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Nourishing Nations: Improving the Quality and Safety of Processed Fish Products in Nigeria

Fish Innovation Lab

Final Technical Report October 2019 – December 2022

Cooperative Agreement 7200AA18CA0030

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Partners/Institutions

WorldFish
Penang, Malaysia

University of Calabar, Calabar
Cross River State, Nigeria

Mississippi State University
Mississippi, United States

Abbreviations and Acronyms

AAS	Atomic Absorption Spectrophotometer
ADP	Agricultural Development Program
ANOVA	One-way Analysis of Variance
ASF	Animal source foods
CVI	Content Validity Index
CVR	Content Validity Ratio
DARDA	Delta Agriculture and Rural Development Authority
FAO	Food and Agriculture Organization
GC-FID	Gas chromatography connected to a Flame Ionization Detector
HPLC	High-performance liquid chromatography
IYC	Infants and young children
IYCF	Infant and young child feeding
LGA	Local Government Area
LLT	Low literacy tools
MAD	Minimum Acceptable Diet
MDD	Minimum Dietary Diversity
MDD-W	Minimum Dietary Diversity for Women
PAH	Polycyclic aromatic hydrocarbons
WHO	World Health Organization
WRA	Women of reproductive age

Glossary

Content validity: The degree of agreement or intersects between performance on the material under investigation and ability to function in the job performance domain.

Low literacy tools: Tools with simple, comprehensible messages to educate about a specific topic. In this project, they included wristbands, aprons, and fans with messages about the benefits of fish for health and nutrition.

Minimum dietary diversity-Women: A dichotomous indicator considered the standard for measuring population-level dietary diversity of women of reproductive age. It is the summation of food groups consumed by a woman from a total of the required ten food groups. The ten food groups include: 1) Grains, roots, and tubers; 2) Legumes/Pulse; 3) Nuts and seeds; 4) Dairy products; 5) Meats or poultry, fish, seafood, and snails; 6) Eggs; 7) Dark leafy green vegetables; 8) Vitamin A-rich vegetables, Vitamin A-rich fruits, and red palm oil; 9) Other vegetables; 10) Other fruits. 6). An indicator of the probability of micronutrient adequacy for 11 micronutrients in a woman's diet consumption is ≥ 5 of the 10 food groups; women who consume ≤ 4 food groups are considered to have low dietary diversity and have a greater probability of micronutrient inadequacy.

Minimum dietary diversity: The minimum dietary diversity score for children 6-23 months old is validated measuring tool designed by the World Health Organization (WHO) to assess diet diversity as part of infant and young child feeding (IYCF) practices among children 6-23 months old as the population-level indicator

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Executive Summary

As an affordable and accessible animal source food (ASF) in Africa, fish is important for many poor and marginalized women, men and youth. However, fish processing methods in Nigeria remain limited to traditional salting, sun drying, and smoking methods. These methods expose fish to pests, insects, microorganisms, sand, and dirt. Smoked fish faces an additional health hazard of accumulation of polycyclic aromatic hydrocarbons (PAHs) due to high wood burning temperatures. Although processing fish is an important method of reducing postharvest loss, traditional methods can lead to a multitude of food safety issues that put consumers at risk. Additionally, heat, sunlight exposure, and fermentation processes alter the nutrient content of fish. Understanding how traditional processing methods impact the nutritional content of fish can help policymakers in prioritizing investments and interventions to ensure the safety of these important food products.

The Nourishing Nations project took place in Delta State, Nigeria from October 2019 to December 2022. WorldFish, Mississippi State University, and the University of Calabar worked together to achieve three objectives: 1) Develop cost per nutrient guides by analyzing the nutrient and contaminant profile of select processed fish products and their respective prices in comparison to other ASF, 2) Build capacity among women and youth fish processors to produce high quality, safe and nutritious processed fish products for local consumption, and 3) Educate women and youth fish processors about the benefit of fish in human diet and develop low literacy tool to help them better market their product. By accomplishing these objectives, the project worked to improve food and nutrition security in Delta State, Nigeria.

Capacity building among fish processors

The project strengthened capacity among fish processors in Delta State through a training program administered across two workshops. During the first workshop, fish processors were trained on the benefits of fish for human health and how to educate others about these benefits using simple low literacy tools, which included wristbands, aprons, and fans with messages about fish for health and nutrition. Sessions were also held on hygienic food handling. The second training workshop focused on providing fish processors with information and hands-on practical experience to improve the quality and safety of fish products, as well as strengthening their business and entrepreneurial skills to expand their businesses and financial access. Sessions during this workshop included topics on entrepreneurship, financial access, business plan development, formation and operation of cooperative societies, fish handling and packaging techniques, traditional and modern fish smoking and drying techniques, and value addition. An evaluation of the second workshop revealed that almost all participants (97%) rated the training highly and were willing to utilize the knowledge and skills gained. Overall, the training program enabled fish processors to grow their businesses, increase their market share, and diversify their product lines.

Engaging women and youth in the fish processing sector

With the majority of training participants women (~70%), this project's focus on women fish processors allowed for gender empowerment through collective action and business strengthening. By participating in the training program, women and youth gained knowledge on the nutritional value of fish and how to develop products that could satisfy the nutritional needs of pregnant and lactating women and infants and young children. This knowledge also gave them the means to develop fish products of higher quality and value, thereby strengthening market demand for their products. The training sessions organized on improved fish handling and processing and entrepreneurship further strengthened their skills as empowered actors in the fish processing sector. Additionally, platforms were developed to link fish processing cooperatives to strengthen collaboration and foster the exchange of knowledge, information, and skills.

Fish for human nutrition

In addition to improving knowledge about the nutritional value of fish and strengthening processors' skills to create high quality fish products through the training program, the project carried research to inform national nutrition policies and guidelines. Data were collected on the nutrient and contaminant profiles of select processed fish products as well as their respective prices with the goal of creating cost per nutrient guides to allow for comparison between fish products and other ASF. The project completed fish sample collection and analysis as well as four market surveys to capture seasonal fluctuations in price. Work is still ongoing to finalize the guides. Once complete, the guides will allow for an informed examination of the food environment in Nigeria and will support government stakeholders as they design nutrition-sensitive programs and policies. The information can also be used to update the Nigerian Food Composition Table and national Food Based Dietary Guidelines, which are often used in the design of nutrition education content and messaging. Data on the contaminants present in the fish products can also be used by policymakers to identify and mitigate food safety issues in this sector.

Recommendations

The project improved food and nutrition security by increasing knowledge and awareness of the importance of fish in the diet and food safety issues in the fish sector, strengthening women's social and economic empowerment through business training and improved product development, increasing production of nutritious and safe fish products, and improving consumer access to high quality and safe process fish products. To expand upon the accomplishments of the project, the following recommendations are suggested:

1. Engage with stakeholders to capitalize use of the training and educational materials developed through the project to continue creating opportunities for fish processors to strengthen their knowledge and skills. Information dissemination on improved fish processing, value addition and new fish products development should continue through workshops, lectures, seminars and sensitization programs on television, radio and social media.
2. Although the processed fish business provides employment opportunities and income to many in Delta State, particularly women, the absence of improved infrastructures, facilities, and equipment for processing may forfeit efforts toward improving the nutrition and safety

of processed fish products. Adequate funding of the sector is critical to promote the adoption of safe and quality improved practices along the fish processing value chain is needed.

3. Conduct additional longitudinal studies to evaluate the food security determinants of dietary diversity among women of reproductive age and children, with emphasis placed on raising awareness on the importance of dietary diversification.
4. Utilize the research gathered on the nutrient and contaminant profiles of fish to inform national guidelines, programs, and policies focused on nutrition, food security, and food safety.

Introduction/Justification

In Africa, fish is often a cheap and accessible animal-source food (ASF) and thus important for many poor and marginalized women, men and youth (WorldFish, 2017). Fish represent over 18.5% of the total ASF within the African region (Tacon & Metian, 2013), but in West Africa, they are the primary ASF for young children (Headey, et al., 2018). Nigeria is highly reliant on fish because of its many inland water bodies and access to the sea (FAO, 2018). Nigeria relies heavily on fisheries for its economy and nutrition (Selig et al., 2018). Per capita fish consumption is estimated at 13.3 kg per capita per year. While this is higher than the regional average for Africa (9.9 kg per capita per year), fish consumption in Nigeria is still substantially lower than the global average of 20.3 kg per capita per year (FAO, 2018; WorldFish, 2017).

Rural inland communities face several challenges to their health and well-being, particularly in regard to malnutrition resulting from low quality diets. Certain micronutrient deficiencies, such as iron, during the first 1,000 days of life (from conception to 2 years of life) are associated with reduced cognitive abilities (Beard, 2008). Fish caught and consumed from inland fisheries may provide some protection against the negative nutrition outcomes commonly seen in the rural poor, especially in children under two years. Many fish contain essential fatty acids and micronutrients such as vitamins A and B12, iron, calcium, zinc and iodine, as well as animal protein. In a meta-analysis including 49 countries, fish consumption was associated with a reduced prevalence of stunting1 (Headey et al., 2018). Small fish have been found to be even more nutrient-rich than large fish and thus capable of contributing a significant portion of the Recommended Nutrient Intake (RNI) of many minerals and vitamins (Bogard et al., 2015; Tacon & Metian, 2013). Small fish are also commonly under-exploited, and their value chain processes unreported, making them of particular interest in finding solutions to improve food and nutrition security (Kolding, et al., 2019). With strategic improvements to the small fish value chain, small fish can play a key role in addressing these dietary deficits.

Methods of processing fish in Nigeria remain limited to traditional salting, sun drying and smoking methods. Salting predominates as the main fish preservation method prior to transport or trade, due to almost complete absence of cold chain and temperature-controlled technology, leaving the fish prone to spoilage because of halophytic bacteria (Akintola & Fakoya, 2017). Sun drying, which is common in rural communities, exposes fish to pests, insects, microorganisms, sand and dirt. Bacterial growth and spoilage from sun drying is especially challenging during the rainy season (Kolding et al., 2019), and newer technologies like solar drying are rarely used. In fish smoking, the high wood burning temperatures and accumulation of polycyclic aromatic hydrocarbons (PAHs) in fish are similar throughout Nigeria and pose a higher carcinogenic risk than modern smoking practices (Yusuf et al., 2015). While traditional processing methods reduce postharvest losses and create value-added products for fish processors, they can lead to potentially unsafe products. This is a challenge shared in many developing African countries where technical advances and infrastructure such as hygienic landing centers, electric power supply, potable water, roads, refrigeration and appropriate processing and storage facilities are scarce (FAO, 2018). Consumers' awareness of food safety issues has increased, but there has been little attention given to addressing safety and quality concerns of traditionally processed fish products in Nigeria. Additional evidence is needed to elucidate how fish sourcing, handling, hygiene practices, and processing techniques affect the food safety conditions of commonly consumed processed fish products in Nigerian markets.

Processing methods can also lead to either a concentration or a reduction of vitamins and minerals. As an example, Vitamin C and β-carotene (a precursor of vitamin A) degrade when exposed to heat or sun drying (Navale et al. 2018). Thus, drying techniques can lead to an almost complete elimination of both micronutrients important for immune function (Roos et al., 2007). However, drying fish can also increase the concentration of nutrients that survive the drying process, thus increasing intakes if the product is consumed dried. In addition to nutrients, metal concentrations can also fluctuate during processing; this is concerning if fish with high metal concentrations are eaten frequently (Bassey et al., 2014). Understanding how traditional processing methods impact nutritional losses and gains can help better quantify the nutritional potential of fish. It can also help policymakers prioritize investments and interventions to ensure the safety of these important food products. Answering key questions about where fish handling and processing practices can be enhanced will lay the groundwork for developing safe and nutritious fish products for Nigerian consumers, while also providing the evidence required by policymakers to develop appropriate policy frameworks and regulatory practices.

Research Methods

Objectives

1. Develop cost per nutrient guides by analyzing the nutrient and contaminant profile of selected processed fish products in the Delta State of Nigeria.

2. Build capacity among women and youth fish processors in the Delta State to produce high-quality, safe, and nutritious processed fish products for local consumption.

