

**SMALL FISH AND FOOD SECURITY:
THE CLEANING AND COOKING METHODS OF SMALL FISH IN POOR
GHANAIAN HOUSEHOLDS**

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This thesis is submitted in partial fulfilment of the requirements for the degree
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Abstract

Background: The increased burden of malnutrition is a persistent problem in low and middle-income countries, but small fish is emerging as a potential source to combat micronutrient deficiencies and malnutrition. Fish is an important part of the everyday diet among the poor population in Ghana, but the rate of malnutrition nonetheless remains relatively higher compared to the wealthy groups. Cleaning, and cooking processes are important to be studied because they can alter the nutrients and the hygiene quality of the fish, yet in Ghana, there is a dearth in this area of research. This study therefore sought to fill the knowledge gap and to pave way for further research into the cleaning and cooking practices among poor households in Ghana.

Objective: Determine the cleaning, and cooking practices of small fish among poor Ghanaian households.

Methods: The study was an exploratory qualitative study. The respondents were purposively sampled to fit the needs of the study. A total of 29 respondents from poor households in the coastal regions of Ghana were interviewed and observed. One-on-one interviews were audio recorded and the observations were videotaped - due to COVID-19, this was done remotely with the help of field assistants and daily contact.

Results: The commonly eaten small fish species found were anchovies, herrings and round sardinella - this is because of taste, low cost, and tradition. Fried or dried anchovies were eaten whole with the head- fresh round sardinella were boiled with viscera, head, gills, fins, and scales removed - herrings were preferred smoked with scales, gills, and fins removed; but the head and viscera of the smoked herring were not included when boiling. Usually, anchovies were fried and eaten after; fresh round sardinella were boiled singly with spices before being added to soup; already smoked herrings were added to soup to boil. Frying lasted 10 minutes average, and sun-drying could take 3 days. Boiling took 15-30 minutes. Smoking was done using a traditional smoker and it lasted for an average of 15 minutes.

Conclusion: Processing, and cleaning methods depends on the small fish species. Only anchovies were eaten whole with head and viscera intact. Although herrings were smoked with head and viscera intact, they were removed before boiling and consumption. There is a linkage between preference for fresh sardinella and direct access to fishermen, or intimacy with a fisherman in this study. Whether or not the poor households are eating a good amount of nutrients or ingesting toxic substances from the small fish they consume is unclear. Thus, these findings presented may be a pivot for future research of this nature.

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Abbreviations

ASABE	The American Society of Agricultural and Biological Engineers
ATLAFCO	The Ministerial Conference on fisheries cooperation among African States bordering g the Atlantic Ocean.
CDC	The Centres for Disease Control and Prevention
COVID-19	Coronavirus disease of 2019
CSIR	The Council for Scientific and Industrial Research
DHA	Docosahexaenoic acid
DHS	Demographic Health Survey
EPA	Eicosapentaenoic acid
FAO	Food and Agriculture Organization of the United Nations
FAOSTAT	Food and Agriculture Organization of the United Nations statistical database
GLSS7	Ghana living standards survey round 7
GPIR	Ghana poverty and inequality Report
GSS	Ghana statistical service
HH	Household
IMR	Institute of Marine Research
JHS	Junior high school
MBARI	Monterey Bay Aquarium Research Institute
MoFAD	Ministry of Fisheries and Aquaculture Development
NIH	The National Institutes of Health
NSD	The Norwegian Center for Research Data
PAHs	Polycyclic aromatic hydrocarbons
RAE	Retinol activity equivalent
TCC	Total colony count
UNDP	United Nations Development Programme
USAID	The United States Agency for International Development
WA-FCT	West African Food Composition Table

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Yaw Opoku Agyei-Mensah,

Bergen, May 2021.

1. Introduction

Fishing and fish for food

Fishing is a well-recognized activity all over the world, and it can be marine, fresh or lagoon water fishing; marine fisheries are the chief contributors of nutritious seafood (Pauly, 2016). Fisheries are the most energy efficient of all the food production systems and have the lowest environmental impact in terms of greenhouse gases and use of freshwater, fertilizers, or insecticides or herbicides (Kolding, 2020). Many African farmers are part-time fishers. Fish represent by far our biggest source of harvestable protein and the unique nutrient content of fish plays a significant role in combating the triple burden of hunger, micronutrient deficiencies and non-communicable diseases. Nevertheless, the qualities of fish are not recognized in the global food security discourse, and fish is strikingly missing from strategies to combat micronutrient deficiency.

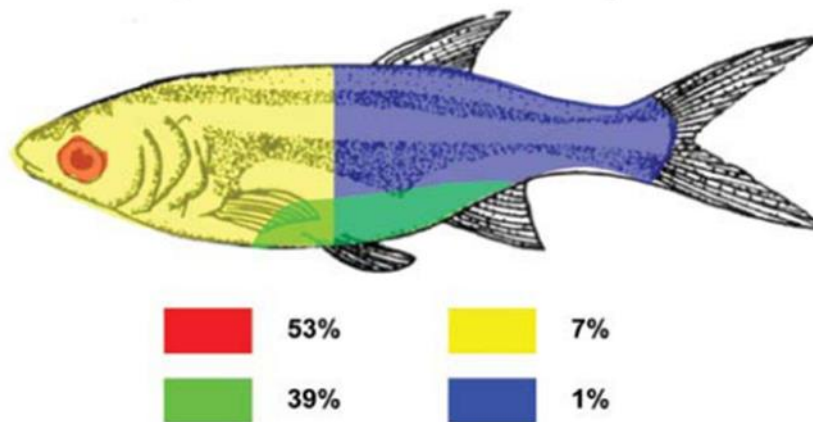
At the global level, fish intake increased from an average of 10.1 kg/capita per year in 1965 to 16.4 kg in 2005 (FAOSTAT, 2009). In Africa and Asia, several developmental interventions related to fish consumption, aqua culture, and capture fisheries have aimed at improving the nutritional status of households through direct dietary intake, production and increase in household income (FAO, 2020; FAOSTAT, 2009). Majority of Ghanaians consider fish to be a major source of animal protein, and the commonest type of fish consumed by the high socio-economic class is tilapia- which is the most farmed fish as well (ASABE, 2016). The per capita consumption of fish for the average Ghanaian is about 26 kg per annum, making Ghana one of the highest fish consumers in Sub-Saharan Africa (FAO, 2020). Fish represents about 53.9 percent of the animal protein consumed in Ghanaian homes (FAO, 2020; Akuffo, 2019).

A variety of small indigenous species account for 50–80 percent of the total amount of fish consumed by rural Asia (Roos, 2003) and similar trends seem to exist in Sub-Saharan Africa. Over the past three decades, fishing for small pelagic fish species have expanded massively in Africa's great lakes and reservoirs. Reviews from the 1980s (Petr 1983; Marshall 1984) noticed their unutilized potential, but questioned their economic profitability, although they also realized that they represented a highly important resource for sustaining the continued growth of Africa's human populations. In some West African countries like Nigeria and Ghana, whereas national statistics indicate a consumption level of about 24.6 gram per person per day (FAO, 2008), household statistics reveal the values of smoked fish consumption to be

approximately 217 gram per person per day for whole fish in households in the inland areas and around 124 gram per person per day for both smoked and fresh whole fish in the coastal areas (Gomna & Rana, 2007).

In general, one would expect the population that benefits from fish nutritional intake to be found along the coasts. However, data shows that such benefits are also found among the inland population, as fish is a highly commercialized commodity that ‘migrates’ extensively within and between countries, even after it is caught. In Sub-Saharan Africa, for instance, dried and smoked fish from Lake Chad travel more than 1000 km through a very efficient truck transportation network to be traded in urban markets in the south of Nigeria (Ladu, 2000). Similarly, in Ghana, smoked fish from coastal villages are traded as far as 600 km to Northern Ghana and sometimes even further north to Burkina Faso (Akufo, 2019). Nutrient composition analysis has shown wide variability in the nutritional value of different fish species, with small indigenous fish species (SIS) such as anchovies, herring, and sardinella being particularly rich sources of iron, zinc, calcium, vitamin A, vitamin B₁₂ and iodine (Hasselberg et al., 2020) in comparison to commonly farmed species in Ghana like tilapia, catfish and heterosis (FAO, 2016). In addition, fish enhances the bioavailability of iron and zinc from the other foods in a meal (Cook, 1976). As most small fish species are eaten whole, with eyes and viscera, they are a very rich source of highly bioavailable calcium while some are rich in vitamin A and or iron and zinc (Kawarazuka, 2011). Analysis of the different parts of ‘mola’, an example of small fish, showed that the eyes contain the highest proportion of the total vitamin A, followed by the viscera (Figure 1) (Roos et al., 2002).

FIGURE 1
Distribution of vitamin A in "mola". Vitamin A content: 2,680 RAE¹/100 g
raw, edible parts. Length of whole "mola": 6–8 cm;
weight of raw, whole "mola": 5–9 g.²



¹ RAE: retinol activity equivalent.

² Source: Roos *et al.* (2002).

Data on fish consumption, cleaning, and cooking practices of commonly consumed small fish species and fish dishes at the household level in Ghana are needed to identify the present and potential contribution of small fish. In determining the contribution of fish species to the recommended intake of micronutrients, factors such as cleaning and cooking methods (other than plate waste) are important. It has been demonstrated that sun drying of mola destroyed nearly all the vitamin A (Roos, 2002). Nevertheless, a recent study by Hasselberg *et al* (2020) states that processed *i.e.*, salted, or smoked small fish eaten whole are rich in vitamins, minerals, and essential fatty acids due to the low water content, and can therefore contribute with high-quality proteins and essential micronutrients in order achieve a balanced Ghanaian diet, which consists of mostly starchy staples. The FAO (2007) made a similar statement that salted and smoked fish from Ghana can thus be regarded as a high-quality protein source but there are high levels of PAHs in some fish samples (Hasselberg *et al* 2020). This opens the opportunity for further research to fill the knowledge gaps with regards to how small fish is cleaned and cooked among the urban poor at the household level.

Micronutrient deficiency and small fish

Globally, more than two billion people, especially women and children in Sub-Saharan Africa and Asia, suffer from micronutrient deficiency of essential minerals and vitamins like vitamin A, iron, and zinc (FAO, 2007). In resource-poor communities, it has become clear that malnutrition is attributable not solely to insufficient amounts of food but also to the poor nutritional quality of the available food supply. The triple burden of malnutrition is an

incessant issue in low and middle-income countries, and fish has the potential to mitigate this burden (Hasselberg, 2020). Micronutrient deficiency is a challenge in Ghana though fish is an essential part of the Ghanaian diet and is accessible at a low cost, with an apparent per capita consumption of 28 kg/year and constituting 50–80 percent of consumed animal protein (Sumberg et. al., 2016; FAO, 2016b; FAO, 2018b). Malnutrition remains widespread in Ghana with prevalence of stunting of 19 percent in children under five, underweight 11 percent and wasting 5 percent (DHS, 2014). These hidden consequences of micronutrients deficiency affect immune function, cognitive development, the growth of children, reproductive performance, and work productivity (Marinda, 2018).

