

# A Preliminary Descriptive-Data-Gathering Study among Fish Handlers in Accra

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**Abstract:** Fish retailers and processors in Ghana are directly exposed to fish and are at high risk for fish-related zoonosis, but the epidemiology and prevalence of such fish-based bacteria zoonosis among them remains understudied. In order to formulate an appropriate prospective cohort and laboratory-based study, the current study was aimed at obtaining the necessary preliminary information from women working in the fish industry in Accra, Ghana.

A questionnaire based exploratory cross-sectional study, with a convenience sampling procedure within a wide covering study area was used to obtain data from 116 persons working within the fish value chain in Accra.

A greater proportion of the predominantly female participants had been involved with only retailing (26.5%) and processing (20.0%) of fish. About 55.6% of them had observed lesions on fish. A few of the participants (24.8%), who were mostly involved with retailing and processing fish, reported having had a rash.

The observance of fish lesion and skin rashes among most retailers and processors of fish, necessitates a study of the prevalence of Mycobacterial spp and the emerging *Shewanella* spp infections among women in the fish business in the coastal region of Ghana.

**Keywords:** Questionnaire, Fish lesion, Skin rashes, Zoonosis, Fish handlers.

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## 1. INTRODUCTION

Infections of fish by bacteria occur both among sea and fresh water fish and vary with or are specific to seasons and climate; an example of such is the infection by *Moritella viscosa*, which causes the winter ulcer disease [1] and *Shewanella* infections that occur in warm climates [2]. Some of these fish-infecting bacteria cause skin lesions of fish such as ulcers and fin erosions [1] and may be pathogenic to humans [3–10]. For example, the fish infecting bacteria, *Erysipelothrix rhusiopathiae* may cause blubber finger in human. Additionally, *Mycobacteria marinum* which is associated with changes in pigmentation and skin ulceration in fish [11, 12], have been speculated to also be involved with mostly asymptomatic granulomas on the upper arm or hand of humans, which may last for several month before spontaneously healing particularly among non immunocomprised individuals [10]. *Streptococcus iniae* which causes dermal lesion and meningoencephalitis in fish may be associated with cellulitis and lymphangitis of the hand in humans [7, 10]. An emerging fish bacterial cause of human infectious disease, which is increasingly being reported, is the infection by about seven species of the genus *Shewanella*, of which two, *S. algae* and *S. putrefaciens*, are of most clinical importance [13, 14, 2]. These *Shewanella* infections are increasingly being associated with new disease symptoms such as skin and soft tissue infectious outcomes such as ulcers and necrotizing fasciitis, [13, 6, 15, 8, 2].

As has been reported as fairly common, but varying with seasons, human infections caused by pathogens transmitted from fish or the aquatic environment have been influenced by human contact with fish and related environment, human dietary habits and the immune status of the exposed person [10, 16]. Fish-handler's disease is a nonspecific term, in the medical and lay literature, that describes a disease or syndrome of humans that may occur after handling fish or, in some instances, other aquatic organisms [6, 17]. Studies of fish handler disease in Accra, Ghana are limited, if available, and therefore, this study sought to assess the possibility, if any, of the presences of lesions on fish worked on by fisher-handlers in Ghana.

In Ghana, retailing and processing of fish is largely a profession of women, as such women are at a high risk of infections resulting mostly in skin rashes that affects their quality of life for a considerable period of time. This study was designed with the aim of obtaining preliminary descriptive information on the observance of lesions on fish, and rashes on those working with fish. This will help the formulation of a prospective cohort study for evaluating the epidemiological features of fish-based zoonosis and inform a laboratory-based study on the identification and prevalence of related infections among women working in the fish industry in Accra, Ghana.

## 2. METHODOLOGY

### *Study Design and Setting:*

This was an exploratory cross-sectional study that sought to describe the specific knowledge/experiences of persons working in the fish value chain in Ghana (target population). It was conducted in the urban communities of the Greater Accra Region of Ghana (study population), one of the three coastal regions that has a high proportion of both marine and inland (fresh water) fish business in Ghana. Based on an estimated 50.0% observance of features/lesions on fish, a margin of error of 1% (0.1) and a design effect of 1.2, a minimum sample size of 115 participants, calculated with the simple random sample size formula, needed to participate in the study. In order to recruit this minimum number or more to participate in this study, purposive (landing beaches, markets and communities traditionally known for fish business) and passive-search sampling (within other communities of the Greater Accra) of persons working with fish were employed in this study.