3. Educate women and youth fish processors in the Delta State about the benefit of fish in the human diet and develop low literacy tools to help them better market their products

Study area

The study was carried out in Delta State, Nigeria because it a USAID Zones of Influence. The State is an oil and agricultural producing area bound by water bodies, estuaries, and sea, which all promote fishing activities. It is situated in the South-South geopolitical zone of the country with a population of about 5,663,362 according to the National Bureau of Statistics (2016). The capital city is Asaba, located at the northern part of the State, while Warri, located at the southern end, is the economic center of the State and is the most populated. Delta State has a total land area of 16,842 square kilometers. It covers a land mass of about 18,050Km square (6,970sqmi), of which more than 60% is land. The State lies approximately between Longitude 5° 00° and Latitude 6° 45° E and 5° 00° and 6° 30° N. It is geographically located in Nigeria's Midwest region, bounded in the North and West by Edo State, the East by Anambra, Imo and Rivers States, southeast by Bayelsa State, and on the southern extreme is the Bight of Benin which covers about 160 kilometers of the State's coastline.

Delta State consists of 25 Local Government Areas (LGA), which include: Aniocha South, Aniocha North, Bomadi, Burutu, Ethiope East, Ethiope West, Ika North East, Ika South, Isoko North, Isoko South, Ndokwa East, Ndokwa West, okpe, Oshimili North, Oshimili South, Patani, Sapele, Udu, Ughelli North, Ughelli South, Ukwani, Uvwie, Warri North, Warri South and Warri South West. The State is administratively, divided into three senatorial districts namely Delta North, Delta South and Delta Central as shown in **Figures 1a and 1b**.

Figure 1a: Map of Delta State showing the three senatorial districts.

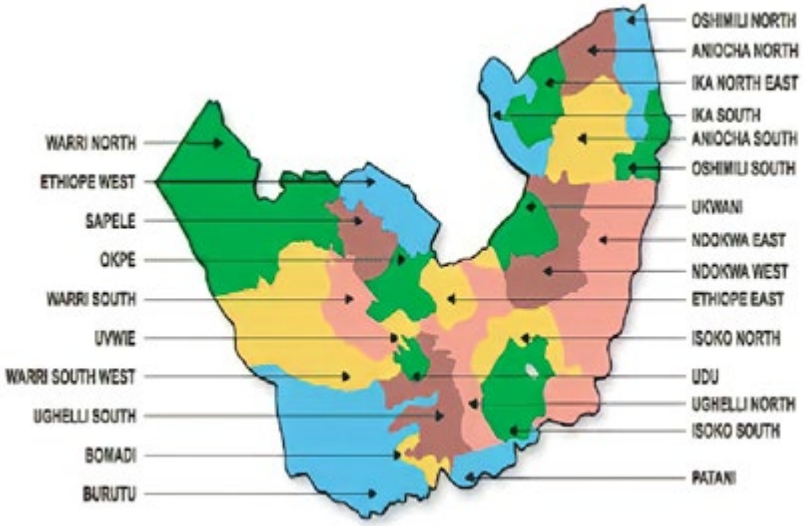


Figure 1b: Map of Delta State showing the LGAs

I. **Objective 1:** Develop cost per nutrient guides by analyzing the nutrient and contaminant profile of selected processed fish products in the Delta State of Nigeria.

a. Study design

The study used a combination of designs: cross-sectional, longitudinal, and experimental. Cross-sectional surveys were used to collect fish samples for nutrient analyses and to assess fish consumption among women of reproductive age (WRA) and their infant and young children (IYC) in Delta State. A longitudinal survey was used to collect market data on fish prices over a period of one year. Analyses of fish samples was experimental.

b. Study population

For the market survey and fish sample collection, the study population comprised all fish market vendors and the various fish species sold in Delta State, while for the consumption pattern study, WRA and their IYC between the ages of 6-23 months (mother and child pair) in the three senatorial districts of Delta State, Nigeria, made up the study population.

c. Sample size

To determine the sample size for the survey of WRA and IYC, Cochran's Formula was used (Cochran, 1963), such that:

$$n= Z^2 Pq/e^2, \text{ where}$$

e = desired level of precision (margin of error) at 0.05

P = Prevalence rate of malnutrition (i.e., stunting) among children (0-59 months) in Delta State = 18.1% (National Nutrition and Health Survey 2018)

q = 1-P

Z = 95% Confidence level = 1.96

Based on this formula, the sample size was calculated as n = 228

To account for non-response, the sample size was increased by 32% = 72.96, such that 228 + 72.96 = 300.96

Therefore, for the three senatorial districts, n = 300 respondents

d. Sampling technique

Sampling of LGAs. The State was divided into two depending on the availability of water bodies: area with abundant water body and less water body. In each senatorial zone, two LGAs with abundant water body and two with less water body were randomly selected, giving a total of 12 LGAs (6 with abundant water body and 6 with less water body). In each of the selected LGAs, a town with a major fish market was purposively selected based on large volume of the processed fish products, fish marketers and high patronage by majority of the consumers in the locality.

Table 1: Selected LGAs, towns and markets for the survey				
SELECTION CRITERIA	**SENATORIAL DIVISION**	**SELECTED LGAs**	**SELECTED TOWNS**	**SELECTED MARKETS**
AREAS WITH ABUNDANT WATER BODY AND FISH PROCESSORS	Delta North	Oshimilli South Ndowka East	Asaba Ossissa	Ogbe-ogonogo Main market
	Delta South	Patani Warri North	Patani Koko	Main market Inland market
	Delta Central	Ughelli North Uvwie	Ekiugbo Effurun	Main market Main market
AREAS WITH LEAST ABUNDANT WATER BODY AND FISH PROCESSORS	Delta North	Aniocha South Ika South	Ogwashi-uku Agbor	Afor-Ogwashi Ultra-modern market
	Delta South	Warri South Bomadi	Warri Bomadi	Ogbe Ijoh Main market
	Delta Central	Sapele Ethiope West	Sapele Oghara	Main market Ugbenu

Sampling of WRA and IYC. In all the selected LGAs and towns, the major Hospitals or Primary Health Care Centers where most mothers go for routine immunization of their babies were identified and selected. In each Hospital or Health Care center, using convenience sampling, 25 respondents (mother-child pair) that fit into the inclusion criteria and who were willing to participate in the study were selected for the survey.

Inclusion and exclusion criteria: Only women with IYC aged 6-23 months (mother-child pair) were selected for the study. Women with IYC below 6 months and above 23 months were excluded. Mothers with very sick children were also excluded from the study.

Sampling for market survey and fish sample collection. For the market survey, all the markets in the selected LGAs were used. The reason for the selection of areas with abundant and less water body is to check for variation in the prices of fish products based on location, as it is commonly assumed that proximity to the main source of fish may influence the price. In each market, depending on availability and consent, three to five randomly selected processed fish vendors of specific fish species of interest were used to obtain price information during each visit.

The fish sample collection was conducted in two markets per senatorial zone (one from area of abundant water body and one from area of less water body LGA) due to some logistics reasons

e. Ethical approval and informed consent

Ethical approval was obtained from the National Health Research and Ethics Committee (NHREC), Abuja. Informed consent was obtained using a written consent form that was read out to participants for their approval. It included the objectives, procedures, and duration of the survey. Participants were made to understand that their participation was solely voluntary, that there were no risks whatsoever, and that they were free to opt out should they at any point in the survey feel the need to discontinue. They were required to sign the consent forms when they had given their approval.

f. Data collection and methods

Instrument for data collection from respondents. A well-structured questionnaire was constructed by the researcher and used to obtain information from the target population. The questionnaire assessed the nutritional knowledge and practices of WRA, their perceptions of fish and fish consumption patterns, commonly consumed fish species by the target groups, and dietary diversity using a 24-hour dietary recall. The questionnaire was content validated by a nutrition expert in the Department of Human Nutrition and Dietetics, University of Calabar, Calabar and pre-tested by administering to 20 WRA in the University of Calabar.

Recruitment and training of research assistants. Research assistants, made up of final year students in the Department of Human Nutrition and Dietetics, University of Calabar were recruited to assist in administering questionnaires to respondents. The researcher assistants were trained for three days on objectives and importance of the survey, the instrument for data collection, and method of administration of the questionnaire for efficient and effective data collection.

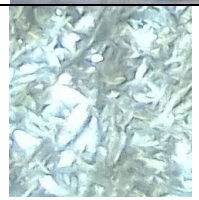
Administration of questionnaires. Questionnaires was interviewer-administered in English language and pidgin to 300 WRA (15-49 years) in Delta State who were currently with infants (6-23 months) (**Appendix 1**). The respondents were acquainted with all that the survey entails and were asked questions from the questionnaires. For the dietary diversity measurement, women were asked to recall and mention all foods and drinks consumed and/or given to the child the previous day (24-hour recall). These included all meals, snacks, and drinks. They were encouraged to remember every food consumed per meal and in-between meals. If the woman did most of the cooking for herself or the household, she was asked to name or describe all ingredients and condiments used for preparation of the meal.

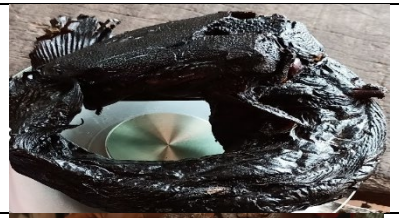
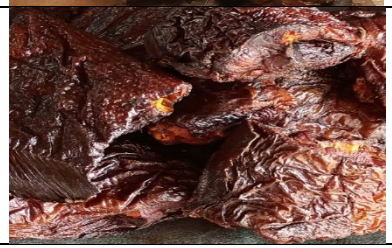
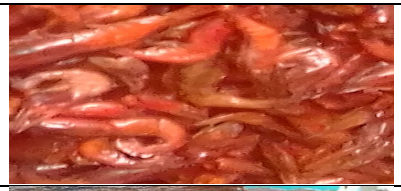
Collection of price Information. Market surveys were carried out quarterly (December 2021, March 2022, June 2022 and August 2022) for a period of one year using an interview form (**Appendix 2**) to collect the prices of processed fish products and other ASF sold in the markets in Delta State. For each type of fish and ASF considered in the study, prices were obtained from five vendors in each market. A measuring scale

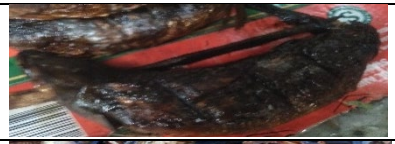
(Prochef electronic kitchen scale, 3Kg/1g capacity) was used to determine the weights of the products as their prices were being determined. The price and weights of the following ASFs were determined: beef, cow liver, cow heart, cow kidney, poultry, egg and milk (powder and liquid). These were selected because they are the most commonly consumed by the target groups.

Collection of processed fish samples. Fish samples were obtained from only six markets that have been included in this study and two markets represented one senatorial district. They are: Ogbe Ogonogo market in Oshimili South LGA and Ogwashi-uku main market in Aniocha South LGA representing Delta North; Ugbenu market in Ethiope West LGA and Ekiugbo main market in Ughelli North LGA representing Delta Central; Koko inland market in Warri North LGA and Ogbeijoh market in Warri South LGA representing Delta South. For each district, one of the markets was selected from an area with abundant water body and the other from an area with less water body. The fish species collected for analyses were species with no data in the West African and Nigerian food composition tables, and those that are in the food composition table but not in the forms that are commonly consumed in Delta State. **Table 2** shows fish species collected for the study.