Even though small fish species are indispensable providers of animal protein and micronutrients in many African societies, policies around modern food production is almost unilaterally concerned with terrestrial agriculture and livestock production rather, with very limited attention paid to the role of small fish in diets. Among animal-source foods, the importance of fish for food and nutrition security is increasingly being recognized, as it is an emerging potential in addressing hidden hunger (Underwood, 2000) but the decision whether to consume fish, what type of fish to consume and how much of that to consume are believed to be affected by various influences – social factors like family size, education, wealth, etc. have been found to be associated with nutritional status in developing countries like Kenya and Ghana (Mwase, 2015; Nti, 2008) and the relationships between these social determinants and nutritional status have been found to change over time (Hoffman, 2017). For example, sea bream, cassava fish and red snappers are preferred by Ghanaians, but they are expensive and therefore the urban poor cannot afford to buy (USAID, 2009).

Some studies indicate that inadequate food or nutrient intake is one of the major factors responsible for undernutrition in Asia and Sub-Saharan Africa. Other studies have also looked at the potential role of small fish species in improving micronutrient deficiencies in developing countries and fish cultivation as a livelihood option for small scale farmers in Asia (Kawarazuka, 2011) but not much has been done on the cleaning, and cooking methods of these small fish by households in Africa, including Ghana. According to Anihouvi (2005), in the traditional procedure of cleaning, the first step is the dressing which consists in scaling, gutting, and washing of fresh fish. Based on recent study findings, one major problem among fish processors is the lack of proper hygiene during cleaning of the fish leading to poor end-product in both microbiological and chemical aspects - improper handling and hygiene practices, storage, and insufficient smoking or drying can increase the likelihood of

recontamination and growth of microorganisms including pathogenic bacteria from faecal sources (Feglo, 2004; Ikutegbe, 2014).

Ghanaian Fisheries

Fishing is a steadily expanding activity in the world, and may be in the form of marine, fresh or lagoon water fishing. FAO (2004) statistics suggest that fishers make up for about 36 million worldwide; Out of these, 90 percent are classified as small-scale fishers and 95 percent are based in the developing countries. Fisheries offers full time jobs for over 4,600,000 fishers as well as 1.5 million people who are involved in fish processing and marketing- most of the traders and fish processors are women in West Africa (FAO, 1997). Commercial fish farming in Ghana increased from 1 200 tonnes in 2005 to 38 500 tonnes in 2014, spurred by high prices of the most consumed fish tilapia. The Government has placed aquaculture as one of the top priorities in the country's development agenda and substantial support is being given to fish farmers in various aspects of the industry. Small-scale fisheries are crucial to the coastal and rural poor households - to decrease unemployment levels in Ghana, the artisanal marine fisheries extend employment for more than 100,000 fishermen, through the canoe census of 1986 (Odotei, 2002).

The fisheries industry in Ghana can be classified into marine fisheries (the sea, lagoons) and inland fisheries (rivers, lakes, dams, reservoirs, and aquaculture). Marine fisheries provide the bulk of fish landed in Ghana making it the most important source of domestic fish production.

Marine fisheries

Marine fisheries mainly consist of the sea, but some lagoons are included as well. The yield of the marine fisheries i.e., the time that a lot of species of fish are caught, relies on an 'upwelling system'- upwelling is a process whereby nutrient rich cold water from the deep sea is brought to the surface of the sea usually by wind. Upwelling provides the nutrients needed to sustain large populations of microscopic algae (i.e., phytoplankton). Phytoplankton sustain larger marine organisms including fish (MBARI, 2005), this in turn promotes the productivity of the various marine fish species.

About 85 percent of total fish caught in Ghana comes from the marine sector (Nunoo, 2014). There are two seasons of upwelling on the continental shelf of Ghana which include the major season occurring from July to September and the minor season occurring from late

December to early February (MoFAD, 2015). These periods mark seasons of plenty fish catch.

Inland fisheries

Inland fisheries cover fish resources from rivers, lakes, dams, lagoons, and aquaculture. The Volta Lake contributes the largest to inland fisheries with about 90 percent share of total inland fish catch. Fish species captured from the Volta Lake include tilapia, and catfish. Non-finfish species captured from inland fisheries include shrimps and prawns. Aquaculture (fish farming) is an inland activity and production focuses on few species including tilapia, catfish and heterosis. Tilapia is the main species cultivated and constitutes about 88 percent of total aquaculture output, followed by catfish (10 percent) while other species accounts for the rest (Onumah et al., 2010).

Small fish resources

In Ghana, small pelagic fish capture represents about 65 percent of total fish landings (Nunoo et al. 2015a) and there is a law about the minimum landings based on the fish species (Fisheries regulations, 2010). The most important species exploited in Ghanaian waters are the small fish species-sardinellas, anchovy and mackerel together make up the majority (about 80 percent) of the total small pelagic fish stocks (Lazar et al., 2017). The abundance of small pelagic species in Ghana is significantly influenced by rainfall which causes high production of plankton (Nunoo et al., 2015a; Lazar et al., 2017). As a result, landings of these pelagic are seasonal in nature with July – September being the major season of abundance whereas late December to early February (rarely into March) being the minor season (Nunoo et al., 2015a).

Aside sardinellas, anchovies are the second most abundant small pelagic species contributing on average around 25 percent of total fish catch in Ghana (Lazar et al., 2017). The landings of mackerel have fluctuated over the years. The year 2000 recorded the highest catch of mackerel and landings have since declined (Lazar et al., 2017).

Fish consumption and health outcome

The waters of Ghana are endowed with valuable fish stocks. The main fisheries resources identified can be broadly divided into small pelagic, large pelagic and demersal species. Also, tilapia, catfish, heterosis, etc. are fish resources obtained from lakes, rivers, dams, and aquaculture. There is a strong need for fish in Ghana and three-fourth of total domestic fish is consumed locally - demand for fish has increased over the years and fish consumption levels

for 2009, 2010 and 2011 were 518,612 metric tons, 550,233 metric tons and 588,874 metric tons respectively (El Ayoubi & Failler, 2012). Over the past three decades, fisheries for small pelagic fish species have expanded massively in Africa's great lakes and reservoirs according to reviews from the 1980s (Petr et al., 1983; Marshall et al., 1984).

Fish is normally consumed and sold in many forms to consumers: fresh, smoked, dried, fried, canned, and grilled. Factors including region and proximity to water bodies such as the sea, lakes and rivers influence fish consumption levels and patterns in Ghana. Populations in the southern sector of Ghana especially the tribes inhabiting the towns and cities along the coast are associated with high levels of fish consumption while populations in the northern sector of Ghana have low levels of fish consumption because they are more oriented towards livestock rearing (Amissah, 2009). People in the south of Ghana consume more fresh fish while people in the north (or inland areas) consume more processed fish (USAID, 2009).

A study in Uganda used local dried fish mukene as an ingredient of low-cost supplement porridge to feed undernourished children. The experiment shows better outcomes in weight growth and mortality compared with the diets of imported skimmed milk that are usually used for undernourished children in hospitals (Greco et al., 2006). Similarly in Ghana, a study reported that fish powder from smoked anchovies mixed with fermented maize porridge supports rates of infant growth comparable to those obtained from a cereal–legume blend with vitamins, minerals, and fortified supplements, indicating the potential role of local fish in the improvement of infant growth (Anna et al., 1999).

Cleaning and nutrients in small fish

It is well recognized that fish and small fish specifically, are a rich source of animal proteins, minerals, and vitamins. There are high levels of vitamins D and A in raw anchovies and mackerel according to the West African Food Composition Table (WA-FCT) (Stadlmayr, 2012). Some fresh small fish species such as sardines are a rich source of calcium, iron, and zinc (Aaker et al., 2020). The level of vitamins B₁₂ are high in raw anchovies, sardines, and mackerels and similarly high levels of iron, magnesium, zinc, and phosphorus are present in them but anchovies have low levels of iron (Aaker et al., 2020). The total content of mineral components such as zinc, calcium, iron, and iodine in the raw flesh of fish and invertebrates is in the range of 0.6–1.5 percent of wet weight; the level of calcium is up to 1 mg/100 g, whereas those of iron, zinc and iodine are less than 1 mg/100 g (Kietzmann et al., 1969). Minerals, fatty acids, and vitamins are important for human nutrition and are essential in

combating micronutrient deficiencies (Sikorski et al., 1990). In recent studies, omega-3 fatty acids (EPA and DHA) have been associated with improved cardiovascular function in terms of anti-inflammatory properties, proper foetal development, and supplementation during pregnancy (Mousa, 2012); vitamin B₁₂ is essential in the earliest days of foetal growth for healthy development of the brain and spine (CDC, 1992); vitamins A and D supports healthy eyesight and immune system functions and builds strong bones by helping the body absorb calcium (Imdad, 2017; NIH, 2021); zinc promotes immune functions and helps individuals resist infectious diseases including diarrhoea, pneumonia, and malaria; zinc is also needed for healthy pregnancies (Ackland, 2016); iron is critical for motor and cognitive development.

Nti (2008) has reported that 95 percent of households in rural Ghana consume small fish daily - a meal of small fish species that are fried and eaten whole including the head and bones are an important dietary source of calcium and teenage boys and girls need calcium because they are growing rapidly at this age (Roos, 2007). Small fish are eaten whole, including the bones, are therefore a rich calcium source. Large fish do not contribute to calcium intake because their bones are discarded (Roos, 2001). Thorseng et al (2005) found that, the contents of calcium and iron were considerably higher in raw, cleaned samples with the head than in samples in which the head was discarded during cleaning (calcium 58 percent higher and iron 25 percent higher). Another research work from Hansen et al emphasized that humans are better able to absorb the protein contained in these animal foods compared with plant foods. The high content of calcium in small fish bones helps humans to develop and maintain strong bones and teeth and has been shown to have the same high bioavailability as calcium from milk in both humans and rats (Hansen, 1998; Larsen, 2000).

Accessibility and cooking of small fish

There are many factors related to accessibility and the small size of fish species, which make them especially favourable for inclusion in the diets of the rural poor (Thilsted, 2012). For many rural households, fish is more accessible and affordable than meat; People can raise fish in small ponds and rice fields or catch wild fish even if they do not have money to buy fish (Hautvast et al., 1999; Madise et al., 2011; Pienaar et al., 2013; Dooling et al., 2011). Much of the small fish is sold in small rural markets, and this is the major source of fish for consumption by the rural population. Small fish are sold in small heaps of mixed species, can be bought in quantities which are affordable, and can be cooked for one meal or for daily consumption, favouring a high frequency of consumption (Roos, 2001).

