Risk assessment for staphylococcal food poisoning due to consumption of street vended chicken

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Introduction

- The great majority of poor people in developing countries obtain food from informal or “wet markets”
  - They are often neglected by food safety authorities
  - Little is known about their impacts on public health

- Studies in SA indicate:
  - a need for improving safety of street vended foods (von Holy & Makhoane, 2006)
Other studies show the importance & the benefits associated with the informal sector (Steyn et al., 2012)

- Informal markets support the local industry
- Important source of nutrition for urban poor- source of low cost & readily accessible nutritious food

Some issues related to informal markets (Grace et al., 2012)

- Studies have found high levels of hazards in foods
- Hazards may be high but risk to health may be low and vice versa
- Very few studies have attempted to quantify risk to human health
- Need to balance management of hazards & enhance role of informal markets
Introdn: focus on *S. aureus*

- Staphylococcal food poisoning
  - is one of the most common food-borne diseases that affects hundreds of thousands of people each year worldwide
  - poses health risks to consumers & economic burdens on individual communities & nations
  - CDC: 240,000 illnesses, 1,000 hospitalizations & 6 deaths associated with SFP occur annually in USA

*S. aureus*, photo Microbeworld
OBJECTIVE OF THE STUDY

- Assess the risk of staphylococcal food poisoning (SFP) through consumption of RTE chicken sold by informal vendors
  - Quantify the risk or determine the likelihood of contracting SFP following consumption of RTE sold by informal vendors
Research methods

- Participatory risk assessment methods
  - Following the procedure of the Codex Alimentarius Commission system framework

- Why participatory research methods
  - well suited where there is a need to improve understanding of issues & yet data is scarce
  - Participatory methods include:
    - interviews & focus group discussions, visualizations, & proportional piling (Catley and Berhanu, 2003)
Risk assessment

- Hazard identification
  - the identification of the agent which can cause adverse health effects to humans

- Hazard characterization
  - the qualitative and/or quantitative evaluation of the adverse health effects associated with the hazard

- Achieved by reviewing literature
Risk assessment

- Exposure assessment:
- Two sources of data
  - parameters from field work
    - Collected ready-to-eat chicken
    - Established bacterial counts
Risk assessment

Exposure assessment:

- Data from literature
  - very little amount of SE (20-100 ng) needed to cause SFP (Asao et al., 2003)
  - *S. aureus* start to produce SE at concentrations of $>10^5$ CFU/g
    - Probability of exposure to the hazard was modeled to be exposure to $>10^5$ CFU/g of SA
Risk assessment

- Exposure assessment
  - Several authors show that the proportions of *S. aureus* having enterotoxigenic genes varies
    - 25% by Le Loir et al. (2003),
    - 37.5% by Acruri et al. (2010), and
  - In the present paper, we used most recently reported-37.5% by Acruri et al. (2010).
Risk assessment

- Modeling exposure to SE
  - Determined the probability of ingesting SE = $Pingest$
    $$Pingest = P_{exc} \times P_{gene} \sum_{i=1}^{6} P_{cont_i} \times Sales_i$$
  - Where $P_{exc}$ is the probability that bacterial concentration of a sample contaminated with *S. aureus* equal to or exceeds $10^5$cfu/g,
  - $P_{gene}$ is the probability of *S. aureus* having the SE gene,
Risk assessment

- Modeling exposure to SE
  - the probability of ingesting SE = $Pingest$

\[
Pingest = P_{exc} \times P_{gene} \sum_{i=1}^{6} P_{cont_i} \times Sales_i
\]

- $P_{cont_i}$ is the probability of purchasing RTE chicken in a market studied $i$ (six markets were studied) and
- $Sales_i$ is the relative quantity of sales in a market $i$. 
Risk assessment

- Risk characterization
  - Defined as the combination of exposure assessment and dose-response relationship.
    - The dose-response relationship was modeled to be 100% given ingestion of enterotoxin;
    - **limitation in this dose-response relationship** was failure to model:
      - the proportion of SE with emetic ability and
      - proportion of susceptible population (assumption = all persons are equally susceptible)
Results

- Contamination of RTE chicken
  - high prevalence of *S. aureus* (44%) ; and
  - high prevalence of RTE chicken of unsatisfactory quality (>10³ cfu/g)

- Previous studies reported that bacterial concentration on informally-sold RTE chicken ranged from 10² - 10³ cfu/g

- Food with reduced numbers of competitors is suitable for *S. aureus*
Results: Risk

- **Contamination of RTE chicken**
  - The mean *S. aureus* counts in the ready to eat chicken
    - $10^{3.6}$ (90%CI: $10^{3.3}$ – $10^{3.9}$),
  - The risk of purchasing chicken of unsatisfactory quality (>10$^3$cfu/g)
    - 32.9% (90%CI: 25.5%-40.4%).
Results: @ Risk

- The risk of illness - @risk
  - low (1.3% (90% CI: 0%-2.7%).
  - Concentration of *S. aureus* on the chicken rarely exceeds $10^5$ cfu/g (threshold for *S. aureus* required to produce sufficient toxins to cause SFP)
  - low mean cfu/g of *S. aureus* on RTE chicken observed in the present study.
Discussion

- Sensitivity analysis
  - probability of *S. aureus* having the enterotoxin gene was the most sensitive parameter for SFP.
  - followed by *S. aureus* concentration in RTE chicken and
  - lastly the prevalence of *S. aureus* in ready-to-eat chicken

- **NOTE:** present study does not take into account the proportion of SEs with emetic property & the proportion of susceptible population, it may be over-estimating the risk
Conclusion

- Due to low risk observed, sale of RTE chicken by informal vendors can be encouraged.
- Hygiene training to reduce the concentration levels of *S. aureus* on the RTE chicken is recommended.
  - promote the sale of safer affordable source of protein for the large urban poor population in South Africa.
Thank you

Questions

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