MAKERERE UNIVERSITY

PREVALENCE AND FACTORS ASSOCIATED WITH *ERYSIPELOTHRIX RHUSIOPATHIAE* INFECTION AMONG RAW PORK HANDLERS IN KAMULI DISTRICT, EASTERN UGANDA

By

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Declaration

I **Angella Musewa** declare that all the work in this dissertation is original and has never been submitted for any other academic award at any other institution of higher learning.

Signature_____ _____

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Dedication

This book is dedicated to all those people who are earning a living by engaging themselves in the pig industry and all organizations/bodies that have come together to support them.

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List of acronyms

BHFB	Brain Heart Infusion Broth
EDTA	Ethylene Diamine Tetra Acetic acid
ER	*Erysipelothrix rhusiopathiae*
ESM	*Erysipelothrix* Selective Media
FGDs	Focus Group Discussions
ILRI	International Livestock Research Institute
KII	Key Informant Interview
MDA	Modified Blood Agar
MoH	Ministry of Health
PCR	Polymerase Chain Reaction
SPVCD	Small Holder Pig Value Chain Development Project
SSA	Sub-Saharan Africa
TSA	Trypticase Soya Agar
UBOS	Uganda National Bureau of Standards
WHO	World Health Organization

Operational definitions

Raw pork- This is pig meat with or without fat that is not cooked/ processed into sausages or bacons or ready for consumption.

Raw pork handlers

These were defined as adults >18 years (males or females) who were in contact with raw pork; they included butchers, abattoir workers, slaughter men or cooks.

Infection: The invasion and multiplication of microorganisms such as bacteria, viruses, and parasites those are not normally present within the body.

An abattoir

This is a facility where animals are killed and processed into meat products, (FAOSTAT, 2011).

Abattoir workers

These were adults > 18years (males or females) who were working in pig abattoirs/ pig slaughter houses during the study period. Their work involved handling live pigs, slaughtering pigs in the three study sub counties.

Butchers

These were adults > 18 years (males or females) with retail butcheries in Namwendwa, Kitayunjwa and Bugulumbya sub counties.

Consumers/pork buyers - These are adults >18 years (males or females) who bought raw pork from butchers and abattoirs during the study period or prepared pork for consumption at the different butcheries or eating places where the study was conducted.

Abstract

Introduction: *Erysipelothrix rhusiopathiae* (ER) is a zoonotic, ubiquitous gram-positive bacterium, which causes erysipelas in swine, mammals, birds and erysipeloid in humans. The study was conducted in Kamuli district because farmers had reported signs of disease in their pigs which was reported at a prevalence of 67%. Therefore this study determined the prevalence and factors associated with ER infection among raw pork handlers in Kamuli district, Eastern Uganda.

Methods: A cross-sectional community based study was done which employed quantitative and qualitative methods for data collection between January and March 2016. The study was conducted in Namwendwa, Bugulumbya and Kitayunjwa sub counties in Kamuli District because the farmers reported signs of the disease in their pigs. A total of 302 participants (butchers, abattoir workers and cooks) were enrolled consecutively for quantitative data collection. Participants for qualitative data collection were sampled purposively. *E. rhusiopathiae* infection among the handlers was determined by collecting whole blood which was used for culture and isolating the bacteria. The infection was confirmed the infection using biochemical tests and gram staining of the resulting isolates.

Results: The prevalence of *E.rhusiopathiae* infection was 9.9 % (95% CI: 7.35 -12.52). Type of raw pork handler and alcohol consumption increased the risk of acquiring the infection. Working in the abattoir and butchery increased the risk of the infection at (aOR= 26.13 95% CI: 5.29-129.10) and (aOR= 8.37 95%CI: 1.79 -39.10) respectively. Alcohol consumption was associated with *E.rhusiopathiae* infection (aOR= 4.02 95%CI: 1.07 -15.03).

Conclusion: The overall prevalence of *E. rhusiopathiae* infection was low compared to those from previous studies. Abattoir worker and butchers were highly infected with *E. rhusiopathiae.*

Alcohol consumption, working in the abattoir and being male increased the risk of acquiring the infection. The main causes of *E. rhusiopathiae* were poor hygiene of the personnel especially the abattoir workers and butchers. Increased alcohol consumption among participant was associated developing the infection.

Recommendations: Abattoir workers, butchers and cooks/pork buyers should be sensitized on the risk of being infected with *E.rhusiopathiae* infection and how to prevent it while carrying on with their duties. Raw pork handlers should avoid working under the influence of alcohol as this would impair their sense for judgment and increase their exposure to *E. rhusiopathiae* infection.

CHAPTER ONE

1.0 Background

Erysipelothrix rhusiopathiae is a gram-positive, facultative aerobic, non-spore forming, non-acid-fast bacterium which causes erysipelas in swine, mammals, and erysipeloid in humans (Brooke *et al*., 1999). The organism can survive in soil for a long period of time ranging from fourteen days to six months but can also persist in frozen and chilled meat as well as decaying carcasses (Wabacha *et al*., 1998). It is also reported to withstand salting, pickling and smoking (Wabacha *et al*., 1998).

Approximately 60% of all human diseases and 75% of all emerging infectious diseases are zoonotic (Taylor *et al*., 2001), spreading from livestock including pigs, chicken, cattle, goats, sheep and camels (WHO, 2013). Globally this zoonotic infection affects 24-55% (WHO, 2013) in USA, Asia and Europe leading to loss of life. The piggery industries in the USA, Europe and Asia have lost billions of money because of the reduction in trade and carcass burning (WHO, 2013).

The most common form of *E.rhusiopathiae* infection in humans is erysipeloid (Kichloo *et al*., 2013b) though patients also present with generalized and systemic forms, usually transmitted through skin cuts. The population at risk of this infection includes people handling infected animal tissue. These groups are often exposed due to their occupation and comprise of veterinarians, butchers, abattoir workers and cooks (Joshi *et al*., 2015; Kichloo *et al*., 2013b). Nearly, 31% of all erysipeloid cases progress to serious complications requiring surgical debridement, reconstruction surgery, or amputation (Kichloo *et al*., 2013b). The complications may present in the form of abscesses, septic arthritis, osteomyelitis, and necrotizing fasciitis (Pereira *et al*., 2010). If not treated, complications can yield more debilitating conditions like

septicemia, endocarditis or even death (Kichloo *et al*., 2013b). This extreme systemic infection of erysipeloid has been reported to occur in 1/3 of all patients with alcohol and drug dependence, immunosuppression, poor hygiene and chronic liver disease (Kichloo *et al*., 2013b). Penicillin given either parentally or orally depending on the clinical severity is the treatment of choice for erysipeloid (Stevens *et al*., 2016). This study therefore sought to determine the prevalence and factors associated with *E. rhusiopathiae* infection *among* raw pork handlers in Namwendwa, Kitayunjwa and Bugulumbya sub- counties in Kamuli district, Eastern Uganda.

1.1 Problem statement

In 2015, a preliminary study done in Namwendwa, Kitayunjwa and Bugulumbya sub counties, Kamuli District reported the prevalence (seroprevalence) of E.rhusiopathiae infection in live pigs at 67% was isolated in 45% of the fresh pork samples sold in the different pork butcheries and from slaughter abattoirs.

Erysipelothrix rhusiopathiae is transmitted from infected raw pork and live pigs to humans. If *Erysipelothrix rhusiopathiae* is prevalent in pigs these groups of pork handlers may be at an increased risk of acquiring *Erysipelothrix rhusiopathiae* infection (Kichloo et al., 2013b).

There is limited awareness of *Erysipelothrix rhusiopathiae* infection which makes it very hard to diagnose and treat which if recognised early and treated is curable. Nearly 31% of all Erysipeloid cases progress to serious complications which if erysipeloid is not recognized , it can lead to bacteremia and endocarditis, valve replacement, (36%) of the patients (J. Bille, 1999); where mortality is reported at 38% in patients who develop endocarditis (Brooke et al., 1999).

1.2 JUSTIFICATION

Preliminary study has shown that the seroprevalence of *E.rhusiopathiae* was at 67% in live pigs and isolated in 45% of fresh pork sample sold. Since *E. rhusiopathaie* is a zoonotic bacteria and prevalent in pigs thus pork handlers and pig owners are at an increased risk for developing the infection. Infection with *E.rhusiopathiae* can lead to serious complication which may require surgical debridement, reconstructive surgery or even amputation.

Therefore this study seeks to determine the prevalence and factors associated with *E.rhusiopathiae* infection among raw pork handlers in Kamuli district, Eastern Uganda.The results from this study will help guide policy on pork handling and also create awareness about the burden of *E.rhusiopathiae* in the community so that the infection is controlled.

1.3 The conceptual frame work

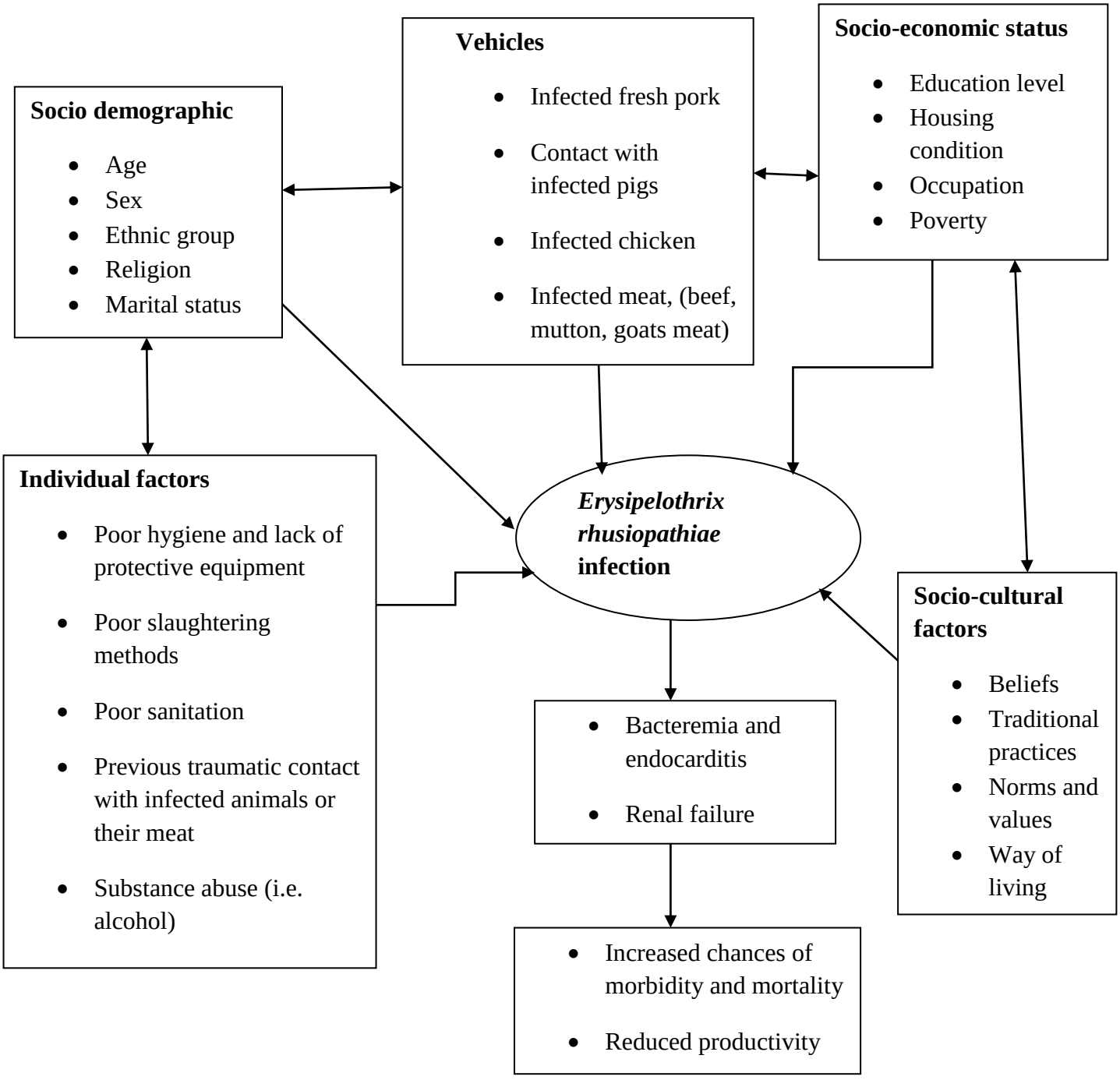


Figure 1: **Conceptual framework of the factors associated with *E. rhusiopathiae* infection among raw pork handlers and its consequential outcomes**

1.3.1 Conceptual framework and scope of the study

The conceptual framework, (**Figure 1**) outlines the predictors of *E.rhusiopathiae* infection among raw pork handlers in Kamuli district and the possible outcomes. The prevalence of *E.rhusiopathiae* infection among humans would be reported to be high among those individuals who have been exposed to those vehicles when they are compared to those who are not exposed. Age and sex have also been stated as important factors to be studied in relation to the infection since it is reported that males are likely to be more infected compared to the females due to the occupational nature of the disease. Similarly, age is reported to be an important factor to study since it is reported that the occupation is mainly dominated by subjects who are above 40 years, (Pereira *et al*., 2010). This study looked at the sociodemographic factors, individual factors and socio cultural factors.

1.4 Research questions

1. What is the prevalence of *Erysipelothrix rhusiopathiae* infection among raw pork handlers in Kamuli district?

2. What factors are associated with *Erysipelothrix rhusiopathiae* infection among raw pork handlers in Kamuli district?

3. What socio-cultural factors influence *Erysipelothrix rhusiopathiae* infection among raw pork handlers in Kamuli district?

1.5 Objectives

1.5.1 General objective

To determine the prevalence and factors associated with *E.rhusiopathiae* infection among raw pork handlers in Kamuli district.

1.5.2 Specific objectives

1. To determine the prevalence of *E. rhusiopathiae* infection among raw pork handlers in Kamuli district.

2. To determine the factors associated with *E. rhusiopathiae* infection among raw pork handlers in Kamuli district.

3. To explore the socio-cultural factors associated with *E. rhusiopathiae infection* among raw pork handlers in Kamuli district.

CHAPTER TWO

Literature review

2.1 Introduction

Erysipelothrix rhusiopathiae is a nonsporulating, gram-positive, rod-shaped bacterium which was identified more than 100 years ago as the etiologic agent of swine erysipelas (Reboli and Farrar, 1992). Since then, it has been found to cause infection in several dozen species of mammals and other animals. Humans become infected through exposure to infected or contaminated animals or animal products (Kichloo *et al*., 2013b). Approximately 50 cases of endocarditis have been reported; all but one recent case have involved native valves. The organism may be isolated from biopsy or blood specimens on standard culture media (Brooke *et al*., 1999). It is identified by morphology, lack of motility, and biochemical characteristics; identification may be confirmed by the mouse protection test (Bender *et al*., 2010). It is susceptible to penicillin, cephalosporins, erythromycin, and clindamycin, but it is often resistant to many other antibiotics, including vancomycin, a drug frequently used in empiric therapy for infections due to gram-positive bacteria (Reboli and Ferrar, 1989).

2.2 Etiology of *E. rhusiopathiae* infection in humans (erysipeloid)

Erysipeloid is an acute, occupational bacterial infection of traumatized skin and other organs, (Bernard, 2008). Direct contact between meat infected with *E. rhusiopathiae* and traumatized human skin may result in erysipeloid (Krasagakis *et al*., 2006). Humans acquire erysipeloid after direct contact with infected animals or animal products. Erysipeloid is more common among farmers, butchers, cooks, homemakers, and veterinarians (Bonnetblanc and Bedane, 2003), all groups of people who are more exposed due to their occupation. The risk of infection in humans is based more on opportunistic exposure, and factors such as age, sex, vehicles, race and socio-economic status relate only to this opportunity (Reboli and Ferrar, 1989) (McGinnes *et al*., 1934). Individuals with close contact to animals, animal products or animal wastes are at greatest risk. Thus, *E.rhusiopathiae* infection is said to be occupationally related (Kichloo *et al*., 2013b).

