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Current State of Handling, Processing and Quality of Omena (*Rastrionebola argentea)* in Mfangano and Rusinga Islands, Kenya

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Abstract

The livelihood of many Small Scale Fishers in Lake Victoria is based on the Omena *Rastrionebola argentea* fishery. The processing and trading in Omena in Kenya is dominated by women (80%) who derive their livelihood from the sale of the fish species. Their operations and practice in handling, processing and packaging of the fish is characterized by poor methods and low quality of the fish product due to current wide, traditional practice of drying the fish on the ground or on old fishing nets. This drying method results in fish products which are contaminated by microorganisms and debris. As a result Omena products on the market are of low quality, value and demand. The objective of this research was to determine the current status and practice in the handling, processing and quality of Omena in Suba District and appropriate technological interventions needed to improve the quality and add value to Omena products for a better sale price and to reduce post harvest losses especially during the rainy season. The second objective was to determine gender disparities among the small scale processors and the effects on fish quality and practice. Results indicate that there is no difference in the fish handling and processing practice among the genders. The quality of the Small Scale Fish processors' fish products was low as fish samples tested were contaminated with debris and had a high bacterial load which included faecal coliforms. The experimental solar tent and rack dried fish samples were of high quality such as low bacterial count and free from faecal coliforms. Solar tent and rack drying technology if adopted by the Small Scale Fish processors can improve the Omena quality, raise the market value and increase income for poverty alleviation.

Introduction

According to the 2006 Lake Victoria fish catch statistics, Omena *Rastrionebola argentea* contributed 54% to the total commercial catch. In both Kenya and Uganda, Mukene/Omena contributed 41% to the total commercial catch. The estimated total catch in the whole of Lake Victoria in 2006 was 1,061,107.6 m. tons and Omena contributed the higher percentage (54%) than Nile perch (24%), Tilapia (7%), Haplochromines (13%) and other species (< 1%) (National Frame Survey Reports 1 & 2). In both Kenya and Uganda, Mukene/Omena contributed 41% to the total commercial catch (Table 1).

Table 1: Lake Victoria fish catches 2006

	Uganda**		Kenya*	
Species	**Weight (m. tons)**	**% age**	**Weight (m. tons)**	**% age**
Nile perch	80,977	46.8	55,224	38.4
Tilapia	19,557	11.3	18,429	12.8
Mukene/Omena	70,001	40.5	57,929	40.2
Others	2,489	1.4	12,326	8.6
Total	173,024	100	46,996	100

Source: * National report on the Lake Victoria (Kenya) fisheries frame survey of 2006 ** National report on the Lake Victoria (Uganda) fisheries frame survey of 2006.

Suba district, located on the Southern part of Nyanza Province, is made up of 16 islands and Rusinga and Mfangano islands are the largest. The district which is the most productive in Lake Victoria landed 57,483 metric tons of various fish species with an ex-vessel value of Kshs 2,805,042,000 in 2006. The main species composed of *Rastrineobola argentea* (45.0%), *Lates niloticus* (33.5%), *Oreochromis niloticus* (11.6%), *Haplochromis* (4.8%) and *Clarias* (3.2). A total of 225,841 m. tons of Omena valued at 841,383,442 K. Shs was landed. This was over 45% of the total catch in the district (Fisheries Annual Statistical Bulletin, 2006).
All the fish landed is processed by small scale processors who comprise mostly womenfolk (80%), who derive their livelihood of the sale of the fish species. Their operations and practice in handling, processing and packaging of the fish is characterized by poor methods leading to low quality fish product. The current wide spread practice of drying the fish directly on the ground or on old fishing nets results in fish products which are contaminated by microorganisms and debris. As a result Omena products on market are of low quality, low market value and acceptability. The main research objectives were therefore to assess the current practice and gender disparities of the small scale processors, to determine technological interventions to improve the quality of Omena products for a better sale price, to reduce post harvest losses especially during the rainy season and to promote production of value added products for better income for poverty alleviation.

