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EFFECTS OF SOCIO- ECONOMIC CONDITIONS OF SMALL-SCALE TRADERS ON QUALITY OF POST HARVEST TILAPIA IN KISUMU.

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ABSTRACT

The small-scale fisheries and fish trade sector is important in global and national economies by providing millions with income and consumers with food. Nile perch *(Lates niloticus*), Nile tilapia (*Oreochromis niloticus*), and small cyprinid (*Rastrineobola argentea*) form the basis of commercial fishery in Lake Victoria. From 1997 to 2000, East Africa suffered a series of fish export bans due to contamination by Salmonella, cholera epidemics and use of chemicals in Lake Victoria. Kenya thereafter adopted hygiene requirements in European directive 91/493/EEC for fish and fish products. Kenya's fish production from the lake declined from 180,000 metric tons in 2003, down to 133,000 metric tons in 2010. Globally, 30% of total fish catch is lost through poor post harvest handling. The objectives of this study were to determine the socio-economic conditions of small-scale fish traders, to investigate hygienic practices in handling, storage and processing of fish, and to isolate and identify human pathogens in both fresh and processed fish sold in Kisumu markets. A structured questionnaire was used to get demographic, socio-economic, safety and quality practices information. Samples of fresh and processed fish were tested for Aerobic Plate Count, *Coliform, Escherichia coli* and *Vibrio cholerae* counts. Results revealed that women traders were 81% in number while men were 19% and most of the traders (40%) were aged between 26 and 35 years. The highest level of education attained by majority (51%) of the traders was primary level. The traders' most frequent income was KES 200-399 (USD 3 to 5) a day which cannot sustain a family. Most traders (57%) had additional sources of income to subsidise their needs. Many traders lacked good transport, refrigeration facilities, water, toilet, waste disposal and rubbish disposal. Total plate count was above 10^6 per g which is the maximum allowed. The association between Total Plate Count and hygiene quality status of the samples was significant negatively at p value ≤ 0.001. Traders should be trained on hygiene requirements and economic skills for better practices to improve business performance.

Key words: small-scale fish traders, hygiene, income

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INTRODUCTION

Lake Victoria is the major source of fish in Kenya. Prior to the 1960s Lake Victoria basin was the home of unique and expansive ichthyofauna such as Haplochromines, *Labeo victoriarus* Boulenger, *Brycinus* spp, *Barbus* spp, *Momyrus* spp and *synodontis spp* that formed a special delicacy to the people of its shores. The diverse fish fauna of the lake and its multi-species fishery comprised 14 of which two tilapine species, (*Oreochromis esculentus* and *O. variabilis)*, were the most important [1, 2, 3, 4]. The report of the first fishing survey of the lake of 1927/1928 [1] and subsequent reviews (such as EAFFRO, 1954 – 1960) [5] all emphasized the dangers of over-fishing tilapia stocks. At present, two exotic species; the predatory Nile perch *(Lates niloticus*) and Nile tilapia (*Oreochromis niloticus*) stocks and the small native cyprinid (*Rastrineobola argentea*) form the basis of the commercial fishery [6]. Small-scale fisheries and fish trade sector plays an important role in the global and national economy by providing millions of people with income and the consumers with an important food protein source, for food security. In Kenya. the lake Victoria fisheries activities create employment for about 40,000 artisanal fishermen as well as suppliers in auxiliary industries like boat making, net making and packaging, and earns foreign exchange and income for the government. Approximately 75% of those engaged in local small-scale fisheries business are women [7, 8, 9].

Export markets included the European Union (EU), USA, Israel, Japan, Australia and Malaysia. The EU imported 70% of Kenya's fish export [10]. In 1997, Spain, the main importer and Italy claimed the presence of Salmonella in fish thus contravening quality requirements in the EU directive 91/493/EEC [11]. This resulted in a drop in fish exports, and foreign exchange dropped by 13% that year. In January to June 1998, EU banned East African fish because of a cholera epidemic which caused a drop in Kenya's fish export by 24% and of foreign exchange by 32% compared to 1997. In 1999 there was another ban by EU based on reported use of chemical to harvest fish in Lake Victoria. This was lifted later the same year. In 2003, Kenya's fish production from the lake reached 180,000 metric tons valued at about KES 6.5 billion and exports of 50000 tonnes of the catch per year. Nile perch constituted 80% of the export [10]. In 2010, fish production was 133,600 metric tons valued at KES 11.3 billion [12].

Fish is a highly perishable commodity and if not meant for immediate consumption, requires proper post harvest management and refrigeration, or ice to improve and maintain its safety and quality [13, 14]. Globally 30% of total fish catch is lost through poor post harvest handling, which reduces fish supplies for both domestic and the export markets [15].

