Fish Contamination in the Market Supply Chain

Lake Malawi – Nkhata Bay – Mzuzu

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Introduction

Based off the 1978 study by Rao and Gupta at the Kakinada Research Center in Andhra Predesh, India and requests from members of both the state and university fisheries departments, a research study was performed to collect data on the presence of *E. Coli* and other coliform along the fish supply chain in the Nkhata Bay and Mzuzu markets. The earlier 1978 study resulted in an increased amount of *E. Coli* being found further along the fish supply chain (more at the market than with the fishermen or middlemen.) A similar hypothesis was formulated along the same lines of these earlier findings, resulting in a prediction that a greater amount of *E. Coli* would be present at the Nkhata Bay and Mzuzu markets.

The fishing industry is extremely important in the daily life and health of the Mzuzu population, and this led to the research request from the fisheries departments. Fish provides over 60% of the dietary animal protein intake and 40% of the total protein supply (Press Corporation Limited, 2007) and the fisheries sector employs both directly and indirectly roughly 400,000 people (Kanyerere, 2009). However, quality management in the industry is not well developed due to the shortage of trained personnel (Kapute 2008) and the food source is hampered by poor and inadequate food safety and handling practices (Ashie 1996; Ghaly 2010). The goal of the research project was to identify the major contamination points of *E. Coli*, if any, along the fish supply and value chain. Due to the time restraints and amount of data collected, this research project is a strong pilot program that can identify weak points in the chain that will lead to future, and more in-depth, research projects.

Methods and Materials

Fifteen discrete sample locations were used as follows: hold of the boat prior to bringing in fish catch, hands of the fisherman prior to bringing in catch, hold of the boat at the end of the fish catch, hands of the fisherman at the end of the fish catch, fish from the fish catch, in-transit transport container prior to adding fish from middleman, hands of middleman before fish transfer, in-transit transport container upon arrival at the market, hands of middleman upon arrival at market, transport container upon arrival at the market, display table at the market, fish being sold in the market, wash water at the market, and container where the customer puts the fish.

Swab samples were collected in 20 mL test tubes that contained four mLs of 1/4 strength ringer solution; for each discrete location where data was collected. For every sample, a new swab was inserted into the ringer solution in the designated test tube, a 10 cm x 10 cm area was swabbed, the swab was reinserted into the solution, and the test tube was sealed and labeled. In addition to collecting swab sampling, samples of any standing water found along the fish handing chain were taken at: hold of the boat both before and after the fisherman go out, and the wash water used in the market. Whirlpak bags were used to collect these samples, which were sealed, labeled, and stored in a dry bag along with all of the other samples. The Whirlpak bags contained a preservative in them; however, to keep all the sample wait times consistent, both the swab samples and the Whirlpak samples were processed and put into the incubator in a time span of no more than six hours.

Swab samples in the test tubes were vigorously shaken for three minutes prior to being processed. 1 mL of each sample was pipetted in duplicate onto Petri films (Manufacturer: 3M Corporation), and incubated at 35 C for 24 hours. For every ten samples that entered the incubator, a control comprised of equipment blank using 1 mL of boiled and cooled water was used.

Results

The most E. Coli and Total Coliform were found on the first day of data collection, with a significantly less amount of contaminants found during the following three days in the field. The following tables show the total counts of each of the key data sampling locations along the four days of collection.

Table 1: Escherichia Coli Swab Data for each Discrete Location by Day

	E. Coli Counts (cfu per 10 cm x 10 cm swab)				
	Day 1	Day 2	Day 3	Day 4	Average
Hands of Fishermen (Before)	38	0	0	0	9.5
Hands of Fishermen (After)	72	0	0	0	18
Fish in Boat	4	0	4	0	2
Transit Container	8	0	0	0	2
Hands of Middleman	26	0	0	0	6.5
Hands of Market Seller	2	0	0	0	0.5
Table	8	0	12	0	5
Fish in Market	2	0	0	0	0.5

Table 2: Escherichia Coli Whirlpak Data for each Discrete Location by Day

	E. Coli Counts (colonies per 100 mL)			
	Day 1	Day 2	Day 3	Day 4
Hold of the Boat	12500	550	240	0
Wash Water	2400	0	0	350

Takeaways

- The majority of the E. Coli found was in the fishing boats and on the fishermen's hands.
- Greater contamination was found on busier days; a linkage between high market volume and high E. Coli contamination was identified.
- Large amounts of Coliform were found in all the data collected, however it is important to recognize that not all Coliform is harmful.
- Overall, small amounts of E. Coli were found in this study.

Future Steps

- Follow both the fish supply chain and the fishermen after fishing in any future studies.
- Educate all active participants along the supply chain about the major contamination points and on overall food safety procedures.
- Perform further sampling of specific Coliform that could allude to other possible types of contamination (ex. salmonella, listeria).