### *Ethical Approval and Consent of Participants:*

Working within the guidelines of the Radiological and Medical Science Research Institute's Ethical Review Committee, this study was conducted in accordance to the ethical standards as declared in Declaration of Helsinki and the Belmont Report. The study was only commenced following the provision, to each prospective participant, of the full information and other relevant explanations regarding the study (such as its objectives, benefits to science, the participants and persons working with fish, the role of the participants in the study and their contributions as well as the risk involved in taking part in the study). In addition, participants' autonomy regarding their participation in the study was fully explained to and respected, and those who volunteered to participate, confirmed same by providing verbal informed consent. Assurances were given and efforts were made to protect the privacy and confidentiality of the participants enrolled and their collected data. As such personal/demographic data as well as data that will be useful for identifying the participants were not collected.

### *Data Collection and Statistical Analyses:*

Subsequently, structured questionnaires were used, by an interviewer-administration method, to collect information from 117 participants on their experiences in the fish business, the observance of features/lesions on fish and the participants' as well as their customers' perception of the observed features. Pictures (figure 1) were used with the questionnaire to help in the identification of the common features/lesions of interest on fish. Collected data were entered in Microsoft Excel, transferred to and analysed by Statistical Package for Social Science (SPSS) version 20. Categorical data were described as counts and proportion of the total or subtotal number of participants and presented as frequency distribution tables. Association between the categorical data were determined by the Chi-square test at 95% confidence level.



**Fig. 1:** Some of the pictures indicating different types of skin defects on fish.

**Quality Control**

For a study that depends on the pictorial identification and the recall of the observance of lesions, there was a high potential for bias, obviously emanating from the dependence on memory, and thus the study was designed with quality control in mind. These included, the use of more than one question, on different pages of the questionnaire and worded different, to obtain the same information from the participants. Additionally, data on the experience (duration of working with fish, types of fish worked with, source of fish etc.) of the participants were obtained and analysed to assess full coverage of all possibilities. Responses were cross-tabulated to assess consistency.

**3. RESULTS**

**Study Locations:**

The 117 participants of this study, consisting of 111 females and 3 males, and 3 persons whose sex was not indicated, were recruited from 40 communities and/or localities in Accra, including the major markets in these communities. Some of the participants were recruited while hawking within the communities and others at the landing beaches. The source of the fish the participants worked with included almost all the major fish sources of the Greater Accra Region. These are indicated in supplementary table S1. Additionally, cold stores located in major markets in the Greater Accra Region were also sources of fish for the participants. These markets included the following; Agbogloshie market, Ashiaman market, Tema market, Dome market, Kasoa, Mallam Attah market, Asikuman market, Madina market, Nungua market and Odorkor market.

**Participants' Fish Business Characteristics:**

The distribution of the type of fish business the participants were involved with (Table 1) showed that some of them were involved in more than one type. Specifically, a greater proportion, 26.5%, of them were only retailers of fresh fish, while 20.6%, 4.3% and 2.6% were involved with only processing, buying and wholesaling fresh fish respectively. On the other hand, among those who were involved in two types of fish business, the commonest combination was buying and retailing (16.2%). The other combination were buying and processing fish (7.7%), retailing and processing (9.4%), and wholesaling and retailing (1.7%). Additionally, a few of the participants were involved with buying, retailing and processing (3.4%) and only one participant was involved with buying, wholesaling and retailing at the same time. There were 2 fishermen (1.7%) and 4 participants who did not indicate the type of fish business they were involved with.

The distribution of the duration of the participants' involvement in the fish business was one of the measures to assess the experience of the participants working with fish. Table 2 shows that 41.4% of the participants had been working with fish for between 1 and 5 years while slightly more than a third of them (34.5%) had been working with fish for 6 to 19 years. Furthermore, a marginal proportion (22.4%) had been working with fish for 20 or more years and 2.5% had been working with fish for less than one year. The second measure of experience of the participants in the fish business was the number of different types of fish they have worked with. Overall, the participants have worked with over 30 different types of fish.

