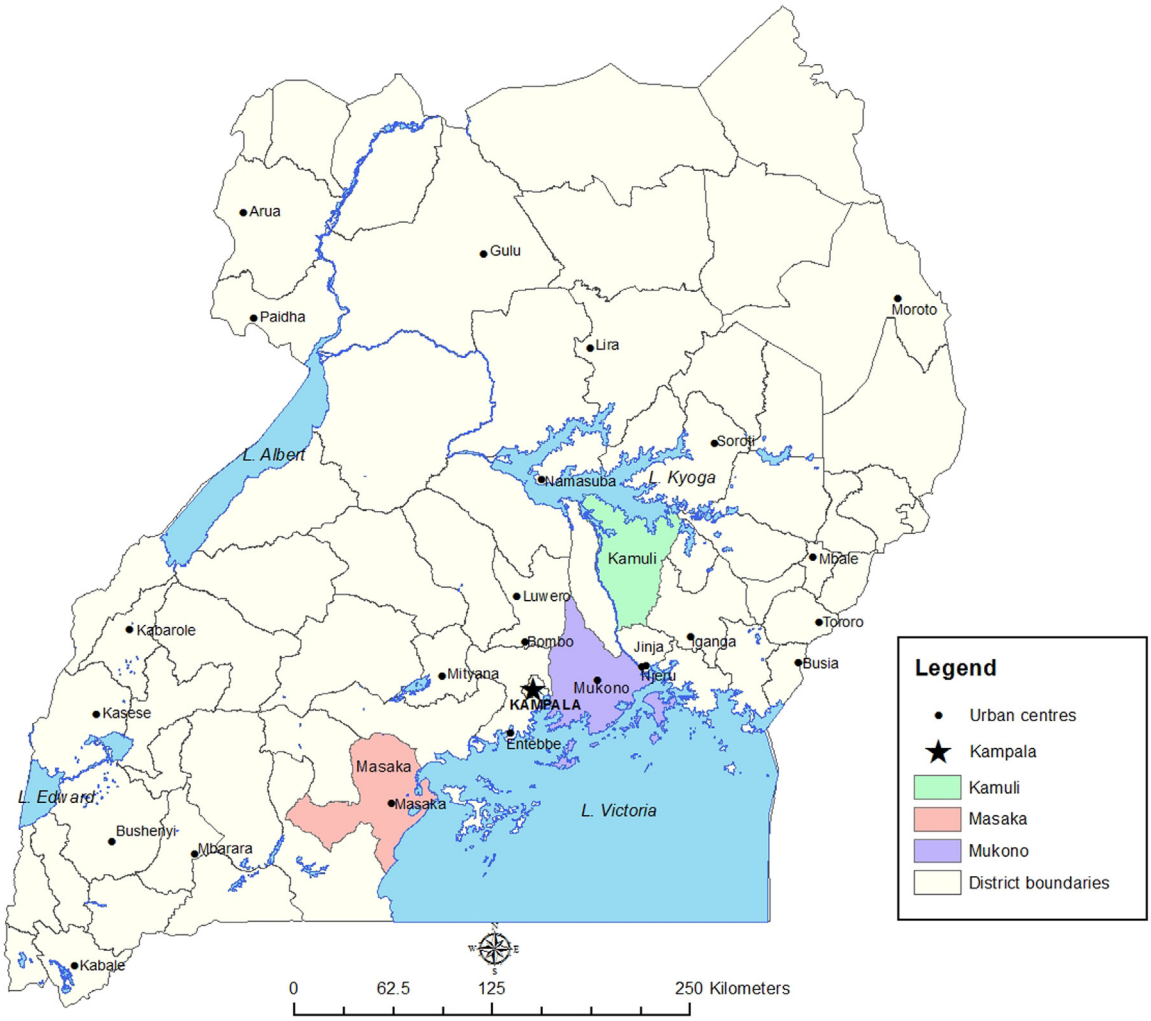

Fig. 1. The districts included in the study: Kamuli in Eastern, Masaka and Mukono in Central Uganda (ILRI/Ochungo).

of Agriculture Animal Industry and Fisheries MAAIF/ Uganda Bureau of Statistics UBOS, 2009) in Uganda (Fig. 1). In all villages, the farmers were engaged in four thematic and parallel discussions on feeds/ feeding, breeds, input and output marketing, animal health, and zoonoses including food safety and nutrition (Ouma et al., 2015). The findings from the thematic discussions on food safety, nutrition and zoonoses are presented here.

Generic guidelines to assist a rapid integrated assessment (RIA) of food safety, zoonoses and nutrition in informal animal source food value chains were designed as one facet of this comprehensive value chain assessment, and are applicable for use in dairy, pork, small ruminant, poultry and fish value chains. These guidelines consider several components for which different methods are applied: 1) literature-based assessment of hazards likely to be present in the animal sourced food studied; 2) an assessment of food safety, zoonoses and nutrition knowledge, attitudes, beliefs, practices and incentives of actors engaged in the value chain; 3) investigation of consumption, income and other health relevant benefits of the animal sourced food studied and exploration of how these are influenced by gender and other social determinants; 4) a prevalence survey of key hazards and associated risk factors; 5) a qualitative risk assessment for key hazards and identification of critical control points; 6) an assessment of nutritional risks and suggestions for their mitigation and eventually, 7) comparison between different animal sourced food value chains.

The findings presented here relate to components 2 and 3 and informed the subsequent steps of the RIA. Qualitative and semi-quantitative data on pork consumption patterns, preparation methods as well as knowledge, attitudes and practices on pork safety were gathered from 292 randomly selected pig farmers in 34 villages in the above mentioned districts. In addition, 79 urban consumers in Kampala were engaged in the study. Generic guides were used with all groups (Table 1) and included PRA tools adapted for participatory epidemiology (PE) such as focus group discussions, ranking and scoring methods, Venn diagrams and seasonal calendars (Supplement 1).

These activities were used to answer a set of research questions, specifically: Who eats pork, when and why? What are reasons not to eat pork? What is the role of pork and other animal sourced foods in pig farmers' and their children's diets? Are pig keepers pork eaters? Does pig feed production compete with human food production? How accessible is pork? What attributes are important to consumers when buying pork? What are knowledge, attitudes and practices that potentially increase or reduce the risk of pig- and pork-borne diseases?