Early developments in the field of nutrition predicted that certain nutrients important for the proper functioning of the human body, are lost during cooking of foods. During cooking, chemical, and physical reactions take place, which improve or prejudice the food nutritional value (e.g., digestibility is increased because of protein denaturation in food but the content of vitamins or polyunsaturated fatty acids is often reduced) (Flick & Kuhn, 2012). The various cooking methods invariably alter the nutritive value of fish; both fatty acids and iron are reduced (Roos et al., 2007d; Thorseng, 2007).

The effects of different cooking methods on proximate and mineral composition of several fish species have been reported - Increased ash content was noticed in all the cooked fillets when compared to raw fish fillets and was due to the reduction in moisture (Marimuthu et al., 2012; Ersoy et al., 2006). The protein and fat content in fried fish fillet increased due to reduction of water content and the absorption of sunflower oil by the fish during frying (Marimuthu et al., 2012). No loss of calcium, iron, and zinc was noticed in grilled fish when compared to that of raw fish hence based on the results obtained on mineral composition, the grilling of fish is the best among all the cooking method for preserving calcium, iron, and zinc (Marimuthu et al., 2012; Gokoglu et al., 2004).

It is reported the urban poor in Ghana normally have a diet concentration of starchy staple foods, like cassava, yams, bananas, and cereals (rice, maize) and are often complimented with small fish to emerge as a buffer in any local cuisine; these dishes are well-liked, easy to prepare as well as contribute to dietary diversity (Nti, 2008; FAO, 2010).

Fish processing

Fish is a highly perishable commodity and as a result the quality begins to deteriorate few hours after harvesting. Due to this, several traditional methods are used to process fish to preserve and increase its shelf life. Processed fish can be stored for longer periods of time and they can be transported over long distances. Traditional products such as dried, smoked, salted, and fermented small fish, as well as fish paste, and fish sauce are made at household level and bought in small quantities from local markets. The main traditional methods employed to process fish include smoking, salting, sun-drying, and frying and fermentation (Amissah, 2009). The methods of smoking and sun-drying are the two most widely used ways for processing and preserving anchovy as shown in the figure 2 below (Samey, 2015b; Atikpo, & Kpodo, 1992).



FIG. 1. Sun-drying of small fish in Ghana

In Ghana, fish processing is a females' activity. Fish smoking, salting, and drying are performed by women along the coasts and riverbanks. The main species of fish processed using smoking include sardinella, anchovy, horse mackerel and chub mackerel. According to Samey (2015b), approximately 70 – 80 percent of local marine and inland fish capture are consumed the in smoked form.

A study in Thailand discovered that sun-drying processing methods destroy 90 percent of the vitamin A content in small fish. In contrast oven-drying were shown to result in a 50 percent loss only (Sungpuag et al., 1999). In Bangladesh it was found that nearly all vitamin A in small fish is destroyed after sun-drying (Roos, 2001). High levels of heating lead to chemical and physical changes and therefore the content of thermolabile compounds and polyunsaturated fatty acids is often reduced (Flick et al., 2012). But in Ghana, Hasselberg (2020) found that smoked fish is a good source of vitamins like D, B₁₂, minerals like calcium, iron, and fatty acids like EPA and DHA, although PAHs are present in the fish due to the use of traditional smokers. Similarly mentioned by Kiczorowska (2019) that the reduced water content from smoking of fish increases the concentration of several nutrients like vitamins, minerals, and fatty acids.

Nutritional loss through processing is a specific issue with fish; although in developing countries fish is often sun-dried, salted, fermented, or smoked for preservation purposes, protein, and minerals remain stable even after processing (Kawarazuka & Béné, 2011). All these literatures have looked at the processing, preservation, and cooking effects on small fish in various locations but there remains a gap to be filled on the cleaning and cooking methods used by the urban poor in Ghana since they are the ones who suffer the most micronutrient deficiency.

2. Objectives of the study

This thesis is a part of the Small Fish and Food Security: Towards innovative integration of fish in African food systems to improve nutrition (Small Fish Food) project in collaboration with several partners. This part of the project is in alliance with the CSIR food research Institute of Ghana, the University of Ghana, the University of Bergen, and the Institute of Marine Research.

Generally, there is a lack of scientific papers regarding the cleaning and cooking practices among the poor households in Ghana. Although small fish is considered a potential source of micronutrients to combat micronutrient deficiency in Ghana, there is not much focus on the cleaning and cooking practices among the poor population. This therefore is a knowledge gap that this study sought to fill with the central objective of determining the cleaning, and cooking methods of small fish in poor Ghanaian households.

The specific objectives were:

- Ascertain the commonly consumed small fish species and why they are the commonly consumed species.
- Identify the parts of small fish that are removed or kept during cleaning and the reasons why these parts are removed or kept.
- Identify the preferred form (fresh or processed) of small fish and observe the cooking methods.

The focus was on the poor populations because small fish could serve as a potential cheap source of micronutrients and vitamins to help them combat micronutrient deficiency (Kawarazuka, 2011; Underwood, 2000). Further, the poor may not have the resources to buy and maintain nutritional supplements which in turn, creates a higher rate of nutritional security among them compared to the wealthier population. Thus, it is necessary to find a cheaper and easily accessible source of micronutrients, minerals, and vitamins – small fish food could be this potential source.

3. Methods and materials

This section presents the research methods, research instruments, the study area, participants and their selection, the field work, credibility and dependability of the study, data analysis, and ethical consideration of the research study. Qualitative data were gathered from a primary data source in poor coastal Ghanaian households using one on one interviews with the respondents and observations of the cleaning and cooking methods they use for small fish.

Research instrument

An interview guide together with an audio and a video recorder were used as research instruments to help with the interviews and observations. There is a method or approach that lies between the survey method and participant observation: the interview (Eyles & Smith, 1988).

The interview guide (**Appendix I**) was prepared in such a way that before a household was interviewed, the research assistant must tick options that indicate that the household meets the inclusion criteria requirement i.e., poor household. The interview guide had three sections; A, B, and C. Section A was for demographic details of the respondent, Section B was details about small fish species, the parts that were removed and the reasons, and the Section C was a guide for the things to look out for during the video observation. During the field work in February 2021, one to two interviews were done per day and a total of 29 interviews were recorded for the study. The average duration of the interviews was ten to twenty minutes per respondent in each household.

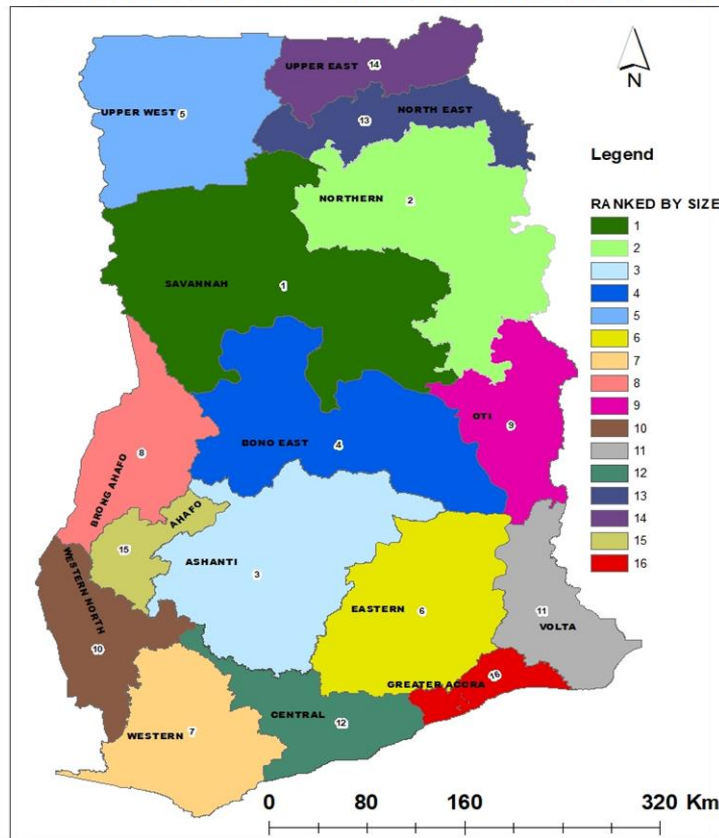
Initially the plan was to collect the data on the cleaning and cooking methods of small fish through participant observation; but due to unforeseen circumstances i.e., the COVID-19 pandemic, it became impossible to spend too much time staying with the communities as there were several restrictions and lock downs. Due to this, the researchers employed the overt observation method and video recorded the procedures used in cleaning and cooking small fish among the poor households to contrast the previous answers given by the respondents in the interviews. The duration of the observations was ten to thirty minutes per respondent in each household.

Study area

This study was conducted in the four administrative coastal regions of Ghana namely Greater Accra, Volta, Central, and the Western. Ghana is a West African country in Africa, along the Gulf of Guinea, just a few degrees north of the equator. Ghana spans an area of

238,535 km² (92,099 sq. mi) and has an Atlantic coastline that stretches 560 kilometres (350 miles) on the Gulf of Guinea in Atlantic Ocean to its south (Ghana: Geography Physical 2013) It lies between latitudes 4°45'N and 11°N, and longitudes 1°15'E and 3°15'W. The Prime Meridian passes through Ghana, specifically through the industrial port

FIG 3. NEW REGIONS OF GHANA AFTER REFERENDUM



BY: SAKO.COM

town of Tema. The climate of Ghana is tropical and there are two main seasons: the wet and the dry seasons (UNDP Climate Change Country Profile: Ghana 2013). The eastern coastal belt is warm and comparatively dry, the south-west corner of Ghana is hot and humid, and the north of Ghana is hot and dry (Ghana: Geography Physical 2013). The capital city of Ghana is Accra which is at the same time the capital city of Greater Accra Region. It is the second most populated region, after the Ashanti Region, with a population of 4,010,054 in 2010, accounting for 16.3 per cent of Ghana's total population (GSS 2018). The **Greater Accra region** is bordered on the north by the Eastern Region, on the east by the Volta Region, on the south by the Gulf of Guinea, and on the west by the Central Region.