**Table 1: Distribution of fish businesses the participants were involved with**

Involvement with fresh fish business		Number of Participants	Percentage
Single	Buy	5	4.3
	Wholesale	3	2.6
	Retail	31	26.5
	Process	24	20.5
Double	Buy and Retail	19	16.2
	Buy and Process	9	7.7
	Wholesale and Retail	2	1.7
	Retail and Process	11	9.4
Triple	Buy, Wholesale and Retail	1	0.9
	Buy, Retail and Process	4	3.4
Fishermen		2	1.7
Non response		6	5.1
<b>Total</b>		<b>117</b>	<b>100</b>

**Table 2: Distribution of the observance of lesions stratified by the duration of working in the fish business**

Years in business	Number (%) <sup>#</sup> of participants who		Total, (%) <sup>^</sup>
	did not observe features	observed features	
Less than 1	2 (66.7)	1 (33.3)	3 (2.5)
1 - 5	24 (50.0)	24 (50.0)	48 (41.3)
6 - 19	16 (40.0)	24 (60.0)	40 (34.5)
> 20	9 (34.6)	16 (65.4)	26 (22.4)
Total	51 (44.0)	65 (56.0)	116

<sup>#</sup> percentages are of row totals. <sup>^</sup> percentages are of column total

**Table 3: Distribution of the kind of fish business stratified by the observance, frequency of observance and the experience of rash by participants**

Kind of Fish business	Indication of observance of features, n (%) <sup>#</sup>			Frequency of observance of features, n (%)				Experience rash	
	Not observed	Observed	Total	More frequently	Frequently	Less frequently	Total	Had rash	Total
Buying	16 (42.1)	22 (57.9)	38	1 (4.5)	4 (18.2)	17 (77.3)	21	5 (13.1)	38
Wholesaling	2 (33.3)	4 (66.7)	6	0 (0.0)	1 (25.0)	3 (75.0)	4	2 (33.3)	6
Retailing	29 (46.2)	38 (53.8)	68	1 (0.0)	3 (7.9)	34 (89.5)	38	13 (19.1)	68
Processing	21 (43.8)	27 (56.2)	48	2 (7.4)	4 (14.8)	21 (77.8)	27	15 (31.3)	48
Total <sup>*</sup>	51 (44.0)	65 (56.0)	116	3 (4.6)	8 (12.3)	53 (81.5)	65	29 (24.8)	116

\* The sum of the numbers within each column does not add up to the stated total of that column because of the multiple representation of participants in the categories of fish business as fully expressed in table 1.  
<sup>#</sup> Percentages are of the row totals

**Observance of Lesions:**

As depicted in tables 2 and 3, this study shows that 56.0% of the participants had ever observed these lesions on fish during the course of their work with fish. It was also determined that these features had been observed on each type of fish the participants indicated they had worked with. In spite of the fact that a high proportion of participants reported they had observed these features, table 3 shows that only a very small proportion (4.6%) of these participants observed these lesions more frequently. Furthermore, while most of these participants (81.5 %) observed these lesions less frequently, a small proportion (12.3%) indicated a frequent observance of these lesions.

A further analysis of the data (Table 2) showed that a smaller proportion of the participants who had been working in the fish business for less than one year (1 of 3) had observed the lesions. Equal proportions of the participants (24 of 48) who have been working in the fish business for between 1 years and 5 years, had either observed or not observed the lesions. However, 24 of 40 participants who had worked for between 6 years and 15 years (60.0%) had observed the lesions. Among those who had been working for more than 20 years, 16 of 26 participants (65.4%) had observed the lesions. A chi square test (at 95% CI) showed a nonsignificant association ( $p = 0.52$ ) between the years in business and the observance of the lesions on fish.

After stratifying the distribution of the observance of the lesions by the type of fish business the participants was working with (Table 3), it was clear that a greater proportion of the participants with each kind of fish business had observed the lesions. However, with exception of wholesalers who were only 6 in number (too small for a useful statistical comparison) the proportions among the remaining kind of fish business; buying fish (57.9%) and processing fish (56.2%), retailing (53.8%); were compared. A chi square test (at 95% CI) showed a not significant association ( $p = 0.94$ ) between the type of fish business and the observance of the lesions on fish. A further stratification with the frequency of observance showed the similar distributions (Table 3), which are, the highest proportion of those who observed the lesions more frequently were involved in processing (7.4%) and buying (4.5%).