2.2. Recruitment of participants

The districts, where the assessment was conducted, were selected in a participatory process with project stakeholders (Ochola, 2012), and specific villages and farmers selected as described by Ouma et al. (2014). In Kampala, six pork joints in four locations were purposively selected, and 27 respondents were interviewed either individually or in groups of two to three people during lunch break. Focus group discussions with 52 mothers of children under five years were conducted

Table 1
Pork consumption assessment tools used by district (for details see Supplement 1).

Tools used per study district	Participatory rural assessments with producers		Participatory rural assessments with consumers		Focus group discussion with mothers of children under 5 years	
	Number of group discussions	Number of participants	Number of group discussions	Number of participants	Number of group discussions	Number of participants
Kamuli	4	38	4	34	5	28
Masaka	14	121	0	0	14	95
Mukono	6	49	6	50	8	37
Kampala	0	0	6*	27	5	52
Total	**24**	**208**	**16**	**111**	**32**	**212**

* The urban consumer guide was a shortened form to accommodate urban customers' time constraints.

in five health facilities in Kampala.

2.3. Data management and analysis

Two male and two female facilitators were trained in the use of the tool. Each session was facilitated by a moderator who spoke the local language in the setting (e.g. Lusoga and/or Luganda). He or she was supported by a note taker who took minutes of the meeting, recorded hand counts, took photos of the flipchart diagrams and other illustrations and documented group dynamics. Data were entered into Microsoft Excel for basic descriptive analysis and data visualization. The notes facilitated the write-up of the narrative.

2.4. Ethics

The research involved obtaining information from individual people on food consumption practices. Names of participants were neither recorded nor disclosed to warrant confidentiality. Approval to carry out the study was obtained from the Research and Ethics Committee at the College of Veterinary Medicine, Animal Resources and Biosecurity, Makerere University, Kampala (Ref.: VAB/REC/13/103), the Uganda National Council for Science and Technology (Ref.: A 525), and the ILRI Institutional Research Ethics Committee (Ref. IREC 2013–03). Informed consent was obtained from all individual participants included in the study.

3. Results

The findings in the following section represent collective views of groups of people, not individuals. In total, 292 smallholder pig farmers (101 men and 191 women) from 34 both rural and urban production sites as well as 79 urban consumers (27 clients in pork joints and 52 mothers of children under five years) in Kampala shared their thoughts that are presented in this report. The first section represents the views of the pig farmers as pork consumers, while the subsequent sections present opinions of consumers in Kampala.

3.1. Pig producers as pork consumers

3.1.1. Who eats pork, when and why?

Eighty percent (234/292) of the pig farmers in the survey eat pork, only in one sub-county this proportion is much lower at 50%. Both men and women eat pork, although the proportion of male consumers is marginally higher (89%) than the female (74%). Consumption is mainly driven by festivals as shown in Fig. 2. More pork is consumed when cash is available, for instance after the coffee harvest in Masaka during June/July. Less pork is consumed at the beginning of new school terms when pigs are sold to pay for school fees.

Taste is one of the main reasons to eat pork; it is considered "so sweet", and pork ranks second after chicken in terms of taste (Fig. 3). It is occasionally given to children under five years as food for good growth ("body building food"). In rural sites, pork is believed to clear the skin, make strong bones, or even cure a skin rash in children called "measles" which is perceived to be caused by eating goat meat (Kamuli district); however, the aetiology of that skin rash (e.g., measles virus) is unknown. In other places, "measles" in children are prevented by eating silver cyprinids (*Rastrineobola argentea*), locally known as *mukene*, or sheep fat.

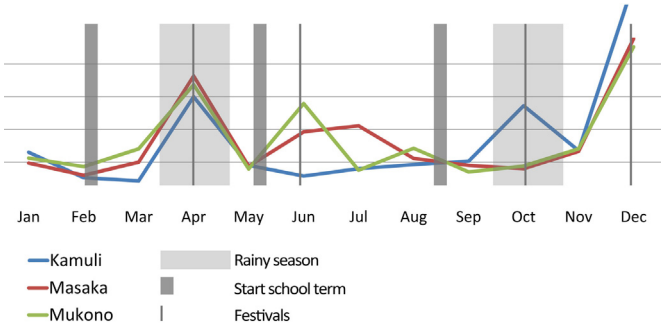

Fig. 2. Seasonality of pork consumption among 294 pig farmers in Kamuli, Masaka and Mukono districts. Festivals: Easter (April, all districts); Martyr's Day (June, Masaka and Mukono districts); Independence Day (October, Kamuli district); and Christmas (December, all districts). The bars indicate proportions established by group consensus and have not been further quantified.

3.1.2. What are reasons not to eat pork?

The biggest constraint to eating more pork in both rural and urban areas is low income, as summarized by one rural farmer: "The rich eat more because they can eat whatever they want whenever they want, unlike the poor". Other factors include religion or traditional beliefs; for instance followers of Islam, Seventh Day Adventists (who consider pork "food for the demons") and Born Again Christians are not allowed to eat pork in accordance with their religious code. However, in the study sites these rules are not rigorously observed by all followers. Some of the women who do not eat pork claim that they were raised at times when women were denied pork because men believed that eating it makes women too strong and outspoken. Moreover, according to local tradition in Masaka district, elderly women are not supposed to eat pork, chicken and red meat. Instead, they are given eggs, fish and even bone marrow as this is believed to keep them strong. Almost all (93%) of the mothers emphasized that nobody eats offal, referring to white offal (guts and intestines), partly because pigs may eat anything including faeces and snakes. Although considered very tasty, customers acknowledge that pork is not the healthiest food, especially if the fat layer is too thick, eating pork may cause heart disease. Pregnant women in rural Masaka should not eat pork because otherwise "the child might have a mouth like a pig". Moreover, if the children are fed offal, they are said to potentially become dumb.