Methodology

The study was conducted on Rusinga and Mfangano Islands, Suba district, which have recorded the highest catches of Omena. Two landing sites were identified for each of the islands. Yokia and Masisi were selected on Mfangano; and Luanda-Rombo and Litare on Rusinga islands. The four landing beaches had many fishing boats targeting Omena fisheries and a large number of small scale fish processors compared to the other sites.

Data collection and analysis

Data were collected on the current practices in fish handling and processing by holding focus group discussions and using structured questionnaires. Respondents also gave information on the current practices on fish handling practices, processing, storage, packaging marketing and challenges they meet on day to day basis. The bio data, aspirations and assistance received or sought by SSF operators was also collected. Direct observations were made and recorded as the SSF conducted their daily businesses in order to identify shortfalls in the current practices.
Fish samples (100 – 250g) processed by the Small Scale women fish processors for both

human consumption and animal feed production were collected and taken to the laboratories for analysis. The samples were delivered to the Kenya Bureau of Standards (KEBS), National Health Laboratories in Nairobi and Government Chemist in Kisumu in plastic bags. The fish samples were analyzed for The Standard Plate Count at 30°C, for the presence of fecal Colliforms at 37°C, *Escherichia coli* at 44°C, *Staphylococcus aureus*, *Shigella* sp. and *Salmonella* sp. using both aerobic surface and enriched cultures. The following physical and chemical test moisture, dry matter ash, proteins and fat content were done on the fish samples.

Experimental drying trials were conducted at Mbita point, Suba district, Kenya using a natural convection solar tent and a photo voltaic fan driven forced convection tent and open racks. The fish was washed using tap water and sorted to remove the bycatch (*Haplochromis sp* and *Caridina* sp). The fish was then soaked in 10% brine salt solution for 15 minutes. Ten kilograms of fish was weighed and spread on six trays and left to drip for 30 minutes. Three trays were then placed on a raised rack in the open while the other three were placed inside the solar tent and the exhaust fan switched on. The weight of the fish was recorded at two hour interval and the physical parameters including humidity, temperature and weight loss were recorded at hourly intervals.

The Focus group discussion and questionnaires data were coded and analyzed using SSPS statistical package and presented as descriptive statistics percentages, means and graphs. Data from fish samples were analyzed in Excel to generate graphs and tables.

Results and discussion

Characteristics, status and gender disparity of small-scale fish processors

The majority of the small scale fish processors (80%) were married women with children. Majority (75%) were residents on the islands where they moved to do business. The majority of the processors have been in the business for over five years. Most of fish processors (60%) lived with their spouses and children on the islands. The majority of the women processors (63.6%) indicated that they are assisted by their spouses and children during the processing of the fish. The only method used to process Omena is sundrying. The majority of fish processors (58.5%) dried the fish on fishing nets spread on the ground while the others (41.5%) dried the fish directly on the ground. They reported that the drying process took 8-10 hours during the dry season. During the rainy season, however, drying could take up to two days leading to post harvest losses and low quality products. Most of the processors (95.1%) stored the dried fish product on the floor inside their residential houses. The storage period ranged from one day to two weeks but the disposal time depended on the demand. Most of the women processors sold their fish to the traders or their agents on the same day. The bulk (97.5%) of the fish was processed for human consumption.

The majority of the fish processors lacked sufficient capital and had no access to credit facilities such as loans to expand their businesses. Banking facilities were also lacking at the landing beaches. The lack of improved fish processing facilities left fish processors to dry the fish on the ground or fishing nets with exception of a few locations where raised racks have been provided the Government and donor agencies. Fish were washed directly in the lake water which is contaminated due poor sanitation. The majority of the fish processors reported low profit of less than 10%. Women revealed the prevalence of the practice of sex for fish "*Jaboya System*" which compromised their dignity and sexuality and limited their capacity

to engage fully in the fish processing business. The credit advance system commonly used by the fish traders/agents resulted in conflicts between buyers and sellers when payments are not remitted on time and loans or cash advances are not serviced in good time. Details of the small scale fish processors are presented in Table 2.