Table 2. Fish species included in the study

	Scientific names	**Source**	**Local names**	**Pictures**	**Common names**
1	*Ethmalosa fimbriata*	Captured	Ukaka (Urhobo)		Bonga (smoke-dried)
2	*Oreochromis niloticus*	Captured/ Cultured	Ife (Urhobo)		Tilapia (smoke-dried)
3	*Clupea harengus (clupieds)*	Captured			Iseun (smoke-dried) Iseun (sun dried)

4	*Clarias gariepinus*	Captured/ Cultured	Onrueri (Urhobo)		Catfish (smoke-dried)
5	*Elops saurus*	Captured	Ukpoku (Urhobo)		Lady fish (smoke-dried)
6	*Gymnarchus niloticuss*	Captured			Asa (smoke-dried)
8	*Procambarus clarkia*	Captured	Isha (Igbo) Iku (Urhobo)		Crayfish (smoke-dried)
9	*Macrobrachium rosenbergii*	Captured/ cold store specie	Oporo		Prawn (smoke-dried)
10	*Cynoglossus brown*	Captured	Bolibo		Tonguesole (smoke-dried)

11	*Merluccius capensis / merluccius*	Cold store specie	Okporoko		Stock fish (Air dried) Panla (Smoked)
12	*Trachurus Trachurus*	Captured/ cold store specie	Chiny		Horse Mackerel (smoked)
13	*Scomberomorus maculatus*	Captured/ cold store specie	Scumbia		Atlantic mackerel (scombia) (smoked)
14	*Hyperopisus Bebe Occidentalis*	Captured	Ewo (Itsekiri)		Broke manage (smoke-dried)
15	*Penaeus spp*	Captured	Ikpa		Shrimp

In each market, a sample of each fish species was purchased from seven vendors. There 17 fish species to be collected making a total of 119 fishes from each market and 714 fish samples from the six markets. The samples were put into sterile zip lock bags and properly identified with the following details: the common name, scientific name, location and date of sample collection. The samples were put in Styrofoam boxes with ice packs and transported from the point of collection (market) to the laboratory. The samples collected from the markets were stored in a deep freezer until ready for analyses.

g. Sample handling/preparation

Depending on the fish species, the parts for analysis were prepared the way they are being consumed in Nigeria and did or did not include head, viscera, bones, scales or other parts. The fish samples collected were classified as small and large fish. Small fish are fish typically consumed whole with the head, skin, tail, bones and viscera intact, while for large fish only the fillet is typically consumed (Bogard et al., 2015)

Prior to preparation, fish samples of the same species were pooled into composite samples, with each composite sample representing one species from one location. Samples were pooled based on senatorial districts. Fish species that are consumed whole, were left whole, while others with inedible parts had their inedible parts removed as shown in **Table 3**. The moisture content of fish samples as purchased were determined and samples were shredded into bits and air oven-dried at a temp of about 55oC for about two hours or more depending on the level of moisture they contained. After drying, fish samples were homogenized using a grinder and afterwards, were packed in Ziplock bags and stored in the freezer until ready for analyses.

Table 3: Fish species and parts analyzed

Scientific names		**Common names**	**Parts to be analyzed**
1	*Ethmalosa fimbriata*	Bonga (smoke-dried)	Fillet Whole Fillet + Bone
2	*Oreochromis niloticus*	Tilapia (smoke-dried)	Edible portion Fillet
3	*Clupea harengus (clupieds)*	Iseun (smoke-dried)	Edible portion Fillet
		Iseun (sun dried)	Whole
4	*Clarias gariepinus*	Catfish (smoke-dried)	Edible portion Gill
5	*Elops saurus*	Lady fish (smoke-dried)	Edible portion Gill
6	*Gymnarchus niloticuss*	Asa (smoke-dried)	Edible portion Gill

7	*Procambarus clarkia*	Crayfish (smoke-dried)	Whole
8	*Macrobrachium rosenbergii*	Prawn (smoke-dried)	Fillet Whole
9	*Cynoglossus brown*	Tonguesole (smoke-dried)	Edible portion
10	*Merluccius capensis / merluccius*	Stock fish (air dried)	Edible portion Gill
		Panla (Smoked)	Edible portion
11	*Trachurus Trachurus*	Horse Mackerel (smoked)	Edible portion Gill
12	*Scomberomorus maculatus*	Atlantic mackerel (scombia) (smoked)	Edible portion Gill
13	*Hyperopisus Bebe Occidentalis*	Broke manage (smoke-dried)	Edible portion Whole
14	*Penaeus spp*	Shrimp	Whole

h. Nutritional analysis of fish samples

The samples were analyzed for contents such as:

Proximate – protein, fat, moisture, and ash content

Mineral composition - Iron, Zinc, Selenium, Calcium, and Iodine

Vitamin analysis - Vitamin A, Folic acid, B1, B2, B3 and B12, vitamins E and D.

Fatty acids

Amino acids

The nutrients above were selected based on three reasons: 1) How essential they are to the target population; 2) Nutrients fish and other ASFs have in common; 3) Nutrients fish is a good source of.

Methods of Nutrient Content analyses**:**

1. Moisture content was determination using Air-oven drying method.
2. Protein by Kjeldahl method.
3. The fat contents of the samples were analyzed by continuous Solvent/mixed solvent extraction method.
4. Ash content of the samples were analyzed using ashing method.
5. Vitamins: High-Performance Liquid Chromatography (HPLC) technique was employed.
6. Minerals: Wet ashing followed by Atomic Absorption Spectroscopy was employed.
7. Amino acids: High-Performance Liquid Chromatography was employed.
8. Fatty acids: HPLC was employed in the analysis of fatty acids

Determination of Carbohydrates. The carbohydrate content was determined by subtracting the sum of protein, fat, moisture and ash from 100.

%Total Carbohydrate = 100 – % [protein + fat + moisture + ash] (AOAC, 2010).

i. Contaminant profile

Microbial analysis. Microbial analysis of samples using ten-fold serial dilutions was carried out applying the methods of (VonSchelhorn, 1980; Downes and Ito, 2001). Fifty grams each of the sample was weighed and placed in sterile blender previously sterilized with 70% alcohol and rinsed with deionized water. The samples were then blended aseptically, and twenty-five grams of the product was placed in 225ml of sterile maximum recovery diluents (peptone) in sterile flask for enrichment. Inoculation and incubation were done using the pour plate method of Downes and Ito, (2001). One milliliter (1 ml) of desired dilution (10-3) was pour plated in duplicates onto Nutrient agar, MacConkey agar, mannitol Salt agar and sabouroud dextrose agar.

All the bacteria plates were then incubated at 37ºC for 24 hours while the fungi plates were incubated at 25ºC for 48-72 hours. Colonies were counted using a colony count machine (J - 2 Colony Counter, Kenkos Tech INC). Enumeration and isolation of pure cultures was done using a

sterile inoculating loop to transfer each discrete colony on a petri dish into plates containing freshly prepared Nutrient agar and was incubated at 37ºC for 24-48hrs. After incubation, the colonial morphologies (cultural characteristics) of the isolates were recorded and compared with descriptive features contained in the manual of (Holt, 1994). Microbial load was calculated using the formula (CFU/g) = (Number of CFUs on plate x 103) / dilution.

Aflatoxin analysis. The analysis was done using the Agilent method for the determination of aflatoxin with high-performance liquid chromatography (HPLC). Agilent 1260 Infinity system, consisting of solvent rack, quaternary pump (with built-in degasser), standard auto sampler, column compartment and fluorescence detector, was used for separation and quantification. Sample weighing 25g and 2g of sodium chloride were put into highspeed blender jar and 125ml of HPLC Grade methanol:distilled water (60:40, v:v) was added into the jar and blended for 1 minute at high speed. The extract was diluted with 125ml of distilled water, mixed well by swirling, followed by filtering approximately 40-50 ml of sample extract through Whatman No. 4 filter paper immediately, 10ml of the filtrate (equivalent to 1g of sample) was transferred into the glass syringe barrel for passage through the prepared immunoaffinity column (ref. to AFLAPREP® column preparation manual) at a flow rate of 2-3 ml/min. Then 10ml of distilled water was added to the glass syringe for washing the column. The residual water was expelled from the column and 1ml of HPLC grade methanol was transferred accurately to elute aflatoxins from the column. All the methanol elution was collected and diluted with 1 ml of distilled water before injection into HPLC system for results to be displayed.

HPLC Conditions Column were: Zorbax Eclipse Plus C18, 4.6 x 150 mm x 5 µm Column Temp.: 40 °C Mobile Phase A: 1L water containing 238 mg KBr and 700 µL 4M HNO3 Mobile phase B: MeOH Isocratic: A：B = 50 : 50, 12min Flow rate: 1.0 mL/min Detection: Ex: 362 nm, Em: 455 nm, gain = 15 Injection: 20 µL Electrochemical Current: 100 µA setting Reaction coil: 0.5 mm i.d.*34 cm long peek tubing (from the exit of KOBRA cell to the entrance of FLD).

Heavy metal analysis. Heavy metal analysis was done using the Atomic Absorption Spectrophotometer (AAS) (Agilent 55 Atomic Absorption Spectrometer) with the metal solution standards as it varies. Heavy metal standard (0.20 grams) was weighed and dissolved by adding to it about 100ml of distilled water in a 250ml beaker. The solution was transferred to a 500ml volumetric flask and made up to volume by diluting with distilled water and mixed well. Concentration was calculated in terms of part per million (ppm) (Concentration in ppm = Amount of solute/Amount of whole solution x 106). Final concentration was about 100 ppm for the experiment.

Standard solutions were prepared with the following concentrations 6ppm, 4ppm, 3ppm, 2ppm and 1ppm. The above solutions were aspirated, and the absorbance measured. Then correlation coefficient by the instrument/computer was calculated. Thereafter 50mg of the sample was weighed into a round bottom flask and 20ml of a well-mixed acid (HNO3 and HCL-Aqua-regia) in the ratio of 1:3 was poured into the flask containing the solid sampling the fume hood. This was heated mildly at 80 ºC for about 15-20 minutes in the electro-thermal heater to a little dryness when digestion is complete. This was allowed to cool; 50ml of distilled water was poured into the flask, swirled, then filtered using Whatman filter paper into 100ml volumetric flask and made up with distilled water to the mark. Then analyzed using the Agilent 55 AAS instrument and results displayed on the screen. Heavy metals of interest were Lead, Nickel, Zinc, Copper, Mecury, and Cadnium

Pesticides analysis. The analysis was done using the extract method for GC-(FID). A Hewlett Packard 5890 series II gas chromatography connected to a Flame Ionization Detector was used. One microliter of the sample was injected in the pulsed spit less mode onto a 30m x 0.25mm ID DB 5MS coated fused silica column with a film thickness of 0.15 micrometer. Helium gas was used as a carrier gas, while hydrogen and compressed air were used as the ignition gas. The column head pressure was maintained at 20psi (pounds per square inch) to give a constant of 1ml/min. Other operating conditions include; injector temperature 250°C, Detector temperature 300°C, oven temperature program, initial temperature 80°C hold for 1 min, Ramp temperature 30°C/min to 175°C hold for 4 min, then 3°C/min to 225°C and hold for 6 min. Gas chromatography flame ionization detector (GC-FID) Hewlett Packard 5890 series was set with the Accu-standard.

Then 50mg of the sample was weighed with an electronic weighing balance into a beaker and 10ml of the solvent mix (1:1 - Hexane: Dichloromethane) was measured and poured into the beaker flask to dissolve and homogenize the extract. The homogenized extract was cleaned up with 100 -200 mm mesh silica gel and 3 g of anhydrous sodium sulfate in a well-packed column, conditioned with hexane to form a slurry. The extract is ready for analysis and one microliter of the sample in the vial was injected into the injector part/ Inlet of the GC-FID machine. The analysis was allowed to run for 35minutes as programmed by the system. The analysis terminated automatically at the end of the run time and the result was displayed on the screen. Pesticides of interest were the Organochlorine pesticides (OCPs).

PAH analysis. The analysis was done using the extract method for GC-(FID). A Hewlett Packard 5890 series II gas chromatography connected to a Flame Ionization Detector was used. One microliter of the sample was injected in the pulsed spitless mode onto a 30m x 0.25mm ID DB 5MS coated fused silica column with a film thickness of 0.15 micrometer. Helium gas was used as a carrier gas, while hydrogen and compressed air was used as the ignition gas. The column head pressure was maintained at 20psi to give a constant of 1ml/min. Other operating conditions were preset. The column temperature was initially held at 55°C for 0.4min, increased to 200°C at a rate of 25°C /mins, then to 280°C at a rate of 8°C /mins and to a final temperature of 300°C at a rate of 25°C /mins, held for 2mins. The identification time was based on retention time, and components with lower retention time elute first before those with higher retention time. 50mg of the sample was weighed with an electronic weighing balance into a beaker and 10ml of the solvent mix (1:1 - Hexane: Dichloromethane) was measured and poured into the beaker flask to dissolve and homogenize the extract. The homogenized extract was cleaned up with 100 -200 mm mesh silica gel and 3 g of anhydrous sodium sulfate in a well-packed column, conditioned with hexane to form a slurry. The extract is ready for analysis. 1 microliter of the sample was injected through the injection port into the GC-FID .and result displayed after the run time (35 minutes).

j. Data/statistical analysis

Data analysis. Data obtained from questionnaires were coded and analyzed using Statistical Package for Social Sciences (SPSS). Using FAO (2021) and WHO (2008) cut off for Dietary Diversity Scores, estimates obtained were categorized as low, medium and high for both WRA and IYC as follows:

DDS for WRA: Low = <5; Medium = 5 – 7; High = >7

DDS for IYC: Low = <4 excluding breast milk; Medium = 4 – 6; High = >6

Calculation of nutritive cost. The nutritive cost of fish and other ASFs were calculated per 100g edible portion (EP).