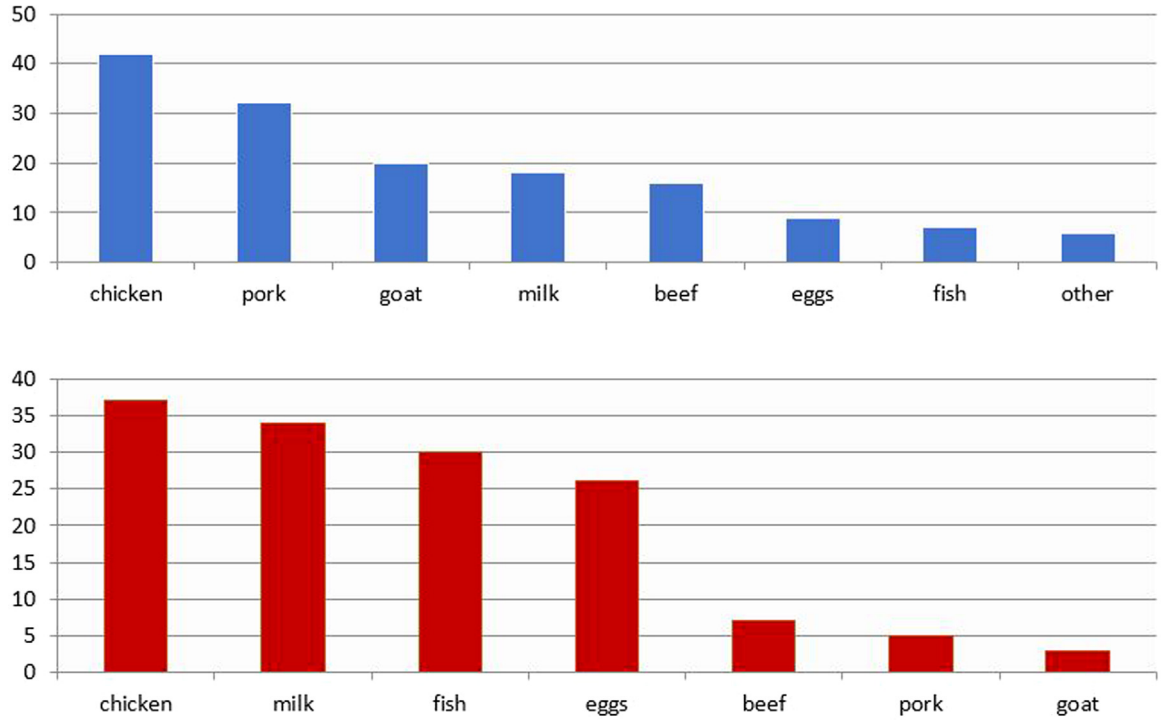

Fig. 3. Pork is considered the second most tasteful (top) and second least healthy (bottom) animal sourced food in Mukono and Kamuli districts (n = 10 groups). Rankings made by the individual groups were converted into scores, and total scores represent the height of the bars.

3.1.3. What is the role of pork and other animal sourced foods in pig farmers' and their children's diets?

The closer to urban centres, the more frequently pork and other animal sourced foods are eaten (Fig. 4), e.g. weekly to daily. In rural areas, animal sourced foods are consumed less regularly and mostly at special occasions due to low income as claimed during 25/27 (93%) focus group discussions with mothers.

Pork, chicken, goat, beef and cow milk are consumed in all of the villages in the survey. Eggs are explicitly mentioned in all but one village in Mukono district. Turkeys, ducks and rabbits are consumed occasionally in most of the villages in Kamuli and some of the villages in Mukono district. In all villages in Mukono, due to their proximity to Lake Victoria and the river Nile, capture fishery is common and fish is eaten on a regular basis, mostly *mukene* but also tilapia (*Oreochromis niloticus*) and Nile perch (*Lates niloticus*). In Kamuli district, fish is only consumed in one village and the respondents explained that they eat it rarely due to the distance to Lake Victoria (> 60 km) and to Lake Kyoga (> 25 km). Ghee, clarified butter, is eaten in both rural and urban settings but more frequently in urban areas. Mutton is not eaten in the survey villages in Kamuli because it is considered "cold meat", and people dislike it. In Mukono, mutton was listed in only two out of six villages in the rural areas. Milk is the most frequently consumed animal sourced food. Mothers of young children in rural Mukono explained that they would like to feed their children more goat milk which they consider highly nutritious, but it is very scarce. On average, one to two cups are drunk at any given time. The amount of meat that is usually purchased at any given time is one kilogram for pork, beef and goat meat. Chicken and other poultry like turkey or duck is usually bought and consumed as a whole animal.

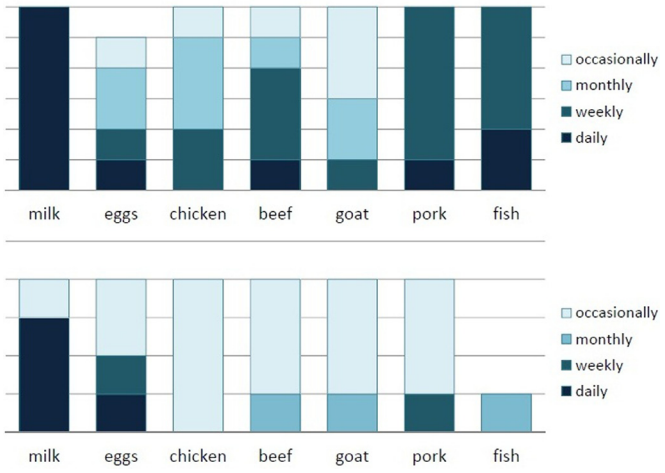

Fig. 4. Consumption of animal sourced food (ASF) in urban (top) and rural (bottom) Uganda. The bars indicate proportions established by group consensus and have not been further quantified.

3.1.4. Are pig keepers pork eaters?

Generally, pig keepers like to eat pork. However, in the rural study sites, pig farmers rarely slaughter their own animals as one farmer summarized that "one pig has too much meat for one meal". They prefer to use the money generated from sales of live pigs for meeting family needs such as school fees, and instead buy one kilogram of meat whenever they can afford it. Home slaughter is mostly practiced around Christmas, when one pig is often slaughtered and shared between several groups of people. The closer to urban centres, the more frequently pigs are kept for both sale and home consumption (Fig. 5). Livestock products in general, are kept for sale, and among other things the income is used to supplement the family's diet. Cattle are usually kept at home for the milk and the animals are sold for the meat at a later time. The same applies for eggs; however, chickens are more important in the diets of rural farmers who keep them either for home consumption only or both for sale and home consumption. Fish (tilapia) is only farmed in Mukono district.