Table 2: Characteristics and gender disparities among the small scale fish (Omena) Processors

Characteristic	Men		Women	
Residence on the islands	43%		50%	
Membership of an organized group	30%		60%	
Age of respondents/ processors	Below 20 years 21– 30 31– 40 41–50	10% 33% 40% 4%	Below 20 years 21 – 30 31 – 40 41 – 50	20% 50% 10% 20%
Highest education level	Primary Secondary	60% 40%	Primary Secondary	80% 20%
Marital status	Married Single Separated Widowed	56% 1% 23% 16%	Married Single Separated Widowed	40% 30% 30%
Main activity of the respondent	Fish processor Fish trader Boat owner/ processor Trader/processor	53% 32% 5% 10%	Fish processor Fish trader Boat owner/ processor Trader/processor	40% 10% 10% 10%
Weekly income (K Shs)	Less 2,000 2001 – 3,000 over 4,000	23% 52% 25%	Less 2,000 2001 – 3,000 over 4,000	50% 40% 10%
Number of years in the Omena industry	1 – 5 years 5 – 10 years over 10	32% 36% 32%	1 – 5 years 5 – 10 years over 10	60% 20% 20%
Training received	Fish processing Marketing Mentoring Book keeping		Fish processing Marketing Mentoring Book keeping	
Current fish drying method	On a net on the ground Directly on the ground On raised racks	75% 24% 1%	On a net on the ground Directly on the ground On raised racks	70% 20% 10%
Drying process duration	1 – 8 hours 1 day 2 days	58% 24% 7%	1 – 8 hours 1 day 2 days	72% 28% -
Current storage method after drying the fish	On the floor In sacks	90% 10%	On the floor In sacks	88% 12%

Storage period before sale	1 day 26% 1 week 53% 2 weeks 11%	1 day 30% 1 week 50% 2 weeks 20%
Utility of the dried Omena	For human consumption 80% For animal feeds 20%	For human consumption 66% For animal feeds 33%
Targeted market	Local areas/market 70% Distant markets 30%	Local areas/markets 50% Distant markets 50%
Profit margin (%)	10 33% 20 33% 50 33% 100 -	10 42% 20 15% 50 15% 100 28%
Mode of marketing	Sold to a trader 84% Sold to an agent 16%	Sold to a trader 66% Sold to an agent 33%
Consumers complaints about fish quality	Sandy 33% Bitterness 36% Dirty 10% Not properly dried 23% Discolored 1%	Sandy 25% Bitterness 14% Dirty 25% Not properly dried 25% Discolored 10%
Challenges	Fish price fluctuations Low price Closed season Low profit Poor transport Storage space Delays in payments Poor marketing system Access to banking facilities and loans Lack of capital High competition for fish when catches are low	Low fish price Fish drying during rainy season Lack of capital Poor market system Access to banking facilities and loans
Improvements requested	Storage facilities Drying racks Improved marketing and pricing system Formation of processors groups Access to banking facilities and loans Training in fish processing Better transport system New markets	Storage facilities Modern processing methods Access to Loans New markets Fish drying racks Clean water

Other issues raised	Animal feed products are adulterated with sand Omena for human consumption should be dried on racks Exchange visits to processors in other regions	Access to banking facilities Need for better marketing system Formation of marketing and processing groups Better fishing vessels

Fish Handling and Marketing

The common practice of fish handling involved piling the catch in the middle compartment of the fishing boat (Plate 1). At the landing beach, the fish was offloaded using basins washed and carried on the head to the drying ground. The carrying of the fish is done mostly by women with little participation of men. The fish is washed in the lake water using plastic baskets and trays before being carried to the drying ground where it is placed directly on the ground or on old fishing nets (Plate 2). The fish was turned over frequently using local brooms to ensure even drying.