Yield percentage = (Edible portion Quantity)/(As purchased quantity (APQ)) X 100

Edible portion cost = (As purchased cost)/(Yield percent)

Statistical analysis. The data from respondents were cleaned prior to analysis by running frequencies of data entered to ensure the absence of duplicates and missing values within the dataset. The data were analyzed using descriptive statistics such as frequency, percentages, mean, mode, median and represented using pie-charts or bar charts. Inferential statistics were used in testing the relationship between categorical variables. Statistical significance was set at $p<0.05$.

Price data were analyzed using Microsoft Excel and presented as average cost of ASFs per Kilogram. Results obtained from nutrient analysis of processed fish products and price information was analyzed, and comparisons were made against selected ASFs using One-way Analysis of Variance (ANOVA) for respective nutrients.

II. **Objective 2:** Build capacity among women and youth fish processors in the Delta State to produce high-quality, safe, and nutritious processed fish products for local consumption.

A training program composed of two workshops was held to build capacity among women and youth fish processors. The first workshop is described in detail under Objective 3. The second workshop, which had the theme, “Improving fish processing, value addition and investment opportunities for fish processors in Delta State, Nigeria,” is described in detail here.

The second workshop took place between 5th and 9th December 2022 in Asaba with participants from three Senatorial zones (Delta North, South, and Central) of the State. Participants included 75 (54 female and 21 male) fish processors. The trainings covered the following topics:

1) Entrepreneurship
2) Access to financial space/Funding for fish
3) Developing fish business plan
4) Fish handling techniques
5) Traditional/modern fish smoking techniques
6) Traditional/modern fish drying techniques.
7) Fish Value Addition
8) Fish packaging techniques
9) Cooperative societies
10) Practical sessions

Training manual was developed by the joint efforts of the project team and the facilitators. The facilitators included the following:

1. Mr. Bernard Ofuani, Girls Power Initiative, an NGO
2. Mr Charles Eze, DARDA
3. Dr. Endurance Okhale, Dept of Animal Science, Edwin Clark University, Kiagbodo, Delta State.
4. Mrs. Ogochukwu Anigbere, CNFA- Feed the future Ag-investment Activity
5. Mr. Charles Mordi, Director Fisheries, DARDA, Delta State
6. Mr. Oleh Donald, Dept of Aquaculture and Fisheries Management, University of Benin, Edo State
7. Dr. Kenneth Omoruyi, Dept of Aquaculture and Fisheries Management, University of Benin, Edo State
8. Dr. Marinus Egwenomhe, Dept of Aquaculture and Fisheries Management, University of Benin, Edo State
9. Mr. Chinweike Nwankwo, an entrepreneur fish processor, Asaba, Delta State.

A full description of the events for each day of the workshop are provided below:

DAY 1 (5th December 2022): Opening session

The day began with the arrival of the team arriving at the training venue, Delta Agriculture and Rural Development Authority (DARDA) at about 8.43am. Registration of participants commenced and was handled by the M.Sc. students, Ikenna Okere and Joy Esate. The training started proper at 11:32am where Dr. Nuntah Joseph, the moderator welcomed everyone present and called on Mrs. Mamode Ogboru, the director of Extension, DARDA to take the opening prayer and afterwards, the Nigeria National anthem was sung. The underlisted persons were present at the opening session:

1. Mr. Chukwuemeka Israel, Programs Manager, DARDA
2. Mr. Charles Mordi, Director Fisheries, DARDA
3. Mrs. Mamode Ogboru, Director of Extension, DARDA
4. Mr. Edafe Orovwovo, DARDA
5. Mr. Ashoro Collins, SRC, LIFE-ND Project
6. Prof. Henrietta Ene-Obong. Co-PI. Nourishing Nations Project, University of Calabar
7. Mrs. Anigbere Ogochukwu, CNFA- Feed the future Ag-investment Activity.

Introduction: There was a general introduction whereby participants introduced themselves. This was followed by a short presentation titled “opening remark and objective of the training” given by Prof. H. N. Ene-Obong, the Co-Principal investor for the project in Nigeria. She started out by introducing the project and all members of the team. She also stated the benefits of fish and reminded the processors what they learned during the first training with regards to the safety of fish and how they provide essential nutrients in a more absorbable form than other animal food sources and emphasized the importance of fish for women of reproductive age and children. She also stated the objectives of the Nourishing Nations project and shared the project’s success story. It was on this note that she encouraged processors to be attentive during the training and try to put into practice what they will learn. She added that they could process fish into powdered form and package for sales which could be used as an alternative to “soya bean powder” which mothers used in enriching cereal pap for infants and young children. A welcome remark was given by the Program Manager, DARDA, Mr. Chukwuemeka. He commended the team for their efforts in putting the training together, and

emphasized how grateful and happy they were having the team in Delta State. He also added that he has worked with Feed the Future on several projects.

Goodwill messages: Goodwill messages were given by several persons, one of which was Mr. Ashoro Collins who appreciated the project and encouraged participants to be involved in the training so they can benefit from it. Another message was given by Mrs. Mamode Ognoru, who thanked the team for keeping their words and coming back as promised, and encouraged participants to learn as much as possible. Mrs. Ogochukwu stated the fact that she has been involved in Feed the Future projects and told the participants that they were very fortunate to be part of the training and asked them to make the most of it. Mrs. Bosin and Mr. Orila, former participants in the Nutrition and Safety training said they benefitted a lot from the previous training. After the goodwill messages, a group photograph was taken at about 12:15pm and tea break followed.

Presentations: The first presentation titled "**Entrepreneurship**" commenced at 1.05pm and was given by Mr. Bernard Ofuani who spoke extensively on the topic. He talked about evolving in business which is very necessary for sustainability and added that in addition to making profit, *a business must solve problems and that any business not solving problems cannot be sustained.* He taught the house SWOT analysis, which is a method that helps companies achieve their goals, improve efficiency and maintain brand relevance. He went on to talk about the benefits of this analysis and how it could help participants have a sustainable business. He ended the lecture by saying that *one of the threats to businesses is poor record keeping and an unwillingness to learn.* After the lecture, Mrs. Pamela, a participant asked how one could adapt to changes in the marketplace, Mr. Ofuani responded by saying that adaptation and evolving go hand in hand and that one has to look around to see the problems and try to adjust by either changing approaches or methods.

The next presentation, "**Funding for Business**" was given by Mrs Ogochukwu Anigbere, a representative of Feed the Future Nigeria Agribusiness Investment Activity. She spoke about her organization and the role they play which are: broaden access to finance, connect agribusinesses particularly women or youth-owned and investors, partner and collaborate with agribusinesses. They also offer technical assistance by fine-tuning business models and prepare people for their interaction/discussions with investors. After the lecture, a participant, Mr. Charles requested to know what technical assistance the organization offers, she responded by saying the organization facilitates the process of accessing funds. Another participant, Mrs. Adaeze wanted to clarify whether the organization help processors meet the bank or the processors have to meet the bank themselves. Mrs Ogochukwu said processors could come to their organization and they could guide them on the banks to meet depending on their needs. She stated that they as an organization could also step in to mediate the process of accessing funds. Another question was asked by Dr. Endurance whether the organization only work with people already in their plan or would like to incorporate the participants. Her response was that they allow people show interest and once that is done, they step in and begin to help.

The third presentation was titled "**Developing a Fish Business Plan**" was given by Dr. Endurance Okhale at about 2. 45pm. He began by saying that *a business plan is like a road map which gives direction on how the business should go.* He clearly defined the features of a good plan and practically showed the house how to write a good business plan using a well drafted plan. He mentioned some key points one must include in a plan, one of which is an ***executive summary*** which highlights the contents of the entire plan, a ***background***- which describes the business, ***the objectives of the business, business location, and operational cost.*** Participants were asked to tell what they had learnt, of which a few stood up to share what they learnt. Prof. Ene-Obong mentioned that the participants will be shared into 5 or 6 groups in order to practicalize what has been taught regarding the development of a business plan.

Mr. Charles Eze, a facilitator at 3.30pm gave a very brief introduction on **Cooperatives.**

Goodwill messages were given and Mrs. Bridget expressed her excitement towards the project and prayed God sustains the project. Mrs. Esther Soweperegha thanked the team and encouraged other participants to learn as much as they could.

Prof. Ene-Obong, towards the end of the day's meeting, reiterated the fact that the participants were very privileged to have these kinds of information at their disposal and encouraged them to take what they learn seriously and put them into practice. Dr. Nuntah ended by appreciating all facilitators and participants for being part of the day's training. The closing prayer was taken by Mr. Orila and the training ended at 4.03pm

DAY 2 (6th December 2022): Session 2

The second day started with registration of participants at about 9.35am, while the training started proper at 10.38am with opening prayers led by Miss Jennifer. The National anthem was sung thereafter. A recap of the previous day's activities was done by Joy Esate.

The first presentation was titled: **Fish handling procedures** and was given by Mr. Charles Mordi, Director of Fisheries, DARDA. He began by stating that spoilage of fish starts immediately after harvest from the gills with a change in colour, therefore, certain procedures must be carried out to ensure the fish is safe for consumption. He went on to talk about fish handling/preservation methods such as salting, sun-drying, smoking, and freezing, laying emphasis on salting as the best and most affordable method.

The second presentation was given by Dr. Kenneth Omoruyi with the title: **Traditional and Improved Fish Smoking Techniques.** He spoke extensively on the types of smoking stating that there are two types: cold smoking which is carried out at 30°C-80°C, and hot smoking carried out between 80°C - 120°C. He also taught the procedure for fish smoking and went further to clearly differentiate between traditional and improved methods of smoking, stating that traditional smoking involves suspending fish in a smokehouse over slowly burning wood, while the improved method involves the use of sophisticated equipment. The participants also learnt three forms of smoked fish which includes smoked chunks of fish, folded fish and whole fish. After the presentation, questions were welcomed as well as contributions and a lot of participants asked questions to which they got answers. Of particular note was a contribution by Mr Chidi, a participant who mentioned that proper handling of fish results in a longer shelf life of the fish. He stated that after capture, the visceral should be completely removed and blood, thoroughly washed off as it contributes to spoilage and that low heat should be used for smoking to avoid burning and to ensure that heat is evenly distributed all through the fish. The participants also learnt that there exists two types of charcoal: soft wood and hard wood charcoal, and were encouraged to use the latter as it is best. Tea break was at 12:34pm.

The next presentation was given by Mr. Donald Oleh on "**Traditional and improved fish drying techniques**". He began by stating fish processing steps and talked about contaminants present in fish which could be evident or not. He went on to discuss the steps involved in drying and gave the differences between traditional drying and improved drying methods. He also mentioned that the use of solar tent is the newest improved method. After the presentation, questions were raised regarding the terms "smoking" and "smoke-drying". Dr. Omoruyi clearly defined both methods and stating that one of the main differences is in the moisture content of the smoke fish and smoke dried fish. Smoked fish have more moisture compared to smoke-dried fish and smoking is done at a low temperature while smoke-drying is at a higher temperature. There was also a controversy on why fishes were rejected during exportation. Some of the participants thought that fishes were rejected because they were smoked. Dr. Omoruyi clarified that by saying that most processed fishes were rejected because they did not meet up with recommended

standards. It was not necessarily due to the fact there were smoked fishes. He added that smoking impacts special flavour to fish and acts as a preservative.

The fourth presentation was a very interesting and engaging one with the title: "**Fish Packaging Techniques**" handled by Dr. Marinus Egwenomhe. Here, participants learnt what product packaging entails, the benefits of packaging and various packaging materials. He also mentioned that sealing machine should be used to remove air from the packaging materials in order for the fish to be preserved for a longer time. The meeting ended at 4.08pm with closing prayers.