3.1.5. Does pig feed compete with human food production?

Feed has been identified as one of the major pig production

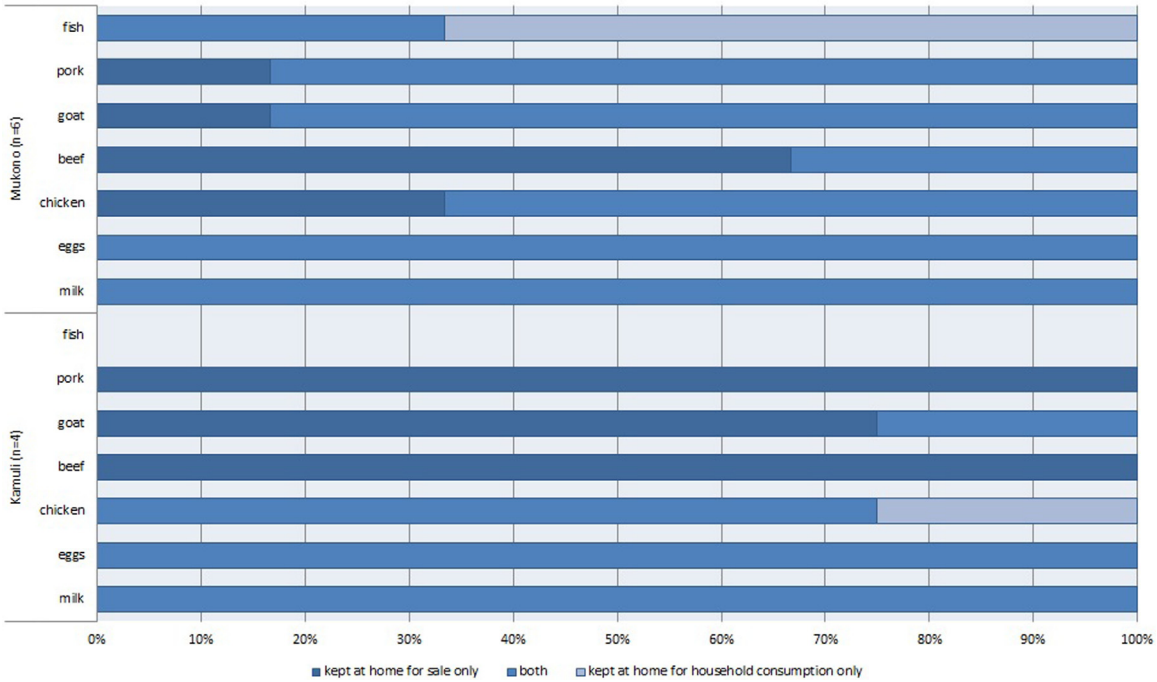

Fig. 5. While in urban areas (top) livestock is kept for both sale and consumption, in rural areas (bottom) livestock such as pigs, goats and cattle are kept mostly for income generation.

constraints for farmers who wish to improve production outputs (Ouma et al., 2015). However, according to the pig farmers, food for people does not compete with pig feeds, as the animals are fed on leftovers such as peels from cassava, potatoes, bananas or maize porridge. Alternatively, they are fattened during "times of plenty", shortly after the seasonal rains, with tubers (i.e. Irish potatoes, sweet potatoes, cassava) and fruits (i.e. avocado, sweet bananas, jackfruit, mango, papaya) before being sold to avoid losing them during the dry season which is known for higher levels of pig disease, water and feed scarcity.

3.1.6. How accessible is pork?

People have access to pork in all study sites, and 70% of the meat is consumed outside the homes in pork joints, which enjoy great popularity in Uganda. At the pork joints, meat is consumed fried (Kamuli) or roasted (Mukono and Masaka). In rural areas, the consumers are mostly men, whereas in towns both men and women gather at pork joints for lunch or at night, to watch football or soap operas, play pool, or simply socialize over pork and drinks. The survey villages in Kamuli district are all located in a very remote setting, more than 60 km away from the next urban centre, and at the time of the study were only accessible over a dirt road in poor condition. In the rural areas, consumers have much less choice of butchers and the retailers are reported to slaughter diseased animals or sell products in a dirty and unsafe environment (Fig. 6).

Generally, both women and men go out to buy the pork; however, in some villages in rural Kamuli women claimed they were too shy and that the men usually have the money to make purchases. The "shyness" was often related to socio-cultural perceptions as well as religious taboos, for instance, if the woman is a Muslim but married to a Christian (common in Uganda), she does not want to be seen by other people and sometimes even sends the child to by the pork. The respondents in rural Kamuli also emphasized that there is no supermarket anywhere near, so if they want pork, they buy it from a pork joint which is both a ready-to-eat restaurant and abutchery where raw meat can be obtained. In rural Mukono, both women and men buy the meat to bring it home for home preparation and consumption. Some women stated that "anyone can buy the pork but some of us are widows. Thus, we are the mothers and the fathers of the home". In one village in Mukono district there is even a supermarket selling pork, but usually, the meat is taken to Kampala and not available for the consumers in the village. Generally, pork consumers in Mukono district have a much bigger choice of where to buy pork.

3.1.7. What attributes are important to consumers when buying pork?

The main quality criterion that pig farmers consider as important when purchasing pork is the cleanliness of the meat (ranked first) and was defined as meat free from visible dirt and flies; a moderate fat layer (ranked second) is considered important because in the view of the discussants too thick may cause human disease such as "stomach pain or even heart problems" and too thin could indicate pig disease (e.g. weight loss due to sickness) and is considered "less satisfactory and tough, and one needs more oil and fuel for the preparation". Freshness ranked 3, colour ranked 4, texture ranked 5 and smell of the meat ranked 6. Farmers across all sites, preferably in the rural sites, might eat meat from diseased pigs if they cannot find a market for their animals.

Fig. 7 shows the major reasons for rural and urban consumers when not to buy pork from a butcher. Meat being not clean but covered with blood and hair is the main reason for about 77% of the respondents for not buying pork at a certain outlet. Visible dirt and blood is associated with disease in the pig or that it has died of disease before slaughter – "that meat cannot be soft and tasty". Bad smell in meat deters about 56% of the customers, a rotting smell implies lack of freshness, that meat has stayed at the butchery for too long, or that the pork came from a diseased animal and hence is neither tasty nor healthy and might even cause diarrhoea. The male smell of a boar in the meat is disliked by many people. Moreover, the colour of the pork is important to at least one third of the clients, reddish (blood) or green suggesting disease. Eighteen percent of the respondents consider meat from old pigs a reason not to buy as "it is not tasty and needs a long time to prepare because it is very tough". Too young, on the other hand, is also not an option for about 12%. They claim the meat is "slippery", smells badly and hence cannot taste well. Meat from piglets is avoided as it is considered stolen; and the cleanliness of the butcher him- or herself is also an important criterion to customers (27%) as it is associated with the