The **Volta region** (or Volta) is one of Ghana's sixteen administrative regions, with Ho designated as its capital (GSS 2018). It is located west of Republic of Togo and to the east of Lake Volta. Divided into 25 administrative districts, the region is multi-ethnic and multilingual, including groups such as the Ewe, the Guan, and the Akan peoples. It has a

population of about 2,118,252 (GSS, 2018). The **Central region** is one of the sixteen administrative regions of Ghana. It is bordered by Ashanti and Eastern regions to the north, Western region to the west, Greater Accra region to the east, and to the south by the Gulf of Guinea. The Central Region is a hub of education, with some of the best schools in the country; It has an approximate population of about 2,206,863 (GSS, 2018). The **Western region** is in south Ghana, spreads from the Ivory Coast border in the west to the Central region in the east, includes the capital and large twin city of Sekondi-Takoradi on the coast, coastal Axim, and a hilly inland area including Elubo. It includes Ghana's southernmost location, Cape Three Points, where crude oil was discovered in commercial quantities in June 2007. The region covers an area of 23,921 sq. km and had a population of 2,376,021 at the 2010 Census; the latest official projected population as of 2019 is 3,093,201 (GSS 2018).

Selection of participants

Time and the restrictions due to the spread of the corona virus would not permit the assessment of household economic status i.e., household income rate, assets owned, or household consumption level etc; thus, poor households in this study were defined and selected based on the review by the Ghana Statistical Service (2018), Ghana living standards survey round 7 (GLSS7) (2018), the Ghana poverty and inequality Report (2016), and the following other factors:

According to the GSS (2018) most fishing communities are poor and survive on a low income. As stated by the Ghana poverty profile report (2018), households who do not have access to essential utilities like electricity, or households who use or share sanitation facilities like public toilets are considered as poor households.

Houses in slummy or congested areas; families that lived in one room; houses in bad condition or environments, for example places with no proper waste management items like trash cans; buildings that appeared to be crumbling (GPIR, 2016), were included as poor for the sake of this study. The study was carried out in at least two communities from each of the four coastal regions of Ghana. The selection of these areas was because fish is a livelihood and heavily consumed along the coast. Again, most of the fishing communities are regarded as poor or low-income communities (GSS, 2018). The respondents were mostly women who prepare meals in their households with small fish.

According to Thagaard (2009), the size of the sampling should be assessed to a saturation point. This implies that the sample is sufficiently large when studies of more units do not give further understanding of the phenomenon. It is also a point that the number of informants or respondents in qualitative samples should not exceed the number that can be analysed thoroughly. The duration for the entire survey was about 24 days and the final study samples included 29 households. The region, districts, population size per region and number of respondents are summarized in the Table.

Table 1. Regions, Districts, Population Size, Households, and Days.

Region	District and No. of Households	Population size per region (2010 census)	Total Households (interviewed and observed) (29)	No. of days (24)
Greater Accra	Ningo-Prampram (5) Krowor (5)	4,010,054	10	8
Central	Asebu/Gomoa (3) Mfantsiman MA (3)	2,206,863	6	5
Western	Nzema East (3) Shama/Prampram (4)	2,376,021	7	6
Volta	Ketu South (3) Anloga (3)	2,118,252	6	5

Inclusion and exclusion criteria

Respondents that were from households that ate small fish; individuals who cooked in the house; willingness to participate in the study; households that met the researcher’s definition of poor; households with permission from the family head (husband usually). Those that were excluded declined to participate and those that did not meet eligibility requirements after being assessed – one respondent stated that their household does not consume small fish and so was excluded after assessment. Figure 4 shows the flow diagram for participants selection:

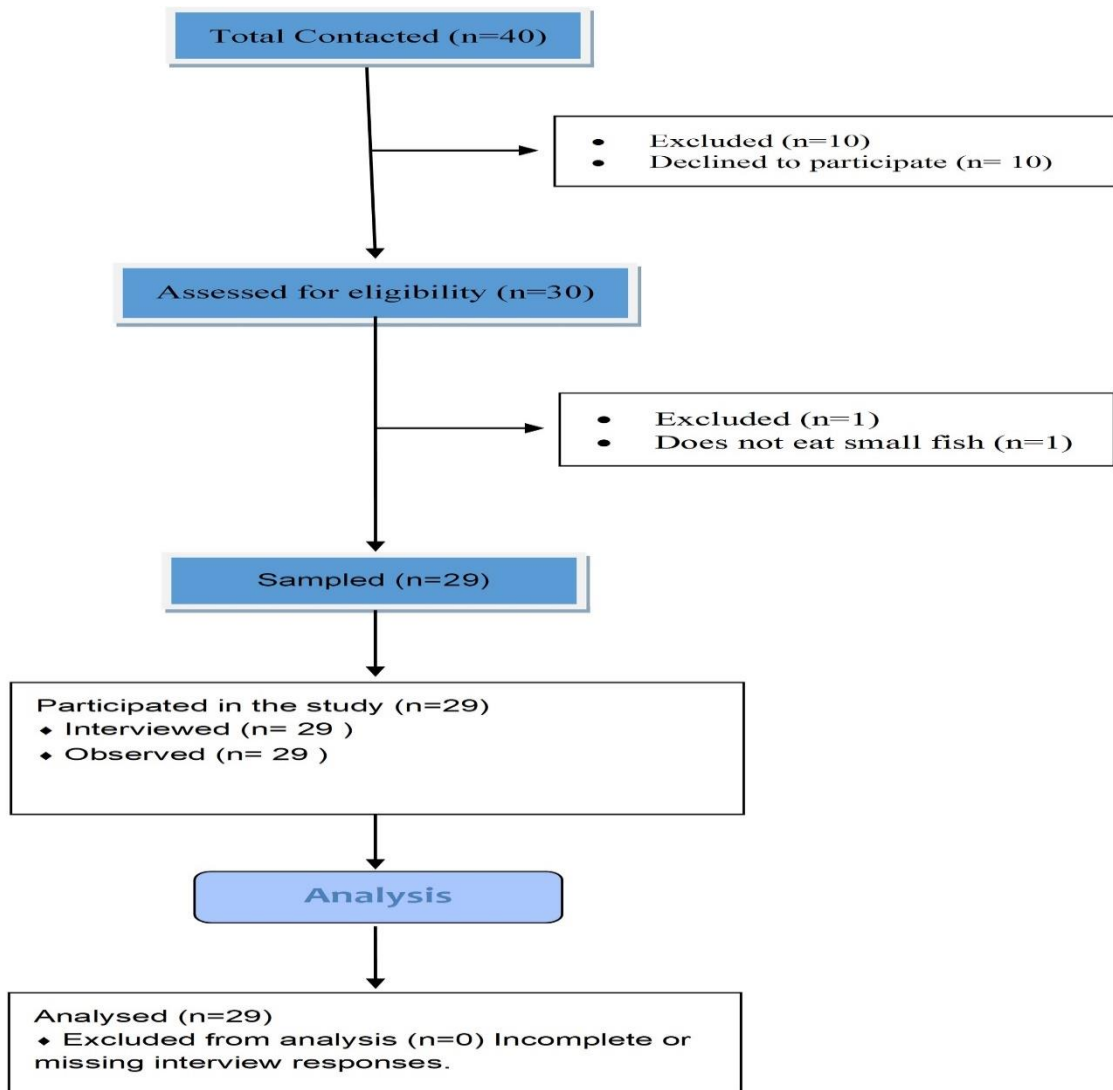


FIG. 4. Sampling Flow Chart

Source: CONSORT Flow Chart 2010

Sampling technique and field work

A purposive sampling technique was used to collect data from the poor households in the coastal regions of Ghana. The study began in February 2021 from Greater Accra, then Volta, Central and end at the Western region in March the same year. Data was collected with the help of research assistants since I could not make it to Ghana due to COVID-19, but I was involved daily. Before being able to identify the poor households for this study, an important landmark (e.g., Bank, church) in the selected community was located and any direction was chosen. Then, slums or houses that meets the selection criteria were purposively selected. Selected households were about at least 100 to 150 meters apart. This was to ensure proper distribution of the data collected in each community.

Whenever there were more than one eligible household in a house, just one was chosen. All public health safety protocols such as hand washing and sanitization, at least one meter distance, putting on of face/nose mask were all maintained to prevent the spread of the virus. This was done in all the communities. Selected representatives from the communities accompanied the researchers to collect the data as they were foreigners. In the Greater Accra, Central, and Western Region, the researchers had no need for interpreters since they understood the GA and Akan language.

By making use of purposive sampling implies that the researcher selects the informants and sites for study because meaning to the research problem and main phenomenon in the study can be provided by them (Creswell, 2007). Using purposive sampling also gives permission to select a case because it demonstrates some feature or process in which the researcher is interested in (Silverman & Marvasti, 2008).

COVID-19 and distance methodology

This study was conducted in the 2020/2021 academic year during the covid 19 pandemic. It was originally planned that I will do the fieldwork myself but due to the severeness of the situation and travel restrictions/bans, it was not possible. The project group had to employ research assistants in Ghana with good credentials to undertake the fieldwork on behalf of the main researcher. The main field assistant for this study was Obiri Yeboah, a micro and molecular biology technician at CSIR-Food Research Institute, Ghana, supervised by PhD students Theophilus Annan at Kwame Nkrumah University of Science and Technology, Richard Ansong and Matilda Steiner-Asiedu at the University of Ghana, and senior scientist Amy Atter at CSIR-Food Research Institute. The data collected during the field work was

with the help of the online platform called KoBoToolbox. An account was created for both the main researcher and the research assistant on this platform and all interview responses and notes were added by the research assistant by the end of each day of the fieldwork. One supervisor had access to the KoBoToolbox as well. Media files such as audio recorded interviews, and video recorded observations were uploaded separately to 15 gigabytes google drive created exclusively for this study. Only the main researcher and the assistant had access to the files during the field work. This ensured privacy and security of the data collected. The media files were categorized and organized into folders based on regions and the household number assigned to them to avoid mixing the data. Apart from the cloud storage, the media files were backed up on an encrypted external hard drive by the main researcher to ensure that the data can be recovered at any time.

Both the main researcher and the assistant were in constant communication whenever necessary during the field work; communication was done through WhatsApp and other times on the Zoom video calling app. There were translators for the various regions the data was collected from except in the Greater Accra because the field assistant understood the language. Unfortunately, the main researcher did not understand the Ga language, so the assistant had to translate them into English. The research assistant recorded himself in English as he listened and translated from the Ga language. The audio was then uploaded to the google drive space and organized in a different folder.

All public health safety protocols by the Ghanaian Ministry of Health were followed throughout the data collection period. The research assistant put on a face mask all the time he was with the respondents. At least a 1-meter distance was maintained between the assistant and the respondents, but the audio recorder was positioned in such a way both voices can be captured clearly. Frequent hand washing and hand sanitizing were practiced where necessary, less or no touching when not needed was a priority as well. The respondents were gifted hand sanitizers to help control the spread of the corona virus. The covid 19 situation caused delays in the start of the fieldwork but did not have any major negative impact on the data collected.