DAY 3 (7th December 2022): Session 3

The day's training began with registration at 9.10am. The opening prayers was led by Prof. Ene-Obong at about 9.22am and afterwards, the National anthem was sung. Prof. Ene-Obong made the participants recall what they were taught the previous day. There was also a recap by Joy Esate.

The day's presentation was titled "**Fish Value addition**" and was given by Dr. Endurance Okhale. He started the presentation by defining value addition stating that it is the extra value one adds to the original product. *He added that the value one adds to fish determines the value one gets from it*. He mentioned that a lot of people may not like fresh fish, therefore, it is preferable to turn them into varying products that would appeal to various groups of people. He also said that there is no part that is useless as far as fish is concerned. He went on to talk about the advantages and disadvantages of value addition, value added fish processing procedures, as well as value added fish products. He ended the presentation by giving recipes for some value added fish products, such as fish fingers, sausages, fish balls, and fish powder. Questions were raised by participants and there were answers and clarifications made to them. There was a concern regarding the use of preservatives such as sodium benzoate, and most persons were of the opinion that it is safer not to use artificial preservatives, but Dr. Endurance gave a contrary opinion saying that there are safe levels to these preservatives and since one is producing commercially, it is necessary to add preservatives, but in recommended amounts. At the end of this session, Prof. Ene-Obong encouraged the participants to solve problems with their businesses and be more concerned about the nutritional value of their products.

The practical session began at about 11.40 am and took place at the processing unit of DARDA. The participants were divided into 5 groups to practicalize fish smoking process. The following took place: harvest of fish, immobilization using salt, removal of slime, gutting of fish, washing thoroughly to remove blood and other substances that may trigger fast spoilage, folding some fishes and cutting others into chunks, spicing using salt or other spices and finally, placing the cut or folded fishes on the smoking kiln. The fishes were dried in 3 different ovens: Chorkor (traditional), Burkinabe and an improved smoking kiln.

After the practical session, there was a discussion session between facilitators and participants, and the day's training ended at 4.30pm.

DAY 4 (8th December 2022): Session 4

The day's training started at 10.06am with prayers followed by singing of the National anthem and then a recap of the previous day's activities. Participants were asked to share what they learnt. Mrs. Ifeoma shared that she never knew salt could deactivate/immobilize fish but learnt that in the course of the practical sessions. Another participant also shared that she never knew that the slime in catfish was not to be consumed, but learnt that during the practical, and added that she was very excited to be part of the training. A question was raised afterwards on how to

determine a spoilt fish and Mr. Chinweike, a facilitator and other participants responded by stating that the colour, texture and disintegration of the flesh of the fish are pointers to fish spoilage.

Dr. Kenneth Omoruyi clearly described the recipe for the production of fish cracker, but the practical was not conducted due to time constraint. At the fish processing unit, the participants practically learnt how to make fish barbecue, fish in batter as well as different packaging styles and methods for smoked fish using different materials such as cartons, woven baskets and ziplock bags and were also taught how to cost and market their products to make profit. The training ended at 5.10pm with a closing prayer by Dr. Kenneth.

DAY 5 (9th December 2022): Session 5

The participants were registered and the training began at 10.00am with opening prayers led by Miss Faith, a participant. The national anthem was sung afterwards and there was a recap of the previous day's activities. A few participants shared what the learnt the previous day and seized the opportunity to appreciate the team and facilitators for having organized the program and impart so much on them.

There was a presentation on Cooperatives by Mr. Charles Eze, where he clearly defined cooperatives, the values, principles, benefits of joining cooperatives, how to register and become a member of a cooperative society as well as different kinds of meetings usually held by cooperative societies. At the end of the presentation, questions were raised and answered duly.

Participants were then divided into 6 groups and asked to write a business plan, at the end of it, each team leader presented the group's plan. At the end of each presentation, there was a discussion by facilitators on the quality of the plan and the groups were made to be aware of their strengths and weaknesses.

Closing ceremony: During the closing ceremony, there was a closing remark by the Co-PI whereby she thanked the participants, facilitators and all those who in one way or the other contributed to the success of the training workshop. She also thanked USAID, through Feed the Future Innovation Lab for fish for funding the workshop. She furthermore encouraged the participants to put into use what they had learned and asked them to feel free to contact the project team or facilitators whenever they encounter challenges. Some of the facilitators also were given opportunity to give some words of advice and encouragement to the participants. A representative of the participants also was given opportunity to appreciate the project team and facilitators. At the end of it all, certificate of participation was distributed to participants and the training formally came to a close after a group photograph with facilitators and participants displaying their certificates.

III. **Objective 3:** Educate women and youth fish processors in the Delta State about the benefit of fish in the human diet and develop low literacy tools to help them better market their products

Summarized methodologies and strategies for completing Objective 3 are in Appendix 3. The tables contain objective, formulated hypotheses, the instrument for data collection, methodology, applicable statistical test, and analysis.

a. **Objective 3.1**: Validate the relevancy and test the acceptability of newly developed low literacy materials and tools on nutrition and food safety.

i. Study design

This was a pilot evaluation study by design using mixed methods (quantitative and qualitative). It involved the evaluation of education and training intervention using the baseline and the post-survey. The study aimed at improving knowledge about nutritional benefits of fish, improving quality and safe fish production through nutrition education and food safety training, promoting dietary diversification, evoking positive behavioral change towards hygiene and food safety, and economic empowerment to eradicate hunger and poverty through fish value-added products and programs. The training approach was “Train the trainer” using the participatory or interactive teaching method. This study was submitted, reviewed, and approved by the Institution Review Board for Human Studies at the Mississippi State University (IRB number IRB-20-072). All COVID-19 protocols and WHO recommendations were strictly adhered to doing this study.

ii. Methodology for the objectives

The schedule of events is presented in Table 4, showing the timeframe of the training. Summarized methods and strategies are in **Appendix 3**.

Table 4. Training schedule per senatorial district

Senatorial Districts	Week		
	Day 1	Day 2	Day 3
Modules	1, 2 and 3	4, 5 and 6	Module 7, Training evaluation. Self-knowledge evaluation
Time /duration	1hour 20 mins/ Module	1hour 20 mins/ Module	1hour 20 mins/ Module

Total duration of training	9-10 hours

iii. Preliminary meeting

A preliminary ("taking stock") meeting, was held in collaboration with the USAID Feed the Future Innovation Lab Nourishing Nations team, with the representative of the Agricultural Development Program (ADP), the stakeholders, and the representatives of potential participants, women fish processors in Delta State. The University of Calabar PI and the project coordinator facilitated the meeting and led through a discussion forum to engage the women and youth in identifying the main barriers, limitations, challenges faced as small-scale fish processors. This forum provided the opportunity for the need assessment and examining the expectations of the potential study participants. The meeting also assisted in getting relevant information in preparing our instruction material, and in shaping the learning tool and techniques.

iv. Recruiting participants and inclusion criteria

The proposed number of participants in this study was a minimum of 100 women and youth fish processors in Delta State, Nigeria. 40 Subjects were recruited from the three senatorial districts of the study area: Delta Central, Delta North, and Delta South. (122 participants enrolled for the study to give even representation of each district and to account for approximately 20% dropout rate). Study participants included low-income and low-literacy women and youth fish processors. These participants were recruited in collaboration with the ADP agency at the Ministry of Agriculture in Delta State, Nigeria. Inclusion criteria include women aged 19-49 years and youth (means and include young adult men within 19-35 years of age), who rely on fish processing as a source of livelihood. Recruited subjects participated in the baseline and end-line survey administered by the trained enumerators and were compensated with incentives after completing the survey.

v. Recruiting and training enumerators.

Three graduate students of Aquaculture and Fisheries and Management of a university in Nigeria were engaged to administer the baseline and end-line (post) survey. These enumerators were recruited by the host country principal investigator and project coordinator.

The Ph.D. student at Food Science Nutrition and Health Promotion department at Mississippi State University, trained the enumerators, and familiarize them with both the hard and soft copy of the survey instructions. The enumerators were acquainted with the online version of the questionnaire (Qualtrics online survey), for application and optimum efficiency. Three training meetings were held virtually via zoom. Each recurring meeting lasted for approximately 60 minutes.

vi. Engaging facilitators

Officials from the Delta State Ministry of Agriculture and Natural Resources, Delta Agricultural and Rural Development Authority (DARDA), and Delta State Primary Health Care Development Agencies; the state nutrition officer, Ministry of Health, and the director of planning, research, and statistics, Delta State, Nigeria were engaged as a peer facilitator for the nutrition and food safety training alongside the PhD student researcher, and the FIL Nourishing Nations team.

The PhD student researcher acquainted the co-facilitators with the training curriculum and materials via internet-enabled platforms such as zoom. All training materials were provided to educators including facilitator's guide, flipbook, low literacy tools, and other additional educational materials. Facilitators strictly used the training material (Nutrition education, food safety, and safe fish handling practice guide for fish processors) designed, validated, and approved for this study. This study also used appropriate teaching methodology (participatory) for the low-literacy adult learners. The training material was easy to read (Plimpton & Root, 1994) and was tested for comprehension, to facilitate retention and increase the expected outcome of the training intervention. Per diem was given to the co-facilitators at the end of each day of the training.

vii. Baseline (Pre) survey

All enrolled fish processors (122) were invited to participate in the baseline study. The study was explained to them in entirety, and those that were willing to participate in the baseline survey (99) signed the consent form.

The data collected from the baseline survey were reviewed and the training program was tailored to meet additional identified needs and fill the knowledge gaps during the training intervention. For example, the baseline survey, question A3 (A3.1- A3.5) contained nutrition information and communication survey questions. Questions A3.1- A3.4 explore the participant's preference on nutrition education and communication means. Question A3.5 was examined to determine the participant's perception of the effectiveness of the nutrition information and communication tools by computing the five Likert scale scoring. Information obtained from the baseline survey was used as a guide in addressing knowledge deficits in nutrition, food safety, and fish handling practices among the fish processors during the training.

viii. Training overview

Women and youth fish processors were engaged in multiple participatory training sessions of the seven modules on nutrition and food safety training manual and explored new processing techniques to improve their knowledge about the quality and safety of fish products. They also explored opportunities for new fish products, good practices, and fish business upgrading strategies through the training series.

Participants were given an incentive in form of transportation, tea-break snack, and lunch throughout the 3-days training. After the training, the low literacy educational tools; aprons, wristband, and hand fan containing nutrition information were given o participants as a reminder of the

information learned. The wristband was chosen as one of the training tools based on existing research that shows that the use of bracelets heightens vaccination awareness and improves immunization coverage (Siddiqi et al., 2020).

ix. Training procedure

The participatory training was designed to be in three locations within Delta State to accommodate participants from three senatorial districts. These locations were identified by the project coordinator and the in-country Co-PI in the host country. The training was accomplished in three days in each location. There were three training sessions per day, each session was 1 hour, 20 minutes long, with 15 minutes tea-break intervals before the next training session.

x. Registration and Identification of the participants

There was registration on the arrival of the participants to the training centers on the first day. The registration lasted for 30 minutes, from 9:00 am - 9:30 am (WAT). The subsequent training days started at 9:30 am and end at 1:30 pm (WAT). Participants were given a name tag and ID number for identification reasons and to facilitate recognition among the participants. The participant's given ID number was used for data analysis. Each participant also received training material; educational materials including a pen, drawing, and writing materials on arrival. They were also given the training outline containing all the sessions, modules, and the facilitator's name. Following the registration, the participants were briefed about the training sessions and expectations. Participants were encouraged to ask or answer questions and contribute throughout the training.

xi. Training agenda

The facilitator introduced himself or herself and established a relationship by acknowledging the participant's attendance. After the brief introduction, the facilitator informed the participant that there would be pre and post quizzes for each module taught in the training. The facilitator introduced the topic of the module, and a pre-quiz was administered to the participants as a formative assessment. The quiz contained three multiple-choice questions on each of the seven modules taught during the training. Each quiz lasted for 5 minutes. The facilitator assured the participants that their performances on the quizzes did not affect their benefits and it was okay if they do not know the answers to the questions. The participatory training included interactive sessions that lasted for 45 minutes. The newly developed and validated training manual and other relevant nutrition and food safety educational tools that facilitate learning were used. The participants were randomly grouped into small groups, (Buzz group) of 5-10 people to discuss the specific question for a short time. Buzz groups are effective ways of engaging every participant quickly and it served as an energizer to the group. There was a closing discussion for another 10 mins, and the modules taught were concluded with the post quizzes, which contained the same questions as the pre-quiz for another 5 mins.

xii. Duration of the training and time

The entire training lasted for three weeks. The participatory training was scheduled into the first week, at Delta North, the second week, at Delta Central, and the third week at Delta South, respectively. There were three participatory training sessions in a day. Each training day lasted a total of 4 hours; an estimate of 1hour 20 minutes were allotted per module, to amount to 9-10 hours of training altogether.