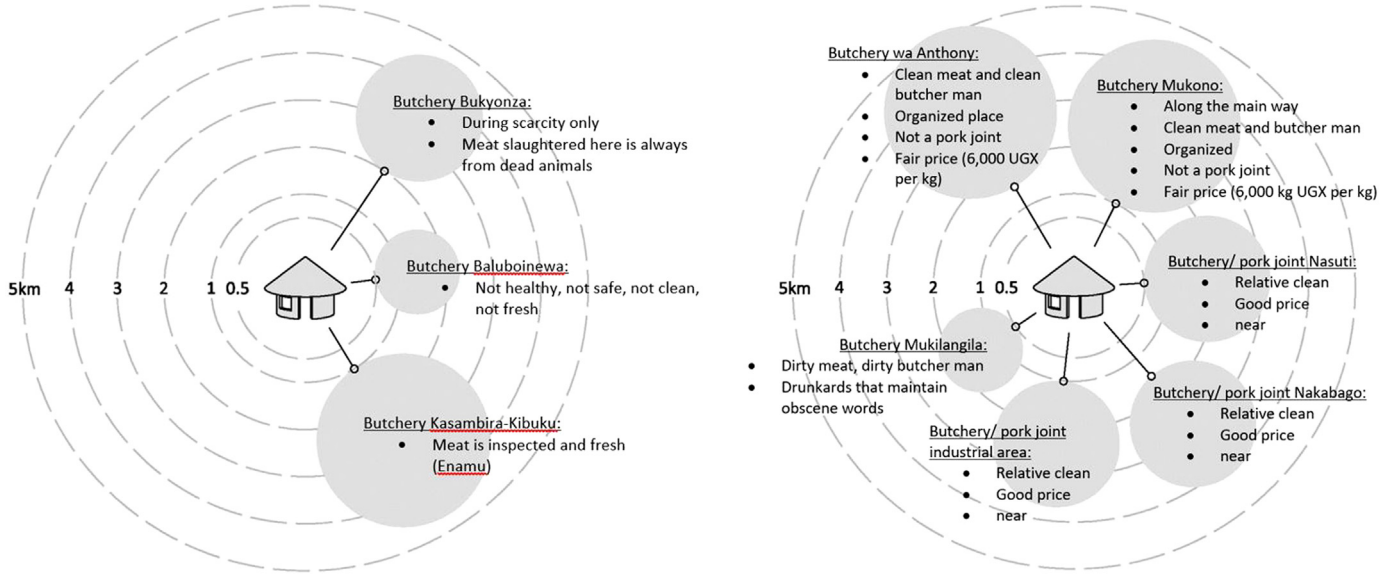

Fig. 6. (Exemplary) Venn diagrams developed by the group discussants to describe availability, accessibility and preferences for sources of pork. Left: Baluboinewa village in rural Kamuli district; right: Kitete village in urban Mukono district. The size of the circle represents the relative importance of the source.

presence of cholera.

3.1.8. What are knowledge, attitudes and practices that potentially increase or reduce the risk of pig- and pork-borne diseases?

Raw pork is considered unsafe for human consumption and a potential source of diseases across all sites. Pork ranked fifth after chicken, fish, beef and eggs in terms of perceived safety; milk ranked last. While cow milk is considered very nutritious and is consumed frequently, thick milk is said to cause constipation in children, and in rural Mukono, milk from other animals such as sheep is not healthy at all due to the sanitation of the animals. Raw milk in the same areas is said to cause worms in children. All pig farmers agreed that they can contract disease from eating pork; symptoms described were worms (26%), stomach pain (20%), diarrhoea (16%) and fever (13%) (Fig. 8). It is

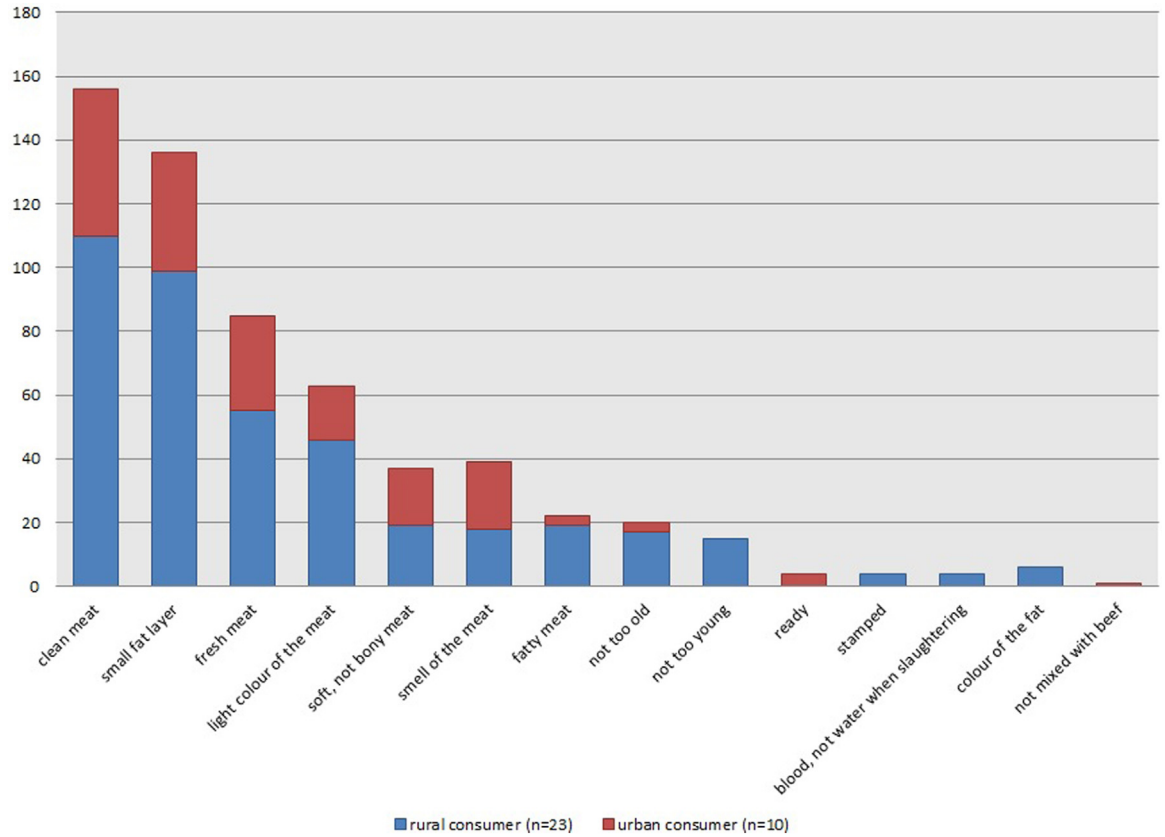

Fig. 7. Quality attributes as reasons not to buy pork as perceived by pig farmers in Kamuli, Masaka and Mukono districts. The bars indicate proportions established by group consensus through ranking and subsequent conversion of the ranks into scores. The y-axis represents the total number of scores (absolute); n refers to the number of groups completing this exercise, e.g. 33/34 pig farmer groups.