2.3 Prevalence of *E.rhusiopathiae* infection humans

Globally 829 cases of *Erysipelothrix rhusiopathiae* infection per 100,000 have been reported. However research in humans has not been done for more than a decade without research due to the difficult in diagnosis of the bacteria (Reboli and Farrar, 1992). In sub Saharan Africa there is limited research on the disease with only reports from Kenya and Nigeria that reported *Erysipelothrix rhusiopathiae* infection pigs (Friendship and Bilkei, 2007). However the prevalence of *E.rhusiopathiae* infection in humans varies from region to region.

A study conducted in Czech Republic on the occupational infectious diseases reported a prevalence of 29% of erysipeloid among agriculturalists, game managers and forestry workers. Among the zoonoses was erysipeloid infection (Brhel and Bartnicka, 2003). Another study conducted by (Amal *et al*., 2004) on the epidemiology, clinical features, and evolution of

erysipeloid in the Marrakech region reported the relapse of *E.rhusiopathiae* infection in 12 % of the cases studied (Amal *et al*., 2004).

2.4 Research on *E. rhusiopathiae* infection in East Africa

A systematic review by Ocaido *et al*., 2013 reported that there is a gap in knowledge and added that no study has been in Uganda to establish the prevalence and factors associated with *E. rhusiopathiae* infection in pigs and humans. Two outbreaks of swine erysipelas were reported in Kenya (Wabacha *et al*., 1998) and (Friendship and Bilkei, 2007). In the first outbreak, Wabacha *et al* reported that ten pigs from a herd of 181 pigs in a medium-scale, semi-closed piggery in Kiambu district, Kenya, contracted the clinical disease in 1997. Friendship and Bilkei (2007) reported a concurrent outbreak of *E.rhusiopathiae* and *Clostridium novyi* occurring in a large outdoor pig-breeding unit in Kiambu district in Kenya resulting in high mortality. In 2012/13, during participatory appraisals conducted with pig farmers conducted in Masaka, Mukono and Kamuli district , pig keepers in four villages reported signs of e*rysipelas* (*Okumyuka* in Lusoga language) to be one of the diseases affecting their pigs (Roesel *et al*., 2014).

2.5 Epidemiology of *Erysipelothrix rhusiopathiae* infection

E. rhusiopathiae is a gram-positive bacillus and has for long been an important pathogen in veterinary medicine as well as a cause of serious disease in humans (Wang, 2004). As stated, *E. rhusiopathiae* is an occupational illness with 89% of the cases linked to high-risk epidemiological situations (Kichloo *et al*., 2013b). It is reported to affect birds, mammals, animals and humans. Study findings by Nakazawa (1998) reported a prevalence of 30% *E. rhusiopathiae* in chicken samples collected from an abattoir in Nagano Prefecture, Japan. In soil

it may live long enough to cause infections, for two weeks to six months after initial contamination (Nicoleta *et al*., 2010). People with the highest risk of exposure include butchers, abattoir workers, veterinarians, farmers, fishermen, fish-handlers and housewives, (Reboli and Ferrar 1989).

The principal reservoir of *E. rhusiopathiae* infection seems to be swine, the etiologic agent has been isolated from the tonsils of up to 30% of apparently healthy swine world (WHO, 2013). In a study carried out in Chile, the agent was isolated from tonsil samples of 53.5% of 400 swine in a slaughterhouse, (Skoknic, 1981). *E.rhusiopathiae* was isolated from 25.6% of soil samples where pigs live and from their feces (Wood *et al*., 1981). It can survive a long time outside the animal organism, both in the environment and in animal products, which contributes to its perpetuation (WHO, 2013).

2.6 Factors associated with *E. rhusiopathiae* infection among raw pork handlers

2.6.1 Hygiene of the slaughter house

Slaughter hygiene has been documented to be one of the major predictors of erysipelas and erysipeloid infection in pigs and humans. Pigs acquire the infection through feeding on contaminated feeds, water and housing. Humans acquire the infection through handling infected pork without protective gears (Kichloo *et al*., 2013a).

2.6.2 Occupational exposure

Individuals involved in occupations or recreations with contact with animals, animal products or animal wastes are at greatest risk. Thus *E. rhusiopathiae* infection is said to be occupationally related (Brooke *et al*., 1999). It follows that those in occupations with most frequent animal contact, such as butchers, abattoir workers, veterinarians, farmers, fishermen, fish-handlers and housewives are the most commonly infected (Brooke *et al*., 1999).

2.6.3 Alcoholism

This is also a known risk factor for erysipeloid in humans in a case study since it compromises the immunity of the personal. Therefore when the bacteria invade the person it multiplies easily in the body and hence weaken him/her leading into severe infection (Kichloo *et al*., 2013a). A case study on *E.rhusiopathiae* endocarditis and presumed osteomyelitis in a 67 year old woman reported that the patient had a history of drinking hard liquor that reduced her immunity thus developing endocarditis, (Romney *et al* .,2001)

2.6.4 Environmental factors

The bacteria have the ability of surviving in the environment and marine locations. Because of its resilience it has the ability to affect others, especially the farmers. While it has been suggested that the incidence of human infection could be declining because of technological advances in animal industries, like processing (transforming pork into other roducts like sausages) infection still occurs in specific environments (Brooke *et al*., 1999).

2.6.5 Age of the raw pork handler

A study conducted by Pereira and others found that age was an important risk factor for erysipeloid. They concluded that participants who were greater than 45 years of age were at increased risk of acquiring the infection with a population of 428 patients (Pereira *et al*., 2010)**.**

2.7.6 Sex of the raw pork handlers

Sex was reported as an important risk factor for *E. rhusiopathiae* infection in a study of 428 patients. Males have been reported to have a high prevalence of the disease compared to the females. One reason may be that a greater percentage of males work in the food industry compared to females, however both are infected with the bacteria, (Pereira *et al*., 2010).

2.7 Prevention and control of *Erysipelothrix rhusiopathiae* infection in humans

Containment and control of *E. rhusiopathiae* are the most effective means of preventing the spread of infection in man and animals (Brooke *et al*., 1999). An awareness of the infection is essential for individuals in occupations which put them at risk. Suggested preventive measures include but are not limited to wearing of gloves or other protective hand wear, good hygiene especially frequent hand washing with disinfectant soap and the prompt treatment of any small injuries (Conklin and Steele, 1979). Good general health is considered an important factor in prevention, as any condition suppressing the immune system, including chronic alcoholism, may predispose to the serious forms of infection. Control of animal disease by sound husbandry, herd management, good sanitation and immunization is recommended if practitioners are made aware of the infection, signs and symptoms,(Nicoleta *et al*., 2010).

2.7.1 Disinfection

Erysipelothrix spp. can be inactivated by commonly available disinfectants (Conklin and Steele, 1979) and several commercially available home disinfectants have been found to be highly effective; however, structurally complex equipment which contained organic matter was more difficult to disinfect especially without prior mechanical cleaning of surfaces with hot water and soap (Fidalgo, 2002). Due to the inability of disinfectants to fully remove the organism from the

environment, a multifaceted approach composed of sound husbandry, herd management, sanitation, and immunization has been recommended,(R. L. Wood, 1999)

CHAPTER THREE

3.0 Materials and methods

3.1 Study design

A cross-sectional community based study was done which employed quantitative and qualitative methods for data collection between January to March 2016.

3.2 Study setting

The study was conducted in Kamuli district in Eastern Uganda. This district forms part of the Busoga sub region. It is multi-ethnic and multi-cultural region with Basoga forming 76% of the population, while Iteso make up 3.8%, Banyoro and Bantu make up 1.8% (Local Government Kamuli district, 2009). It is bordered by Buyende district in the North, Luuka district in the East, Jinja district in the South and Kayunga district in the West. It has an estimated population of 662, 407 and 55,998 pigs (Local Government Kamuli district, 2009).

The district was selected in a participatory manner for a research for development program to improve the performance smallholder pig value chains in Uganda, led by the International Livestock Research Institute (Ochola, 2012).

The study was based in three sub counties of this district including Namwendwa, Kitayunjwa and Bugulumbya which had reports of swine erysipelas in 2013 (Roesel *et al*., 2014). The setting has three abattoirs, one in each of the sub counties.

3.3 Population

3.3.1 Target population

Adult raw pork handlers in Kamuli district, Eastern Uganda.

3.3.2 Accessible population

Abattoir workers, butchers, farmers, veterinarians and cooks in eating places and homes, resident in the three selected sub counties.

3.3.3 Study population

Adult healthy raw pork handlers (abattoir workers, butchers, and cooks who buy raw pork from the butcheries) in Namwendwa, Kitayunjwa and Bugulumbya sub counties.

3.4 Selection criteria

3.4 1 Inclusion criteria

Adult healthy raw pork handlers (abattoir workers, butchers, and cooks who buy raw pork from the butcheries) in Namwendwa, Kitayunjwa and Bugulumbya sub counties during the study period, and who gave written informed consent.

3.4.2 Exclusion criteria

All those participants who wouldn't comprehend Lusoga, luganda and English were excluded from the study.

3.4.2 Withdrawals

Participants who did not adhere to the procedures of the study proposal e.g. refusal to draw blood for the *E. rhusiopathiae* test were considered as withdrawal.

3.5 Sample size estimation

3.5.1 Sample size for objective 1, prevalence of *Erysipelothrix rhusiopathiae* infection among raw pork handlers in Kamuli District.

The sample size was calculated using the Kish Leslie formula, (Kish Leslie., 1965)

$$N = \frac{Z^2_{\alpha/2}\, p(1-p)}{d^2}$$

Where

p is the proportion of *ER* in humans. However, in animals p= 0.67 in Uganda (Musewa *et al*., 2015-forth coming) assuming the transmission rate to humans is 50%, therefore p =0.50

d is the precision, usually 5%, (0.05)

$Z_{\alpha/2}$ is the critical value at 95% level of confidence, =1.96.

This gives a sample size of **385**.

3.5.2 Sample size for factors associated with *E. rhusiopathiae* infection among raw pork handlers in Kamuli District.

This was adopted from a text book of designing clinical research by (Cumming, 2013).

$$N = \frac{[Z_{\alpha/2}\sqrt{p(1-p)(1/q_1 + 1/q_2)} + Z_{\beta}\sqrt{p_1(1-p_1)\,1/q_1 + p_2(1-p_2)\,1/q_2}]^2}{(p_1 - p_2)^2}$$

Where

p_1 is the proportion of participants greater than 50 years with *E. rhusiopathiae* infection,

p_2 is the proportion of participants less than 50 years with *E. rhusiopathiae* infection,

N is the required sample size,

q_1 is proportion of subjects with >50 years,

q_2 is proportion of subjects with ≤ 50 years.

Z_α is standard normal value corresponding to level of significance, 1.96,

Z_β is standard normal value corresponding to power of the study at 80% corresponds to a value of 0.84.

A study by Pereira reported a prevalence of *E. rhusiopathiae* infection was 60% among participants >50 years .Therefore p_1=0.6, considering a clinical significance of 30%, the difference in proportions in those above and below 50 years *E.rhusiopathiae* is 0.3*0.6 = 0.18. The proportion (p_2) = (0.6-0.18) =0.42. Estimating the ratio of 50 years and above, below 50 years being 2:1, the proportion of those with *E.rhusiopathiae* below 50 years = 1/3=0.333, (q_1) and proportion of those with *E.rhusiopathiae* above 50 years = 2/3=0.667 (q_2).

Therefore, P= (p_1*q_1+p_2*q_2), P= (0.6*0.667) + (0.42*0.333) = 0.5006.

Substituting the above proportions in formula above gave a sample size of 269 participants. However since this is smaller the sample size for objective one, the two objectives were answered with the sample size for the first objective.

3.5 Sampling

3.5.1 Sample population

The sample population included all raw pork handlers (abattoir workers, butchers and consumers) in Namwendwa, Kitayunjwa and Bugulumbya sub counties.

3.5.2 Sampling unit

Abattoir workers, butchers and cooks residing and sourcing pork from the sub counties under study were sampled for this study.

3.5.3 Sampling procedure for quantitative data collection

Since the sampling was done in three sub counties with Namwendwa subcounty having the highest numbers of bucthers and consumers, participants were sampled depending on the number of butchers available in the subcounty. However all abattoir workers (38 from the three sub counties) and 59 butchers were included in the study. Cooks who fulfilled the selection criteria were sampled consecutively as they came to the butcheries to buy raw pork. All cooks were sampled from the butcheries. This was because there was no clear population of cooks who buy pork though there were daily customers at different pork joints. However some cooks felt shy to be interviewed from the joint/butchery and asked us to go to their homes. This was done to see us raise the sample size required for this study and for confidentiality purposes of the study participants.

3.6 Variables and measurement

3.6.1 Dependent variable

E.rhusiopathiae infection was the outcome variable.

3.6.2 Independent variables

3.6.2.1 Demographic factors

Age of the RPH, sex, ethnic group, religion, marital status

3.6.2.2 Socio-economic factors

Education level, housing, occupational exposure, duration on job

3.6.2.3 Socio-cultural factors

Traditional beliefs, traditional practices, norms and values, way of living

3.6.2.4 Individual factors

Personal hygiene, poor slaughtering methods, eating undercooked pork, no personal protective wear when handling raw pork

3.6.2.5 Vehicles: Infected fresh pork, contact with infected pigs, infected chicken, infected meat, (beef, mutton, goat's meat).

3.7.2.6 Socio-cultural factors

The socio-cultural factors were explored during the focus group discussions (FGDs) and key informant interviews (KIIs). The FGDs were conducted separately for each group in each subcounty at the subcounty headquarters. The participants were categorized as; butchers, abattoir

workers and cooks. Males who dominated the butchers and abattoir workers were in different focus groups and also the cooks, (where females were selected were separated from the males) during the focus group discussions. Nine participants were included in each FGD, and KIIs were conducted with nursing officer and a health assistant and Veterinarian in each of the sub counties.

Question guides were designed for the FGDs and KIIs, (**Appendix 9 and 10**). The FGD guide was translated to Lusoga while that of the KIIs were not translated, (**Appendix 11 and 12**).

3.7 Data collection

Both qualitative and quantitative methods of data collection were used. The principal investigator directly observed data collection.

3.7.1 Quantitative methods of data collection

Participants were asked to give a written consent after the study had been explained to them,**(Appendix 6**) Questionnaires were administered to the participants by the research assistant (*Lusoga* native speakers). A tourniquet was tied on the upper arm and vein was observed. An alcohol swab was used to clean the area of blood draw. Blood was drawn from the participants by the principal investigator. Before the participant left, the questionnaire was cross checked to ensure that all the gaps and the necessary information was obtained. Data from all butchers and abattoir workers was collected at their places of work and data from cooks was collected from the butcheries and abattoirs where they bought the raw pork whereas others told the research team to follow them home for safety and privacy issues.

Whole blood, (EDTA) was collected from the participants. A sterile syringe and new needle were used for each participant to draw 4ml of fresh blood. The syringe and needle were disposed

into a hazardous waste bin and the blood was kept on ice in a cool box then transported to Kamuli district regional referral hospital deep freezer until when it was transported to the microbiology laboratory, College of Veterinary Medicine, Animal Resources and Biosecurity at Makerere University in Kampala for analysis.

3.8 Laboratory diagnosis

Different laboratory diagnostic approaches have been reported for isolation and identification of *Erysipelothrix rhusiopathiae infection* in animals and humans**.**

3.8.1 Growth conditions and requirements

Erysipelothrix rhusiopathiae is a facultative anaerobe organism (Reboli and Ferrar, 1989). Newly isolated strains are micro-aerophilic, but laboratory adapted cultures grow both aerobically and anaerobically, with some strains being favored by incubation in $C0_2$ 5% or 10%. The organism can grow at temperatures between 5oC-44°C, optimally between 30^oC- 37°C. Best growth is favoured by an alkaline pH (Conklin and Steele, 1979), and the limits of growth as 6.7-9.2 (Sneath et al., 1951). Growth is enhanced by the inclusion of serum 5- l0%, blood, glucose 0.1 -0.5%, protein hydrolysates, or surfactants such as Tween 80 in media (Ewald, 1970). The exact nutritional requirements of the organism are not known, but riboflavin, small amounts of oleic acid and several amino acids, particularly tryptophan and arginine are needed for growth (Ewald, 1970).