Incidence during fieldwork

There were a few unpleasant issues that were faced during the fieldwork particularly in the Greater Accra and the Central region. Though the people in the capital, Accra, are perceived to be civilized and educated, it was to the researchers dismay that some men in the

households threatened to cause harm if the researcher do not leave immediately; this was due to the believe that the researchers were spies sent by the government to trick them into taking the COVID-19 vaccine. Again, due to the increased rates of scam in the country, some of the households thought it was a new method to defraud them. In the Central region, despite it being known as the hub of education (having the best educational institutions) there was an incident where the researchers were sacked from a household because one of the assistants had sat on their “god” (in the form of a big stone on the ground).

At a certain point in time, the researchers had limited time as it was getting late and dark, and some of the respondents were fed up and very busy. However, detailed answers, and good rates of responses were generated from a total of 10 households from the Greater Accra and 6 households from the Central region.

The Volta region is made up of mostly the Ewe people though there are a few other tribes present in the region. Before entering the Volta region, the researchers had heard many myths and stories about the Ewe people such as: The Anlo people generally gain power from the assistance of evil spirits mostly for divining, they are spiritual murderers, and they kill people using juju. But contrary to what they thought, it was the region where they had the best experience; the respondents were highly engaging and educated. When the Researchers entered the region, they were connected to Patrick, a very popular and educated guy in the area. He became the gatekeeper for the researchers by acting as the interpreter and making the researchers look less of outsiders to the respondents due to his popularity.

In the oil city, Western region, the respondents showed high levels of literacy, and showed excitement to be a part of the research project. One District Chief Executive in the region was very nice to the researcher assistants during their time there; he provided an (signed and stamped) official letter which meant they can carry on with the study without ethical issues whatsoever in that district.

Thematic data analysis

This section involved, transcription of audio data, organization, and coding of the data. Data collected was constantly reviewed to focus on themes and patterns that emerged in subsequent interviews and observations. Data transcription involves listening to the tape and simultaneously writes down or types everything that is said on the tape (Mack et al. 2005). Transcribing the data was very tedious and time consuming. My research assistant did not translate some of the recorded interviews to me before transferring. I had to transcribe those

ones together with my research assistant to ensure a better understanding of the records and to avoid misinterpretation or loss of information. Data was then analysed after transcription using inductive analysis. Inductive analysis refers to approaches that primarily use detailed understandings of raw data to derive concepts, themes, or a model through interpretations made from the raw data by an evaluator or researcher (Thomas, 2006). Using inductive data analysis approach, analysis was done through open coding. Open coding refers to the part of analysis that pertains specifically to the naming and categorizing of phenomena through close examination of the data (Lawrence & Tar 2013). I followed the J. Attride Stirling thematic network analysis. Thematic network follows a systematic process where codes are identified from textual data. This information is then clustered into basic themes, then organizing themes, and finally to a global theme (J. Attride Stirling, 2001). Analysis started by going through the transcribed data to familiarize myself with the collected information. I identified and clustered codes that express the same or similar ideas into key basic themes. Basic themes that seem to express similar ideas were grouped into organizing themes. Finally, the Organizing themes were placed under the global themes which captured the importance of the obtained information. A final total of 29 households were used in the data analysis. The table 2 shows the analysed data.

Table 2. Thematic Analysis

<i>Codes</i>	<i>Basic themes</i>	<i>Organizing Themes</i>
<p>...the small fish gives a lot of blood. ...eating small fish gives me protein. ...eating small fish makes my children grow well. eating small fish makes bones stronger</p>	<i>Nutritional value of small fish</i>	<i>Reasons for consuming small fish</i>
<p>.... small fish is not expensive. we get it for free. Very cheap when bought in bulk. I get a lot for cheap. I do not need too much money.</p>	<i>Cost of small fish</i>	
<p>.....small fish is delicious. small fish tastes good. small fish is delightful. small fish makes food taste nice. small fish feels good in my mouth.</p>	<i>Good taste of small fish</i>	
<p>.... we ate small fish even as children. our parents gave us small fish. we cannot eat without small fish at home. small fish is our family food. small fish known in our culture.</p>	<i>consuming small fish as a tradition</i>	
<p>.....those parts cannot be eaten, it has a lot of bones the head bony the head contains stones those parts are not food</p>	<i>Unconsumable Small fish parts</i>	<i>Reasons for eating small fish whole or removing parts.</i>
<p>.... the guts can spoil your food. the guts taste bad. the head has no good taste. I do not like the taste of the guts and head</p>	<i>Bad taste of small fish parts</i>	
<p>...there is nice taste in the head of anchovy. ...it tastes better eating all of it. ...it delicious when eaten whole with a local food. every part taste good</p>	<i>Good taste of small fish</i>	
<p>...the bones give calcium. ...the nutrient in the whole fish makes us healthy. my children are smart because of the brain in the head. eating the whole fish prevents diseases. Gives blood when eaten whole</p>	<i>Nutritional value of small fish</i>	
<p>... You can eat it quickly. fresh Anchovies will break when boiled. gives it a unique smell and taste. takes away the excess water</p>	<i>Preferring processed small fish</i>	<i>Preferring fresh or processed small fish</i>
<p>...I like to work on it by myself. ...It is better when it is fresh. ...it tastes amazing when fresh and spicy</p>	<i>Preferring fresh small fish</i>	

Source: Data transcripts

Verification & credibility

The findings of the research were disseminated to each community (households) before the final departure in which approximately 29 respondents participated. At the end of each interview and observation, the major findings were shared with the respondents and confirmed by all participants of the data collection process. Primary data generation, in-depth engagement and crosschecking the data with the communities through the individual respondents were all ensured to have a credible and dependable research data as already mentioned by Petty (2012b) and Hanson (2011) that qualitative researchers make use of certain strategies to create credibility and dependability i.e., Systematic documentation and recording of data, prolonged engagement, persistent observation, and skilful interview techniques altogether contributed to the credibility and dependability a qualitative research study (Petty et al., 2012b; Hanson et al., 2011).

Ethics

Ethical approval was retrieved from the Norwegian Center for Research Data (NSD). Also, the project team applied for an ethical approval from the Noguchi Memorial Institute for Medical Research in Ghana with reference numbers 009/20-2 and IRB 00001276. A thorough project description, including the project proposal and the proposed interview guide were all submitted as part of the requirements to meet the ethical approvals. An information letter was provided by the Norwegian Center for Research Data (NSD) as a confirmation of their approval of the research which was conducted. This information letter (**Appendix II**) was carried to the field as well to establish the authenticity of the research carried out and as a form of protection for all the participants and the researcher.

Before the researchers started collecting data in any community, they sought permission from the assembly man, district chief executive, or the chief fisherman, and finally and most importantly the head of the house which is the husband usually. Before the start of each interview in a household, the nature of the research to its full extent was explained to the respondents including the fact that they could withdraw at any time without giving reasons. Since the interviews were audio recorded, a verbal consent was sought from the interviewees.

Operational definitions

- Small fish - fish under 25 cm at maximum size were basically categorized as small fish.
- Large fish - fish over 25 cm at maximum size were defined as large fish.
- Cleaning – washing, and removal of parts (gills, head, guts, fins, visceral etc.) of the fish.

- Processing – Smoking, frying, salting, drying, etc.
- Cooking – steaming, grilling, boiling etc. of the fish.
- Undernutrition - includes wasting (low weight-for-height), stunting (low height-for-age) and underweight (low weight-for-age).
- Micronutrient deficiency (hidden hunger) - insufficient or deficiency in minerals as iron and calcium.

4. Findings

In this study the main objective was to explore the cleaning, and cooking methods of small fish in poor Ghanaian households. Small fish are a valuable natural resource that have the potential for fighting micronutrient deficiency among the urban poor in Ghana. Some practises like the cleaning, and cooking methods of small fish by the fish processors and consumers affect the nutritional content of this fish yet, not much research has been focused in this area and there remains knowledge gaps that need to be filled. Thus, it was significant for the researcher to research how the cleaning and cooking methods are carried out at the household level among the urban poor. The main research question that guided this study was, ‘how do poor Ghanaian households clean, and cook small fish?’ and the results are organized according to the specific research questions. This chapter mainly focuses on the research findings and includes the themes that emerged from the data analysis.

Participants demographics

Data was collected on a total of twenty-nine (29) respondents after assessment of eligibility in this study. Included respondents were those who ate small fish, cooked in the house, and urban poor households (according to the researcher’s definition) i.e., congested neighborhood, and/or bad building condition, and/or inadequate basic amenities. Ten (10) respondents in the Greater Accra, seven (7) respondents in the Western, and six (6) respondents each in the Central and the Volta regions of Ghana were interviewed and observed as they cooked a certain species of small fish.

The enquiry commenced with an inquisition on the respondent’s household and an idea of their economic status (occupation), as well as their preference for small fish. The respondents were within the age bracket 30-50 years, with a married majority. The average household size was five (5) people in a household and nearly all the respondents had a low educational background, with the bulk emerging from a fishing community. The feedback from the respondents testified that they oversaw making meals in their households and that they occupied an urban settlement together with individuals of poor to moderate economic status. Within the context of this section, the informants were represented with HH1, HH2 ...HH29. A summary of the characteristics of the respondents have been made in Table 3.

Table 3. Characteristics of Respondents

Respondent	Sex	Occupation	Education
HH 1	Female	Shop Attendant	Primary
HH 2	Female	Fish processor	JHS
HH 3	Female	Fish trader/processor	JHS
HH 4	Male	Fisherman	Non-formal
HH 5	Female	Fish processor	Primary
HH 6	Female	Fish trader/processor	Non-formal
HH 7	Female	Fish processor	Non-formal
HH 8	Female	Fish trader/processor	JHS
HH 9	Female	Fish processor	JHS
HH 10	Female	Fish processor	Non-formal
HH 11	Female	Fish processor	Non-formal
HH 12	Female	Seamstress	Non-formal
HH 13	Male	Cobbler	Non-formal
HH 14	Female	Fish processor	JHS
HH 15	Female	Fish trader	JHS
HH 16	Female	Fish trader/processor	Non-formal
HH 17	Female	Fish trader/processor	Non-formal
HH 18	Female	Fish trader	Primary
HH 19	Female	Fish processor	Non-formal
HH 20	Female	Unemployed	JHS
HH 21	Female	Fish trader/processor	Non-formal
HH 22	Female	Fish trader	JHS
HH 23	Female	Fish processor	Non-formal
HH 24	Female	Fish processor	Non-formal
HH 25	Female	Fish processor	JHS
HH 26	Female	Fish processor	Primary
HH 27	Female	Unemployed	Primary
HH 28	Female	Fish trader/processor	Primary
HH 29	Female	Fish trader/processor	JHS

Source: Field work, 2021

Commonly consumed small fish species and reasons behind their consumption

Throughout the interviews, the respondents made mention of different species of small fish which included bigeye grunt, anchovy, round sardinella, herring and others (**Appendix III**) but the commonest among the responses was anchovy followed by herring and round sardinella. Based on the answers of the respondents, diverse basic themes emerged i.e., nutritional value of small fish, cost of small fish, good taste of small fish, consuming small fish as a tradition; these based themes were then clustered to form the organizational theme “*Reasons for consuming small fish*”. An example of some of the responses based on tradition and cost is:

When we were young, our parents used to give us a lot of fish like the herring and anchovy. I also give my children and my husband this fish almost every day; it is part of our family food now because of what our grandparents and parents started. I buy it in bulk and store them so that I can use it every day or whenever I want to, it is cheaper that way and I do not have to spend money every time I need it.