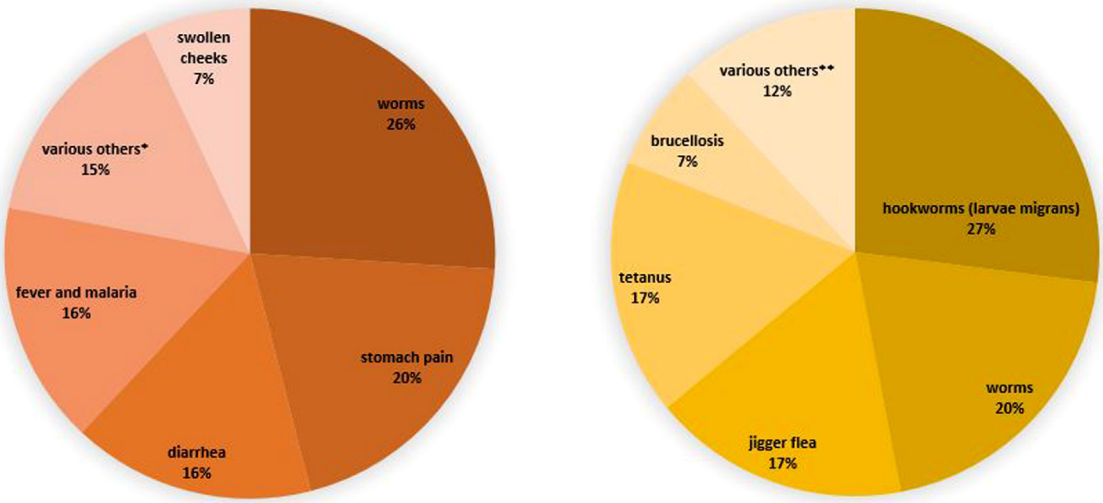

Fig. 8. Diseases believed to be caused by eating pork (left) and diseases believed to be contracted from live pigs or pig manure (right) (n = 24, where n refers to all pig producer groups). Footnotes: * Various others (each at 3%): measles; pig diseases (e.g. swine fever); swollen joints; vomiting; worms that might cause madness. ** Various others (each at 3%): fever; flu; lice; rotting fingers with wounds.

believed that undercooked pork can cause madness or epilepsy in humans. Fifty percent of the participants have heard about foodborne diseases in their community (e.g. brucellosis from milk and beef, or disease food consumed at social functions, or when consuming papaya, mango, cassava, sick animals), and 31% of them agreed that children are most affected. Foodborne diseases are not considered fatal but all agreed that it seriously weakens the person affected and reduces his or her ability to work or concentrate at school. More than 12% of the pig farmers (all of them in the rural areas) think they cannot contract disease from live pigs or pig manure. In the urban setting, the groups unanimously agreed it is possible. The most likely pig diseases to affect humans are hook worms (27%), worms (20%), tungiasis known as jiggers (17%) and tetanus (17%) (Fig. 8).

When talking to pig farmers about the diseases affecting or even killing their pigs (results not shown here), they were also asked if someone might eat these animals. The poor were mentioned in 80% of the groups, followed by “drunkards and mad people”. The reduced price at which the pork was sold was given as the main reason. However, when turning the question around to find out in what types of situations people would eat sick pigs, another group of people emerged: the farmers themselves, across all districts and all value chain types, preferably in the rural sites and especially if they cannot find a market for their animals. Ignorance of the consequences from eating sick animals was one reason given and seems to be motivated by a misperception that “people think infection [in the pig] stops with death”.

In most villages, the general cleanliness of the slaughter place and the carcass is very important as it attracts customers. In 59% of the villages, banana leaves are used as an underlay for pork; in about 56% of the villages, the pig is hung on a tree or a poll for proper bleeding and evisceration. Twenty-nine per cent make sure the head is cut off and sufficient time is allowed to properly drain the blood from the carcass. In one village in Kamuli, the inner parts are used to drain the blood by leaving them hanging outside of the body cavity. The intestines are usually buried to avoid flies. The pathognomonic signs of swine erysipelas (diamond-shaped skin lesions caused by *Erysipelothrix rhusiopathiae*) have been reported by pig farmers in all villages in Kamuli districts indicating a risk to people handling raw pork such as butchers and house wives preparing the meat.

Pork is usually bought between late morning and the afternoon hours, stored wrapped in banana leafs, and prepared for supper by the women. Fig. 9 shows the preparation steps that are very similar across sites. At home, pork is thoroughly cooked for at least one hour before eaten, and women reportedly do not taste the raw meat during cooking as it might cause disease such as worms, stomach pain, fever or malaria. Seventy-four per cent of the groups of mothers reported they wash utensils used for cooking in between cutting meat and vegetables as they are aware of cross-contamination. When eaten outside of the homes, fried or roasted meat is usually consumed with raw vegetables such as tomatoes, cabbage and onions. When discussing meat preservation, the mothers were initially amused because according to them there are no leftovers when a kilogram of meat is bought. However, especially in Masaka district, home slaughter is common and refrigeration is described as the most common modern way of preserving meat. Nevertheless, some mothers argue that the pork loses taste when kept in the fridge. In one village in rural Masaka it was debated that freezing the meat can even result in a change of colour and texture (e.g. it becomes too soft). More common traditional ways of preserving pork in all sites is smoking where the meat is cut into small pieces, occasionally pre-boiled and then put onto sticks and smoked over a charcoal fire on a wire mesh. The usual smoking differs from three hours in rural Masaka over five to eight hours in both Kamuli and Mukono district. In Masaka, banana or onion leaves are added for additional flavour of the smoked meat.

3.2. Urban pork consumers at pork joints

The major criteria pork consumers consider before buying pork are the hygiene of the premises, utensils, and the waiters themselves who should “look smart” (translating into clean and professional). Some stated that if the butcher has “dirty clothes, we do not buy”. Moreover, the freshness of the pork (e.g. considered fresh when it still has some visible blood in it) and the location of the pork joints in clean surroundings are important. Flies on the meat are considered an indicator for “unfresh meat” or disease carriers and should be scared away with chemicals or sprays. Also important is the availability of toilet facilities, that the butcher provides the customers with water and soap, and the hospitality of the waiters – “pork joints with smiling waiters” are preferred, and honesty of the butcher in terms of “measurements” and preparation is appreciated. Generally, pork consumers prefer to purchase hind legs (less bones) and ribs (less fat), marbled meat (sometimes called “beefy meat”), and others prefer pig ears or the jaws. Frozen pork is not a preferred option as it is said to lose its taste.