2.8.2 S- and R-shape (indicator for virulence)

On blood agar *E.rhusiopathiae* is alpha-hemolytic with green hemolysis often reported but is never beta hemolytic. After growing for 24 h at 37°C, colonies are small, circular, and transparent, with a smooth glistening surface and edge. These are smooth or S forms. Larger

flatter colonies with a matter surface and fimbriated edge are R-form or rough colonies. Forms, (R and S shape) are usually light blue in color or sometimes green. Intermediate forms are also seen.

S-form colonies dissociate to give rise to intermediate and R-form colonies. R-form colonies also give rise to S forms. In broth, S-form organisms cause a slight turbidity and a powdery deposit; R forms have a tangled hair like appearance. Microscopically, S-form organisms are 0.3 to 0.6 by 0.8 to 2.5 ,um, while R-form organisms form long non branching filaments which can be >60 ,um in length ,(Reboli and Farrar, 1992)

3.8.3 Microbiological cultures

Whole blood from humans was cultured in order to isolate *E.rhusiopathiae* from EDTA blood (**figure 3**). The dependent outcome was measured by culturing EDTA blood on trypticase soya agar, brain heart infusion broth, modified blood agar and gram staining. Erysipelothrix selective broth, (this was made in the laboratory with the available reagents) and confirmed using biochemical tests like catalase, gelatine test and aesculin test and gram staining.

3.8.4 Principle and preparation of the test– Selective culture media

Selective media allows growth of certain type of organisms and inhibit growth of other organisms. Some organisms have the ability to utilize a given sugar and are screened easily by making that particular sugar e.g. glucose, the only carbon source in the medium for the growth of the microorganism. Selective inhibition of some types of microorganisms can be studied by adding certain dyes, antibiotics such as kanamycin and neomycin, salts or specific inhibitors that will affect the metabolism or enzymatic systems of the organisms (Wang *et al*., 2010).

Twenty five grams (25g) of infusion broth was dissolved in 1 litre of 0.1 phosphate buffer solution (12.02g) of Na_2HPO_4 (12.02g) and KH_2PO_4 (2.09g) per liter of distilled water and then autoclaved for 1hour and 15mins. Sterile fetal bovine serum (5%), kanamycin (400mg/ml) and neomycin (50mg) was added to the broth and specimens were cultured on *Erysipelothrix* species-selective agar (Bender *et al*., 2010).

3.8.5 Preparation of modified blood agar

Forty grams of horse heart infusion agar was dissolved with 0.4g of sodium azide in 1000ml of distilled H_2O. The media was sterilized at 121^oC for 1hour and 15minutes. It was cooled to room temperature and 20ml of defibrinated bovine blood and 50ml of horse serum were added aseptically (Harrington *et al*., 1971).

3.8.6 Preparation of trypticase soya agar

Twenty five grams of trypticase soya were dissolved in 1000 ml of distilled water. The solution was left to stand for 15 minutes until all the powder was dissolved. Four grams of European agar were added and mixed gently. The dissolution was autoclaved at 121^oc for 1 hour and 15minutes, the medium was cooled to room temperature and sterile blood was added (Shimoji *et al*., 1998).

3.8.7 Biochemical tests for confirmation of *E.rhusiopathiae infection*

3.8.7.1 Biochemistry

The genus *Erysipelothrix* is relatively inactive and gives negative results for catalase, oxidase, methyl red, indole and Voges-Proskauer reactions (Cottral, 1978). Andrade's agar with horse serum 10% is the recommended medium for biochemical tests, (Brooke *et al*., 1999). The majority of strains produce H_2S gas, but again the extent of this production varies with the culture medium. The best reaction is demonstrated on triple sugar iron agar.

3.8.7.2 Catalase test

This was done to confirm the presence of *E. rhusiopathiae* and distinguish it from the microorganisms with similar characteristics. Using a wire loop, a bacteria colony was picked from the culture plate and placed into a test tube. Three millilitres of hydrogen peroxide were added and for positive test , bubbles were formed while for a negative test , no bubbles were formed (Forbes *et al*., 2007).

3.8.7.3 Aesculin hydrolysis

Aesculin was used in a microbiology laboratory to aid in the identification of *E. rhusiopathiae* infection. *E. rhusiopathiae* is group D Streptococci which hydrolyzes æsculin in 40% bile. Aesculin was incorporated into agar with ferric citrate and bile salts (bile aesculin agar).When aesculin was hydrolyzed it formed aesculetin and glucose. The aesculetin formed dark brown or black complexes with ferric citrate. The bile aesculin agar was streaked and incubated at 37°C for 24 hours. The absence of a dark brown or black halo indicated that the test was negative (Forbes *et al*., 2007).

3.8.7.3 Gelatin test

Nutrient gelatin was a differential medium that tested the ability of an organism to produce an exoenzyme, called gelatinase that hydrolyzes gelatin. A wire loop was used to pick colonies and put them in a test tube. Nutrient gelatinase was added. Breakdown of proteins was read upon formation of bubbles and no bubble formation indicated a negative test .

3.8.7.4 Gram staining

Using a sterile wire loop, a drop of normal saline was added on the slide. A colony was picked from the culture plate and added to the normal saline. A thick smear was air dried then fixed on heat. The smear was placed on a staining rack to cool. The slide was fold with crystal violet stain for 1minute. The stain was washed off with tap water. Iodine solution was added much enough to cover the smear. The Iodine stayed for 1minute. The Iodine was washed off using tap water. Acid acetone, (50%) was added as a decolorizer to wash off the excess stain.

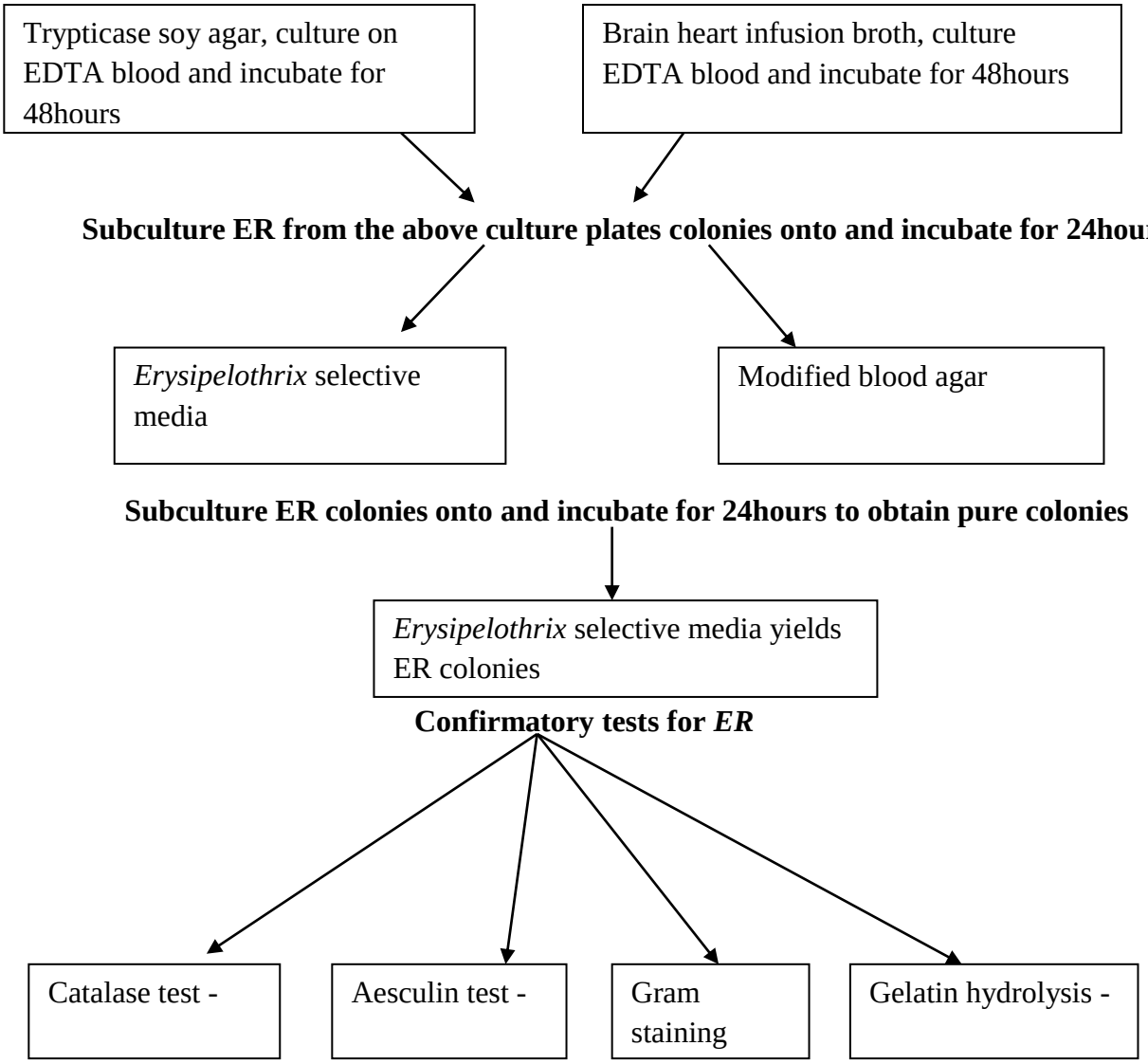
The smear was counter stained with carbol fuchsin for 1 minute. Tap water was used to wash off the stain from the slide. The slide was left to dry off and excess stain was wiped off using clean cotton wool. The slides were left to stand until dry prior to examination. Using a light microscope with an objective lens of X100, the slide was loaded on the microscope and adjustments were made, until a fine focus was made for the examination of *E. rhusiopathiae*. *E.rhusiopathiae* is a gram positive organism. Positive gram stained *E. rhusiopathiae* isolates had a purple/ bluish background, with purplish curved rods.

3.8.8 Sample preparation

Whole blood, (EDTA) was put on a working bench to thaw. After thawing all bottles were sterilized before picking an inoculum. A sterile wire loop was used to pick an inoculum from the sample and then added to appropriate media for culture.

3.8.9 Sample culture

Trypticase soy agar and brain heart infusion was poured on sterile culture plates and left to cool. Using a wire loop, blood from the resultant procedure above was strake on the plate and incubated for 24-48 hours in an incubator at room temperature. The plates were read after incubation. Colonies with morphological characteristics of *Erysipelothrix rhusiopathiae* were subculture on modified blood agar, *Erysipelothrix* selective media and on trypticase soy agar. This was incubated for 24 hours and bacterial colonies on the plates were sub cultured on the Erysipelothrix selective media. The colonies that grew on the media were biochemically confirmed using the catalase, aesculin test and the gelatin test and gram staining.



NB: Gram staining and any one of the above stated biochemical tests can be used in confirmation of *E.rhusiopathiae* infection.

Figure 2: **Diagnosis of *Erysipelothrix rhusiopathiae* infection in humans**

3.9 Data management

Data was checked for completeness daily, edited, coded and double entered using EPI Data version 3.00. Daily backups were done in drop box and using google drive. When data was

checked for completeness and consistency it was exported to STATA version 12.0 for cleaning and then analysed.

3.9.1 Data analysis

3.9.1.1 Univariate analysis

Descriptive statistics were used to summarize baseline characteristics of the study participants. The prevalence of *E. rhusiopathiae* infection among raw pork handlers was reported in percentages with its 95% confidence interval when clustering was considered. The numerator comprised of all subjects who confirmed positive with *E. rhusiopathiae* infection and the denominator comprised of all the participants in the study. Continuous independent variables were summarised into, medians, range, standard deviations; and histograms were displayed for age.

3.9.1.2 Bivariate Analysis

This was one to determine the association between *E. rhusiopathiae* with each of the categorical independent variable using the binary logistic regression. Continuous variables were categorized and the chi-square test was used to get the factors associated with *E. rhusiopathiae* infection. All variables with $P=<0.20$ were considered for multivariate analysis.

3.9.1.3 Multivariate analysis

To determine the factors that are independently associated with *E. rhusiopathiae*, all independent variables with *P <0.20* at bivariate analyses were entered into multiple logistic regression models.

Multivariate logistic regression was used because the outcome was rare to identify the predictor variables with *E. rhusiopathiae*, among raw pork handlers in Kamuli. Interaction was assessed using the chunk test. This was done using the stepwise regression method, the significantly independent factors associated with *E. rhusiopathiae* among raw pork handlers, in Kamuli district that stayed in my final model were used to form interaction terms which were tested for significance. Product terms were formed with the predictor and other independent variables and the difference in the (-2LL) log likelihood of the reduced and the full model was calculated.

Confounding was determined by calculating the difference in crude and adjusted odds ratios. A 10% difference will be taken as significant. All variables which had a difference greater than 10% were retained in the model thereby controlling for confounding.

3.10 Qualitative methods of data collection

To explore the socio cultural factors influencing *E. rhusiopathiae* infection among raw pork handlers in the three sub counties, Six (6) FGDs were conducted with butchers, abattoir workers and cooks with six participants in FGDs that were included in the butchers and abattoir workers. Since there were many cooks in the study, three FGDs with nine cooks/pork buyers in each FGD at the respective sub counties. The FGDs was moderated by a Lusoga Natives speaker and information was tape recorded by the Lusoga speakers as the principal investigator was tape

recording and watching how the FGDs were conducted. A FGD guide was used during the focus group discussions, (**Appendix 9**), to elicit dialogue and ensure that they are no responses obtained from the guide but from the participant's view regarding the theme being discussed. The FGD guide was translated from English to Lusoga because the all participants in the FGD were conversant with Lusoga language. Key informant interviews were conducted using a question guide, however it was not translated to Lusoga the respondents were literate. The FGDs conducted until the circulation point, where no new inform was coming out of the responses regarding each sub theme discussed.

3.10.1 Analysis of qualitative data

Tape recorded information and notes taken during the conduction of FGDs were transcribed and translated from Lusoga to English and then typed into word. This was also applied for the key informant interviews; they were taped into word after transcription. The investigator was immersed into the data to generate content from it and then thematic analysis was used for analysis in line with major themes used during data collection.

3.11 Quality control

The following procedures were undertaken by the principal investigator to ensure quality control:

All questionnaires were translated to *Lusoga* and back translated by qualified and competent persons (native speakers) for ease of the interviews and to give chance to the participants to go through the questionnaire and all research assistants were trained before they conducted the interviews. In the laboratory, cultures were done in duplicates to avoid any misdiagnosis/ wrong diagnosis in culture, identification and isolation of *E. rhusiopathiae*. Isolates were kept in the fridge until the work is published. All reagents were prepared according to the manufacturer's instructions and technical support was sought from the laboratory staff.

Data was cleaned, edited and double entered to minimise errors and all the filled questionnaires will be kept under lock and key. Data was protected with security codes and backed up in different locations to avoid loss of information. Comparison of tape recorded and written records from FGDs for qualitative data was obtained and safely stored until the study findings have been published.

3.12 Ethics

Permission to conduct this study was sought from the Clinical Epidemiology Unit, Kamuli district commissioner and ethical approval was obtained from the School Of Medicine, Research and Ethics committee, (SOMREC) and the International livestock Research institute, Institutional Research and Ethics committee, (ILRI-IREC2014-07).

Participants gave written (informed) consent. Oral informed consent was obtained from the FGD respondents and confidentiality was ensured through keeping all records under lock and key and confidentiality of the blood culture results. However, before participants provided the written and oral consent the principal investigator briefed them about the study, study purpose, procedures, risks and benefits, why they are selected/ considered for this study, issue about confidentiality, costs and compensations, reimbursement and voluntariness. Participants were given time to ask questions pertaining to the study, questions about their rights and their own will to join the study or withdraw from the study at any time without penalty. Those who agreed to join the study gave informed written or/ oral consent.