Other respondents on the other hand, said their consumption of small fish is based on nutrition and taste. An example is this statement:

We eat small fish a lot, it gives a lot of blood, and it tastes very good especially anchovy. Sardinella has a great aroma when boiled and it makes food delicious.

Further example:

Small fish like the anchovy makes us stronger and gives us strong bones too because we chew all the bones in it. Herring gives proteins and it does not have a lot of fats in it, so it helps my children to grow very well.

Though responses were given regarding the less commonly consumed small fish species, statements like the above and similar ones are presented since majority of the replies were occupied by anchovy, herring, and sardinella and because it answers the research questions the researchers sought to explore.

Parts of small fish consumed according to species

Pertaining to the parts which were removed from the small fish during cleaning, the respondents gave varying reasons as to why they take out those parts. Whether a fish was eaten whole, or some parts removed was dependent on the species. For the commonly

consumed small fish species identified in this study, i.e., anchovy, herring, round sardinella, the respondents had diverse reasons for removing the parts or consuming it whole.

Most of the respondents indicated that they prefer to consume anchovy in the whole state and the reasons given were grouped into the basic themes – nutrition and good taste. A statement to clarify this finding is:

Oh, for anchovy, I do not need to take out any part because it is delicious with the head. Even the dry skin is crispy, and I like to eat it with banku and pepper sauce. I do not get sick often because of it and my husband and children also like it.

A further statement in support of it is:

The bone in anchovy gives me calcium and gives my children strong bones. I eat all of it because if I should take it out then I will not get the nutrients and energy in it. It tastes good too.

For herring, the narrations showed that the respondents usually remove the guts, fins, gills, and scales; several respondents also made mention of breaking of the head. Examples of such responses are:

If you do not remove the guts before using it in cooking, it can spoil your food. This fish has a lot of bones and if you are not careful it can hurt you. I remove all of them because I cannot eat them.

One more respondent related:

There is nothing in the head, it is just bones like the fin and tail, and it tastes as bad as the guts. The first time I ate the guts and the head, I regretted it and from then I always removed those parts; it tastes better that way and safer if there are not many bones in it.

Regarding round sardinella, some respondents mentioned that they remove the fins, gills, scales and do not consume the head as it contains stones. Examples were as follows:

Just the fish's body itself tastes good so the head does not add anything to it. Sometimes there are a lot of stones in the head of the fresh ones, so after washing them I cut the fins, tails, and then remove large scales on the body sometimes.

Another related response is:

I do not eat the whole fish. When I am making food, I break the head and throw it away; it does not serve any purpose just like the fins and those bony parts – tail, gills, scales, since they cannot be eaten. But my children like the eyes so usually I save it for them.

The responses related to the removal of parts of both herring and round sardinella were grouped into the basic themes – unconsumable parts and bad taste of parts. The initial basic themes emerging for the anchovy were linked and clustered with the basic themes emerging for both herring and round sardinella to form the organizational theme “*reasons for consuming small fish with or without parts.*”

Since anchovies were preferred in the whole form by most of the respondents, none of them in this study was seen or observed removing parts of this fish species. The mainly observed cleaning practise among the respondents of this study was the cleaning of fresh round sardinella and a handful of herring being cleaned to be processed i.e., smoked. After the interviews households that were preparing meals or getting ready for the market with round sardinella were observed while they cleaned the fish as they normally did. The fresh fish is first put in a big bowl and then filled with clean water. It is rinsed for some time then the dirtied water is poured away leaving just the fish in the bowl. The cleaning process begins from the head; for those that do not include the head, it is just cut off, but for the others, only the bony parts of the fish’s mouth is cut off. They then go on to remove the fins and then start scaling the fish on both sides. The gills were also removed then it is cut open to get rid of the viscera; the tail is usually the last part to be removed. All the removed unwanted parts were dropped in the same bowl containing the remaining parts of the fish. The remaining parts were then put in another bowl containing clean water and washed; both dirty waters were poured away afterwards.

Preferred form, processing, and cooking methods of small fish

During the observations, it was noted that several of the respondents preferred varying forms of small fish (**Appendix IV**) – either processed or fresh small fish depending on the species. Thus, two (2) basic themes emerged from the responses given; preference for processed small fish, and preference for fresh small fish. These basic codes were then put together to form the organizational code “*preferring fresh or processed small fish*”. Only one or two respondents mentioned that they like it in both forms; fresh and processed regardless of species.

Preference for processed small fish

Majority of the respondents mentioned that they prefer dried, or smoked, or fried anchovies and do not usually cook it in the fresh form. This was what one respondent had to say:

If you use the fresh anchovies in the boiling food, it might break into pieces because they are small. It is better when smoked or fried.

A relating response was also given by one more respondent:

I dry my anchovies in the sun mostly and sometimes too I fry them because drying takes a long time to finish. You can eat it quickly without doing anything to it.

Herring was also a small fish that was preferred in the processed form specifically when smoked as stated by the respondents. Some respondents prefer it in this form because to them, it tastes and smells better that way, and to some other respondents it is more delicious when the excess water is drained through the smoking process. Here is a statement to support this finding:

When you smoke it, the excess water is taken away to make it more delicious when you eat with your food.

An additional example is:

Smoking the herring gives it a unique smell and taste. It tastes better that way instead of using the raw one.

Preference for fresh small fish

Fresh unprocessed round sardinella was another commonly consumed small fish species in the coastal regions of Ghana as per this study findings. Though a few of the respondents said they preferred it dried or smoked, the remaining majority preferred it in the fresh state. This is a statement made by one respondent:

When I am not making soup, I like to spice and boil the fresh sardinella anytime my husband brings some from work – it tastes amazing when fresh and spicy.

An added response revealed that:

The freshness makes it taste better and makes the food more delicious. It becomes soft after putting it in the soup making it feel good in the mouth.

Cleaning, processing, and cooking methods

At the time of the observations, which included video recordings, not all the various households were getting ready to cook the main small fish species identified in this research work i.e., anchovy, herring, and round sardinella. Some respondents were preparing other small fish species like bigeye grunt, lesser African threadfin, African moonfish, and red pandora.

The respondents made the researchers aware that drying of small fish may take up to 3 days for it to be fully dried. From what was observed, frying anchovy and other species with cooking oil took an average of 10 minutes to finish and it was one of the most used cooking methods.

Another observation was that smoking was done through a specially made traditional smoker – as observed by the researchers, after the small fish e.g., herring was washed and scales, gills, fins removed but the head and viscera intact, they were placed on the smoker for the heat to roast it for some time. This process takes a while to complete, lasting for at least 15 minutes on average depending on the heat level. When this was done, it was usually ready to be eaten by the households just as it was or to be added to an already boiling soup before they consume – when it was added to a boiling soup, the head and viscera were removed and not consumed. It stayed in the soup for an additional 10 – 15 minutes average before it was done.

Regarding the observational findings made on the cooking of fresh small fish e.g., round sardinella, the respondents first wash it in a big bowl filled with water, and then remove the unwanted parts which included the head, viscera, fins, gills, tails into the same bowl. The remaining parts were then washed in another bowl containing clean water; both dirty waters were poured away afterwards.

The small fish was then boiled with spices and vegetables alone first, before it was added to the soup or sauce to boil together with it again before it the food was ready for consumption. This cooking process lasted approximately 15 – 30 minutes depending on the heat level.

5. Discussion

The main intent of the study was to determine the cleaning, and cooking methods of the most preferred small fish species in poor Ghanaian households. Some of the main small fish species identified were the bigeye grunt, red pandora, anchovy, sardinella, and herring, but the commonly consumed in this study were anchovy, sardinella, and herring.

Small fish has been study as a potential source to combat nutrition insecurity and malnutrition (Hasselberg, 2020) which remains widespread in Ghana especially among the poor communities, though there is a high consumption rate of fish in the country. It was therefore prudent to study the cleaning and cooking methods used by the urban poor in Ghana since those activities are a determinant of the nutritional quality of the fish. The study utilized an exploratory qualitative design to assess the cleaning, and cooking methods of small fish in poor Ghanaian households.

In exploratory research, a thorough inquisition into the existing phenomenon is a priority since further evidence must be established to make room for a viable solution overall (Singh, 2007). This design was appropriate for the study because it aided the researchers to better understand the existing phenomenon, to propose the way forward or a further action on the same concept. Most importantly, this design assisted the researcher to increasingly use the general knowledge about the phenomenon to identify issues and predict for any further study (Singh, 2007). The study additionally made use of a qualitative approach, and for that matter, non-numerical data were gathered and used to address the specific research questions raised in the study through themes development.

The qualitative data were gathered from a primary data source via one-on-one interviews and observations. This research approach was fitting for the study because of the in-depth responses required by the researcher to understand why the respondents use certain cleaning procedures for the different small fish species, and why particular cooking methods were used for the various small fish species. Owing to some grounds like daily schedule, observations, and convenience, the researcher had to employ a qualitative approach. The study sought to assess one main research objective i.e., determine the cleaning, and cooking methods of small fish in poor Ghanaian households.

Though not many research investigations have been done about the cleaning practices and cooking methods of small fish at the household level among the urban poor in Ghana, there

were a few literatures that state similar or varying findings to the one in this study. The findings that emerged at the end of the study have been discussed below.

Commonly consumed small fish species

As there is no universal definition for small fish, it was defined as any fish that is harvested at a maximum length of 25 cm for the purpose of this study. The species that were identified in this study were within the maximum length per the researcher's definition. Under the first specific research question, the researcher sought to assess the commonly consumed small fish species, and then the reasons behind their consumption in the various households. It was paramount that in Ghana, fisheries vary, and among such variations include marine, freshwater, and aquaculture sectors (Lauria *et al.*, 2018).

As was discovered by this study, Samey (2015) also observed that the species of fish that are predominant in the Ghanaian urban circles included the main species identified in this study i.e., herrings, round sardinella, and anchovy. Another survey in the northern part of Ghana revealed that small pelagic fish species such as sardinella, anchovy and mackerel together were popularly consumed compared to large pelagic species such as tuna and demersal species such as cassava fish, sea breams, etc. which agrees with this study findings; because these small fish species are not only available in easy to cook forms, but they are relatively affordable and nutritious (Afoley, 2018), as was also ascertained in this research work.