The gram negative bacteria which mainly encompasses enterobacteriaceae family that includes coliforms *(Escherichia, Klebsiella, Aerobacter* and *Citrobacter), Salmonella* and *Shigella* are water and airborne. Living fish carries normal bacterial flora from the environment, predominantly gram negative psychotropic bacteria on their external skin surfaces of about 10^2- 10^3 cfu/gm. The fish's alimentary canal contains 10

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bacteria per gram of gut contents, mainly *Pseudomonas, Acetobacter, Achromobacter, Flavobacterium* and *Vibrio*. In addition fish is contaminated during harvesting and handling. Increase in numbers of bacteria causes spoilage [16].

Good quality fish will have counts of less than 10^2 per cm^2 at 20^oC. Fecal coliforms should not exceed 10 cfu/gm. *Salmonella* should not be present and *Vibrio paraheamoliticus* should not exceed 100 cfu/gm. *Escherichia coli* strains are a common cause of diarrhea, whereas *Salmonella, Shigella* and *Campylobacter* are frequent pathogens in gastro intestinal tracts especially of humans. Coliforms ferment lactose with production of acid and gas [17].

Globally, fish and fish products have been known to serve as vehicles that transmit infections caused by microorganisms such *as Escherichia coli, Vibrio cholera, Clostridium botulinum, Aeromonas hydrophilia, Pseudomonas* spp and *Streptococcus* spp [7, 18]. Bacterial infections constitute the largest proportion of fish and fish borne diseases. Viral infections outbreaks due to consumption of oyster from sea water contaminated with sewage water have been reported in Europe and America [19]. In a study along Lake Victoria, the *E. coli* and *Vibrio cholerae* pathogens associated with fresh fish were found at sampling points on surfaces of fish preparation areas and insulated containers used by fish traders [18]. Inappropriate handling of fish allows cross contamination and the fish spoils faster due to high temperatures. The sequence of spoilage are; bright colours fade, slime increases on skin and gills, eyes sink and turn to yellow, the flesh becomes soft and finally it becomes putrid [20].

The Kenya Bureau of Standards has adopted the Codex standard code of practice for handling and distribution of fish. In the year 2000, Kenya adopted European directive 91/493/EEC for fish and fish products. It includes regulations on stages in fish product chain, environmentally safe beaches, inspection of grading, processing, packaging and distribution [21]. In Kenya the competent authority which supervises fish trade is the Ministry of Fisheries. Most of fisheries development efforts have focused on large-scale commercial fisheries especially export oriented ones and not attending to small-scale traders [8].

The objectives of this study were to determine the socio-economic conditions of fish traders, to investigate hygienic practices in handling, storage and processing of fish, and to isolate and identify human pathogens in both fresh and processed fish in Kisumu markets.

MATERIALS AND METHODS

This study used descriptive design to assess socio-economic conditions and hygienic practices by small-scale fish traders [22] and tested the hygiene quality of fish that are traded after purchase from beaches.

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Study on Traders' Socio- Economic Conditions

Population and sampling of the traders

The target population was all small scale fish traders in Kisumu. Local authorities in charge of the markets have not registered the traders but estimated that there are 15 immediate markets in Kisumu city and about 400 small-scale traders who sell fresh and processed tilapia.

The markets were sampled by writing the name of each on a piece of paper. The papers were put in a container, mixed and units were randomly picked for the sample of ten. The selected markets were: Jubilee, Oile, Kondele, Kiboswa, Mamboleo, Dunga beach, Otonglo, Kibuye, Manyatta, and Nyamasaria.

From the estimated 400 traders, 50% were selected. Due to the movement patterns of traders the research information was received from only 156 traders, with 20 from each of 6 markets and 9 from each of 4 markets.

Questionnaire instruments and Data collection.

Questionnaires were structured into three sections; demographic, socio-economic, and safety and quality. These questionnaires were used to interview the traders.

Key informants Interview

Key informants interviewed in the study were 2 fishery officers and five local authority officers who explained the policy and environmental issues governing fish handling processes in the trade.

Microbiological Surveys and Testing

Collection of fish sample

Two fresh fish and one processed fish pieces were collected from each market which made a total of 30 units in the sample. Sampling was done between 6 am and 6 pm. The samples were then wrapped in an aluminium foil, labelled with date, sample number and location of collection. They were immediately placed in a cooler box containing ice cubes and temperatures maintained at not more than 10^{o}C. They were transported to the laboratories immediately after collection and kept under refrigeration at 4^{o}C and analysed within 24 hours after their arrival.