CHAPTER FOUR

4.0 Results for the quantitative study

4.1 Description of study population

The study was conducted between January and March 2016 in Namwendwa, Kitayunjwa and Bugulumbya sub counties in Kamuli district, Eastern Uganda. A total of 302 participants were enrolled into the study to determine the prevalence and factors associated with *E. rhusiopathiae* infection among raw pork handlers in Kamuli District. Three KII were done, (a nursing officer, veterinarian and a health assistant each). Six FGD were conducted with 18 butchers/ abattoir workers and 26 consumers.

4.1.2 Graph showing the age of the study participants

The median age was 39 years, interquartile range, 18-47 (**figure 4**).

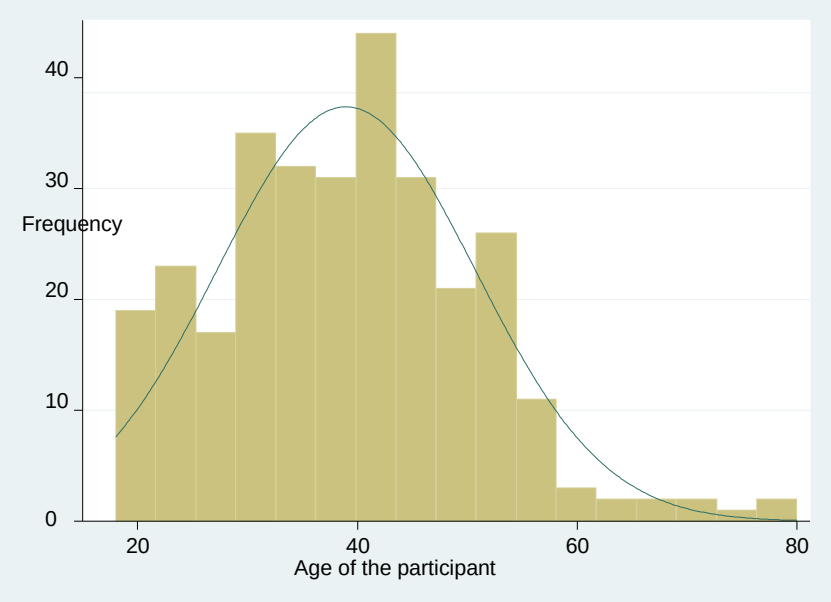


Figure 3: Age distribution of 302 participants in Kamuli district, Eastern Uganda.

4.1.3 Socio demographic characteristics of the study participants

From (**Table 1**), majority (154/302, 50.99%) of the participants were from Namwendwa subcounty. Most of the participants were males (155/302, 51.3%) and majority of the participants were Anglicans (157/302, 52%). The married participants dominated the study with (219/302, 72.5%), with primary education being the highest level of education (158/302, 52.3. The consumers studied were (205/302, 67.9%).

Table1: Socio demographic characteristics of the 302 study participants in Kamuli District Eastern Uganda, 2016

Variable	Frequency (N=302)	Percent
Sub county		
Namwendwa	154	51
Kitayunjwa	99	32.8
Bugulumbya	49	16.2
Sex		
Males	155	51.3
Females	147	48.7
Religion		
Catholic	113	37.4
Anglican	157	52
Others*	32	10.6
Education level		
Never	78	25.8
Primary	158	52.3
Secondary	54	17.9
Tertiary	12	4
Raw pork handler		
Butcher	59	19.5
Abattoir worker	38	12.6
consumers/pork buyers	205	67.9
Marital status		
single	47	15.6
Married	219	72.5
Divorced	22	7.3
Widowed	14	4.6

**other religions included Pentecostals, 7.9%, 1% born again and 1.7% Muslims*

4.1.4 Individual factors of the study participants

From (**Table 2**) 93.7% of the participants reported that were had no training prior to handling raw pork. Participants who reported receiving training from NGOs like volunteer efforts for development, Entebbe veterinary training school and other training skills from veterinary officers in the different Sub counties. Majority of the cooks reported that they buy their raw pork from butchers (62.0%). The type of pork bought by the consumers was raw pork (93.7%). Alcohol consumption was reported by majority of the participants (54.6%).

Table 2: Individual characteristics of raw pork handlers in Kamuli district Eastern Uganda, 2016

Variable	Frequency (N=302)	Percent
Participant's training prior to handling raw pork		
Yes	19	6.3
No	283	93.7
Source of pork for consumers and butchers*		
Abattoirs	100	43.5
Butchers	130	56.2
Source of pigs slaughtered for butchers and abattoir workers*		
Pig farmers	51	70.8
Pig traders	14	19.5
Market	7	9.7
Type of pork bought by the consumers#		
Raw	192	93.7
Roasted/cooked pork	13	6.3
Alcohol consumption		
Yes	165	54.6
No	137	45.4
Participant's duration on exposure to raw pork		
Below 10 years	261	86.4
Above 10 years	41	13.6
Engagement in other pig related activities		
Yes	144	47.7
No	158	52.3
Frequency of handling raw pork		
Daily	99	32.8
Weekly	113	37.4
Others**	90	29.8

**source of pork for consumers and butchers while the source of pigs slaughtered was studied for butchers and abattoir workers; #The type of pork bought was studied for consumers since the butchers and abattoir workers usually handled raw pork; **Frequency of handling raw pork, other frequency included monthly and yearly handling of raw pork.*

4.2 Health related factors

4.2.1 Medical checkup of the respondents

Majority of the respondents (249/302, 82.5%) reported that they had never gone for a medical checkup ever since they started handling raw pork or consuming pork since they added that it rather improved their lives especially the HIV/AIDS infected people who supported that pork added nutrients to their body and would give them more energy.

4.2.2 Period when they last suffered from a skin infection

Two hundred and seventy four participants (274/302, 90.7%) reported that they have never suffered any skin related infection during the past year.

4.2.3 Previous use of antibiotics

Majority of the respondents reported that the last time they fall sick, they went to hospital and were given medicine (8.0%).

4.2.5 Taking on the intervention in case results are positive

All respondents reported that they would allow the intervention (medicine) which will be given to them in case their results turn positive for the infection.

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4.3 *E. rhusiopathiae* infection among raw pork handlers in Kamuli district, 2016

The overall prevalence of *E.rhusiopathaie* infection among raw pork handlers was (9.9%, 30/302) with a CI 7.35-12.52 after adjusting for clustering as shown in the table below (**Table 3**).

Table 3: Overall prevalence of *Erysipelothrix rhusiopathiae* infection among raw pork handlers in Kamuli district Eastern Uganda, 2016

Blood result	Frequency	Percent	95% CI
Positive	30	9.9	7.35-12.52
Negative	272	90.1	86.67-93.46

#This blood result was for both biochemistry and gram staining

4.4 Prevalence of *E. rhusiopathiae* infection among raw pork handlers within the social demographic characteristics in Kamuli district Eastern Uganda, 2016

The prevalence of *E.rhusiopathiae* infection was highest among participants from Kitayunjwa (11.1%); males (13.5%), catholic participants (11.5%), those who have never gone to school (12.8%) and among abattoir workers (36.8%) as shown in (**Table 4**).

Table 4: Prevalence of *E.rhusiopathiae* infection among raw pork handlers within the socio demographic characteristics in Kamuli district Eastern Uganda, 2016

Variable	Number (N=302)	ER infection positive	Prevalence (%)	95% CI
Sub county				
Namwendwa	154	15	9.7	5.02-14.46
Kitayunjwa	99	11	11.1	4.86-17.36
Bugulumbya	49	4	8.1	0.39-15.94
Sex				
Males	155	21	13.5	8.12-18.98
Females	147	9	6.1	2.21-10.03
Religion				
Catholic	113	13	11.5	3.02-17.44
Anglican	157	14	8.9	2.28-13.40
Others*	32	3	9.4	0.93-19.68
Education level				
Never	78	10	12.8	3.81-20.32
Primary	158	18	11.4	2.54-16.38
Secondary	54	2	3.7	2.59-8.81
Tertiary	12	0	0	
Type of raw pork handler				
Butcher	59	9	15.3	5.90-24.54
Abattoir worker	38	14	36.8	21.1-52.44
Consumers	205	7	3.4	0.90-5.92
Marital status				
Single	47	5	10.6	1.69-19.58
Married	219	21	9.6	5.66-21.44
Divorced	22	2	9.1	3.25-21.44
Widowed	14	2	14.3	4.81-33.38

Other religions studied include born-again Christians, Pentecostals and Muslims.

4.5 Prevalence of *E. rhusiopathiae* infection among raw pork handlers within the individual characteristics in Kamuli district Eastern Uganda, 2016

From (**Table 5**) Respondents who had no training prior to handling raw pork reported a higher prevalence of *E.5rhusiopathiae* infection (10.2%, 29/283) while bucthers and abattoir workers who bought pigs for slaughtering from pig farmers also reported a high prevalence (18/51, 35.3%). Consumers who reported to buy processed pork had a high prevalence compared to those who bought raw pork (23.1%, 3/13). Participants who reported handling raw pork on a daily basis had a high prevalence (13/99, 13.1%) while those who reported engagement in other pig related had a prevalence of (12%, 19/158) and for those who reported alcohol consumption had a prevalence of (16.4%, 27/165).

Table 5: Prevalence of *E. rhusiopathiae* infection among raw pork handlers within the individual factors in Kamuli district, Eastern Uganda, 2016

Variable	Frequency (N=302)	ER positive infection	prevalence	95%CI
Participant's training prior to handling raw pork				
Yes	19	1	5.3	5.1-15.62
No	283	29	10.2	6.79-13.8
Source of pork for cooks and butchers*				
Abattoirs	100	5	5	1.32- 9.88
Butchers	130	2	1.5	0.09- 3.45
Source of pigs slaughtered for butchers and abattoir workers*				
Pig farmers	51	18	35.3	15.34- 40.44
Pig traders	14	4	28.6	12.31- 33.70
Market	7	1	14.3	5.23- 19.36
Type of pork bought by the consumers*				
Raw	192	4	2.1	0.87- 4.24
Processed	13	3	23.1	11.74- 29.99
Alcohol consumption				
Yes	165	27	16.4	
No	137	3	2.2	
Engagement in other pig related activities				
Yes	144	11	7.6	3.27-12.01
No	158	19	12.03	6.92-17.13
Frequency of handling raw pork				
Daily	99	13	13.1	6.42-19.85
Weekly	113	12	10.6	4.89-16.34
Others*	90	5	5.6	0.78-10.33

***Other times of pork preparation are monthly and yearly*.**

4.6 Frequency of *E. rhusiopathiae* infection and skin infection

The study reported that (2/26, 7.1%) of the respondents who had ever skin infection before were positive for *E. rhusiopathiae infection* among the raw pork handlers. Respondents were asked about the signs they experienced, (2/11, 18.2%) who had burning signs were culture positive, (1/5, 20%) who had wounds were culture positive and (27/274, 9.9%) who reported no sign tested culture positive **(Table 6).**

Table 6: Frequency of *Erysipelothrix rhusiopathiae* infection among raw pork handlers who reported skin related infection in Kamuli district Eastern Uganda, 2016

Variable	ER infection Positive	percent	Total
Skin related infection			
Yes	2	7.1	28
No	28	10.2	274
Signs			
Burning	2	18.2	11
Skin rash	0	0	12
Wounds	1	20	5
None	27	9.9	274

When participants were asked about previous medical complications (160/302, 53%) reported to have had experienced complications like malaria, syphilis, kidney problems, gonorrhea, diarrhoeal and headache. The study reported 14/160, 8.8% of those who reported medical complications were positive for *E. rhusiopathiae***.**

4.7 Bivariate analysis of the socio demographic characteristics among raw pork handlers in Kamuli district Eastern Uganda

From (**Table7**) the study reported that working in the abattoir was associated with *E. rhusiopathiae* infection (OR=16.5, 95% CI: 6.06-44.91). Similarly, working in the butcher was associated with *E. rhusiopathiae* infection, (OR= 5.09, 95%CI: 1.8-14.33). Sex of the participant was associated with *E. rhusiopathiae* infection. Males were more likely to develop the infection compared to females (OR=2.4, 95%CI: 1.04-5.44).

Table 7: Bivariate analysis of the association between socio demographic factors and *Erysipelothrix rhusiopathiae* infection among raw pork handlers in Kamuli district Eastern Uganda, 2016

Variable	ER infection positive	ER infection negative	Odds ratio	95% CI	P value
Raw pork handler					
Consumers	7(3.4)	198(96.6)	1		
Butchers	9(15.3)	50(84.8)	5.09	1.80-14.33	0.002
Abattoir workers	14(36.8)	24(63.2)	16.5	6.06-44.91	<0.001
Subcounty			.	.	
Namwendwa	15(9.7)	139(90.3)	1		
Kitayunjwa	11(11.1)	88(88.9)	1.2	0.51-2.64	0.726
Bugulumbya	4(8.2)	45(91.8)	0.82	0.26-2.61	0.742
Sex					
Females	9(6.1)	1.38(93.9)	1		
Males	21(13.6)	134(86.5)	2.4	1.06-5.44	0.035
Religion					
Others**	13(11.5)	100(88.5)		1	
Catholic	14(8.9)	143(91.1)	0.75	0.34-1.70	0.49
Anglican	3(9.4)	29(90.6)	1.10	0.21-2.98	0.74
Marital status					
Single	5(10.6)	42(89.4)	1		
Married	21(9.6)	198(90.4)	0.82	0.32-2.50	0.83
Divorced	2(14.3)	12(85.7)	0.84	0.15-4.71	0.84
Widowed	2(14.3)	12(85.7)	1.5	0.24-8.14	0.71
Education level					
Never	10(12.8)	68(87.2)	1	1	
Primary	18(11.4)	140(88.6)	1.4	0.24-8.14	0.75
Secondary	2(3.7)	52(96.3)	0.87	0.38-2.00	0.092
Tertiary	0	12(100)			

********Other religions that were studied include Born-again Christians, Pentecostals and Muslims.*

4.8 Bivariate analysis of individual factors among raw pork handlers in Kamuli district Eastern Uganda, 2016

From (**Table 8**) respondents who had no training prior to handling were more likely to develop *E. rhusiopathiae* infection (OR=2.06, 95% CI: 0.26-16.0). The type of pork bought by the cooks and butchers, (roasted/ fried) was associated with *E. rhusiopathiae* infection (OR= 2.56, 95% CI: 1.09-5.99). Buying pork from butchers was associated with developing *E. rhusiopathiae* infection (OR=2.24, 95% CI: 1.04-4.79). Consumption of alcohol was also associated with *E. rhusiopathiae* infection (OR= 8.74, 95% CI: 2.59-29.49).

Table 8: Bivariate analysis of the association between individual factors and *Erysipelothrix rhusiopathiae* infection among raw pork handlers in Kamuli district Eastern Uganda, 2016

Variable	ER infection positive	ER infection negative	OR	95%CI	pvalue
Participant's training prior to handling raw pork					
Yes	1(5.3)	18(94.7)	1		
No	29(10.2)	254(89.8)	2.06	0.26-16.0	0.483
Source of pork for consumers and butchers* **					
Abattoirs	5(5)	95(95)	1		
Butchers	2(1.5)	128(98.5)	2.24	1.04-4.79	0.038
Source of pigs slaughtered for butchers and abattoir workers*					
Pig farmers	18(35.3)	33(64.7)	1		
Pig traders	4(28.6)	10(71.4)	1.24	0.38-4.01	0.716
Market	1(14.3)	6(85.7)	0.36	0.15-0.89	0.026
Type of pork bought by the consumers**					
Raw	4(2.1)	188(97.9)	1		
fried/Roasted	3(23.1)	10(76.9)	2.56	1.09-5.99	0.03
Alcohol consumption					
No	3(2.2)	134(97.8)	1		
Yes	27(16.4)	138(83.6)	8.74	2.59-29.49	<0.001
Engagement in other pig related activities#					
Yes	11(36.7)	133(48.9)	1		
No	19(63.3)	139(51.1)	0.56	0.173-1.81	0.326.
Frequency of handling raw pork			.		
Others##	5(16.7)	85(31.3)	1		
Daily	13(43.3)	86(31.6)	0.39	0.13-1.20	0.077
Weekly	12(40)	101(37.1)	0.786	0.34-1.82	0.573

****consumers and butchers while;* butchers and abattoir workers; **consumers alone; # pig farming and trading; ##monthly and yearly.***

4.9 Multivariate analysis

After bivariate analysis, variables that had p- values less than 0.2 were considered for multivariate analysis. The variables retained as independent predictors of *E. rhusiopathiae* infection were alcohol consumption, type of raw pork handler and sex of the participant and frequency of handling raw pork. There was no interaction in the multivariate model (**Table 9**).