**3.4 Perception of Participants Regarding Observed Lesions:**

An analysis of the perception on these lesions among the 65 participants who indicated they had observed them, showed that (Table 4) only 3.08% (n = 2) were of the view that these lesions were as a result of a disease. A greater proportion of

the participants (20.0%) were of the view that these lesions were as a result of spoilage of the fish, while 10.8% were of the view that the fish were old (this is in reference to those who buy fish not directly from the main source but from cold stores). Some of the participants (15.38%) were of the view that these features were the results of bites during fish fights (mostly among those who buy fish from the main source and fishermen/fish farmers). On the other hand, a slightly higher proportion of the participants (16.92%) were of the view that these lesions were the results of poor handling of the fish. Common among these were net injures during harvesting, injures as a results of how the fish were packed in the boat and scratching or struggling of fish during handling. A few of the participants (4.62%) were of the view these lesions were the result of what they called effects of the sea, which included, sand getting into the gills and decolouration by the sea water. Furthermore, 7.69% of the participants perceived the lesions to be mucus deposits on the fish. One participant insisted the lesions are not indicative of disease and another stated that the lesions were natural features of the fish. Additionally, while 15.38% of the participants indicated they did not know what these lesions were, 3.05% did not provide any indication of their perception.

**Actions of Participants in Respect of Observed Lesions on Fish:**

Among the 65 participants who stated they had observed the lesions on fish, the study inquired what actions they took in respect to fish that had these lesions. The data gathered (Table 5) showed that the commonest action, taken by 24.6% of these participants, was to remove or wash the affected parts with water and use the fish as they would use if it has no such lesions. Furthermore, 20.0% (n = 13) of these participants stated that they sold such fish at a discount and the same proportion either rejected, returned or discarded such fish. Another reported action, taken by 18.5% of theses participants, was to process or give the fish out to be processed by salting. Apart from one participant who did not indicate the action taken, the others (15.4%; n = 10) processed or gave the fish out to be processed by either frying or smoking.

**Table 4: Distribution of the participants' perception on the observed lesions on fish**

Perception	Number of participants	Percentage
Disease*	2	3.08
Infected*	13	20.00
Old fish	7	10.77
Fights, Bites <sup>#</sup>	10	15.38
Injuries during harvesting and handling <sup>#</sup>	11	16.92
Sea effects	3	4.62
Mucus	5	7.69
Others	2	3.08
Do not know	10	15.38
No Response	2	3.05
<b>Total</b>	<b>65</b>	<b>100.00</b>

\*desired perception, <sup>#</sup> other good perceptions

**Table 5: Distribution of actions taken in respect of fish with lesions**

Remedial actions taken	Number of participants	Percentage
Remove or wash affected parts	16	24.6
Sell at a discount	13	20.0
Reject, return or discard	13	20.0
Process by salting	12	18.5
Process by frying or smoking	10	15.4
NR	1	1.5
<b>Total</b>	<b>65</b>	<b>100.0</b>

In respect of informing their customers, 44.4% of the 65 participants who had observed the lesions indicated that their customers had also observed the lesions and had enquired from them what they were. Although the customers of 39.7% of these participants did not ask about the lesions, the participants could not also tell if the customers had observed any of such lesions. For the other 15.9% who had observed the lesions, since they were mainly engaged in processing fish, their customers did not have the opportunity to observe these lesions, since processing, especially smoking, completely masked visible lesions likely to be associated with fish infection/disease.

***Skin Conditions Related to Handling Fish:***

Among the 117 participants of this study, a small proportion 24.8% (n = 29) reported they had had a skin rash related to their working with fish (Table 3). The others either did not respond or reported they had not had a skin rash related to fish work (75.2%). Further analysis among those who reported having had a rash showed that, the rash was commonest among those who wholesale (33.3% of 6 participants) and process fish (31.0% of 48 participants). However, the number of wholesalers in the study was only 6 and therefore this may be misleading. However, 19.1% of the 68 participants who were retailing and 13.1% of the 38 participants who were buying fish reported a history of rash related to working with fish.

Following up on these 29 participants who had had a rash, the findings showed that (Table 6), 34.43% (n = 10) had reported at a pharmacy for medication for the rash and that 9 of these 10 participants used a topical agent such as an ointment on their rash while 1 participants reported otherwise. Furthermore, all the participants who did not report to a pharmacy, 58.62% (n = 17), also did not report to a hospital but used ointments to treat their rash. One participant, who also did not report to a pharmacy nor a hospital, did not use an ointment but rather used salt water to wash the rash as a means of treatment.