About 75% of the fish processors targeted the local consumers. The majority of the fish processors (94.6%) are satisfied with the quality of their product. However, they mentioned that some buyers complained of debris, sand and gravel in the fish, discoloration and bitterness. The price of dried Omena product is influenced by supply and demand which is related to the lunar cycle. The dried fish product price is highest during periods of the full moonlight, a time when the fish catches are low. The sale price of one Kg dried fish product ranges between US $ 1-1.5. The majority of fish processors (55.6%) reported getting a low profit of less than 10%. The volume of fresh fish handled by the processors in a day ranged between 15 – 75 kg.

Plate 1: Fish handling on the fishing boat

Plate 2: Fish washing using trays in Kenya

Plate 3: Fish washing and drying at Yokia Beach, Mfangano Island

Challenges in fish processing and handling

The fish processors mentioned a number challenges they face in processing and handling fish such as weather conditions, pricing of fish, and low profit. Poor weather conditions made it difficult to catch fish and prolonged the drying time thus resulting in poor quality fish. During the rainy season, fish took two days to dry resulting in brown and bitter tasting fish that fetched low prices in the market. The current processing methods result into poor quality products as a result contamination from the surrounding environment, domestic animals and birds. In Kenya most processors washed the fish directly in and contaminated the lake water. The price offered to fish processors was low due to the poor marketing system. The processors also complained of getting very low profit as the sale price is dictated by the buyers.

Improvements to fish handling and processing

The respondents identified the following measures which could be used to improve the quality of fish:

i. Introduction of improved fish drying and alternative processing methods such as deep frying, smoking especially during the rainy season
ii. Training of the fish processors
iii. Provision of credit facilities
iv. Provision of raised drying racks
v. Provision of storage facilities
vi. Provision of clean water
vii. Improvement of sanitation at the landing beaches
viii. Sensitization of the processors and consumers on quality issues

All the fish processors were willing to participate in improved drying methods for higher quality and better price. The small scale Omena fish processors in Kenya have received some assistance to improve their operations in the following areas: business mentoring and counseling, credit and financial aid, marketing avenues and improve the fish drying techniques. This assistance was provided to the fish processors by fish traders, KIPPI, BMU, Adoktimo & Finance Trust Banks and the Fisheries Department. Fish processors requested for additional assistance to improve their businesses. Areas requested for included: business mentoring and counseling, more credit and financial aid, packaging and sealing materials and raised drying racks. There were however not willing to take loans from the lending institutions. They were dissatisfied with the current marketing system and were eager to find new markets outlets.

Experimental fish drying trials

Experimental drying trials were conducted Mbita point, Suba district, Kenya using a natural convection solar tent and a photo voltaic fan driven forced convection tent and open racks (Plates 4(a) & (b)). The fish was washed using tap water and sorted to remove the bycatch (*Haplochromis* sp). The fish was then soaked in 10% brine salt solution for 15 minutes. 10 kg of fish was weighed and spread on six trays and left to drip for 30 minutes. Three trays were then placed on a raised rack in the open while the other three were placed inside the solar tent and the exhaust fan switched on. The weight of the fish was recorded at 2 hour interval and the physical parameters including humidity, temperature and weight loss were recorded at hourly intervals. The temperature inside the solar tent and outside followed the same trend although the temperature inside was sometimes higher. The humidity inside the solar tent and outside also followed the same trend with the humidity inside the solar tent being higher most of the time. The weight loss inside the solar tent and outside was about the same rate (Figures 1, 2 & 3).

