



Pork joints: A mushrooming business in Uganda with implications for public health

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Highlights:

- Pork joints in Kampala sell raw, fried and roasted meat.
- Flies were observed in 80% of pork joints.
- One third of raw pork sampled and one fifth of houseflies tested positive for *Salmonella Enteritidis*, an important and serious cause of gastro-intestinal illness.
- Water, tomatoes and cabbages were also contaminated at lower levels. This is important, because unlike meat, vegetables are often eaten raw and so pathogens are not killed by cooking.
- Insecticide treated netting reduced fly catches by 48%.
- Netting costs just USD 1.50 per square metre and is acceptable to butchers.

Introduction

Pork joints are a mix of a pork butchery and a snack bar where ready-to-eat or take-away food can be bought. Apart from their popularity among Ugandans, they also attract flies. Small in terms of their physical size, flies can have a big impact as pests. Not only are they a nuisance, they are also carriers of parasites and bacteria and are well-known cross contaminators in farms, hospitals and many public places.

Given their feeding and breeding ecology in filthy environments, flies are recognized as vectors for various diseases. Moreover, an association between seasonal peaks

of fly populations and food-associated disease outbreaks has been demonstrated. In particular, synanthropic flies, which live close to humans (syn-anthropos meaning 'with humans'), use human foodstuff, faeces and other organic material as a protein source and breeding place.

Houseflies have siphoning-sucking mouthparts; this allows them to suck up food in the same way a sponge does, thus making food liquid. They do this by vomiting a mixture of enzymes and previously absorbed food, including their potential contaminants. Food contamination can occur through (i) contaminated material harboured in the fly's crop and vomited on food, (ii) contamination with faeces or (iii) mechanical contamination through the flies' body parts.

Figure 1: Safe Food, Fair Food field research team from left to right: Samuel, Dickson, Martin, Angella and Jasper



Why is this a problem?

- If food is properly packaged, stored in a fridge or at least covered, the risk of contamination through pests might be low. But if these conditions are not met, pests can easily spread pathogens on food and contribute to various foodborne diseases.
- Pig keeping and rapidly increasing pork consumption is relatively new in Uganda. Pork joints are a mushrooming sector that offer raw pork as ready-to-eat or take-away food. With little or no governmental food inspection in place, local food handlers have little experience in good hygiene practices in pork preparation.
- A recent study collected samples from the local city abattoir in Kampala and suggested high prevalence of *Salmonella* on raw pork, as well as the occurrence of antimicrobial resistance (Tinega et al. 2016). Together with the ubiquitous occurrence of *Salmonella* species in warm-blooded vertebrates and their human-pathogenic potential, they serve as a significant indicator of pathogens for foodborne diseases and were therefore chosen for this study.

Study objectives

1. To determine the abundance of flies in pork joints in Kampala.
2. To conduct an epidemiological investigation of *Salmonella* spp. on foodstuff, flies and equipment.

3. To assess butcher and customer knowledge, attitudes and practices.
4. To assess the impact of insecticide-treated fence material to reduce the number of flies in pork joints.