4.9.1 Multivariate analysis for the factors associated with *Erysipelothrix rhusiopathiae*

Type of raw pork handler was associated with *E.rhusiopathiae* infection. The study reported that abattoir workers were 26.13 times more likely to develop *E. rhusiopathiae* infection when compared to the consumers (OR=26.13, 95%CI: 5.29-129.10). The butchers were 8.37 times more likely to develop *E. rhusiopathiae* infection compared to the consumers, (OR= 8.37, 95% CI: 1.79-39.10). Alcohol consumption was associated with *E. rhusiopathiae* infection. Participants who reported alcohol consumption were 4.02 times more likely to develop *E. rhusiopathiae* infection compared to those who reported no alcohol consumption, (OR=4.02, 95%CI: 1.07-15.03). Sex of the participants was retained in the model because it was confounding the association between type of raw pork handler and *E. rhusiopathiae* infection.

Table 9: Results of multivariate analysis for *E.rhusiopathiae* infection among raw pork handlers in Kamuli district Eastern Uganda, 2016

Variable	OR	95% CI	Pvalue
Type of raw pork handler			
Consumers	1		
Butcher	8.37	1.79-39.10	0.007
Abattoir worker	26.13	5.29-129.10	<0.0001
Alcohol			
No	1		
Yes	4.02	1.07-15.03	0.038
Confounder			
Sex			
Females	1		
Males	3.85	0.91-16.23	0.067

4.10 RESULTS OF THE QAULITATIVE ASSESSMENTS.

4.10.1 Focus Group Discussions and Key Informant Interviews

Overall, FGD and KII revealed gaps in knowledge about ER infection among raw pork handlers.

4.10.1.1 Participant's perception on the causes of *E.rhusiopathiae* infection among raw pork handlers

Provision of animal/ veterinary services

Participants in the FGDs, (five of the six FGDs) reported that they offer veterinary services like assisting their pigs during delivery and administration of treatment to the pigs when they are sick since they have very few veterinary officers.

"We have very few veterinary officers who ask for money to treat our animals yet we cannot afford the costs charged at times. A veterinary officer can charge you a cost when he is going to treat a very small pig. Since we cannot afford we buy the medicine (obhulezi) and we treat them ourselves. We don't have enough skills but we do it because we need our pigs alive. A participant added that one day, at night I heard my pig scream, when I went out I saw it was giving birth I had to give it a hand in the process to reduce the pain, however I had no protective clothing"(**male FGD, Namwendwa***).*

High poverty levels in the district

Participants reported that the poverty levels are very high to the extent that some families have just three meals in a week. They cannot afford buying food, firewood and even clothing for themselves. Some have decided to start working in the pig abattoirs and butchers to get some money survive with their families.

"Young, youth and the elderly have decided to start working in the abattoir, they lack adequate materials to start the work like gum boots as a safety measure which would protect them from acquiring the infection. The abattoir and butchers have bones that can easily pierce them thereby developing an infection in case they get pierced" (**KII Nam**).

Lack of knowledge on rearing animals and their associated infections

It was perceived that people who work in butchers, abattoir or handle raw pork have never gone school. All FGDs reported that the levels of education are very low in their communities. The highest level of education that was attained among participants that they reported, (majority) was senior one.

"We didn't go school because our parents didn't have money to take us to school. Our children wanted to go to school but they all failed because of poverty. We are so ignorant to the extent that our chairmen (pork slaughter organization) have also not been to school. We lack knowledge on rearing pigs and slaughtering them. We like pigs like our own because they are source of income. However we cannot tell which one is sick and which one is not. They continue spreading diseases to us whether live or not which we cannot tell" **(FGDs, Kamuli).**

Share of utensils with pigs

Participants in the qualitative study also reported that they are very free with their animals. For their animals to live well and healthy like human beings, they need to be treated well. They need to feed and also have shelter like humans though most of them couldn't afford them

.."*Ehhhh I cook feeds for my animals (pigs) from the saucepans we also use. This is a sign of treating them fairly equal as living things. We feed them cooked feeds. After we have cooked*

them we serve them from bathing basins which we also use. May be this might cause some infections but since they are animals they need to be treated fairly. Another participant reported that when it rains my pigs have a section on my house where they sleep. The rain affects my animals in that they can develop other diseases that may require me a lot of treating" **(FGD, Kitayunjwa***).*

Bestiality

Participants reported that bestiality is increasing in their communities. Some men have decided rape animals sexually. This was reported that men who are possessed with demons or those who have been bewitched are raping pigs. This may eventually results into spread of zoonotic infections from the pig to the man and vice versa.

*"FGDs reported that on several occasions they hear their pigs making noise while the pigs have left to feed away from home. At first I thought maybe someone is stealing my pig to take it and sell if off, however I was shocked I found a man behind the pig. He decided to run away. I was so annoyed we ran after the man, he got him and tied him ropes, called a veterinarian to examine the pig only to confirm that the pig was raped. These people who rape pigs transmit infections to pigs and pigs also transmit infections to humans and the transmission cycle continues like that" (***KII and FGDs, Kamuli***).*

Increased alcohol consumption

Key informants and participants during the FGD reported that alcohol consumption is high in their communities. In every kilo meter there is a small drinking bar selling local brew and other alcoholic drinks. Alcohol consumption is reported to suppress the immunity of the individual hence being easily invaded with all kinds of infection.

*"Ohh we need a solution to see this end." Our men drink from morning to morning, most drinking points sell pork, if there are many drunkards at the point, and the person serves half cooked pork which is at times coming from dead animals. People here have a tendency of slaughtering pigs which are reported to have swine fevers, diarrhoeal diseases and pigs that have died abruptly. This has continued to spread such infections" (***KII and female FGDs Kamuli).**

4.10.1.2 Participant's perceptions on lifestyle that predispose them to ER infection

Lack of proper waste disposal

It was noted that homes with no toilets are many in their communities today. People use the bush to solve their stomach problems and the pigs that freely roam end up feeding on the fecal matter. If they get infected they will keep the infection in their bodies that will be carried to the human being when the pig is slaughtered.

"Most people in the village lack toilets. Since we lack toilets, we use the bush and dispose of waste. When pigs are feeding, especially the free roaming pigs, they look for food and eventually feed on the waste that was disposed of by humans. So if the human fecal disposed was carrying any worms or any diseases the pigs will be pick the microorganisms and keep them in the body ad continue to transmit the infection to other human being" **(KII, Kamuli).**

Poor hygiene

Most participants reported that body hygiene is very poor especially for the men working in abattoirs and butchers. Men can spend nearly seven days with changing their clothes or bathing even after they have come back from the activities. They claim soap is expensive that even when they change they will still be made dirty with the blood from the pigs when they slaughter the

following day. However this was reported to increase the chances of acquiring ER in they stay in dirty clothes where the bacteria can stay multiplying and eventually catches the handler**.**

"Men don't want bath." When he puts on a shirt he will have it for a whole week. Even when we provide them with clean clothes they still refuse putting them on thinking. If they have slaughtered a pig which has been infected with a disease transmissible to humans will stay on the body for some time. It will multiply and by the time he bathes the disease has already manifested its self in that human being" **(KII and female FGDs Kamuli).**

Handling infected raw pork and roasted/ fried pork

Participants noted that many bucthers want to work alone because of the limited capital they have in their business. They perform more than one activity at the butchery. They handle that raw pork when cutting to sell off to the cooks and when an order comes to roast or fry pork, the same person will prepare. You find that they may contaminate the roasted or fried meat with the fresh pork since it is one person involved.

"You can hardly find butchery with more than two people working in them. You can find someone with blood on his fingers when you ask him to prepare for you pork, he will just cut and put on fire without washing off the blood. Since we like the pork we shall sit and wait for the preparation, however they keep crossing form cooking to cutting fresh pork for the orders being made, this contaminates our meat and we get ER infection" **(female FGD, Bugulumbya).**

Poor storage methods of pork

Participants reported that the ER infection might be as result of the storage methods that they are employing when meat stays over the next day.

"We lack deep freezers and fridges where we can keep our meat. We normally keep our meat in cut jerry cans or on the cutting boards. Microorganisms can easily multiply with in the meat and the next time we cut it we are exposed to infections" **(male FGD, Kitayunjwa)**

4.10.1.3 Cultural beliefs, norms or practices associated with *Erysipelothrix rhusiopathiae* infection

Tying bones around the waist cures measles

Measles is a disease that affects the young and old. We have seen our elders treat themselves with pig sauce and tying bones around the waist of the person being infected.

"It is believed that measles is a cultural disease. Therefore when people develop it they don't look for medicine immediately because they perceive it is originating in wind and is spread in wind. "We don't immediately buy medicine for those infected with measles, we go to butcheries and abattoir and look for pig bones which can tie around the waist or neck and can cure the measles. We also use these bones to scare away demons in the houses" **(FGDs Kamuli).**

Consumption of ofals believed to cure diseases

It was reported that since pigs have two stomachs, the digestion that takes place is not very rigorous as the one in ruminants with four stomachs. Since that is the case we think the intestines are still nutritious for human consumption and it believed that they cure diseases originating from witchcraft.

"Those days' ofals were taboos. However we had discovered how nutritious ofals are. However we might be picking some infection when we are handling them, because whatever pigs feed on goes through one stomach and it isn't digested very well. Therefore in the end when we are separating them to cook we handle dirty things but the good thing is they cure serious diseases like HIV/AIDS and keep our immunity strong" **(FGDs Kamuli).**

Smearing pig blood on house walls brings blessings

Participants reported that they living in an era of haters. People hate them and can do anything to them if they are successful. However if you pig blood in your house the demon can't cross borders and also the house will receive blessings in the end.

"*Animal blood is a blessing." People go to shrines to look for blessings, however, we believe that our own pigs can bring blessings of children, knowledge and wealth creation. When a healthy pig is cut, we can collect its blood and smear it on the wall, in that process, you can ask for what you want from God because God blessed these animals"***(FGDs Kamuli).**

5.0 CHAPTER FIVE

DISCUSSION

5.1 Prevalence of *Erysipelothrix rhusiopathiae* infection

The overall prevalence of *E. rhusiopathiae* infection among raw pork handlers in Kamuli District was 9.9%. The reported prevalence was low compared to that in Sweden that was reported at 14.5% among abattoir workers (Molin *et al*., 1989). However comparison of the prevalence is difficult since few studied have done similar work in a similar setting like the one where the study was conducted. In the East African region this is the first paper to report the infection among raw pork handler.

Erysipelothrix rhusiopathiae infection was reported at 67% in pig sera, 45% in fresh pork in Kamuli district (Musewa *et al*., 2015). The study reported the prevalence in humans at 9.9% which is lower than the one reported in animals. The prevalence was human African trypanosomiasis was reported at a prevalence of 2.4% in a previous study which is lower than ER infection in humans in Kamuli district, Eastern Uganda.

A study by Brhel and Bartnicka (2003) studying occupational infectious diseases in Czech Republic reported a prevalence of 29% of *E.rhusiopathiae* infection, (erysipeloid) among agriculturalists, forestry workers and game park managers (Brhel and Bartnicka., 2003). The prevalence was higher than the one that was found in this study. This could probably be explained by the fact that the population studied included game park managers, agriculturalists and forestry worker who could be exposed to more than one strain of the bacterium because of the different animals they encounter apart from mammals. The increased incidence of diseases was mostly due to epidemics in the general population, (non-game park managers and

agriculturalists) and its spread was attributed to a low hygiene and social standards, overcrowding, increased migration that created a higher risk for the elderly, mentally retarded and immunocomprised subjects (Brhel and Bartnicka 2003).

A study by Molin *et al* (1989) reported an occurrence of 14.5%. This prevalence was reported among abattoir workers in Sweden. Although the prevalence of the infection among abattoir workers was 36.8% is higher than the one reported in Sweden and Czech Republic, the overall prevalence was 9.9% was lower compared to the two studied. This could probably be explained by the involvement of cooks in the study which deflated the prevalence that would have been reported in bucthers and abattoir workers were the only study participants and increased use of antibiotics.

A study by Golota (1970), studied *E.rhusiopathiae* infection in pigs and abattoir workers, reported that 797/1000 abattoir workers were infected with *E.rhusiopathiae* infection between (1962-1970) in Russia. The incidence of the infection was reported at 25% annually. This study reported a higher prevalence of 79.7% among abattoir workers in the earlier years in Russia because the population of pigs in Russia was high (up to 10 million) pigs, (Golota, 1962). This attracted business for people to work in slaughter houses and abattoirs which activity they conducted without strict regulations pertaining the economic activity. Very many abattoir workers were exposed to the infection because there was no use on protective clothing which would have helped in reducing the spread of the infection.

In Uganda literature and systematic reviews (site) show no studies of *E. rhusiopathiae infection*. This study was done in a setting where the population of pigs is growing with a population of people working in the pig industry growing along the consumers. The prevalence of *E.*

rhusiopathiae infection reported in this study might be an underestimate because of the era of wide use of antibiotics, issues with diagnosis, difficult in isolating the bacteria, because at times it's mistaken as a contamination on the culture plates and the nature of samples, (blood rather than skin scraps). This would have depicted the true picture of *E.rhusiopathiae* infection among raw pork handlers. Given that the prevalence of erysipelas in pigs was 67% and 45% infection in fresh pork this would have given an estimated high prevalence in line with the findings in the from the preliminary study.

The poor pig rearing methods, poor slaughter abattoirs, lack of protective equipment and poor disposal of waste could be some of the factors that could lead to existence of *E.rhusiopathiae infection* in the community. This was justified in the key informant interviews and focus group discussions that were held.

There are no clear guidelines governing handling raw pork, no trainings established by the government prior to this exposure. Therefore very many people especially the rural people, (un educated), have gone far to slaughter pigs in from any source to sell off to the community due to the increased consumption and demand of pork hence increasing the exposure to the infection to the people in the community. Because of this reason many people have opted to join the butchery business pork hence increasing the exposure to the infection to the people in the community. Therefore it is important to inform the ministries concerned like , (Ministry of Health, Ministry of Agriculture and animal fisheries) and non-government organizations concerned in research in animals and zoonotic infections among populations in contact with animal products and animal waste on how to regulate pig slaughtering at the different slaughter abattoirs and proper handling of animal waste (Government of Uganda,

2009). Awareness of *Erysipelothrix rhusiopathiae* infection in both humans and animals should be done to the Veterinarians, Clinicians and Laboratory personnel to make them familiar with the disease, how it is diagnosed and its natural history.

5.2 Factors associated with *E. rhusiopathiae* infection among raw pork handlers

The type of handler and consumption of alcohol increased the risk of *E. rhusiopathiae* infection among raw pork handlers in Kamuli district Eastern Uganda. Abattoir workers were 26.13 times more likely to develop the infection while butchers were 8.37 times more likely to develop the infection compared to the consumers. Respondents who reported to consume alcohol were 4.02 times more likely to develop the infection compared to the non-consumers. This could be associated with the increased pork consumption among the alcoholic and the continued exposure to raw pork among the abattoir workers and butchers.

These factors have been reported in studies that have done similar work and those that have conducted research on *E. rhusiopathiae* infection (Upapan, 2015)**.** Infection in man is occupationally related occurring principally as a result of contact with animals, their wastes products , the infection is occupationally related (Upapan, 2015). Risk of human infection is due to factors such as age, sex, race and socio-economic status all relate to this infection (Reboli and Farrar, 1992).