Microbiological Testing of Fish Contamination

Samples of fresh and processed fish were tested according to the following ISO methods:
ISO 4833- Microorganism colony count, Aerobic Plate Count
ISO 4832- Total *Coliform* Count
ISO 7251– *Escherichia coli* Count.
ISO /TS 21872 *Vibrio Cholerae* Count

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Aerobic Plate Count
Ten grams from each sample was weighed and placed into 90 milliliter peptone water in a stomacher for 2 min. Subsequent dilutions were made to 10^6. All dilutions were plated by pour plate method in duplicate using Plate Count Agar (PCA). The plates were incubated at 35^{o}C for 48 h and duplicate plates containing between 30 – 400 colonies were counted. Average counts obtained were expressed as colony forming units per gram of food (cfu/g).

Total Coliform Count
From the dilutions made for aerobic plate count as stated above, 1 milliliter of the homogenate was plated on Violet Red Bile Agar with Lactose in duplicate plates. This was incubated at 37^{o}C for 24 h. Colonies that were dark red and with diameter of 0.05 mm or greater were counted as coliforms. Average counts obtained were expressed as colony forming units per gram (cfu/g) of food. Fecal coliforms count (FCC) being thermophiles grows at elevated temperature of 37^{o}C.

***Escherichia coli* Count**
Each fecal coliform colony was streaked on Levins-Easin Methylene Blue Agar (L-EMB) and incubated at 44.5^{o}C. Dark centred and flat with or without metallic sheen colonies were taken as suspicious *E. coli* colonies. Each suspicious colony was transferred to a PCA slant and incubated at 37^{o}C for 24 hours. The growing colonies were taken for gram staining and IMVIC tests which included indole voges-proskauer (VP) methyl red test and citrate tests. The tests that gave IMVIC pattern of ++-- and -+-- were taken as *E coli* positive.

Detection of *Vibrio cholera*
Food homogenate of 10 gm and 90 ml of Alkaline Pepton water (PH 8.6±0.2) was incubated at 37^{o}C for 18- 24 hrs. Yellow large colonies (2-3mm) that are smooth and slightly flattened with opaque centres and translucent peripheries are typical *Vibrio cholera* colonies.

RESULTS

Demographic profile of traders by age, sex and number of children.
Among the small-scale fish traders, women were 81% while men were 19% in number. Within the population of traders those aged between 16 and 25 years were 23%, those aged between 26 and 35 years were 40%, while those between 36 and 45 years were 22%. Those who were married constituted 80%, singles were 10%, the widowed were 9%. Average number of children present in the family were 5 in 40% of families. The highest number was 9 at 7% while only 2 children were in 32% of the families.

Education, Training and Experience
The respondents were distributed according to highest level of education and the majority (51%) of traders had attained primary education, 39% attained secondary education and 6% attained post secondary education. Ten percent never went to

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school. Those who had economics knowledge stated that training was vital since after the training they were enabled to understand their trade better. Two percent of the respondents reported that they could handle the fish better after their training as it enhanced their hygiene practices, (Tables 1 and 2).

Income and average spending levels

The least amount of money earned per day was KES 199 as reported by 18% of the traders.

The trader's mode of income was KES 200 -399 a day as reported by 61% , while the highest earning was KES 900 and above as reported by 3% of the respondents.

The majority (62%) spent between KES 140 or less daily. Most of the respondents (57%) had other sources of income other than fish trade to subsidise their daily needs. However 40% of the traders had no other sources of income.

Fish sales and related experiences

The majority (77%) of fish traders reported that they sold fresh fish while 10% sold processed fish. Left over fish which was not processed by the traders was kept under ice or in the refrigerators.

Fish handling and hygiene practices

Based on the use of a score table for various traders' hygiene knowledge and practices, such as use of clean water, cooling facilities, uniform and protective gear, the results showed that 80% reported satisfactory practice while a minority (20%) did not know some requirements.

During transportation of fish from the beach to the market, 74% of the traders packed the fish in woven baskets shaded with leaves, 16% kept their fish in plastic basins while only 1% used ice to cool their fish. Traders used various means of transport for their fish to the markets for sale where 17% used bicycles, 7% used public transport, 1% used handcart and the rest used head loads to transport their fish.

At the point of sale, 55% of the traders packed fish using newspaper and brown paper, 6% used other types of paper, 15% used polythene bags alone while another 15% used both polythene and paper. The majority (90%) of traders experienced fish spoilage before selling their fish. Most fish got spoilt during two hours between harvesting and the point of sale. Spoilt fish was then sold at reduced price.