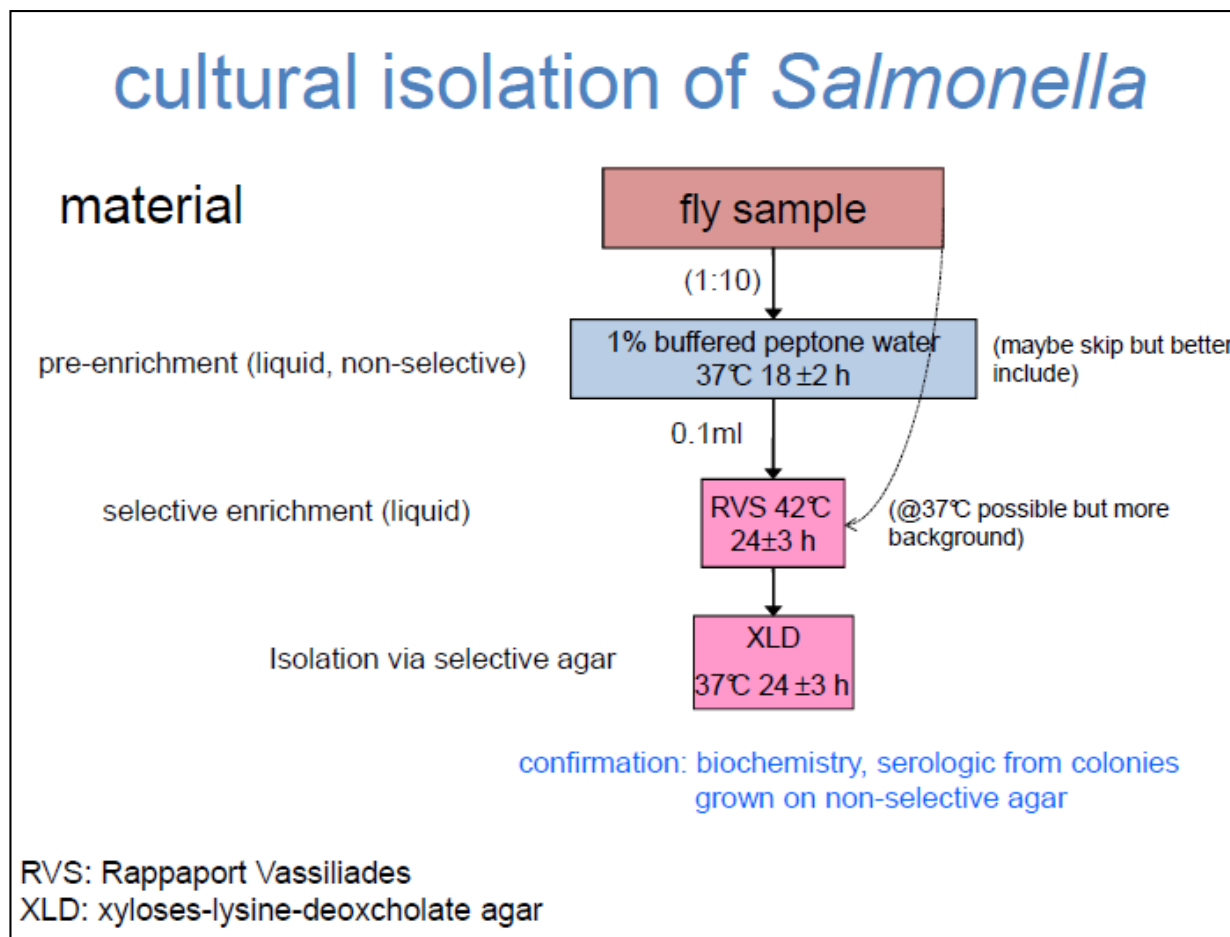
Methodology

From June to October 2014, a baseline study was conducted in Kampala with 60 randomly selected pork joints, including interviews with 60 butchers and 240 customers. Best-worst method, a form of a choice experiment, was employed during face-to-face interviews to assess pork butcher perceptions of what is important to their customers when buying pork.

Samples of housefly guts, foodstuff and equipment were taken once in 77 randomly selected pork joints and tested for *Salmonella* spp. based on ISO 6579:2002. Samples were pre-treated in the laboratory by incubating in 9 ml of peptone water and streaked on XLD agar after selective enrichment. Suspected positives were tested using several biochemical tests for confirmation. Positive isolates were serotyped using immune serum for identification of *Salmonella* serotypes (Figure 2).

After the baseline interviews, a pilot study was undertaken to investigate the impact of insecticide-treated fence material, allocating 18 pork joints to an intervention and five to a control arm. Biphasic weekly monitoring by using sticky traps with pre-intervention and post-intervention was undertaken from August to November 2014.

Figure 2: Protocol used for cultural isolation of *Salmonella* spp. (based on ISO 6579:2002)



Key findings and implications

Raw pork is the most commonly sold form of meat (about 50%) followed by fried (~35%), roasted (~13%) and cooked (~3%) pork.