Plate 4 (a): Convention Proto-type Solar driers

Plate 4 (b): Forced convection proto-type solar tent dryer trials at Mbita Kenya

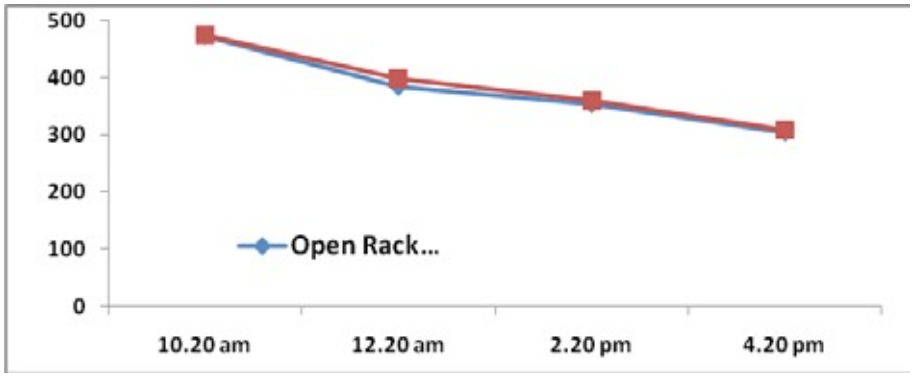

Figure 1. Fish weight loss inside and outside the solar tent.

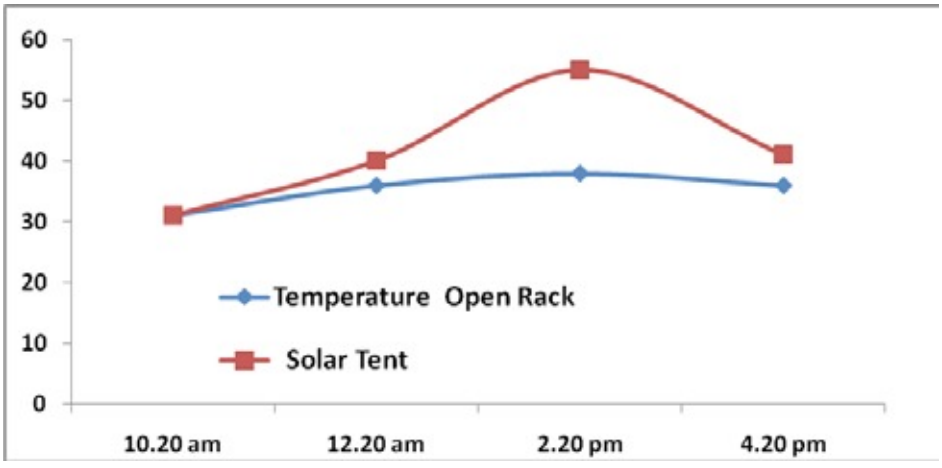

Figure 2. Air tempereture inside and outside the solar tent.

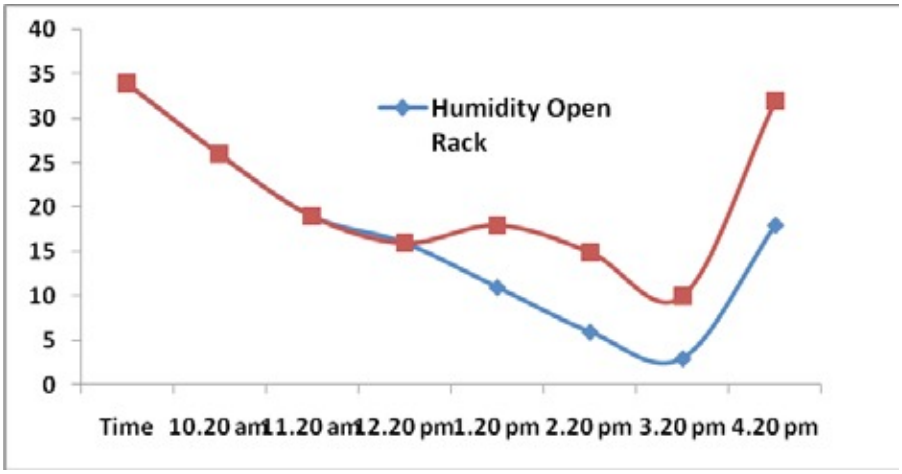

Figure 3. Relative humidity inside and outside the solar tent.