Day 1 training

Modules 1, 2, and 3 were taught by the assigned facilitators and co-facilitators

Module 1. Nutrition education: Healthy eating habits,

Module 2. Animal Source Food: Health benefits of fish consumption or fish nutrition

Module 3. Food Safety: Fish safety and handling.

Day 2 training

Modules 4, 5, and 6 were taught by the assigned facilitators and co-facilitators.

Module 4. Fish Processing: Fish processing techniques

Module 5. Food Poisoning: Fish contamination and poisoning.

Module 6. Hygiene rules and good practices: Hygiene rules for fish handlers.

Day 3 Training

Module 7. Economic benefits of quality and safe fish products.

After concluding participatory training, the participants were given a summary evaluation survey for the training and self-knowledge evaluation survey before and after training retrospectively.

The participants were issued a certificate of participation after the completion of the training and were also given foldable fabric hand fans, wristbands, and aprons containing nutrition and food safety promotional information. The co-facilitators also received a certificate of appreciation and per diem.

xiii. Post survey

The trained enumerators administered the post-survey to the training participants after confirming a sustained willingness to participate in the study by signing the consent form. The post-survey was administered 3 months after the training, to enable us to evaluate the impact of the training intervention and measure the behavior change and the level of improvement in nutrition, quality, and safe fish processing. Participants were appreciated for their cooperation after the completion of the study.

xiv. Evaluation and statistical analysis

The improved knowledge was measured by:

1. True pre-and post-quiz of the 7 nutrition and food safety education modules taught. Each module had three multiple choices questions, the maximum score was 3 and the minimum score was 1.

2. Retrospective pre- and post-knowledge survey using the Summary evaluation survey on a Likert scale of 5.

The behavioral change was measured by:

1. The baseline and post-survey: Session A2, B1, & B3 (Knowledge, Attitude & Practice, KAP)

· Session A2: Nutrition knowledge and hygiene practices (A2.1- A2.8)

· Session B1: Fish preparation and processing behavior and practices (B1.0- B1.8)

· Session B3: Fish safety and post-harvest handling (B3.1-3.2)

xv. Quantitative analysis

SPSS Version 27 (IBM) was used for quantitative data. Quantitative analysis was done using descriptive analysis of the quantitative data derived from the survey.

The improved knowledge was evaluated and analyzed by comparing the means of the pre-quiz and the post quiz for each of the 7 modules using the paired sample t-test, a P-value ≤ of 0.05. The pass mark for the quiz was 2 points (66.6%) out of 3, the maximum score was 3 out of 3 (99.9%), and the minimum of 33.3%. Behavioral changes were determined by conducting a comparative analysis of the baseline and the post-survey data using the paired samples t-test at a P-value ≤ 0.05. The frequency, average (mean), and standard deviation (SD) was determined and presented in a histogram and normal distribution.

xvi. Qualitative analysis

Qualitative data were derived from the open-ended questions of the baseline and post-survey. This analysis involved; (i) coding (ii) identification of common themes, (iii) grouping similar responses of the participant's perception on the survey question, and (iv) selecting compelling extracts that relate with the research question and literature, to produce a scholarly report for the analysis. Details of the qualitative data were considered and discussed with respect to the quantitative results and available literature.

b. Objective 3.2: Improve knowledge on the nutritional value of fish, food safety, and fish processing techniques and stimulating positive behavioral change

i. Developing training and educational materials

The low literacy training materials on nutrition and food safety procedures for fish processors were developed by the Ph.D. student in nutrition under the supervision and guidance of the US PI at Mississippi State University. The training materials were evaluated and validated by experts. The low literacy training manual was prepared at the 4^{h}-grade reading level with adequate knowledge and appropriate illustrations. An extensive literature review was done to select relevant scientific information for creating and constructing the instructional material. Books, periodicals, and publications on nutrition, food safety, safe fish processing and handling, water, hygiene, and sanitation were reviewed for content development. The materials were prepared in both Microsoft documents and PowerPoints presentations.

ii. Content Evaluation Panel

The content evaluation panel (group of experts) was invited to evaluate and validate each item of the module and the entire training material. This group of experts included nutritionists or dietitians, experts in low literacy education, fisheries and fish value chain experts, food safety experts, and academics. A total of six experts accepted the invitation to participate in the content validation of the newly developed training material and completed the task within the specified time (7 days). These panelists also provided recommendations based on their judgment of each item.

iii. Content Validity Index (CVI)

Content validity index (CVI) is used to determine the relevancy or degree of usefulness of each component of the training material. The content validity ratio (CVR) is an item statistic used in determining the rejection or retention of specific items. Using a content validity panel of six members, a minimum value of 0.99 was required for the CVR to satisfy the five percent level, p = 0.05 (Lawshe C.H 1975). The panelist judged the relevancy or essentiality of each item on a Likert scale scoring. The higher the percentage of the panelist's agreement on the item evaluated, the greater the degree of its content validity. CVI is the mean CVR value of the evaluated items.

iv. Content Validity and relevance

Content validity is the degree of agreement or intersects between performance on the material under investigation and ability to function in the job performance domain.

Content validation was done using a self-administered five-point Likert scale; ranging from strongly agree (SA; 5 points), agree (A; 4 points), neutral (N; 3 points), disagree (D; 2 points), and strongly disagree (SD; 1 point). Panelists' judgments were analyzed to determine the essentiality or relevancy of the items in the domains. The content validation was based on ten different domains:1) objective, 2) content, 3) relevance, 4) Language, 5) infographics, 6) design, 7) motivation and 8) culture and 9) methodology, 10) Quiz test. The form can be found in **Appendix 3**.

v. Method

Content validation was initiated after the first version of the training material is completed. A letter of invitation to participate in content validity of a newly developed nutrition and food safety training material was sent to 12 identified potential panelists. Thereafter, a cover letter containing specific and clear instructions on how to complete the task was sent only to those that accepted the invitation. Also, a content validation index form was sent to the experts via email and collected through the same medium. Each panelist completed seven validation forms containing the 10 items for each of the seven modules. The content validity index (CVI) and the concordance rate were determined by computing and analyzing the average CVR. After the content validation, necessary adjustments were made based on the panelist's judgment and recommendations. The training material was subjected to the final validation of the entire training material and approval by the experts before it was used for the training.

vi. Comprehensibility test

The comprehensibility test was performed by administering fill-in-the-gap questions to the five (5) non -participants of the target group using the cloze procedure. The test consisted of at least one question from each of the training modules. This test was done before the training, for determining the comprehensibility or understandability of the training material that was given to the participants.

The Cloze Procedure is designed that every fifth word in a sentence extracted from the training material is deleted and the respondent was to fill in the blank gaps with the exact word as much as they could. The participants were i.) encourage to answer all the questions as accurately as possible, ii.) read through the sentence before answering, iii.) never mind the spelling errors, iv.) write only one word, v.) It is okay to guess, and vi.) reassured that it is not a timed test. The total correctly filled blanks were the final cloze score of the reader (Bastable, 2014). The comprehensibility score for each participant was converted into percentages for easy data analysis and interpretation.

A Score ≥ of 60% indicates that the training material is better understood

A Score of 40 – 59% indicate a moderate difficulty, supplementary teaching will be needed

A Score of ≤ 40% indicates the difficulty and unsuitability of the training material.

vii. Testing literacy material and tools by the target group

The end-line (post) survey question A3.9 was utilized in evaluating the participant's perception of the acceptance, appearance, and usefulness of the low literacy tools; wristbands, and hand fans on a three-scale Likert range scoring. Data were analyzed in descriptive statistics using SPSS.

- How often do you wear the wristband or use the hand fan?
- How comfortable is the wristband?
- How attractive are the wristbands and the hand fans?
- How would you describe the usefulness of these tools?
- How often do they remind you of the training on fish nutrition and safety?
- It is a good way to initiate a conversation with others about the benefits of fish consumption.

c. Objective 3.3: Analyze the dietary diversity of women fish processors and their children under 6-24 months. Minimum Dietary Diversity for Women (MDD-W) 15-49 Years of Age

MDD-W is defined as the summation of food groups consumed by a woman from a total of the required ten food groups. The ten food groups include 1) Grains, roots, and tubers; 2) Legumes/Pulse; 3) Nuts and seeds; 4) Dairy products; 5) Meats or poultry, fish, seafood, and snails; 6) Eggs; 7) Dark leafy green vegetables; 8) Vitamin A-rich vegetables, Vitamin A-rich fruits, and red palm oil; 9) Other vegetables; 10) Other fruits. (All the food groups have been adjusted to reflect the social and cultural diet of Nigerians.)

This study assessed the Dietary diversity in women fish processors using the 10-point women dietary diversity (WDDS-10 survey). The 10-point WDDS-10 survey is a list-based instrument consisting of 10 food groups from which dietary diversity scores (DDS) or Minimum Dietary Diversity for Women (MDD-W) were being generated.

The MDD-W is a dichotomous indicator considered the standard for measuring population-level dietary diversity of women of reproductive age (FAO & 360, 2016). According to the recommended guidelines, an indicator of the probability of micronutrient adequacy for 11 micronutrients in a woman's diet consumption is ≥ 5 of the 10 food groups, which is considered high and portray the likeliness that the woman consumes animal source foods, nuts or seeds, pulses, fruits, and vegetables. Women who consume ≤ 4 food groups are considered to have low dietary diversity and have a greater probability of micronutrient inadequacy. (Analysis, 2018)

In this study, we used the WDDS-10 score as a continuous variable and the MDD-W cut-off 6 food groups as an indicator of dietary diversity.

Women's Dietary Diversity Score = Continuous variable from 0-10

Minimum Dietary Diversity for Women (Population-level indicator) =Dichotomous variable

Women who have MDD score ≥ 6 food groups, from 10 food groups

Women who have MDD score ≤ 6 food groups, from 10 food groups

MDD Score for Women of Reproduction Age 15-49 years old was calculated using the formula:

$$\frac{\textit{Women 15-49 years of age who consumed at least 6 food groups during the previous day}}{\textit{Total number of WRA (15-49 years of age) that participated in the survey}} \times 100$$

vi. Methodology

Information on the food consumed by the respondent; women of reproductive age (WRA 15-49 years) was collected during the baseline and post-survey after the signing of the informed consent. The MDD-W survey in the baseline and post-survey was administered before and after the training and nutrition education on dietary diversity and benefits of fish consumption (as an intervention for malnutrition among women of reproductive ages and their children). The MDD-W method assumes that the participant would know the meals she cooked, served, and eat. The women were asked to recall and mention all food, and drinks consumed for a day (24-hour recall) day and night. These included all meals, snacks, drinks. They were encouraged to remember every food consumed per meal and in-between meals. Those that do most of the cooking for themselves or the household, were asked to name or describe all ingredients and condiments used for the meal preparation.

vii. **Child Dietary Diversity:** The Minimum Dietary Diversity (MDD) Score for Children 6-23 months old

The minimum dietary diversity (MDD) score (for children 6-23 months old) is validated measuring tool designed by the World Health Organization (WHO) to assess diet diversity as part of infant and young child feeding (IYCF) practices among children 6-23 months old as the

population-level indicator (Agbadi et al., 2017). MDD is among the eight infants and young child feeding (IYCF) indicators developed by the WHO to provide straightforward, valid, and reliable metrics for assessing IYCF habits at the household level. It is also a component of a composite indicator, the Minimum Acceptable Diet (MAD).

viii. Complementary Feeding

Child dietary diversity (MDD) is positively associated with the mean micronutrient sufficiency of the diet and so can be used in assessing the diet quality in IYCF and appropriate complementary feeding practices (FANTA, 2006). MDD is a simple and easy to interpret indicator, appropriate for population-level targeting, monitoring and assessment, and target setting.

ix. Methodology

In this study, we asked the participants questions about the child's feeding habits. The minimum dietary diversity for child (MDD) survey embedded in section C of the baseline and post-survey was administered before and after the training. Data on a child's dietary diversity was gathered from a questionnaire that was administered to the child's caregiver, or mother. Respondents were asked to indicate whether their child consumed any food over the previous 24 hours from each of the eight food groups. In this study the eight food groups were adjusted to include the Nigerian staple foods in the courtesy of cultural sensitivity. In the questionnaire, we have 10 food groups which included the 8- MDD Food Groups. They are 1) Breast milk; 2.) Grains, roots, and tubers; 3) Legumes, seeds, and nuts; 4) Dairy products; 5) Flesh foods: meats or poultry, fish, seafood, and snails; 6) Eggs; 7) Dark leafy green vegetable; 8) Vitamin A-rich fruits and Red palm oil; 9) Other vegetables; 10) other fruits (**Appendix 3**) 1 point was given to each question answered as Yes, and the total number of food groups consumed is summated.