It has been reported that 89% of *E.rhusiopathiae* infection in humans is strongly occupationally among individuals working in animal sourced foods and the highest categories at risk are, veterinarians, housewives, butchers, abattoir workers and animal farm workers (Tomaszuk-Kazberuk et al., 2011). Kichloo reported that alcohol abuse is an important risk factor for *E.rhusiopathiae* infection (Kichloo et al., 2013b).

The study found that males were more likely to develop the *E.rhusiopathiae* infection compared to females. This was probably due to the occupation nature of the infection. These findings were in line with those that Brooke and Riley (1999) who reported that males were twice as likely to develop *E.rhusiopathiae* infection and added that this was due to occupational nature of the job (Brooke *et al*., 1999).

Alcohol consumption was reported to be at 55% in Kamuli District among the respondents. The study also found out that men consumed more alcohol (105/155, 67.7%) when you compare them to the women who reported to consume alcohol (60/147, 40.8%). This could probably be explained by the fact that men have social drinking points every evening before and after work. This is in line with the qualitative findings where participants reported men always drink at any time of day as long as they have company. Alcohol is believed to impair some sense of judgment and so the handlers may not use protective wear even when it's available.

This finding is in line with findings from other case studies like Kichloo *et al* (2013) who reported that the patient under study was a abusing alcohol consumption, that by Romney *et al* (2001) who reported that alcohol consumption leads to immune compression hence the body can easily be invaded with the bacteria (Romney *et al*., 2001).

The type of raw pork handler was associated with the infection. As the prevalence in the sub groups indicated, the prevalence was 36.8%, 15.3% and 3.4% among abattoir workers, butchers and consumers. Comparing the odds ratio, the study reported that the abattoir workers were 26.13 times likely to develop the infection compared to the consumers while the butchers were 8.37 times likely to develop the infection compared to the consumers. This could be explained by the continous exposure to raw pork, the poor working environment, lack of protective clothing

and alcohol consumption that was reported among the participants that is known to weaken the immune system.

Sex was reported to confound the relationship between type of handler and *E. rhusiopathaie* infection. No study has reported sex as a confounder but several studies have reported sex to be associated with *E.rhusiopathiae* infection due to the nature of the occupation. A study by Pereira *et al* (2010) reported that the males were highly infected with erysipeloid in his study. He added that males were twice infected compared to the females. He reported that the occupational nature of the infection may have led to that prevalence (Pereira de Godoy *et al*., 2010). The men are reported to be in close contact with animals compared to the females. Brooke *et al* (1999) reported that the kind of life style men live predisposes them to this infection. The pork handling (without any protective clothing, no hand washing after handling) practices predispose them to the infection (Brooke *et al*., 1999).

In this study, we found that males who were raw pork handlers were 3.85 times more likely to develop *E.rhusiopathiae* infection when they are compared to females who are raw pork handlers. Previous studies that have done similar work reported that men are twice more likely to develop the infection when you compare them to the females (Kichloo *et al*., 2013b).

5.2 Strengths of the study

The study was done in a rural setting that was mapped and selected due to high population of pigs and high poverty levels (measured by the economic activities conducted in the area and the housing structure) among the population of people rearing pigs and working with other pig related activities like pig agribusinesses and trading. The setting where the study was conducted had the infection confirmed in live pigs (pig sera) and fresh pork that was sampled during the preliminary study in 2014 hence selection bias was minimised

Data was collected by trained research assistants who had skills in Lusoga therefore communication was adequate using pretested data collection tools.

Phlebotomy was done by a skilled person who had skills in drawing blood. The blood collected was stored in the appropriate anticoagulant tube to prevent it from clotting. The samples were transported appropriate to avoid lysis of cells.

While in the laboratory, all reagents were prepared according to the manufacturer's instructions and stored at the required temperature. As a practice in microbiology to ensure sterility of the equipment the reagents were sterilized at 121^{o}c for 1hour and 15 minutes before use.

Calibration was done to the microscope before examining the gram stained slides which was done by a qualified person hence information bias was minimized.

Confounding was controlled for at the point of analysis and all confounders were retained in the final model.

5.3 Limitations of the study

Random Error: This could have been introduced by the sampling procedure. Consecutive sampling was used because there was no sampling frame for pork buyers (consumers) that would have been used for random sampling. Consumers were enrolled consecutively as they came to the butcheries or abattoirs to buy pork of which this was the most appropriate sampling procedure for this study. Random error would also have been come up by the sample size which was used. The calculated sample size was not achieved but the. However the study had enough power to generalize the findings. However I would conclude that random error was minimal.

Selection bias: in this study, there was no equal chance of being selected since a non-probability sampling method was used. However a census for butchers and abattoir workers in the three study sub counties was done and consumers were selected demanding on who came to buy pork However this was minimal because the consumers were representative of the community since the butchers and abattoir had different cooks (who bought pork) hence selection bias was minimized.

Information bias: This would have been introduced by the data collection tool, (questionnaire) that required participants to address issues that they had to recall for some time which would have introduced recall bias. However this was minimized in the way that the tool was retested on seventeen raw pork handlers in Kampala District and all discrepancies were collected. In the laboratory there was no information bias originating from the instruments used in the laboratory since they were calibrated e.g. microscope. A trained and qualified person observed the bacteria under the study. All reagents used were prepared with working manual and sterilized prior to use.

Confounding: the true association of *E.rhusiopathiae* infection and type of handler was confounded by sex. However this was overcome by controlling for it and reported them in the final model.

CHAPTER SIX

6.0 Conclusions and recommendations

6.1 Conclusions

The overall prevalence of *E. rhusiopathiae* infection was low compared to those from previous studies. Abattoir worker and butchers were highly infected with *E. rhusiopathiae.*

Alcohol consumption, working in the abattoir and being male increased the risk of acquiring the infection.

6.2 Recommendations

Abattoir workers, butchers and consumers/pork buyers should be sensitized on the risk of being infected with *E.rhusiopathiae* infection and how to prevent it while carrying on with their duties.

Raw pork handlers should avoid working under the influence of alcohol as this would impair their sense for judgment and increase their exposure to *E. rhusiopathiae* infection.

We recommend for further studies to help determine causation since cross sectional studies do not determine causal relationships.

Increased awareness of the infection among high risk groups, animal and human practitioners. This will enable appropriate diagnosis and provision of treatment to those who are infected.

Proper hygiene, regular pork inspection, use of protective wear among people working/ in contact with animals should be promoted.

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Table 10: Participants screening log for *Erysipelothrix rhusiopathiae* infection among raw pork handlers in Kamuli district Eastern Uganda, 2016.

Participant ID	Date	PARTICIPANT CODE	INCLUSION CRETERIA			EXCLUSION CRETERIA		ELIGIBLE(	INTERVIEWER
			Adult Raw pork handlers	Adult raw pork handlers (abattoir workers, butchers, and cooks who buy raw pork from the butcheries) in Namwendwa, Kitayunjwa and Bugulumbya sub counties during the study period, and who give written informed consent		Participants who could not comprehend English, Luganda or Lusoga were excluded from the study.			

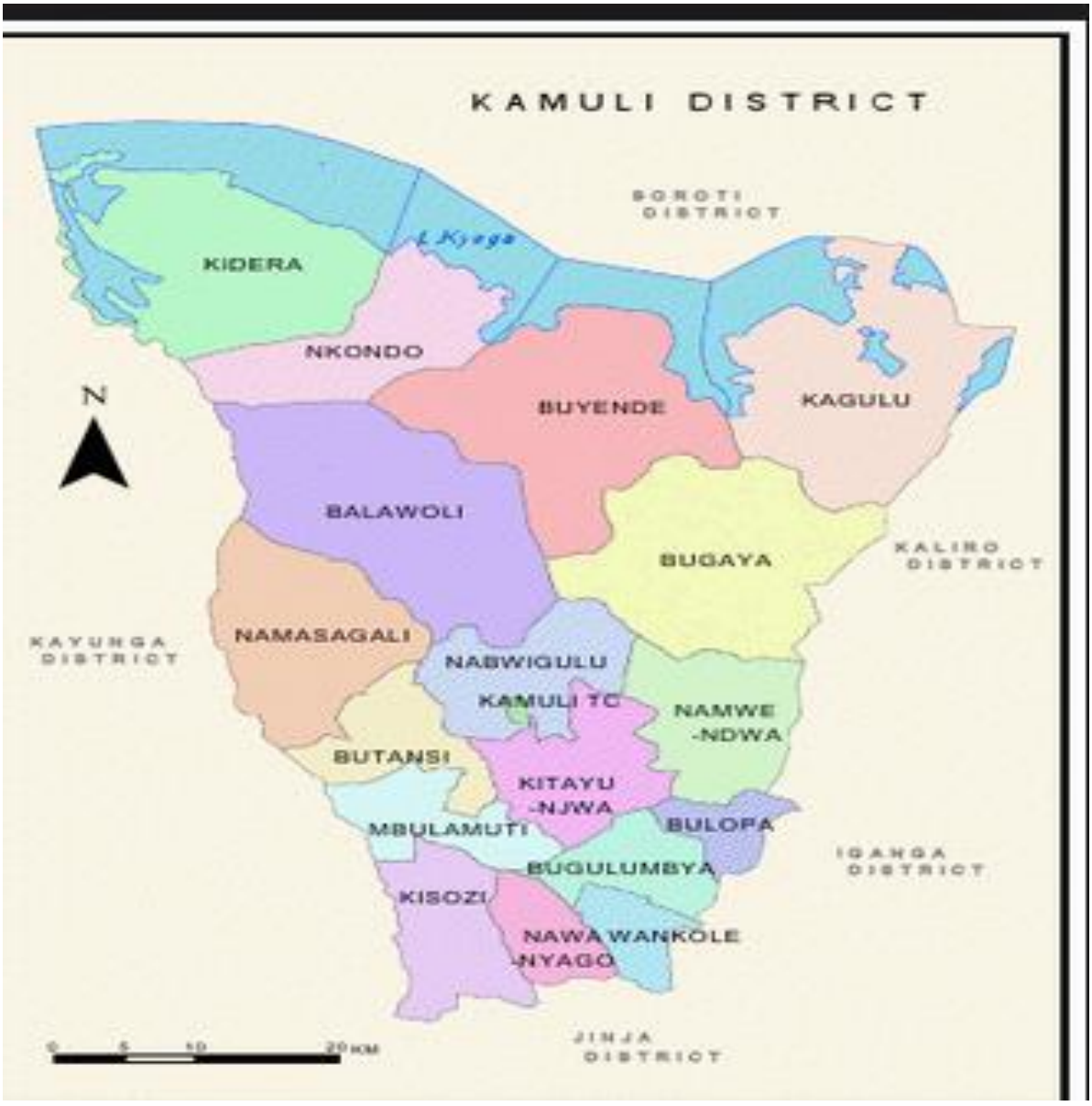

Figure 4: A map showing the 18 sub counties in Kamuli district, adapted from the Natural population and housing census, 2007.

Appendix 1: Questionnaire for butchers and abattoir workers in Kamuli district, Eastern Uganda, 2016.

PREVALENCE AND FACTORS ASSOCIATED WITH ERYSIPELOTHRIX RHUSIOPATHIAE AMONG RAW PORK HANDLERS IN KAMULI DISTRICT, EASTERN UGANDA.

Questionnaire No: ☐ Participant ID: ☐ Date of interview:.__/___/___

Sub country: _____ Parish: _____ Village: _____

General instruction: Indicate the response by ticking the box corresponding to the respondent's response and where there are no boxes; write clearly the response as stated by the respondent

SECTION A: <u>SOCIAL DEMOGRAPHIC CHARACTERISTICS</u>

Q1. Name of the participant_____

Q2. Age of the participant _____

Q3. What is your date of birth? _____

Q4. Sex of the respondent (Observe) ☐ 1: Male ☐ 2: Female

Q5. What is your religion?

☐ 1: Catholic ☐ 2: Anglican ☐ 3: Born again ☐ 4: Pentecostal

5: Other, (specify) ☐

Q6. What is your marital status?

1: Single ☐ 2: Married ☐ 4: Separated/Divorced ☐ ☐ 5: Widowed

Q7. What is the highest level of education attained?

1: Never ☐ 2: Primary ☐ 3: Secondary ☐ 4: Tertiary ☐ 5: University. ☐

SECTION B: <u>EMPLOYMENT HISTORY</u>

Q8. For how long have you been on this job, (exposed to raw pork)? __/___/____

Q9. Did you get any training before you started working? ☐ 1: Yes ☐ 2: No

Q10. Where do you get the pigs you slaughter from?

1: Pig farmers ☐ 2: Pig traders ☐ 3: slaughter abattoir ☐ 4: Other, (specify) ☐

Q11. Do you engage yourself in any pig related activities?

☐ 1: Pig farmer ☐ 2: Pig trader ☐ 3: Other, (specify)

Q12. How many customers do you handle in a day? _____

Q13. Are they mostly females or males (state percentages)? _____

Q14. Do you buy raw/processed pork? _____

Q15. How many people do you work with? _____

Q16. Do you go for any medical check-up?_____

Q17 Do you wear any protective gears when handling/cutting the pork? ☐ 1: Yes ☐ 2:No

Q18. If yes mention them_____

☐ 1: gloves ☐ 2: gum boots ☐ 3: polythene bags ☐ 4: Other, (specify) ___

SECTION C: <u>HEALTH SECTION</u>.

Q20. When did you last suffer from a skin infection/skin related infection? __/___/____ (dd/mm/yy).

Q21. Which signs did you have? 1: Burning ☐ 2: Skin rash ☐ 3: Wounds ☐ 4: Other, (specify) _____ ☐

Q22. Did you visit a medical doctor? 1: Yes ☐ 2: No ☐

Q23. Were you given treatment? ☐ 1: Yes ☐ 2: No

Q24. If yes which treatment were you given?

☐ 1: Antibiotics ☐ 2: Skin tube ☐ 3: Other, (Specify) _____

Q25. How far was a medical doctor from your joint? (In km) _____

Q26. Have you ever had any other complications/ sickness? ☐ 1: Yes ☐ 2: No

Q27. If yes mention them_____

Q28 Do you consume alcohol 1: yes----------2: No----------

Q29. In case your blood results are out would you like to know them?

☐ 1: Yes ☐ 2: No

Q30 In case they are positive will allow taking the intervention given to you.1: Yes ☐ No ☐

Appendix 2: Lusoga translated questionnaire for butchers and abattoir workers in Kamuli district, Eastern Uganda, 2016.

PREVALENCE AND FACTORS ASSOCIATED WITH ERYSIPELOTHRIX RHUSIOPATHIAE AMONG RAW PORK HANDLERS IN KAMULI DISTRICT, EASTERN UGANDA.

Einamba yolupapula. ☐ Endagamuntu. ☐ enaku dhomwezi __/___/___

Eigombolola_____ Omuluka_____ Ekyalo _____

Iramu ebibuzo ebikubuzibwa nga otakhu katika era nawazira kabbokisi, wandkha ayenga owandi mungeri etegerekakha

EKITUNDU EKIGEMA KUKIKULA KYOMUNTU

Q1. Amayinago_____

Q2. Emyakha olina emekha?_____

Q3. Wazalibwa mwakha kii? _____

Q4. Butondhe 1: Male ☐ 2: Female ☐

Q5. Oli waidiini ki?

1: Mukatuliki ☐ 2: Mukulisitayo ☐ 3: Musilamu ☐ ☐ 4: Mulokole

5: Eidhilyonalyona nga otweleku getwogeleku ☐

Q6. Olimufumbo? 1:Timufumbo ☐ 2: Mufumbo ☐ ☐ 3:Twayawukana 4:Nnamwandu/ssemwandu ☐

Q7. Wasomaku pakha kyakumeka?

1:Tyajakumusomero ☐ 2:Mubibina ebyawansi ☐ 3: Muhaya ☐ 4:Mutendekero elyemikono ☐ 5:Mutendekero lyawagulu. ☐

EKITUNDU EKIGEMAGANA NE BYAFAYOBYOKUKOLA

Q8. Ibanga ki lyomaze mumulimo guno ogwembiidhi? __/___/____

Q9. Wafunaku okutendhekebwa kwona kwona nga okaali kutandiika okukola?)1: Yii ☐ ee ☐

Q10. Embiidi dhoosala odhitoola wa?