Hygiene of the traders, water, toilet and waste facilities.

Among traders, 51% reported having protective clothing while 48% had none. Regarding protective clothing, 93% had aprons alone, 2% wore gloves while 5% had headgear. Those who went for medical check up and had certificates were 66%, while 34% were never checked.

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It was revealed that 47% of the traders had no tap water, while 50% had tap water at their trade premises. A total of 80 % of traders had other sources of water away from the trade premises and 9% had no source of water. Only Jubilee fish market and Oil market had tap water. Toilet facilities at the point of sale were available according to 56% while 44% had none. Waste was either thrown on the trade premises by 32% of the traders, or into dustbin by 48%, and 9% put it in the drainage. Rubbish was left behind left behind wrapped by 12%, or unwrapped by 41%, or taken to garbage dropping sites by 23%.

Microbiological risk assessment

Microbiological analysis showed that 67% of the samples of fresh fish and 23% of processed fish exhibited a high plate count greater than 10^6 the maximum recommended level by food standards. High total coliform samples were found in 20% of fresh fish and 8% of processed fish.

There was significant negative association between total plate count and hygiene status of the samples at p value of ≤ 0.001. The association between Total Coliform Count and hygiene quality status of samples was significant negatively at p value of 0.01.

DISCUSSION

The findings of this research showed that the majority of the small scale traders were women (80%) which is comparable with 75% found by Ogutu in 1999 [7], and the traders in ages 26 to 45 years were 62%, those who were married, 80% and those with primary level education, 51% which compare closely with findings by Kamau and Ngugi at 62%, 66% and 67% respectively. The above authors also confirmed that traders obtained capital for their business from their own savings (43%), small-scale agriculture (24%), relatives, husbands and merry-go-round, cooperative loans and sale of property [23]. Women often experienced gender-specific problems such as domestic activities, limited time disposition, no title deeds for land ownership or cattle, and no access to credit, making them more disadvantaged [24]. Some of the female traders often paid with sex in order to purchase the fish from the wholesalers. [25].

Income from fish trade was low and could not sustain a household. The traders' income was less than the poverty line of US$ 1 per capita a day [26] and many of them had additional source of money to cover deficit for daily requirements.

Desired hygienic practices include hand washing before food is touched, cleaning and sanitizing work surfaces and equipment, and sterilization to remove or destroy spoilage and pathogenic microbes [27]. At national level, Kenya has adopted Codex Alimentarius which is a collection of international food standards which aim at protecting the consumers' health as well as economic interests at global and individual levels where they include Hazard Analysis Critical Control Point [HACCP) [28]. From the results of this study, about 78% of the small scale fish traders had not

trained and they lacked skills in fish quality, hygiene and safety standards. They also lacked the capacity to acquire efficient means of transport and refrigeration and hence their fish were subject to spoilage and fetched low prices, and the situation was aggravated by cost of wood fuel that prohibited fish processing [29].

CONCLUSION

In Kisumu, half the number of small-scale fish traders attained low education which is primary school level. Most of the traders had no training for business and hygiene required in fish trade. They have no good transport and refrigeration facilities and so fish got spoilt and had to be sold at low price. About 50% of traders did not practice proper hygiene as they laced provision for water, toilet and waste disposal and they threw substantial amount of rubbish on the trade premises and drainage channels. The traders earned low income of poverty level.

There is need for economic empowerment especially among women traders. The traders should be trained on hygiene and economic skills for better practices to improve business performance. Small-scale fish traders should apply HACCP standards as well as Kenya Bureau of Standard code of practice for handling, processing, storage and the placing in the market of fish and fishery products.

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Table 1: Distribution of Small-Scale Traders in Kisumu by Education and Training

Variable	Frequency (n = 156)	Percent (100)
Education Attainment		
None	16	10.3
Primary	79	50.6
Secondary	60	38.5
Post Secondary	1	0.6
Ever had any training in handling fish		
Yes	20	12.8
No	133	85.3
System Missing	3	1.9
Training Achievements		
Skills	5	3.2
Economic knowledge	11	7.1
Fish handling	4	1.9
System Missing	133	87.8
Would you like to train		
Yes	122	78..2
No	11	7.7

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Table 2: Distribution of Small-Scale Traders in Kisumu by Experience in Fish Trade

Variable	Frequency (n = 156)	Percent (100)
Any Experience in fish trade		
Yes	154	98.1
No	2	1.3
Years of Experience in Fish Trade		
< 1	2	3.2
1- 4	39	25.0
5 - 9	53	34.0
10- 14	29	18.6
15- 16	10	6.4
20 or more	18	11.5
System missing	4	1.3

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