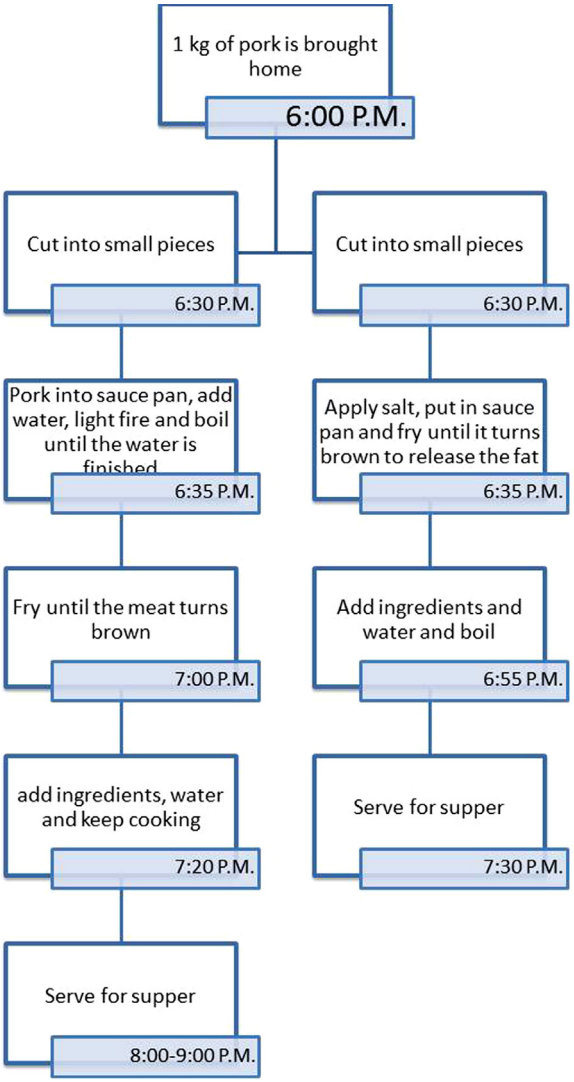

Fig. 9. Preparation steps of pork consumed at home in Mukono (left) and Kamuli (right). The steps are very similar across all sites, and the times indicated are the minimum times for each preparation step.

Many of the respondents are not aware of health risks associated with pork consumption; but a few mentioned infestation with tapeworms, "coloured" pork (blue pork syndrome), swine flu, brucellosis if the pork is not well done, diarrhoea, epilepsy or that the fat of a fatty pork "can accumulate under the skin and you develop hypertension". Many customers state they "are always patient to get ready meat" (e.g. well done meat) because they are aware of the risk of eating undercooked meat ("half prepared meat leads to epilepsy, diarrhoea and worms"); others hope that "inspected meat may have less worms" and prefer pork that carries an inspection stamp. Reportedly, some customers believe that eating pork cures HIV/Aids. Fish ranks highest in both taste and perceived safety but only when fresh, while beef ranks lowest in both categories, chicken ranks second, and pork third. Pork is perceived to be unsafe because "pigs are dirty compared to cows", "they eat everything". However, beef (red meat) is associated with gout while pork is considered white meat by many customers. One customer stated that his "favourite [in terms of taste] was beef but now that he has gout, it is pork". Beef is also associated with brucellosis when half-cooked; some beef butchers seem to be suspected to also sell disguised dog meat, and others state that "beef may be diseased due to injections and drug residues". Broiler chickens, too, are said to be fed with drugs to grow faster, and therefore, village chickens and eggs are preferred over broilers. The frequency of pork consumption varies from daily to once every three months and depends largely on the availability of money. Consumption of pork is preferred over the weekend compared to weekdays. Customers usually do not carry pork home to their families, only at special occasions such as weekends, or festive holidays like Christmas and Easter. Another reason for not taking pork home is that some family members are Muslims.

Direct observations at the pork joints showed that both roasted and fried pork is consumed, and that it is usually eaten with food items like boiled cassava, or raw vegetables (i.e. tomatoes, cabbage, onions, avocado, green and red pepper) on the side. This is how the customers prefer it, even though they acknowledge that salad "can also be a source of contamination". One group stated that "salads are risky but the avocado is masked [skinned] so what we do is to deworm ourselves". Often, table salt is added to the ready-to-eat pork, and commonly, alcohol like beer is consumed with pork. Customers explain they prefer fried pork "because all the fat and blood is burnt completely and you can have a great taste". Observations also showed that in some of the pork joints vegetables are not washed but only wiped with a towel; some joints are located near drainage channels or next to a waste bin with a lot of flies, or near a main road with a lot of dust. At other joints, the pork is protected from contamination because it is kept behind glass. Some areas where food is prepared and dirty dishes or waste is stored are very small and congested; and pork roasted on a stick is sometimes served "not ready enough", especially during the rush hour when many clients are being served.

3.3. Urban mothers of children under five years

The mothers themselves reported to consume beef, chicken, pork, fish (especially *mukene*), milk, goat meat, ghee, eggs and milk. The frequency of pork consumption varies from weekly to occasionally, and most pork was consumed over the weekend. Reasons why some mothers ate more pork than others were availability of financial means, lack of pork joints in their neighbourhood or taste preferences. Some mothers described pork as "sweet". Other reasons why pork was not consumed were adherence to certain religions (e.g. Muslims, Seventh Day Adventists and some Pentecostals) or witch doctors.

Children up to three years are mostly given Irish potatoes, passion fruit juice, porridge, pumpkin, egg yolk, fish, millet bread, rice, maize meal (*posho*), bananas, kidney beans and soy beans. Most mothers consider animal sourced foods important in their children's diets because they are believed to help them grow well, contain important nutrients and are body building foods. The perceived risks of giving very young children foods from animals are red meat causing disease such as brucellosis, fever, heartburn and stomach aches; and that meat is "very hard for children [to chew]", especially when they have not developed teeth yet. That is why liver is preferably given to very young children but generally, all parts of the pig are eaten including the skin and offal, and none of the parts are given especially to the children or adults.