Fish quality

Eight samples were analyzed; 100 – 250 gm of dried Omena samples were collected from the processors and prototype solar dryers and placed in a sealable plastic bag. Samples were collected from five landing beaches namely; Yokia, Mrongo, Luanda Rombo, Litare and Masisi. The fish sample included products processed for both human consumption and animal feed manufacture. The samples were delivered to the Kenya Bureau of Standards (KEBS), National Health Laboratories in Nairobi and Government Chemist in Kisumu.

The fish samples were analyzed for The Standard Plate Count at 30^{o}C, for the presence of fecal coliforms at 37^{o}C, *Escherichia coli* at 44^{o}C, *Staphylococcus aureus*, *Shigella* sp. and *Salmonella* sp. using both aerobic surface and enriched cultures. The following physical and chemical test moisture, dry matter ash, proteins and fat content were done on the fish samples. Results of the tests are presented in Tables 3. The standard plate counts ranged from 3.0 x 10^2 - 3.4 x 10^3 (Table 4). *Salmonella* sp *Vibrio cholera* and *Clostridium welchii* were absent in all the samples tested. Feacal colliforms and *Staphylococcus aureus* were detected in all the samples dried on the ground due to contamination from the ground. *Escherichia coli* was detected in two of the samples dried on the ground sample.

Foreign matter and ash content were highest in the sample from the ground probably from the presence of sand, soil, and vegetation. Moisture was lowest in the sample dried on the net on the ground possibly due to repeated drying during storage crude protein content was slightly higher in the solar tent/rack dried sample. Fat content was higher in the ground dried sample when compared with solar tent and rack samples where there was more dripping. The ash content of ground dried samples was higher due to sand and debris.

Table 3: Physical and chemical test results

Test	Solar tent/ Rack dried	Ground dried For human consumption	Ground dried For animal feed
Foreign matter %	0.13	1.5	21.5
Moisture % m/m	12.5	11.7	-
Protein % m/m	63.21	62.9	-
Fat % m/m	12.3	15.1	-
Ash % m/m	0.13	0.2	-

The results were indicative of the poor handling, hygiene and sanitation at the landing beaches where the fish is processed. All the small scale processors fish samples with exception of one which was washed in salt and dried on the rack at Lwanda Rombo, Rusinga Island, had a high bacterial load. Fecal colliforms and *E. coli* and *Staphylococcus aureus* were isolated from samples dried on the ground at Yokia landing beach, Mfangano Island.

The results did not reveal differences among the landing beaches as the processing and handling methods and practices are similar but Yokia beach samples dried on the ground were the most contaminated. There was no difference in bacterial contamination between fish dried directly on the ground and those dried on a net spread on the ground. Fish processor who process fish intended for animal feed production dried their fish directly on the ground and deliberately adulterated the fish with sand to increase the weight and the product is marketed by weight. The results did not have any gender implications but are in agreement with an observation made by women processors who recommended that all fish processed for human consumption should be dried on raised racks to avoid contamination.

Both men and women processors acknowledged receiving adverse reports from the consumers regarding the quality of their products (Table 4). The fish samples from the experimental prototype solar dryer and rack dryer were free of contamination and had low bacterial count. The solar tent dryer and rack technology together with the availability of treated water can alleviate the high contamination observed in the small scale processors samples. The simple practice of washing fish in 10% common salt solution prior to drying drastically reduces the level of bacterial count and improves the quality of the small scale processors products. If the small scale processors look forwards to seeking new markets then there is need to reduce the levels of contamination, adhere to recommended handling practices and improve sanitation at the landing beaches in order to achieve the Kenya Bureau of Standards (KEBS) specifications for dried Omena. Since women are the majority in the Omena processing sector they will need assistance to achieve the targeted goals.

References

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