MDD score for children 6-23 months old was calculated using the formula:

$$\frac{\text{Number of children 6-23 months of age who received foods from 5 or more food groups yesterday during the day or night}}{\text{Children 6-23 months of age for whom breastfeeding and diet data will be collected}}$$

x. Statistical analysis

Data on Minimum dietary diversity for women (MDD-W) and minimum dietary diversity for a child (MDD) were normally distributed. The dietary diversity and nutrition status of the women fish processors were determined by analyzing and comparing the pre-and post-survey MDD-W and WDDS-10 scores using the descriptive statistics for dichotomous and ordinal continuous variables, respectively at P-value ≤ 0.05

Research Results

I. **Objective 1.** Develop cost per nutrient guides by analyzing the nutrient and contaminant profile of selected processed fish products in the Delta State of Nigeria.

Finalization of the cost per nutrient guides is ongoing as part of the University of Calabar MSc students' academic training. All data collection has been completed. This includes consumer price data from the market surveys and analyses of the nutrient and contaminant profiles of collected fish samples.

Based on the data collected, the cost (Naira) of 100g edible portion of selected fish species and other ASFs is displayed below in **Table 5** and **Figure 2.**

Table 5. Cost (Naira) of 100g edible portion of selected fish species and other ASFs

FISH SPECIES AND OTHER ASFs	Cost (₦:k)

TONGUESOLE	1326.38
PRAWN (FILLET)	2789.28
LADYFISH	1488.11
BROKEMANAGE (EP)	1326.43
PRAWN (WHOLE)	1246.81
CATFISH	955.28
STOCKFISH	932.19
BONGA (FILLET)	929.14
BONGA (BONE AND FILLET)	783.91
BROKEMANAGE (WHOLE)	779.94
SHRIMP	771.11
TILAPIA	706.51
CRAYFISH	647.78
COW KIDNEY	487.95
BONGA (WHOLE)	452.40
COW HEART	438.97
SARDINE	438.55
PANLA	437.44
BEEF	432.93
COW LIVER	401.19
POWDERED MILK	389.04
ATLANTIC MACKEREL	357.51
POULTRY	354.63
LIQUID MILK	190.16
EGG	145.69

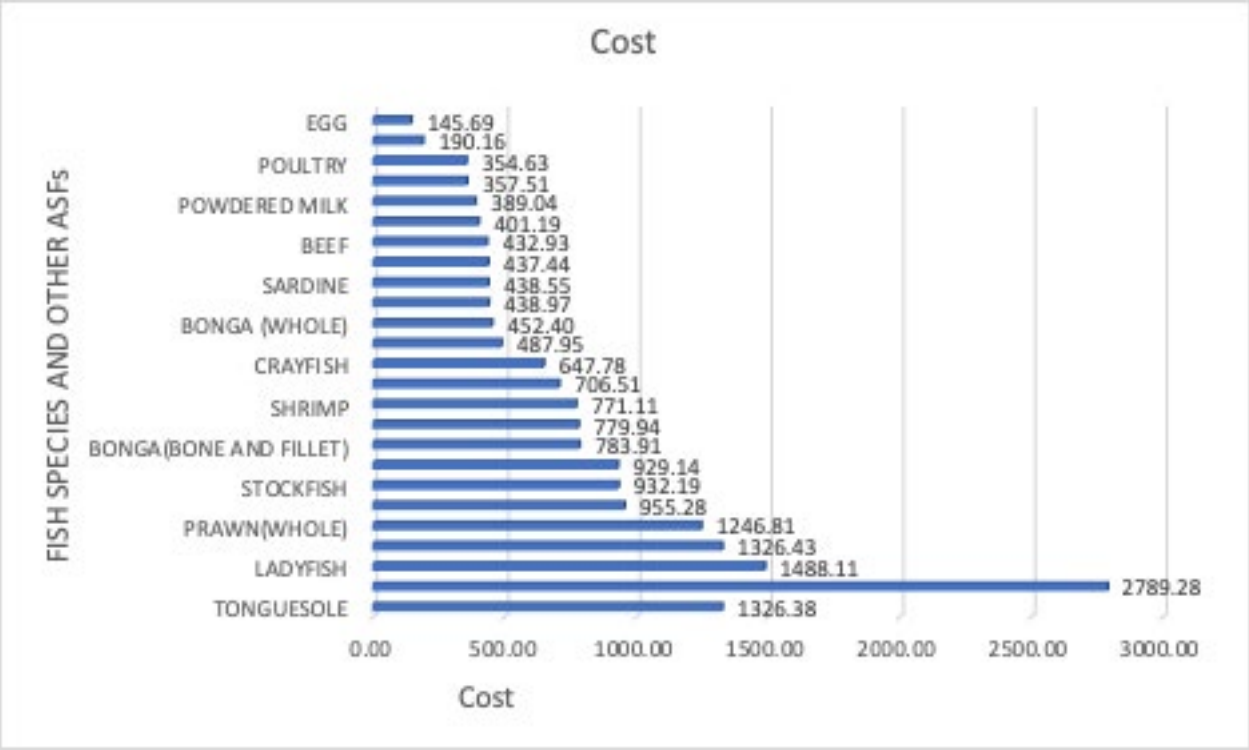


Figure 2. Cost (Naira) of 100g edible portion of selected fish species and other ASF

Datasets of the consumer prices have been uploaded to Harvard Dataverse and submitted to FIL. Average cost per kg for ASF from each of the four market surveys are displayed in **Figures 3 – 6**.

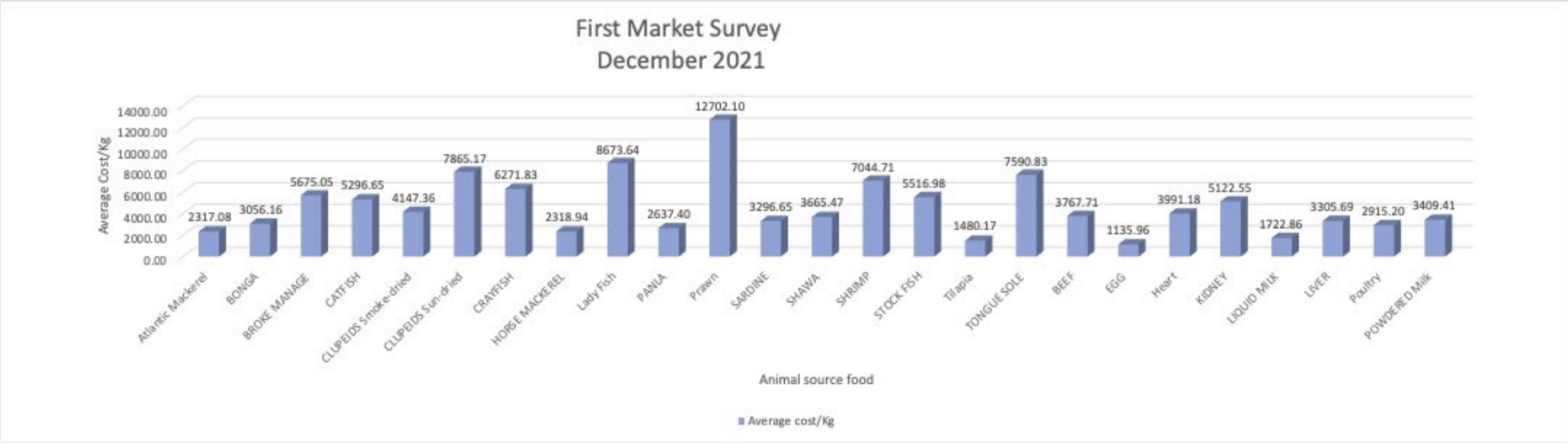


Figure 3. Average cost per kg for ASFs from the first market survey, December 2021.

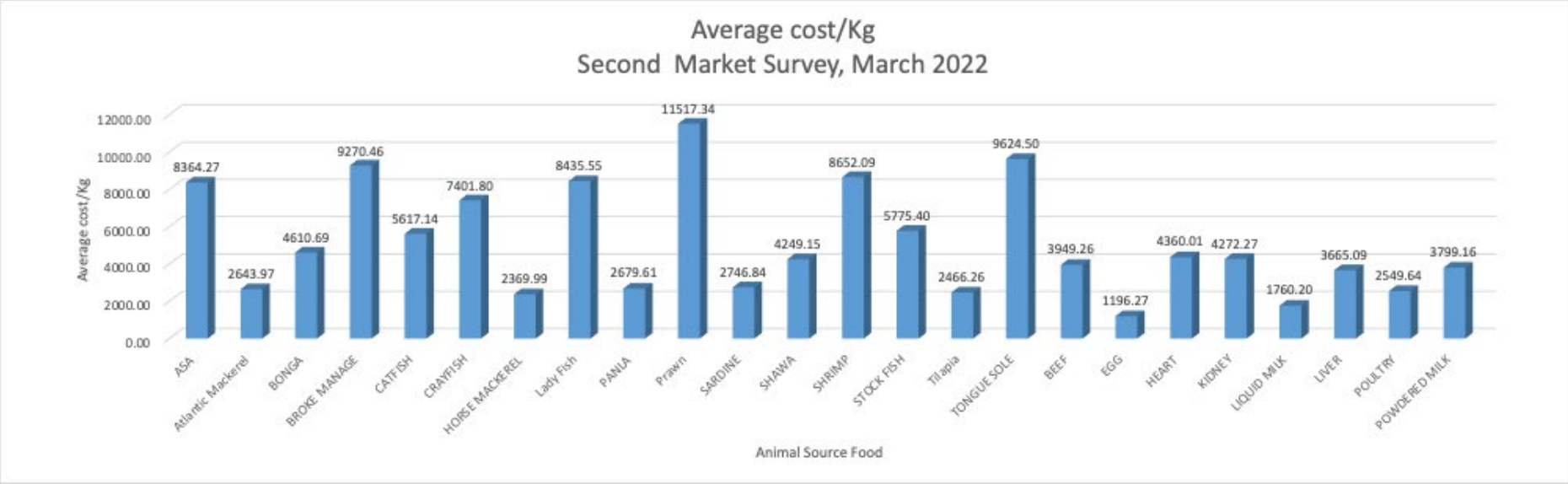


Figure 4. Average cost per kg for ASFs from the second market survey, March 2022.