The validations of these findings can be compared to the affirmations of Hasselberg *et al* (2020) that data suggests that the main species consumed are imported mackerel and sardinella, locally landed herrings, anchovy, and tilapia from inland areas (Hasselberg *et al.*, 2020).

A report by USAID in 2009 emphasized that the most widely consumed fish species in Ghana include the affordable types such as mackerel, sardinella and anchovy. This agrees with the results of this study that small pelagic fishes are the most important species in Ghana in terms of consumption (Samey *et al.*, 2015).

Small fish species consumed with or without parts

The respondents indicated that they consume the anchovies whole with the head without removing any other part due to its small size and nutrients like calcium as indicated earlier in the results.

There were study findings indicating that in Ghana small fish is usually eaten whole with bones, heads, and viscera, as these parts are where most micronutrients are concentrated (Kawarazuka 2011), this therefore signifies the utmost valuable form of consuming fish in terms of nutrient density, providing vitamins A, D and B₁₂, minerals such as calcium and trace elements iodine, iron, and zinc (Reksten, 2020; Nordhagen, 2020; Hasselberg et al., 2020).

In contrast, filets are mostly consumed in larger fish – therefore the micronutrient-rich organs i.e., viscera and bones are usually removed, which limits the potential nutrient content (Underwood, 2000). This current study partly agrees with the research findings that small fish in Ghana are consumed whole since the respondents indicated that they preferred to eat anchovy in the whole form without removing parts; There was consequently the possibility that the respondents in this study do ingest a significant amount of vitamins A, D, B₁₂, and minerals such as calcium and trace elements iodine, iron, zinc essential for combatting micronutrient deficiency and ensure nutritional security.

But for both herrings and round sardinella, the respondents mentioned that they remove certain parts i.e., the scales, viscera, gills, and fins, the head leaving the skin and some bones before consumption, thus different from fillet samples; due to the boniness or spiky areas of these small fish species, it becomes difficult for it to be left whole without those parts before being prepared for consumption. This is therefore in disagreement in (Kawarazuka, 2011) study as not all small fish species in Ghana according to this study are eaten whole. This could be dependent on the species; respondents opted to remove some parts and leave the others - some species like the herring in this study turned out to be bony (contains a lot of bones) and that according to the respondents, is uncomfortable and risky to eat in the whole form. The visceral was also mentioned as bitter for both herring and sardinella thus the reason for their removal.

The cleaning practice observed in this study was like what Roos (2002) found among rural Bangladesh women - the women were asked to clean sampled fish as they normally did - the parts that were removed included gill cover, jaw, head, fin, tail and/or viscera. Since the heads that contain concentrated nutrients compared to just fillets (Kawarazuka, 2011; Roos, 2002) are discarded, respondents could be missing vitamins A, D, and minerals such as calcium and trace elements like iodine, iron, zinc (Reksten, 2020; Nordhagen, 2020) needed

to combat micronutrient deficiency (Underwood, 2000) from the species they do not consume whole according to several study findings (Gondolf & Thorseng, 2005).

Aside the nutritional aspect, there could be a risk of contamination due to a few improper cleaning practises used by the respondents in the study at a certain point of the observation i.e., releasing the visceral of the fish into the same bowl containing the edible fish parts. Feglo (2004) mentioned that improper handling and hygiene practices, can increase the likelihood of growth of microorganisms including pathogenic bacteria from faecal sources. Though these kind of studies in Ghana maybe be limited, Hasselberg (2020) recent microbial analysis of processed fish samples using the total colony count (TCC) states that samples of Ghanaian processed fish showed lower aerobic TCC mainly within the acceptable limit, indicating safety of the fish.

Cooking methods and preference for fresh or processed small fish

As presented in the findings, anchovy is preferred in the sun-dried or fried form by the respondents; they love to usually fry it for an average 10 minutes by themselves or buy the already smoked or sun-dried ones from the sellers. The study identified that the respondents preferred either fresh or smoked small fish depending on the specie except for anchovies which they preferred it fried or sun-dried. The cooking method used is on the other hand is based on the specie of small fish.

Small fish processing methods like sun-drying takes time to complete but since majority of the respondents were either fish traders or fish processors, the smoking or sun drying of the small fish was done by them before it reaches the customers; if not, they would have bought the already smoked or sun-dried ones just like the other respondents did. Though some of respondents preferred to fry anchovies due to the easy access to this small fish species, the processing method commonly mentioned by many of the respondents i.e., smoking and sun drying is not different from the findings of Atikpo et al. (1992) and Nunoo et al. (2015) but agrees that smoking and sun-drying of small fish which includes anchovies, are the two most widely used ways for processing and preservation in Ghana.

Sun drying was not a method the respondents usually want to do by themselves except the ones who work as fish processors; the reason could be due to time and socioeconomic factors i.e., the respondents do not have the equipment or access to the funds for an equipment to dry the anchovies quickly and efficiently, so, this process can take an average 3 days to complete according to them. Again, this means that there could be a risk of insufficient sun drying or

smoking and the likelihood of contamination with heavy metals or recontamination with microbes (Ikutegbe, 2014) if they try to do it by themselves using the traditional ways.

Because many respondents worked as fish processors and/or fish traders, smoking of herring was a common processing method that they did by themselves in this study. As already recognized in a few studies like Afoley (2018) that in Ghana, smaller fish (e.g., herrings, sardinella and anchovy) are the mostly processed (e.g., smoked) and affordable ones while the bigger fish are relatively expensive and some (e.g., tilapia) are sold in fresh form. Fresh fish is preferred, although processed fish is also often eaten (Mogensen, 2001). According to this study findings, the respondents eat the processed fish because it tastes and smells better that way; this is in concurrent with Quagraine et al (2019) study findings that the most preferred product by majority of Ghanaians is smoked fish due to its flavour and the fact that it remains intact when used in food preparation.

Nunoo et al (2015) explained in his study that the main species that are smoked traditionally included the main species identified in this study i.e., the anchovy, sardinella, and herring but even though several of the interviewed respondents preferred smoked sardinella, most of them in this study opted for the fresh unprocessed sardinella contrary to the findings of Nunoo et. al 2015. A notable difference was that the respondents who usually preferred fresh unprocessed sardinella mostly had partners who worked as fishermen or had direct contact with the fishermen, so they did not bother to stress on drying or smoking the sardinella which requires several minutes to days, while respondents who had no direct contact with fishermen preferred the already smoked or sundried form of sardinella. The difference could therefore have been the target population used in each of the study and the respondent's location and direct access to the fishermen.

Study findings on the effects of sun drying on the nutritional content of small fish have been investigated a limited number of studies. Michaelsen (2009) and Roos (2003) found that sun-drying retains the nutritional value for protein, fat, and minerals (iron, zinc, and calcium) in small fish, but destroys all Vitamin A. This might as well indicate that the respondents are not getting the Vitamin A from their commonly consumed small fish species i.e., anchovy, sardinella though this study findings shows that they were aware of the nutritional benefits of these small fish provide.

In contrast to the studies of Michaelsen (2009) and Roos (2003), processed i.e., smoked, or salted fish eaten whole are rich in vitamins, minerals, and essential fatty acids (Hasselberg et

al 2020). It has been documented that the reduced water content from smoking increases the concentration of several nutrients (Kiczorowska, 2019), but heating processes have also proven detrimental to vitamin D retention (Jakobsen, 2014); despite this, Hasselberg et al (2020) noted that processed small fish in Ghana can be considered a valuable dietary source of Vitamin D and fatty acids (EPA and DHA). Vitamin A levels in fresh unprocessed sardinella and anchovy have been found to be high in the whole state (with head, bone, skin) (Aakre et al., 2020). This is an indication that the small fish that were smoked in this study were likely to be a good source of micronutrients for the respondents of the study, yet there is also a risk of high level polycyclic aromatic hydrocarbons (PAHs) from burned wood or coal, mercury, and lead in the processed small fish (Hasselberg et al 2020).

Limited number of studies indicate that the cooking methods for fish can affect the bioavailability of iron (estimated to be 25 percent for both haem iron and the complex-bound non-haem iron, and 10 percent for inorganic iron) (Thilsted et al., 2012); boiled small fish contained more haem iron than one that was fried (Roos, 2007b). Once more, unlike smoking or boiling of the fish, frying decreases the concentration of fatty acids such as omega-3 fatty acids (EPA and DHA) (Thorseng, 2007; Chung et al., 2008; Vannice & Rasmussen, 2014). Both fresh and smoked sardinella and anchovy had the highest contents of the essential n-3 fatty acids EPA and DHA among a selected species of small fish from the North-western Africa (Aakre et al., 2020). The respondents performed a lot of frying with cooking oil and boiling of the fish as a cooking method during the observations in the study- per these study observations and literatures discussed, this could be a suggestion that to preserve essential minerals like iron, and fatty acids (EPA and DHA) necessary to combat micronutrient deficiency among the poorer populations in Ghana, boiling could be a preferable cooking method over frying of the fish.

Limitations of study

This research was mainly focused on the cleaning and cooking of small fish therefore the main respondents were women since they cook mostly in a typical Ghanaian household. Though they were important for this data research, some were not given permission from their husbands to partake, and so vital information might have been missed because of this. Since this project involved observations, the families involved might have wanted to do things differently than what they normally do, but this was addressed with the respondents before the start of the observations.

Due to the hostile nature of some of the areas, the researchers might have rushed the process to escape this hostility.

Language barrier in some regions might have had some effect on the data collected because the interpreters were from the regions; he might want to conceal some information. There is a current misconception about the COVID-19 vaccination in Ghana, most households met the researchers with hostility; they thought they were going to be forced to take the vaccine.

Time constraints coupled with the restricts due to COVID-19, made the data collection in the various households hectic but this by no means invalidates the findings as high rates and in-depth responses were achieved.

6. Conclusion

The study disclosed that majority the respondents had no or low levels of education and this could dent the hygienic handling, cleaning, and cooking practices relevant to maintain a high-quality fish required to combat micronutrient deficiency. The urban poor in the coastal regions of Ghana i.e., Greater Accra, Central, Western, Volta consume a lot of small fish and it is seen as affordable, a norm, and a valuable source of energy. This study demonstrated that poor households in the coastal areas of Ghana have a strong preference for fresh small fish or processed small fish based on the specie it is – these preferences were influenced by relationship status to a fisherman, proximity to a fisherman or the fishing area, and economic factor. This suggests that intimacy to a fisherman, closeness to fish markets or the fishing area, and the lower or higher price of the fish increases the preference for a fresh, or processed (smoked, sun-dried, fried, salted) small fish. The current study concludes that some improper handling and cleaning practices by the respondents may promote microbial growth and contamination by fecal matter - which can be said for the fresh small fish, undercooked or insufficiently dried or smoked small fish. Possible contamination of the small fish by high level polycyclic aromatic hydrocarbons (PAHs) (from burned wood or coal), mercury, and lead using traditional smokers, was another detrimental effect on the respondent's health and quality of the smoked small fish consumed in this study.