Some mothers explain that they buy already prepared pork from pork eateries or butcheries. If prepared fresh, it is done in different ways, either a) Pork is cut in small pieces, fried until it is dry, then water, tomatoes and onions are added and the stew is left to boil for 40 min to two hours; or b) Pork is smoked to remove some fat, then cut into small pieces and fried until it turns brown. Then, garlic is added and it is boiled for about 50 min. All mothers stated that they have never eaten or tasted raw pork. Fresh vegetables such as tomatoes, onions, cabbage or green pepper are commonly eaten with pork, and these are usually prepared using the same utensils as for the meat.

Diarrhoea and vomiting in children was associated with foods that the children ate before, especially mango, jackfruit and potato. Other mothers learned in the discussions that food can cause gastrointestinal diseases in children. Some mothers started to keep pigs in their homes, and these were commonly given some supplements like cassava, sweet

potatoes and kitchen leftovers in addition to natural pastures.

4. Discussion and conclusion

Pork is listed as “red meat” by the United States Department of Agriculture, a good source of vitamin C, niacin, phosphorus and zinc and a very good source of protein, vitamin B12, iron and selenium (USDA, 2018). Nevertheless, it is also a source of cholesterol, a natural molecule needed in the body's cell membranes and vital for the synthesis of hormones, vitamin D and bile. It is controversially discussed as that if consumed excessively, cholesterol is associated with an increased occurrence of cardiovascular (heart) disease (Dehghan et al., 2017; Mente et al., 2017; Williams et al., 2015).

In the study sites, pork was consumed widely but frequency of consumption increased with proximity to urban areas. Consumers had access to pork in all study sites but quality seemed to be neglected in the rural sites where consumers reported less sources of pork and more meat sold from unsanitary outlets. At the production sites, pork consumption on the occasion of Easter and Christmas often coincided with times of food scarcity; a safe product could therefore contribute to the protein supply of poor farmers and their families during seasons of food shortage. The consumption of offal (internal organs and entrails of an animal slaughtered for meat) was not commonly accepted in the study sites and may need promotion as it provides a source of protein to those who cannot afford to buy pig meat (Schönfeldt and Gibson Hall, 2012). While the farmers in the study sites cooked red offal (heart, tongue, lungs, spleen and kidneys), white offal were only partly used. Meat is scraped off of feet and heads, and in Masaka district, bone marrow is sometimes given to old people to help them maintain their body strength. Brains and genital parts including the uterus and teats were not eaten at all and people do not know about the existence of the pancreas (sweet breads) which is usually discarded in the open by the butchers together with the slaughtered animal's stomach, intestines, blood and faeces, and left for scavengers.

Participatory epidemiology (PE) is an emerging branch of veterinary epidemiology based on the principles and methods of PRA, a concept from social science where “stakeholders in a given community are discussing a problem”. It aims at synthesizing the ideas of the community rather than compiling quantitative data. PE has also proved to be effective in Veterinary Public Health as it provides a fast and relatively cheap way of identifying zoonotic and foodborne risks to public health (Grace et al., 2010). Once more, participatory methods proved to be an efficient and resourceful way of scoping a problem before investing time and resources in quantitative studies. The results presented here, in conjunction with the findings on pig health gathered in parallel sessions with the same pig farmer cohort (Dione et al., 2014) informed subsequent sampling and testing at various nodes of the supply chain (farm, processing, retail) as well as the design of a number of prevalence and risk factor studies (Atherstone et al., 2017; Erume et al., 2016; Heilmann et al., 2017; Kungu et al., 2017b, 2017a; Roesel et al., 2017, 2016b), quantitative nutrition assessments (Alonso et al., 2017) and pilot interventions to improve pork safety (Heilmann et al., 2017).

Tools in PE are designed to have stakeholders elaborate and discuss around different issues without scientists guiding the discussion. While generating data, it facilitates capacity building of the stakeholders, for instance, some urban mothers learned about food causing gastrointestinal disease in children. This is a bottom up approach and also proved effective in identifying public health problems that would have not investigated otherwise: The pathognomonic sings of diamond skin disease (*Erysipelothrix rhusiopathiae*) were reported in four villages in Kamuli district and subsequently led to in-depth research and the first evidence of the disease in Uganda (Musewa et al., 2018) as well as to quantifying the risk to people handling raw pork like butchers and house wives preparing the meat. The discussions also helped to document the common misperception on the life cycle of *Taenia solium* which potentially causes inefficient management of the disease risks. Pork consumers widely believe that eating undercooked pork can cause epilepsy (cause by *T. solium*) which is not the case. Nevertheless, the preference for consuming meat hot and well done is generally a very good risk mitigation practice. In urban areas, where pork is often consumed roasted or eaten with raw vegetables on the side, risk to foodborne diseases is increased.

The tools used also helped documenting attributes that are important to customers at pork outlets, both showing the high level of awareness for good hygienic practices but also giving clues about preferences of customers that can be used as incentives to change behaviour of pork retailers. These include but are not limited to keeping the butchery clean and free of visible dirt, service-oriented butchers (e.g. provision of water and soap at pork joints) or reducing the number of flies (as followed up by Heilmann et al., 2017), a phenomenon that was recently challenged by butchers injecting formalin to meat to preserve meat (Buwembo, 2018). Other good practices such as refrigerating or freezing pork do not seem to be attractive to customers as it is said to alter the taste of the meat. This should be further evaluated taking into consideration the meat condition at slaughter (Jeremiah et al., 1990), and perhaps in some blinded taste experiments. A number of urban customers trusts the meat inspection stamp at purchase, which according to findings at the local slaughterhouse that supplies half of the Kampala pork outlets, should be considered with caution (Roesel et al., 2016a).

Acknowledgments

The study was conducted under the Safe Food, Fair Food project led by the International Livestock Research Institute and carried out with the financial support of the Federal Ministry for Economic Cooperation and Development, Germany (grant number 81141843), and the CGIAR Research Program on Agriculture for Nutrition and Health, led by the International Food Policy Research Institute. We acknowledge the support by ACIAR (Australian Centre for International Agricultural Research) who co-funded the development of the generic assessment tools through the project “Rapid Integrated Assessment of Nutrition and Health Risks Associated in informal livestock and fish value chains (RIA)”. We are grateful for the collaboration with and support of the Smallholder Pig Value Chains Development Project in Uganda, financed by the European Commission through the International Fund for Agricultural Development (IFAD) and the CGIAR Research Program on Livestock and Fish, led by ILRI; and we thank the smallholder pig farmers in Kamuli, Masaka and Mukono districts who shared their views and perception on pork consumption as well as the local government and non-governmental partners for their facilitation.

Authors’ declarations of interest

None.

Appendix A. Supplementary material

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.gfs.2018.12.001.

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