- This reveals that pork joints are not only popular for eating the pork already processed on-site, but also serve as a source of raw pork, which enters the household.

Most butchers (87%) stated that they served cooked pork on-site with raw side dishes, such as avocado, onions, tomatoes or cabbage.

- Given that these side dishes are prepared in the same location and often with the same equipment, cross contamination with potentially unsafe raw pork is most likely. But unlike the pork, these side dishes are eaten raw, so pathogens are not deactivated by heat and can therefore cause various foodborne illnesses.

Flies were observed in 80% of pork joints together with other pests, such as birds and rats in half of the cases. However, the choice experiment revealed that butchers believed that customers care least about the 'Presence of flies in the butchery' and 'Pest animals in/around the butchery', while 'Meat from the same day' and 'Cleanliness in the butchery' were the most important attributes.

- Flies are recognized as pests by both butchers and customers, but seem of less importance to customer pork purchases according to butchers. Additional data from a customer perspective is necessary to get further insight into this perception.

Among 693 samples, 8% tested positive for *S. Enteritidis*. These cases rank from 31% on raw pork (24/77), 22% in houseflies, 9% in water, 5% on tomatoes and 4% on cabbage. Further, *S. Gallinarum* was found in 1% of cases, ranging from 3% on tomatoes, 3% on onions, 1% on cabbage and 1% on roasted pork. All 154 samples from either butchers' hands or their equipment tested negative for *Salmonella* spp.

- The contamination of vegetables is of particular importance from an epidemiological point of view, given that these side dishes are usually served and eaten raw as salad (Figure 3).

Figure 3: A typical plate served with fried pork and raw relishes



Fly monitoring during intervention led to a total of 7953 flies containing 85% *M. domestica*, 14% Calliphoridae and 0.4% Sarcophagidae. The median of caught flies in the netted group before and after intervention corresponds to a reduction in catches of 48% ($p=0.002$), while a slight increase in the control group was observed.

- Despite a relatively small sample size and varying fly numbers, it was possible to prove that insecticide-treated fence material can significantly reduce fly numbers and, therefore, serve as an affordable and sustainable solution for butchers.

With costs of about USD 1.50 per square metre and an easily realizable implementation in pork joints, butchers were open to installing the fence material and eager to participate in the pilot study.

- However, the implementation in the pork joints varied from installation as a window frame, on the wall or as a netted cage. These differences led to strong variations in fly catches and differences in the maintenance of the nets. This led to difficulties in the cleaning of fixed nets on the wall or less visibility of pork, from a customer perspective, through the use of a window frame.

Outlook

Currently, the molecular characterization and identification of the *Salmonella* isolates is being carried out in cooperation with Freie Universitaet Berlin, Germany. Drug sensitivity tests are ongoing but suggest multiple drug resistance. Further analysis is being undertaken on the identification of plasmids by polymerase chain reaction-based replicon typing. In case of the presence of shared resistance plasmids, there is a plan to provide a map to trace the movement of the resistance.

Secondly, a customer study is envisaged regarding pork purchase habits to compare with butchers' point of view in order to get a better understanding of the existing risks and to share this understanding more effectively with butchers and their customers.

The Safe Food, Fair Food project in brief

Since 2008, the International Livestock Research Institute (ILRI) and partners have carried out research on food safety in informal markets in sub-Saharan Africa. Our vision is to improve the livelihoods of the poor by reducing health risks associated with animal-source food and improving nutrition and market access for smallholders. Conventional food safety approaches focus on banning any product with germs or other hazards in it; this is bad news for small-scale farmers. New risk-based approaches seek to find out if there really is a danger to human health and, if so, how significant it is and what can be done about it. Risk analysis is the gold standard for food safety management in developed countries and can be a useful tool for decision-makers in sub-Saharan Africa where resources to address all potential hazards are scarce. The Safe Food, Fair Food project is carried out with the financial support of the Federal Ministry for Economic Cooperation and Development, Germany and the CGIAR Research Program on Agriculture for Nutrition and Health, led by the International Food Policy Research Institute.

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