Q11.Nga otweireku okusala embiidi, elina emirimu egyindi gyewenigiramu egyekuusa kumbiidi?

☐ 1: Olimwayi wembidhi ☐ 2:Olimutunzi wambidhi

☐ 3: Bwobanga toyaya ate nga era totunda, waliyo omulimo gwonagwona ogwekulusanya kumbidhi gwokola

Q12. Abaguzi balinga bameka bootera okuguza buli lunaku?

Q13. Abasinga bakazi oba basaadha?

Q14. Otera okugula enyama nga emaze okulongosebwa?

Q15. Ennambha yesimu:_____

Q16. Okola naabantu bameka?

Q17 .Otera okugyaku yomusawo oba mukalwaliro okukeberebwaku?

Q18. Olina kyoyambala kyona kyoona nga olikusala enyama yembiidi?)1: Yii ☐ 2: Bee ☐

Q19. Bwekiba nga kituufu, biiki ebyo?

EKITUNDU EKIGEMAGANA NEBYOBULAMU

Q20. Li lwewasembayo okulwala obulwaire bwolususu?__/___/____ (dd/mm/yy).

Q21. Buboneroki bwewalina kulususu?

☐ 1:Okukyebhwa ☐ 2:okubutuka ☐ 3: Amabhwa ☐ 4:Other, specify

Q22. Wagyaku yomusawo yenayeena oba muilwaliro lyonalyoona? 1:Yii ☐ 2:Bee ☐

Q23. Wawebwa obwidandhabi? 1: Yii ☐ 2: Bee ☐

Q24. Bwidandhabi ki bwewawebwa?

Q25. Buwanvu ki obwaaliwo okuva wokolera okutuuka awaali omusawo?

Q26. Waali ofunyeku embeera eyindi eyobutewulira bulungi oba obulwaire obundi bwona bwoona? 1:Yii ☐ 2:Bee ☐

Q27. Mbeeraki eyo oba bulwaireki obwo?

Q28. Singa ebiviire mukukebera omusaayi biba nga bifuluime, walyenze okubitegeera?

1:Yii ☐ 2: Bee ☐

Appendix 3: Questionnaire for cooks/household raw pork handlers in Kamuli district Eastern Uganda, 2016.

.

PREVALENCE AND FACTORS ASSOCIATED WITH ERYSIPELOTHRIX RHUSIOPATHIAE AMONG RAW PORK HANDLERS IN KAMULI DISTRICT, EASTERN UGANDA.

Questionnaire No ☐ Participant ID ☐ Date of interview __/___/___

Sub county _____ Parish_____ Village_____

General instruction: Indicate the response by ticking the box corresponding to the respondent's response and where there are no boxes; write clearly the response as stated by the respondent.

SECTION A: SOCIO-DEMOGRAPHIC CHARACTERISTICS

Q1. What is your name? _____

Q2. How old are you/? _____

Q3. What is your date of birth? ____/___/___ (dd/mm/yy)

Q4. Gender (observe). ☐ 1: Male ☐ 2: Female

Q5What is your religion? ☐ 1: Catholic ☐ 2: Anglican ☐ 3: Muslim

☐ 4: Born Again ☐ 5: Other, (specify) _____

Q6. What is your highest level of education? 1: Never ☐ ☐ 2: Primary

☐ ☐ ☐

3: Secondary 4: Tertiary 5: University

Q7. How many children do you have? _____

Q8. Are you responsible for buying pork for the home? . ☐ Yes 2 ☐

Q9. If no who else prepares the raw pork? (Specify) _____

Q10. How many times do you prepare raw pork at home?

☐ 1: Daily ☐ 2: Weekly ☐ 3: Monthly ☐ 4: Other, (specify).____

Q11. Do you put on any protective gears when handling the raw pork? ☐ 1: Yes ☐ 2:No

Q12. If yes mention,

☐ 1: Gloves ☐ 2: Polythene bags ☐ 3: Other, (specify)

SECTION B: <u>HEALTH SECTION</u>

Q13. Do you keep pigs? ☐ 1: Yes ☐ 2: No

Q14 Have you suffered from any skin infection before? ☐ 1: Yes ☐ 2: No

Q15 Which signs did it have? ☐ 1: Burning ☐ 2: Skin rashes ☐ 3: Wounds

4: Other, (specify)_____ ☐

Q16. Did you visit a doctor? ☐ 1: Yes ☐ 2: No

Q17. Were you given any medication? 1: Yes ☐ 2: No ☐

Q18. Which medication were you given?

☐ 1: Antibiotics ☐ 2: Skin tube ☐ 3: Other, (specify)_____

Q19. How far is the medical personal from your place of residence? (Km) _____

Q20 Do you consume alcohol: 1: yes--------- 2:---------- ☐ ☐

Q21. In case the test results are out would you like to know them? 1: Yes 2: No

Q22. If found positive would you accept the intervention given to you? ☐ 1: Yes ☐ 2:No

Contact number: _____

Appendix 4: Lusoga translated questionnaire for cooks/household raw pork handlers in Kamuli district, Eastern Uganda, 2016.

PREVALENCE AND FACTORS ASSOCIATED WITH ERYSIPELOTHRIX RHUSIOPATHIAE AMONG RAW PORK HANDLERS IN KAMULI DISTRICT, EASTERN UGANDA.

Enamba yolupapula ☐ endagamuntu ☐ Enaku dhomwezi __/___/___

Eigombolola_____ Omulukha)_____ ekyalo_____

Iramu ebibuzo ebikubuzibwa nga otakhu katika era nawazira kabbokisi, wandkha ayenga owandi mungeri etegerekakha

EKITUNDU EKIGEMA KUKIKULA KYOMUNTU

Q1. Eliinalyo niwe aani?_____

Q2. Olina emyaka emeka?_____

Q3. Wazalibwaalibwaddi ____/___/___ (dd/mm/yy)

Q4. Ekikula ☐ 1: Mukyala ☐ 2: Musadha

Q5. Oli waidini ki ☐ 1:Mukatulikki ☐ 2: Mukulisitayo ☐ 3:Mulokole

☐ 4:Ediini eyindi

Q6. Wasomaku kyenkana ki? ☐ 1: Tyasomako ☐ 2: Mubibina ebyawansi ☐ 3: Muhaya 4:Mutendereko elyemikono ☐ ☐ 5: Munivasite

Q7. Olina abaana bameka?

Q8 .Niwe avunanizibwaaku okugula enyama yenbiidhi wano waka? 1:Yii ☐ / 2:Bee ☐

Q9. Bwekiba nga tiniiwe, ani afumba enyama eyo embisi?

Q10. Milundi emeka gyofumba enyama yembiidhi waka wano?

☐ 1: Bulilunaku ☐2: Buliwikhi ☐3: Bulimhwezi ☐4: Kiseraki ekindi

Q11. Olina byoyambala ogolikutekateka nokufumba eyama yembiidhi?

Q12. Bwekiba nga kituufu, biki ebyo byoyambala?

KITUNDU EKYOGERA KUBULAMU BWEMMILO

Q13. Olunda embiidi? 1:Yii ☐ / 2:Bee ☐

Q14. Olina byoyambala nga olikutemateema enyama yembiidi? 1:Yii ☐ 2: Bee ☐

Q15. Bwekiba nga kituufu, biki ebyo byoyambala?

Q16. Wali olwaileku obulwaile bwolususu bwonabwona? 1:Yii ☐ 2:Bee ☐

Q17. Buboneroki obwaali kulususu lwo? ☐1: Okwokyelela kwolususu ☐ 2: Amagondyo 3: Amabwa ☐ ☐4: Ekhindhi nga otweleku ebyo byetwgeileki

Q18. Wagyaku yomusawo yenayeena oba mukalwaliro koonakoona? 1:Yii ☐ / 2: Bee ☐

Q19. Wawebwaku obwidhandhabi bwona bwoona?

1:Yii ☐ 2: Bee ☐

Q20. Bwidhandhabi ki bwewaweebwa? _____

Q21. Waliwo buwanvu ki okuva wano waka okutuuka awali omusawo oba akalwalilo? _____

Q22. Singa ebiviire mukukeberebwa biba nga bifulwiime, walyenze okubimanha?

1:Yii ☐ 2:Bee ☐

Q23. Singa oyaganibwa nga olina akawuuka, waaliikiriza obuyambi obukuweebwa?

1: Yii ☐ 2:Bee ☐

Enambha yesimu _____

Appendix 5: Informed consent form for the prevalence and factors associated with ER infection among raw pork handlers in Kamuli district, Eastern Uganda.

MAKERERE UNIVERSITY COLLEGE OF HEALTH SCIENCES

Title: PREVALENCE AND FACTORS ASSOCIATED WITH *ERYSIPELOTHRIX RHUSIOPATHIAE* AMONG RAW PORK HANDLERS IN KAMULI DISTRICT, EASTERN UGANDA.

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BACKGROUND AND RATIONALE FOR THE STUDY

As part of our research under the "Safe food fair food project" coordinated by the International Livestock Research Institute (ILRI), we are planning to conduct research on *Erysipelothrix rhusiopathiae infection* among raw pork handlers. The infection was reported by pig farmers, Diamond skin disease, (Okumyuka) Namwendwa, Kitayunjwa and Bugulumbya sub counties. Pigs, (450) were sampled and 100 fresh pork samples and preliminary results showed a prevalence of 67% of *Erysipelothrix rhusiopathiae* in pigs and the bacteria was isolated in 45 of the 100 pork samples.

STUDY PURPOSE

We are interested in finding out whether the infection exists among raw pork handlers (butchers, cooks, abattoir workers and veterinarians). This study is aiming at identifying the prevalence and factors associated with *Erysipelothrix rhusiopathiae* among raw pork handlers in Kamuli District. Therefore you are requested to be part of the study because you are a raw pork handler hence at an increased risk of acquiring the infection.

The study will involve collection of blood from the vein, taking it to the laboratory and culturing the blood to isolate and identify the bacteria.

PROCEDURES

On agreeing to participate in the study, venous blood (3ml) will be collected using a new sterile needle and syringe, the procedure isn't painful and won't cause and infections. The blood will be kept in Kamuli hospital during the data collection time, and then transported to the College of Veterinary Medicine Animal Resources and Biosecurity, Microbiology laboratory for analysis.

You are required to answer a few questions and provide a blood sample. The interviews will focus on work history of the participant, pork eating habits, pig related activities, health concerns, economic status and demographic factors of the participants. All the information will be every confidential.

The results from this blood will be reported confidentially to you, all those who will be found positive with the disease will be assisted to seek treatment immediately the results are out.

PARTICIPANTS

The participants will include all butchers and abattoir workers in Namwendwa, Kitayunjwa and Bugulumbya sub counties. Cooks who buy raw pork from the butcheries will be included. Six

participants from each of the butcheries will be included. A total of sixty seven butchers and abattoir workers will be studied and 300 cooks.

The questionnaire will take 15 minutes and the blood collection will take 5 minutes. Therefore each participant will spend 20 minutes actively in the study.

RISKS AND BENEFITS

No advance risks will be posed to your life if i take off the blood sample because the procedure isn't painful and all the equipment used will be new. After sample analysis every participant will know his/her status on *E. rhusiopathiae* infection. All butchers and abattoir workers will be provided with protective gears like gumboots, gloves, Jik, soap, jerry can to be used to improve, the other participants will receive gloves, Jik and a bar of soap. The research will benefit the scientific community on publication of the finding in a peer reviewed journal and the knowledge gained from the study finding will be used to inform policy about the infection and develop possible interventions to control the infection.

CONFIDENTIALITY

The results of this study will be kept strictly confidential and used only for research purposes. The identity will be concealed in as far as the law allows. Your name may appear on the forms for purposes of tracing the results but won't be used in reporting and discussing results. Paper and computer records will be kept under the lock and key with password protection respectively.

COSTS AND COMPENSATION OF PARTICIPANTS IN THE STUDY

The costs of the procedure and the culture of the bacteria will be met by the Safe food fair food project. The medical bills for the participants who will be found infected with *Erysipelothrix*

Rhusiopathiae will also be covered by the research project. There will be no direct compensation to the participants.

REIMBURSEMENT

All the costs for transport will be met by the project. The participants will be interviewed and sampled from their place of work/ as they come in to buy raw pork.

QUESTIONS

Participants who have study related questions will contact the investigators or the veterinary and community health care workers.

QUESTIONS ABOUT PARTICIPANT'S RIGHTS

All research participants have equal rights to ask about the ask and the investigator will address them.

STATEMENT OF VOLUNTARINESS

Participation in the proposed study is voluntary and participants may join on their own free will. Participants also have a right to withdraw from the study at any time without penalty.

The interviewer has discussed all the above information with me and offered to answer my questions. For any questions regarding the study, contact Musewa Angella, on Tel: +256702-422-679.

STATEMENT OF CONSENT

I have been briefed about the study and i know what is going to be done, i know that the blood will only be used to check for organisms that affect humans from pigs. The process isn't painful and will take a very short time. The study will benefit me in knowing my status regarding swine erysipelas. After this i will trained on the hygienic practices and look after myself while handling raw pork. I have had an opportunity to ask the ILRI field worker who explained the study to me and answers to any questions that i had about the study.

I agree to join the study.

Name_____ Signature_____

ID_____ Village name_____ Sub county_____ District_____

Tel (if available) _____ Witnessed by_____ Title_____

I_____ Confirm that I have explained the nature of the study to_____ as set out in the study protocols, that s/he understood what I said and had an opportunity to ask questions and freely gave his/her consent for him/her to join the study.

Name of the field worker _____ Signature _____

Date _____

Appendix 6: Translated informed consent form for prevalence and factors associated with ER infection among RPH in Kamuli district, Eastern Uganda.

PREVALENCE AND FACTORS ASSOCIATED WITH AMONG RAW PORK

HANDLERS IN KAMULI DISTRICT, EASTERN UGANDA.

SCHOOL OF MEDICINE, COLLEGE OF HEALTH SCIENCES

OMUTWE

Prevalence and factors associated with *Erysipelothrix rhusiopathiae* among raw pork handlers in Kamuli District, Eastern Uganda.

OMUNONEREZZA OMUKULU

Musewa Angella. BBLT, Makerere University, Kampala

Telephone: +256-702-422-679

EKINUSI KYOMUSOMO OBA ENSONGA OKUNONONKEREZA

Bamukagwa ensonga lwaki tulikola okunononenkera kudwaile yo kumyuka ,twendha tumane oba ekosa abantu abakola emirimu egyekusa mukulabirira ensolo dhaiffe magulu mampi.(nga banaiffe abalokola mubukya,maama abalabirira embidhi dhaffe,ababazi,na basawo abebisoro).Era nga ebinaba biviyile mukunononkereza kuno,tudha bitwalira abasawo abekitongole ekikola kubyobulamu,bigye nimumalwaliro gano agayiffe agabulido nibanayiffe abandhi betukola naboo omulimo guna tusobole okusalalira walala amagegezi engeri gyetusobola okwetangire endwaire eno.obwoniawo,tulete emisomo egyogera kungeri gyokuba

nemere enkalamu era etagemebwa bulwayi,tubasomese obuyondo,tubagabire gilavu okusobola okwerinda endyaiye eno.era bino byakugabibwa eli'abantu abanaba benigire mumusomo guno.

ENGERI OMUSOMO GYEGUJA OKUKOLEBWAMU

Eri abo abanaba bayikiriza okwegayita omusomo guno,tugyabatolaku omusayi nga tukozesa empiso era nga empiso eno teluma atenga buli muntu adha kuba nempiso ye.omusayi ongunaba gubatoleyibwaku gwidhasokha gutelekhebwe mwidwaliro ekamuli era eyogyegunava gutwalibwe e Makerere okwongera okwekebedhebwa.omusayi guno bwegunabanga gumaze okwekebedhebwa,twidakwira tubakobele ebinabanga biviyiremu mumusayi ayenga bino bidha kubabyakyama era abantu betunayaganamu bobuwlayire O' bwo kumyuka, twidha kubalagirira gyebanasobola okuyambibwa mungeri yobwidhandhabi.Iffe abayikiriza okwegayita omumusomo guno,tugyakubuzibwayo obubuzo buto obugemagana kungeri,kumpisa edhabantu nga balya embidhi,mirimoki gyemukola egyekayita mukulabilila embidhi,ebwobulamu,ebyenfuna byaffe enebindhi.Era tubasubiza era nga tweyama nti bulikyetunayogeraku,kigyakumibwa nga kyama.