Recommendation

The findings from the current study have practical, and theoretical implications for understanding the context of cleaning and cooking practices of small fish among the urban poor in Ghana.

For practical implication, findings from the study would provide the urban poor households, consumers, and academia with knowledge of the practice of proper handling and cleaning methods for fish.

The following recommendations are therefore made.

1. Since this research study is the first of its kind, more research studies are recommended to be done for a more concrete finding which can be generalized to most of the urban poor in the coastal regions of Ghana.
2. Further studies on the handling, cleaning, and cooking practices of small fish should be extended beyond the coastal areas, for example into the inland areas, and with a different target population or the same target population.

3. The households and fish processors in the poor fishing communities should be educated on proper fish handling and cleaning through community gatherings by the chiefs or the fishing community leaders.
4. The nutritional benefits of small fish species and the current findings on the effects of cooking and processing (salting, smoking, drying) methods should be well explained and established among the urban poor since they tend to have a lower level of education and make be ignorant of such information.
5. Fish samples from poor households should be tested to determine the nutritional content in them, and to identify any harmful substances that might be present in the processed (salted, smoked, dried) fish that the urban poor consume.
6. The nutritional intake and status of the urban poor in these kind of fishing communities should be assessed to determine if they are getting enough proteins, vitamins A, D and B₁₂, minerals such as calcium and trace elements iodine, iron, and zinc from the main small fish species essentially capable of combating micronutrient deficiency in Ghana.

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Appendixes

Appendix I: Interview guide

Appendix II: NSD information letter

Appendix III: Some common small fish species

Appendix IV: Cooking and processing of some small fish

Appendix I.

The University of Bergen, Norway

SMALL FISH AND FOOD SECURITY: THE CLEANING AND COOKING METHODS OF SMALL FISH IN POOR GHANAIAN HOUSEHOLDS

INTERVIEW GUIDE

COMPLETED BY ASSISTANT

Household Number:

Name of Enumerator

Date of interview..... /...../.....

City and Locality.....

Region.....

Inclusion Criteria (Methodology) (Completed by field Assistant)

- Is your respondent a household based on the sampling criteria? Yes No
- Why do you consider this household to be poor? (Can be multiple answers)
 - Congested neighborhood/poor infrastructure Poor condition of the house No sanitation facility in the house No waste management item Others.....
- Is your respondent the female head of the household (involved in cooking)?
 - Yes No, Give reasons for your answer.....
- Does this household eat small fish: Yes/ No?

DEMOGRAPHICS OF RESPONDENTS

A1. Gender of respondent

A2. Age (Years)

A3. Marital Status

A4. What is your highest level of education?

A5. What is your occupation?

THE MAIN SPECIES OF SMALL FISH CONSUMED

Small fish is defined as any fish that grows to under 25 cm at maximum size.

B1. Where do you get the fish from?

B2. Who gets the small fish for the household?

B3. What main species of small fish do you normally eat?

Name of Species

Specie 1

Specie 2

Specie 3

B4. Do you remove any part of the fish?

If Yes, which parts do you remove and why?

i. Specie 1

ii. Specie 2

iii. Specie 3

B5. How do you want your small fish? Fresh/processed/both.

i. Specie 1

ii. Specie 2

iii. Specie 3

B6. Why do you prefer these species of small fish?

i. Specie 1

ii. Specie 2

iii. Specie 3

COOKING METHODS (OBSERVATION GUIDE FOR ASSISTANT)

C1. Which specie of small fish is being prepared to be eaten?

C2. Is the fish already processed before preparation to eat?

How is the fish processed/being processed? (Fried? Dried? Smoked? Salted? etc.)

C3. Is the fish prepared to be eaten whole or without the head?

Reason

C4. Is the skin of the fish removed before being prepared to eat?

How much skin is removed?

C5. Which other parts of the fish is removed/being removed before preparing to eat?

C5. How is the fish being prepared to be eaten and with what? (cooking with stew/soup, frying, roasting etc.)

C6. For how long is the fish prepared before ready for consumption?

Appendix II

Information Letter (a written consent form)



UNIVERSITY OF BERGEN

Are you interested in taking part in the research project “Small Fish and Food Security: A Study on The Preparation of Small Fish among Poor Ghanaian Households”?

PURPOSE OF THE PROJECT

The purpose of this project work is to study how small fish is prepared before consumption in poor coastal households of Ghana.

This project aims to encourage proper cleaning methods and cooking methods of fish in order to conserve the nutrients in it as much as possible. In addition, this project hopes to bring to light the importance of small fish in battling malnutrition in low socio-economic communities in Ghana.

The main aim of the project is to determine the small fish species consumed and how they are prepared by poor households in the coastal regions of Ghana.

The specific aims are to:

1. Identify the main species of small fish consumed by poor households in Ghana.
2. Observe how small fish is prepared and cooked by poor households in Ghana.
3. Compare how small fish is prepared and cooked by different coastal regions in Ghana.

The project work is a full-time master thesis at the Centre for International Health, Bergen Norway.

WHO IS RESPONSIBLE FOR THE RESEARCH PROJECT?

The University of Bergen and is the institution responsible for the project.

This project is in collaboration with the Institute of Marine Research (IMR) Norway and CSIR Ghana.

WHY YOU ARE TO PARTICIPATE?

You are selected to partake in this study because you are the head cook of this house, which meets the project’s criteria for electing a poor household; poor infrastructure, slums, inaccessibility to basic amenities low class, or in bad condition.

WHAT DOES PARTICIPATION INVOLVE FOR YOU?

If you choose to take part in the project, this will involve that you will be interviewed in depth and observed while preparing your meal; the researcher might join in via video call. Notes will be taken and recordings will be done. It may take approx. 60minutes. The study includes questions about why you choose to prepare and cook the small fish the way you do and the species of small fish you use in your cooking.

PARTICIPATION IS VOLUNTARY

Participation in the project is voluntary. If you chose to participate, you can withdraw your consent at any time without giving a reason. All information about you will then be made anonymous. There will be no negative consequences for you if you chose not to participate or later decide to withdraw.

YOUR PERSONAL PRIVACY – HOW WE WILL STORE AND USE YOUR PERSONAL DATA

We will only use your personal data for the purpose(s) specified in this information letter. We will process your personal data confidentially and in accordance with data protection legislation (the General Data Protection Regulation and Personal Data Act).

- All information will be processed and used without your name or personal identification number, or any other information that is directly identifiable to you.
- The list of details and respective codes will be stored separately from the rest of the collected data.
- The project is scheduled to end around June 2023; Information about you will remain anonymous and will be deleted after the end of the project.
- Data will be collected together with CSIR Ghana and will then be taken by the student to Norway for data analysis and for the rest of the project period.

YOUR RIGHTS

So long as you can be identified in the collected data, you have the right to:

- access the personal data that is being processed about you
- request that your personal data is deleted
- request that incorrect personal data about you is corrected/rectified
- receive a copy of your personal data (data portability), and
- send a complaint to the Data Protection Officer or The Norwegian Data Protection Authority regarding the processing of your personal data

WHAT GIVES US THE RIGHT TO PROCESS YOUR PERSONAL DATA?

We will process your personal data based on your consent. Based on an agreement with the University of Bergen, NSD – The Norwegian Centre for Research Data AS has assessed that the processing of personal data in this project is in accordance with data protection legislation.

WHERE CAN I FIND MORE?

If you have questions about the project, or want to exercise your rights, contact:

- CSIR-Food Research Institute via Amy Atter by phone: +233 508453747
- The Master student Yaw Opoku by email/phone : sagevalor5@gmail.com, +233 547713731
- The University of Bergen via Professor Anne Hatloy by email/phone: anne.hatloy@uib.no, +4799698766.
- Our Data Protection Officer: Janecke Helene Veim by email/phone - Janecke.Veim@uib.no, +4755582029, +4793030721.

- NSD – The Norwegian Centre for Research Data AS, by email: (personvermtjenester@nsd.no) or by telephone: +4755582117.

Yours sincerely,

Anne Hatloy
(Researcher/supervisor)

Yaw Opoku Agyei-Mensah
(Master student)

CONSENT TO PARTICIPATE IN THE RESEARCH PROJECT AS DESCRIBED ABOVE

I have received and understood information about the project *“The Preparation of Small Fish among Poor Ghanaian Households”* and have been given the opportunity to ask questions. I give consent:

- to participate in (interviews and observations).
- to be recorded during the project (audio recordings).
- for my personal data to be processed outside my home country.
- for my personal data to be processed until the end date of the project, approx. June 2021.

Place and date

Participant’s signature

I confirm that I have given information about the research project.

Place and Date

Signature (Researcher)

Appendix III

Some common small fish species

Common name	Scientific name	Local name	Habitat
African moonfish	<i>Selene dorsalis</i>	Ndademire ¹	Marine, demersal
Anchovy	<i>Engraulis encrasicolus</i>	Boeboe ¹	Marine, pelagic
Big eye grunt	<i>Brachydeuterus auritus</i>	Abobi ¹	Marine, benthopelagic
Congo dentex/ red pandora	<i>Pagellus bellottii</i>	Yiyiwa ¹	Marine, demersal
Herring	<i>Clupea pallasii</i> <i>Clupea harengus</i>	Amane/emane ^{2,3}	Marine, pelagic
Lesser African threadfin	<i>Galeoides decadactylus</i>	Sukue ¹	Marine, demersal
Round sardinella	<i>Sardinella aurita</i>	Eban ¹	Marine, pelagic
West African pygmy herring	<i>Sierrathrissa leonensis</i>	One-man thousand ¹	Freshwater, pelagic

¹Local names from Kwei (2005).

^{2,3}Local name from Linda (2017), Online twi dictionary.

Appendix IV

Cooking and processing of some small fish

Name of fish	Parts removed	Processing method	Processing Duration minutes (avg.)	Cooking method	Cooking Duration minutes (avg.)
Anchovies	No parts removed	Frying and sun-drying	10 3 days for drying	Frying	10
Round sardinella	Head, scales, fins, gills, viscera	Fresh unprocessed	N/A	Boiling (spiced and boiled alone)	15 - 30
Herring	Scales, gills, fins,	Smoking, with traditional smokers	15	Boiling (smoked ones added to boiling soup)	15 - 30