**Table 6: Source and mode of treatment for rash related to handling fish**

Actions taken	Had rash related to working with fish, n (%)		
	Did not use an ointment	Used an ointment	Total
Reported at a pharmacy	1 (3.45)	9 (31.03)	10 (34.43)
Did not report at a pharmacy	0 (0.0)	17 (58.62)	17 (58.62)
Did not report at a hospital	0 (0.0)	0 (0.0)	0 (0.0)
<b>Total</b>	<b>1 (3.45)</b>	<b>26 (89.65)</b>	<b>29 (100)</b>

**4. DISCUSSION**

Given the inherent limitation of this study, which are, the possibilities of the occurrence of recall and selection biases, the efforts to control these (ensure validity) can be said to have been successful given the fact that almost all the sources of fish in the Greater Accra Region and the different types of fish business were well represented in the study. Additionally, the participants were able to recognize the lesions on the different types of fish in the pictures. Specifically, the validity of the findings of this study is expected to be high, in respect of the findings that most of the participants (66.0%) were retailers and 40.2% of the participants were also involved with processing fish. These groups of participants were more likely to take closer look at fish they dealt in, much more than wholesalers of fresh fish, who constituted only 5.2% of the participants, and therefore were more likely to recognise such lesions, if they had seen or it had been present on fish they have dealt in or handled at any point in time.

Additionally, the findings that slightly more than half of the participants (54.6%) had been working with fish for between 6 years and more than 20 years (Table 2), suggests a high likelihood that the participants may recognise such lesions if they had seen them or were present on fish they had dealt in or handled. Another indicator of the participants' experience that enhances the validity of the findings of this study was that more than half of them had dealt in or traded in two or more (up to 10) different types of fish since they started working with fish. These imply that the participants of this study were more likely to encounter such lesions if even it were associated more commonly with one or a few fish in Accra. Since the sources of fish for the participants of this study included almost all the possible sources of fish in the Greater Accra Region, including inland/fresh water, marine sources and major markets in Accra, the possibility that the study captured the observance of such a lesion, if it occurs was very high.

The observance of lesions on fish may be said to be moderately common among the major players in the fish business in the Greater Accra Region and possibly the whole of Southern Ghana (coastal regions) since about 56.0% of the participants reported they had observed such lesions on fish. However, these observations were likely to have been infrequent, since as much as 82.8% of the participants reported they had observed such features less frequently (Table 3). Therefore, in planning a laboratory based microbiological study of such lesions, which is a primary reason for this exploratory study, it should be noted that it may take a while to obtain biological samples (fish with lesions) for microbiological analysis. Furthermore, the findings presented in table 3 suggest that for any future study, working with

those involved with buying and processing of fish (as participants) will be best for the collections of fish samples with such lesions since they see and are aware of such lesions the most.

In order to facilitate the collection of fish samples for the intended laboratory-based study, it was important to collate the perception of the participants who had reported observing such lesions. It was clear from the findings that only a minority (23.08%) of them had the desired perceptions of the lesions (Table 4) and that the lesions indicated disease, or infections.. Sadly, one-fifth of the participants sold the fish with the lesions at a discount. For those who sold such fish, almost half of their customers asked about the lesions and the findings suggest that most of the customers were often given the wrong impression, which were same as the participants had stated (Table 4). Otherwise, such fish were processed either by salting (18.5%) or by frying or smoking (15.4%). These imply that customers of about 44.6% of the participants (who washed off affected parts or sold at discount) may be at risk of contracting the infection from such fish (Table 5). However, the participants who were involved in handling, removing and/or washing the affected parts and processing such fish were at a higher risk of contracting infections from the fish, which was the major public health concern that informed the design and conduct of this exploratory study and a prospective laboratory-based study to follow this study.

In order to assess the potential of the existence of this risk of contracting such zoonoses, the study collected data on the experience of skin rashes (particularly on the arm) among the participants [8, 19, 10, 20]. However, for the objective of this study, which is to inform the design of a follow-up study, the occurrence of this zoonosis has been demonstrated and the persons working in the retailing and processing of fish will be an appropriate target population for a follow-up study. On the other hand, for a further study that will focus on the prevalence of *Mycobacteria* infection (or Mycobacteriosis in fish) of fish, those working in the buying and processing (and those engaged in aqua-culture or fish-farming) of fish will be the most appropriate target population.