EMIGANULWO

Emilundi egiisinga tutera okubuza nti yetugyaffunira wa,no kyo kibuzo,twayindgye ngatulibetegefu okukiramu tuti,iffe abagya okwetaba omusomo guno,tugya kutegera engiri obulamu bwaffe bwebwemerire mungeri yakawukano aka *Erysipelothrix rhusiopathiae*,tugyakubagabilayo,kubintu nga,butusi,gilavu,jiki,sabuni no budomola okwongera okutumbula ebyobuyondho era muli-muntu,agyakuvawano neyituu

OKWEKENGERA

Wazira kabenje konako akagye okutuka obantu abanaba batoleyibwaku omusayi

IDHEMBE OKWIKIRIZA OBA OBUTAYIKIRIZA

Iffe twenatwena abaliwano,tulina idhembe lyo kwikiriza okwetababa omumusomo guno oba obutayikiriza

EKYAMA EKIKUSIKUFU

Tusubiza nti ebinavu omukononenkereza kuno,biligya kukumibwa nga bwakyama,era amayina gayimwe,tigagya kubonekera kuwantuntuwonawona,okutolaku kumpapula detugya okwiduuza nimwe okusobola okwawula singa wanabawo alina obulwayire buno.

Empapula,kabwidhibwidhi,nebintu ebindhi byetugya okukozesa togye bikumila mubiffobyetwekakasa nti ezira agyakubitukaku.

Era bisingawo,musobola okwogera ni Musewa Angella, nga mubita kunamba eno Tel: +256702-422-679.

OBUKAKAFU NTI OKHIRIZA OKUKOLA NIFFE

Ndikiriza nti nsomesebwa,kubigegagana no musomo guno,era ntegere ekigya mumayiso,era nti nomusayi ogugya okuntolebwaku gwakukebera obuwuka obukosa embidi era nabantu.ntegere nti okutolaku omusayi tibiluma era nga kitwala akasera katono.Era nga maze okutolebwaku omusayi,ngya kusomesebwa kungeri gyokukumamu obuyondo era nengeri gyesobala okwelabirira nga ngemaku mamba yembidhi.

Ndi mwetegefu okwegayita mumusomo

Nkiziraku buzibu omunonenkereza okukobera abantu amayina gange)

Tyendha omunonenkereza kwogera mayina gange eri abantu)

Emperrebwa omukisa okubuza omunonenkereza ebigemagana nomusomo guna era yandiramu nebibuzo byonabyona byembayire nabyo)

Ndhi kiriza okwegayita on omusomo/okunonenkereza kuno.

Amayina_____ Ekinkumu_____

Endhaga muntu_____ Ekyalo_____ Eigombolola_____

Disitukuti_____ E'namba yesimu_____ Abailewo_____

Title_____

Nze_____ nkakasa nti ninongoile bulungi kubigemagana nokunonenkereza kwetuligya okola _____ mumitendara emitufu,era nga omwami/omukyala o'no ategheire ekinusi kyokunonenkereza kuno,era yambuza nebibuzo era nabiramu,nti era omwami/omukyala akiriza nga tawalirizabwa okwegaita okunononkereza. kuno.

Amayina gomukubiriza_____ Ekinkumu_____

Enakudho mwezii_____

Appendix 7: Oral consent form for the focus group discussions

INTRODUCTION

The consent form is to be administered by an interviewer on the research team. Only those participants who consent to participate in the study will be included.

TITLE OF THE STUDY

Prevalence and factors associated with *Erysipelothrix rhusiopathiae* among raw pork handlers in Kamuli District, Eastern Uganda.

Principal investigator: Musewa Angella, BBLT Makerere University Kampala, postgraduate student, College of Health sciences.

PURPOSE OF THE STUDY

The study is aim of this focus group discussion is to describe the social cultural factors influencing *Erysipelothrix rhusiopathiae* infection among raw pork handlers in Kamuli District.

STUDY PROCEDURE

You as the participant will take part in the focus group discussion.

RISKS AND BENEFITS

There are no direct risks the study results to promote best bet interventions for this zoonotic disease and best preventive methods.

COSTS AND COMPENSATION

There was no direct payment for you to participate in the study. A drink and a snack were provided to FGD participants and a transport refund of 5000.

CONFIDENTIALITY

Whoever accepted to join the study, all records were kept confidential. Your name will not appear on the study documents transcribed from the tapes even on the tapes. Your name will not appear anywhere in the publications.

ALTERNATIVES TO THE PARTICIPATION

If you have never a focus group discussion before you can be excused, some of the questions may make you feel shy but feel free if you can't respond to them. Cultural affiliation will be discussed most here feel free to participate or not to participate; you have a right not to answer questions you do not want. You may decide not to be part of the study and there will be no problem.

PROBLEMS AND QUESTIONS

If you have any questions you can contact the principal investigator Musewa Angella on phone +256702-422-679, or the international livestock research institute on +256 392 081154 or the Clinical epidemiology unit - Makerere University on +25641530022/3. Further information about the research participant's right you can contact School of Medicine, research and ethics committee.

PARTICIPANT'S CONSENT

I have understood all that has been explained to me about this study and accept to participate in this study. I voluntarily agree to be part/ participate in the study.

A copy of this consent will be provided to me

_____ _____ _____

Name of the participant/thumb print signature Date

_____ _____ _____

Name of moderator signature Date and time

Appendix 8: Translated oral consent form for the participants

ENANJULA

Ebaaluwa eno elaga nti okhiriza okubuzibwa,ejakwidhulizibwa nomu kubantu abava kutimu yaffe.

OMUTWE GWOMUSOMO

Twendha okumanya obulyayile buno busasane buwanvuki era nsonga kii edhivaku obulwayire buno okugema abantu abagema kunyama yembidhi embissi.

Okulembeyire ekunsukino ekyokunonereza nomukyala, Musewa Angella, omuyizi mu Makerere University Kampala,mutendekero lyabasawo.eranga anonerezaku kawuka akareta okumyukamu bakolamumbiddi.

Omunonerezza omukulu: Musewa Angella, BLT Makerere University Kampala.

EBIGENDELELWA BYOKUNONENKEREZA

Okunonenkereza kuno,kugendele okulingirira nsongaki edhivireku obulwayire bwo kumyuka era kino tuligya kukilkola nga tuta abantu mububinja obwendhalwo kitusobozese okukuba ebilowozo ebyawalala nga twogera kubulombolombo byaffe,emisoso byaffe,byetwikiriza nga basoga era nebyo byetutayikiilizamu.

ENGIRI OKUNONENKELENZA BWEKUJA OKUKOLEBWAMU

Imwe abatebye on kunonenkereza kuno,ojyatebwa omgulupu edhendhawolo tusobole okukubagannya ebilowozo kunsonga ghetwogeyireku waigulu.

OKWEKENGERA OBA AMIGANOLWO

Wazila buzibu bwonabwo obujja okututukaku, wabula okunonenkereza ogendelerwamu, kkungeriki gyetusobola okutangira okumalawo, obulwaire obuema abantu ne bisoloera nga wano,tulikwogera kumbighi

ENSANSANYA

Tituligya kubasasula,aye tulinayo akokulya na kokunnya ketuligya okubawayo era nga bwetunabanga tumaliriza,tujyabawa entambula ebaiyayo e'wakka.

EKYAMA EKIKUSIKUFU

Tusubiza nti ebinavu omukononenkereza kuno,biligya kukumibwa nga bwakyama,era amayina gayimwe,tigagya kubonekera kuwantuntuwonawona,okutolaku kumpapula detugya okwiduuza nimwe okusobola okwawula singa wanabawo alina obulwayire buno.

Empapula,kabwidhibwidhi,nebintu ebindhi byetugya okukozesa togye bikumila mubiffobyetwekakasa nti ezira agyakubitukaku.

ENGERI GYOKUKUBAGANYAMU EBILOWOZO

Tuligya kwogera kumisoso gyaiffe,okubulombolombo,era nga tubasaba nti muwulile emirembe ngatukubagannya ebilowozo.Bwobanga nga toidhi kyakwiramu obanga toyendha kwramu.osobala okusirika.ayenga kyetusinga okwendha,kyakubanga bulimuntu kwiffe abakunikyayogera.

Ebibuzo oba omutawana gwonagwona

Bwewabanga waliwo ebibuzo byonabyona,osobala okukubia omukyala Musewa Angella ku nambha eno +256702-422-679,oba wagya okukitongole kya International Livestock Resaerch Institute oba e'mulago gyebakola kunsonga dokunonereza.

Bwoba nekibuzo ekigemagana nomusomo guno buzza. Musewa Angella ku+256702-422-679, or

Etendekerolyabasawo ku…….

Ndikiiriza nga tibankase

Nze ntegeyire ebininongolebwa kubigemagana onukunonenkereza kuno,era ndikiiriza okukwetabamu nga tikakhibwa wabula nga nkyeyendgele.

_____ _____ _____

Amayinago Ekinkumu Enakuo dhomwezi

_____ _____ _____

Amayina ogomukubiriza Ekinkumu Enaku dhomwezi

Appendix 9: Focus group discussion topic guide

Date__/___/____

Moderator_____ Recorder_____

Language_____ Time: Start _____ End _____

Good morning/afternoon

You are welcome to my discussion. My name is_____ and my colleague (recorder) is_____

Our team is from Medical school, Makerere University and we would like to discuss the social cultural factors influencing *Erysipelothrix rhusiopathiae* infection among raw pork handlers in Kamuli District, Eastern Uganda. We want to collect information from you about our study of the diamond skin disease among raw pork handlers among abattoir workers, butchers and house wives. I also have a tape a recorder to help us remember about what we shall have discussed about. May I use it? (Moderator asks consent).

Thank you very much

In order to discuss easily, allow me pin your name on your shirts, I will also do the same (one name only).

1. Studies conducted show that 67% of the pigs in Kamuli carry swine erysipelas and 45% of the fresh pork samples are also carrying the bacteria. Do you think there are some factors associated with this?

2. Are there any factors/ reasons why this particular disease was reported in only your sub county?

3. Do you raw pork handlers have a way of living (life) that they practice that predisposes them to the infection?

4. Most of us are Basoga, (biggest percentage) are there cultural beliefs, norms or practices that may predispose us to the infection we get when we handle raw pork.

Appendix 10: Translated focus group discussion guide

Enaku dhomwezzi __/___/___

Omukubiriza_____ Agema amalobozi_____ Olulimi_____

Sawa dhotandikireku _____ Sawa dhomalileku _____

Bassebo/banyabo mwasuze mutya oba musibye mutya

Tubaniriza mumusomo guno ogwalelo gwetuligye okukubaganizamu ebilowozo

Amayina …….era nga ndiwano nimunange ono……

Iffe tuli basawo okuva Makerere university era nga twindye wano olwalelo okukubaganiza walala ebilowo kunsonga edigemagana nekikula ekyomuntu edhileta obulwayire bwo bwokumyuka eri abantu abatera okugema kumamba yembidhi mukamuli mu.iffe tituva mubitongole ebivunanizibwa kumbidhi mu-uganda nti tulikwendha kubatolaku bilowozo byamwe tusobole okuwaandika obutabo obatikyindhi bizinense dhamwe okwigala lwo.aya ekilubilwa kyaffe nikyetwayogeraku.Wano wendi,ninawo,kano akabanzungu akagema amalobozi okusobala okunambako okwidhukira bulikye tujja okwogeraku.nga era byenabakobye mukusoka.

Mwebale okumpuliriza.

Mbayire nsaba nti amayina gamwe kanga timbe kutisati kitusobozese okumanagana bwetunaba tutandise okukubaganya ebilowozo era nga tugyakozesa amayina gayiffe agendini.

Mukunonenkereza okwakolebwa,kilaga nti 67% embidhi dhe Kamuli dhilina swine erysipelas and 45% emamba yembidhi gye twatolanga nga kubukya erimu akawuka kano.imwe mukulowoza kwaimwe mulowza nti eriyo ensonga edhekusa kunsonga eno?

Imwe mulowaza nti eriyo ensonga lwaki a kawuka kano kazulibwa mwigombolola lyamwe?

Mulowaza nti banayiffe bano abatema enyama balina obupisa oba ebintu byebakola ebisobola okubaviraku okufuna obuwuka buno?

Abasing kwiffe tuli basoga,tibwekili bana,aye bwe mulingirira obulombolo byayiffe era ne misoso gyeiffe imwe mulowoza nti,eriyo ebintu byetukola etuviraku of kuna obuwuka buno mungeri gyetugemamu enyayembidhi embissi.

Bassebo/banyabo mwasuze mutya oba musibye mutya

Tubaniriza mu kuteesakuno. Nze _____ Nagema amalobozi ye _____. Iffe tuli basawo okuva Makerere university era nga twindye wano olwalelo okukubaganiza walala ebilowozo kunsonga edigemagana nubulwaile bwembiddi, (Okumyuka) mubakolamumbiddi, (abatinjaji, abatemi nabafumba embiddi) mu Kamuli District.

Mwebaleyino

Mukutessa kuno tugenda kwewndikako elina limu kituyambe mukumanagana.

1.Okunonere okwakorebwa kwasanga obulwaire bwokumyukka mumbi (67%) mu Kamuli ne mumamba yembindi (45%) . Mulowozza waliwo ensonga ezigemagana nakino. 1.Mulowoza waliwo ensonga lwaki obulwaire obuvamundi bulimugombola yamwe.

3. Mulowozza abantu abagema kunyamayembiddi balina obulamu obwendamulo obubalobera okufuna obulwaire okuvamumbiddi.

4.Abasinga muffe tuli Basoga. Tiniko. Muwolozza waliwo obulombolombo nenono ebigemagana nokufuna akawuka bwetukwata munyayembiddi embissi.

Appendix 11: Key informant interview guide

INTRODUCTION

My name is Angella Musewa from Medical School, Makerere University. Together with my team, we are determining the prevalence and factors associated with *Erysipelothrix rhusiopathiae* among raw pork handlers in Kamuli District, Eastern Uganda. Results from this study will be treated as confidential and only used for research purposes.

1. What is your profession?

2. For how long have you been on this job and in this sub county?

3. Have you ever had of *Erysipelothrix rhusiopathiae* infection in humans, (diamond skin disease)?

4. Could there be any factors related to culture that influence infection transmitted from pigs to humans.

5. Why are infections from pigs to humans are rising?

6. How do you prevent these infections?

7. Are there any mechanisms put forward to protect humans from acquiring these infection, if yes which ones have been put.

8. If not what can be done.

Appendix 12: Translated key informant interview guide

ENANJULA

Amayina gange ninze musewa okuva e'makerere university medical school,nze nibange twendha okumanna ngeri ne ensonga edivaku okusansanya obulwayire obuno obwo kumyuka eri abantu ebagema kumamba ye mbidhi embissi mukamuli disutikiti,mubuvanduba bwa Uganda.era ebinava mukunonenkereza kuno,bigyakumibwa nga byakyama.

1. Wakuguka mukhi?
2. Omaze ibanga khi nga okola obulimo guno mwi gombolola lino?
3. Wali owulileku kubulwayire bwo kumyuka obugema abantu oba okumyuka
4. Olowoza nti waliwo ensonga edho buwangwa edhivilileku obulwayire buno okuva mumbidhi okwilakubantu
5. Iwe olowoza kwaki obulwayle buno bweyongere okuvu mumbidhi mukugema abantu?
6. Olowoza nti tusobola tutya okwewala obulyayile buno?
7. Waliwo amagezi oba engeri yonayona etelebwawo okusobala okutangira abantu obutafuna ndwayileno,era bwewabaga wali,engeri khi'edho?
8. Bwewabanga wazila,iwe olowoza khikii ekhiba kikolebwa?