## 5. CONCLUSION

In conclusion, this study has provided useful information that necessitates and can inform the design of a laboratory-based microbiological study on the prevalence of *Mycobacterial* spp and *Shewanella* spp infections of fish in Accra, Ghana. Additionally, the observance of skin rashes among most retailers and processors of fish, who are often women in Ghana, necessitates a study of the prevalence of the emerging *Shewanella* infection among women in the fish business in the coastal regions of Ghana.

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## REFERENCES

- [1] Tørud B, Håstein T. (2008). Skin lesions in fish: causes and solutions. *Acta Vet Scand.*50 Suppl 1:S7.
- [2] Holt HM, Gahrn-Hansen B, Bruun B. (2005) *Shewanella* algae and *Shewanella putrefaciens*: clinical and microbiological characteristics. *Clin Microbiol Infect.*11:347–52.
- [3] Alikunhi NM, Batang ZB, AlJahdali HA, Aziz MAM, Al-Suwailem AM. (2016). Culture-dependent bacteria in commercial fishes: Qualitative assessment and molecular identification using 16S rRNA gene sequencing. *Saudi J Biol Sci.* doi:10.1016/j.sjbs.2016.05.017.
- [4] Abdel-Moein KA, Saeed H, Samir A. (2015). Novel detection of *Helicobacter pylori* in fish: A possible public health concern. *Acta Trop.*152:141–4.
- [5] Gauthier DT. (2015) Bacterial zoonoses of fishes: A review and appraisal of evidence for linkages between fish and human infections. *Vet J.* 203:27–35.
- [6] Janda JM. (2014) *Shewanella*: a Marine Pathogen as an Emerging Cause of Human Disease. *Clin Microbiol Newsl.*36:25–9.
- [7] Abowei JF., Briyai O. (2011). A Review of Some Bacteria Diseases in Africa Culture Fisheries. *Asian J Med Sci.*3:206–2`7.

- [8] Finkelstein R, Oren I. (2011). Soft Tissue Infections Caused by Marine Bacterial Pathogens: Epidemiology, Diagnosis, and Management. *Curr Infect Dis Rep.*13:470–7.
- [9] Austin B. (2010). Vibrios as causal agents of zoonoses. *Vet Microbiol.*140:310–7.
- [10] Novotny L, Dvorska L, Lorencova A, Beran V, Pavlik L. (2004) Fish: a potential source of bacterial pathogens for human beings. *Vet Med – Czech.*, 49:343–58.
- [11] Jacobs JM, Stine CB, Baya AM, Kent ML. (2009) A review of mycobacteriosis in marine fish. *J Fish Dis.*;32:119–30.
- [12] Decostere A, Hermans K, Haesebrouck F. (2004) Piscine mycobacteriosis: a literature review covering the agent and the disease it causes in fish and humans. *Vet Microbiol.*;99:159–66.
- [13] Jampala S.( 2015). Skin and Soft Tissue Infections due to Shewanella algae – An Emerging Pathogen. *J Clin Diagn Res.* doi:10.7860/JCDR/2015/12152.5585.
- [14] Sharma K, Kalawat U. (2010) Emerging infections: Shewanella - A series of five cases. *J Lab Physicians.*;2:61.
- [15] Park JS, Hur S. (2013) Up to date: comprehensive knowledge of human papillomavirus. *Expert Rev Vaccines.*;12:353–5.
- [16] Koh TH, Sng L-H, Yuen SM, Thomas CK, Tan PL, Tan SH, et al. (2009) Streptococcal Cellulitis Following Preparation of Fresh Raw Seafood. *Zoonoses Public Health.*56:206–8.
- [17] Collier DN. (2002) Cutaneous infections from coastal and marine bacteria. *Dermatol Ther.*15:1–9.
- [18] Uhlmann SS, Broadhurst MK. (2015) Mitigating unaccounted fishing mortality from gillnets and traps. *Fish Fish.* 16:183–229.
- [19] Haddad V, Lupi O, Lonza JP, Tyring SK. (2009) Tropical dermatology: Marine and aquatic dermatology. *J Am Acad Dermatol.*;61:733–50.
- [20] Feldhusen F. (2000) The role of seafood in bacterial foodborne diseases. *Microbes Infect.* 2:1651–60.
- [21] Lowry T, Smith SA. (2007) Aquatic zoonoses associated with food, bait, ornamental, and tropical fish. *J Am Vet Med Assoc.*231:876–80.

## APPENDIX - A

**Supplementary Table ; Names of the fish the participants reported they worked with**

Local Name	Common English Name	Scientific Name
Agyensin	Dara	<i>Parakuhlia macropthalmus</i>
Alata Blade(Fante)	Monrovia doctor fish	<i>Acanthurus monroviae</i>
Antele	Bumper	<i>Chloroscombrus chrysurus</i>
Antewano	Flagfin Mojarra	<i>Gerres melanopterus</i>
Cassava fish	Cassava fish (African goby)	<i>Gobioides africanus</i>
Cat fish	Cat fish	<i>Heterobranchus bidorsalis</i>
Cat fish	Cat fish	<i>Heterobranchus longifilis</i>
Cat fish	Cat fish	<i>Clarias gariepinus</i>
Cat fish	Cat fish	<i>Chrysichthys nigrodigitatus</i>
Cat fish	Cat fish	<i>Chrysichthys auratus</i>
Cat fish	Cat fish	<i>Chrysichthys nigrodigitatus</i>
Cat fish	Cat fish	<i>Chrysichthys walkeri</i>
Cat fish	Cat fish	<i>Clarias gariepinus</i>
Cat fish	Cat fish	<i>Clarias laeviceps laeviceps</i>
Cat fish	Cat fish	<i>Clarotes laticeps</i>
Cat fish	Cat fish	<i>Heterobranchus bidorsalis</i>



Ɔdaa	Bigeye tuna	<i>Thunnus obesus</i>
Eboe	Bigeye Grunt	<i>Brachydeuterus auritus</i>
Electric fish	Electric fish	<i>Mormyridae</i>
Eminse	Spot-tail Spiny Turbot	<i>Psettodes belcheri</i>
Emule	False Scad (Scad Mackerel)	<i>Decapterus rhonchus (= Caranx rhonchus)</i>
Esoe	Red Snapper	<i>Lutjanus modestus/Lutjanus fulgens</i>
Grouper fish	White grouper	<i>Epinephelus aeneus</i>
Grouper fish	Dusky grouper	<i>Epinephelus gigas</i>
Kanfena/Eban	Herrings	<i>Llisha africana/Sardinella aurita</i>
Kpanla	Atlantic Horse Mackerel	<i>Trachurus trachurus</i>
Kpole	Atlantic Emperor	<i>Lethrinus atlanticus</i>
Kwame Osei (kwami oseɛ)	Guinean Rainbow Wrasse	<i>Coris atlantica</i>
Kyekyewere	Atlantic Bigeye	<i>Pricanthus arenatus</i>
Mackerel	Mackerel	<i>Rastrelliger brachysoma</i>
Mud fish	Mud fish	<i>Clarias anguillaris</i>
Odeɛ (Odoi)	Goldblotch grouper	<i>Epinephelus costae</i>
Oje onye (Oje -Ewe)	Largehead hairtail	<i>Trichiurus lepturus</i>
okpoku, odaabi, pokupoku	Bullet tuna	<i>Auxis rochei</i>
Opoku	Frigate Mackerel	<i>Auxis thazard</i>
Saflo	West African Spanish mackerel	<i>Scomberomorus tritor</i>
Salmon	Salmon	<i>Oncorhynchus tshawytscha</i>
Silver fish	Silver fish	<i>Lepisma saccharina</i>
Tiger fish	Tiger fish	<i>Hydrocynus vittatus</i>
Tilapia	Tilapia	<i>Oreochromis niloticus</i>
White fish	White fish	<i>Coregonus lavaretus</i>
Emane	Round Sardinella	<i>Sardinella aurita</i>
Wiriwiriwa	Red fish	
Tuna	Tuna	
Amane		
Anofiawo		
Ashijahaiman		
Barakuda (odei)		
Boiboi		
Chiley		
Clocas (korkor)		
Empataa		
Korkor		
Nsesaawa		
Openssa		
Tiorkor		
Sole fish		
Yellow fish		
Flat fish		