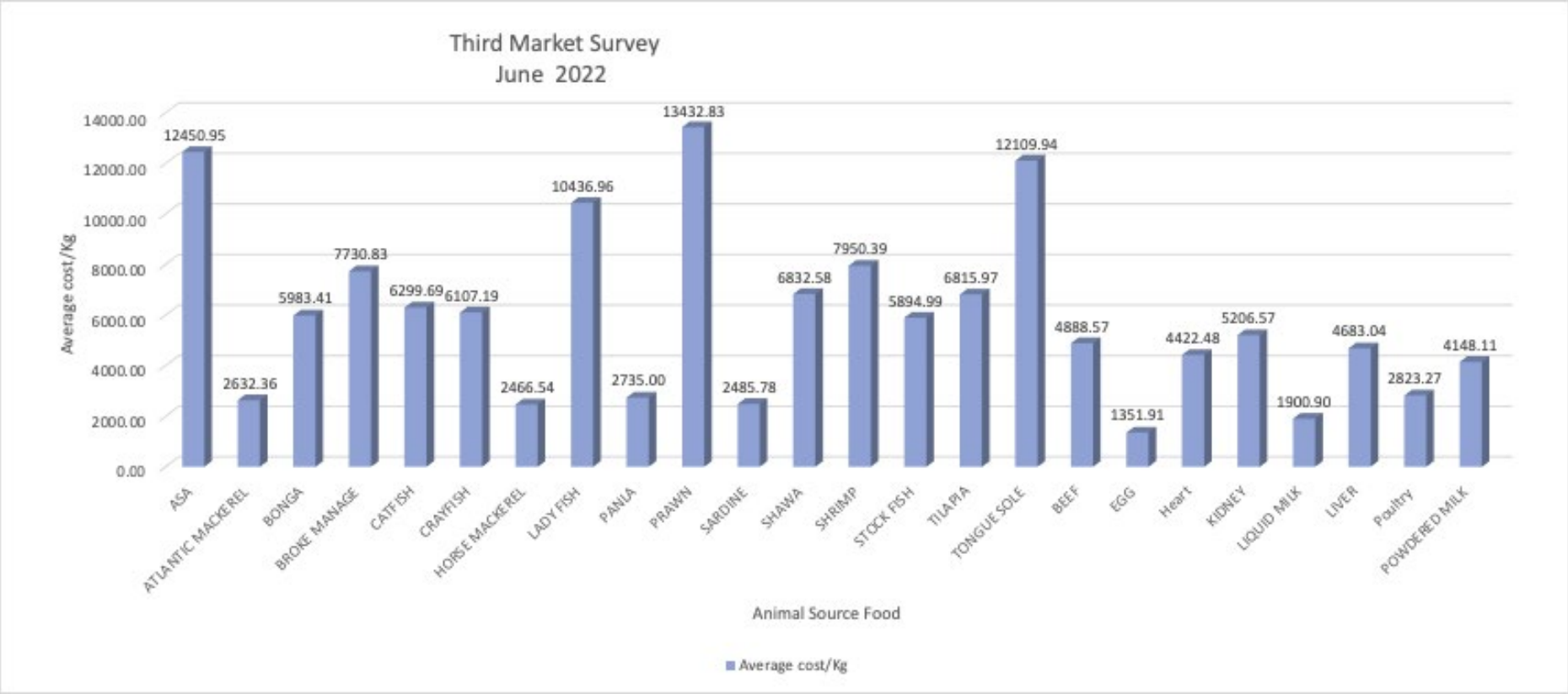


Figure 5. Average cost per kg for ASFs from the third market survey, June 2022.

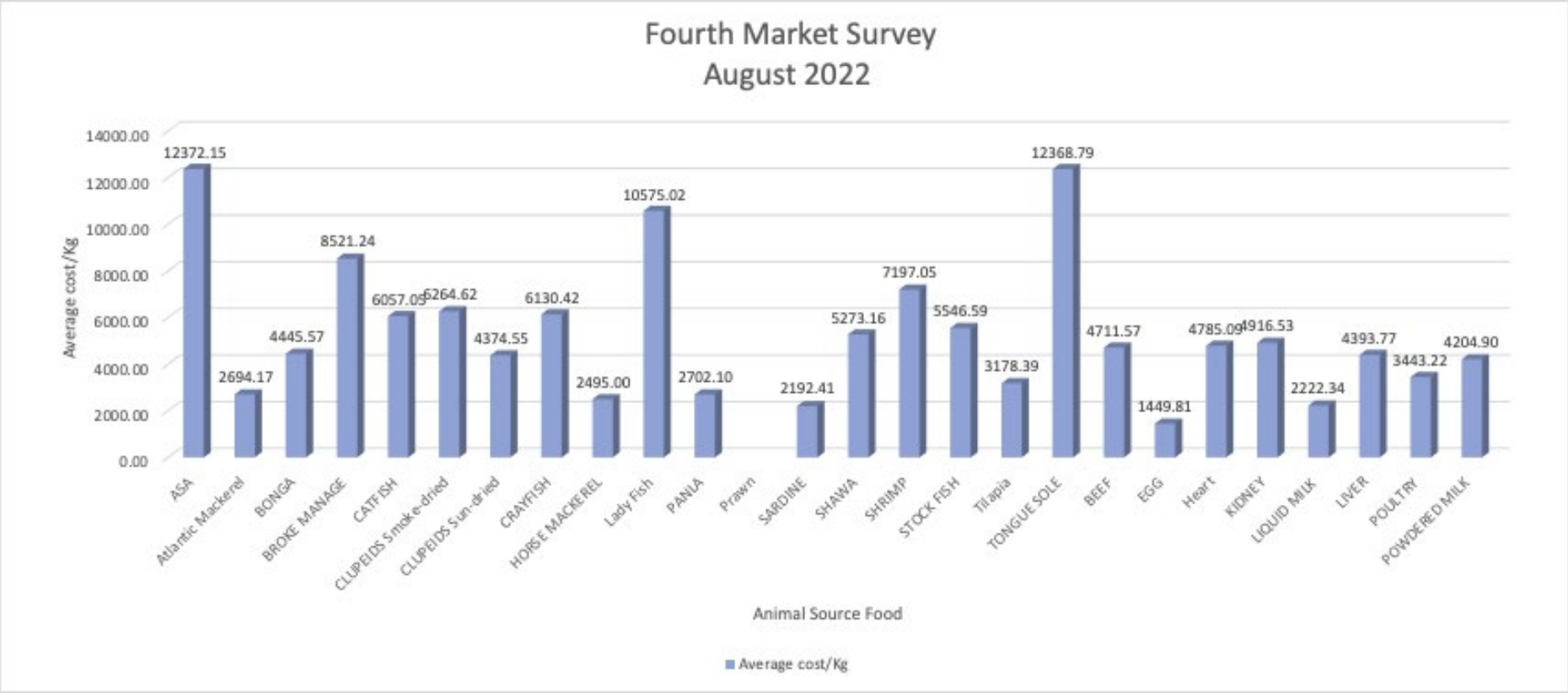


Figure 6. Average cost per kg for ASFs from the third market survey, August 2022.

A dataset containing the results from the nutrient and contaminant analysis of fish samples has been uploaded to Harvard Dataverse and submitted to FIL. The results are also in **Appendix 4**.

II. **Objective 2.** Build capacity among women and youth fish processors in the Delta State to produce high-quality, safe, and nutritious processed fish products for local consumption

At the end of the training workshop held from December 5 – 9, 2022, participants were given an evaluation form to appraise the entire content of the training and the effectiveness of the facilitators. The evaluation showed that participants 90-100% of the participants rated the training highly

(**Table 6**) and 93% perceived the technical materials to be just right (**Figure 7**). **Table 8** shows that the participants came to the training with little or no knowledge on all the training contents and that the training had over two-fold improvement on their knowledge.

Table 6. Participants' evaluation of overall training (e.g., content, organization, facilitator performance, facilities)

	Not at all %	**Somewhat** %	**Very much** %
Presenters were receptive to participants comments and questions.	0.0	1.6	98.4
Exercises helped me to learn the materials.	0.0	1.6	98.4
Training enhanced knowledge and skills in fish handling, processing, value addition and packaging.	0.0	3.3	96.7
Training was well organized.	0.0	0.0	100.0
Presenters were well prepared.	0.0	3.2	96.8
Training was relevant to need.	0.0	6.5	93.5
Enough time to cover all materials.	0.0	14.8	85.2
Training enhanced knowledge on how to form cooperative society, and access fund including writing a business plan.	0.0	10.2	89.8
Training facilities were adequate.	0.0	9.8	90.2
Expect to use knowledge and skills gained from this training!	0.0	3.3	96.7
I would recommend this training course to a colleague	1.6	3.2	95.2

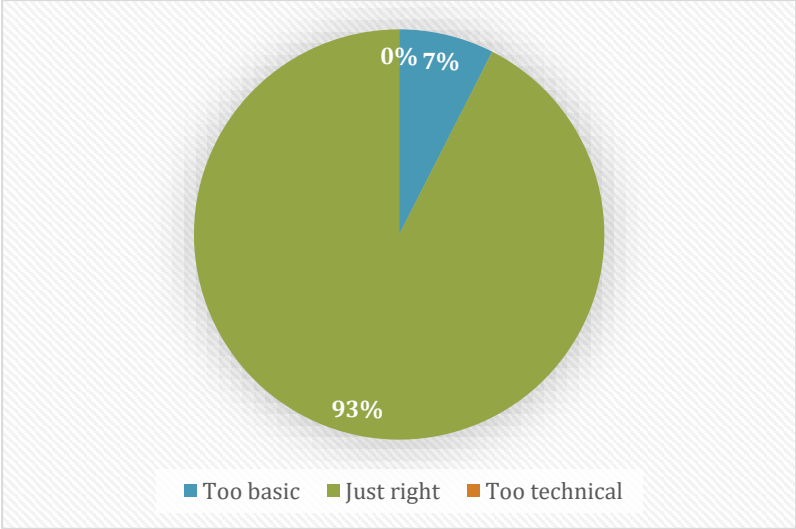


Figure 7. Participants 'perception of the technical level of material used in the workshop.

Table 8. Participants self-evaluation of Knowledge before and after training on the various topics.

Knowledge Scale: 1 = No knowledge or skills; 3 = some knowledge or skills; 5 = A lot of knowledge or skills		
TOPIC	**BEFORE**	**AFTER**
Entrepreneurship	2.6	4.6
Access to fund	2.0	4.2
Development of business plan	2.1	4.3
Fish handling techniques	2.8	4.8
Traditional/improved techniques of smoking fish	2.8	4.1
Traditional/improved techniques of drying fish	2.6	4.7
Fish packaging techniques	2.3	4.8
Value addition	2.1	4.6
Cooperative society formation & operation	1.9	4.4
Knowledge and preparation of Fish barbecue	2.0	4.7
Knowledge and preparation of fish oil	1.4	4.3
Knowledge and preparation of fish in batter	1.4	4.3

Knowledge and preparation of fish cracker	1.2	4.0
Knowledge of preparation fish powder	1.5	4.1
Preparation of fish ball, fingers, sausage and Samosa	1.7	4.2

III. **Objective 3.** Educate women and youth fish processors in the Delta State about the benefit of fish in the human diet and develop low literacy tools to help them better market their products

a. **Objective 3.1.** Validate the relevancy and test the acceptability of newly developed low literacy materials and tools on nutrition and food safety.

Content validity index

Table 9 presents the results of the initial and final validation by six and four panelists, respectively. The I-CVI value of all domains evaluated at the initial stage was 0.83 except for the infographic domain in module one, which was 0.81, and the culture domain in module two, with a value of 0.77. The S-CVI for the initial validation was 0.90 and increased to 0.983 at the final validation after making necessary adjustments based on the panelist's recommendations, as summarized in **Table 10**. The recommendations helped to improve the cultural appropriateness of the newly developed material from the I-CVI value of 0.77 to 0.92.

I-CVI and Modified Kappa Index translation

Table 9 presents the I-CVI evaluation table and the number of panelists agreeing using six and four experts. It also shows the computed probability of chance occurrence (*Pc*) based on the number of panelists (N) and the number agreeing on relevance (A) to determine the kappa designating agreement on relevance (k^*), and compared with the evaluation criteria for kappa (E_K).

Overall, I-CVI = 0.67 when four out of five, or four out of six of the panelists rated an item as relevant; I-CVI = 0.83 when five out of six rated an item as relevant; I-CVI = 0.75 when three out of four rated an item as relevant; and I-CVI = 1 when all the panelists rated an item as four.

The minimum I-CVI in the final validation using four experts panel was 0.75, k^* value = 0.67, and E_k evaluation description as 'good'. The maximum content validity value that could be achieved = 1, k^* value - 1.00 and E_k evaluation description as ‘excellent’.

Table 9 I-CVI evaluation table and number of experts in agreement

Number of experts	The number giving 4 or 5 rating	**I-CVI**	**P_c**	**K^***	**E_K**
3	3	1.00	.125	1.00	Excellent
3	2	.67	.375	.47	Fair
4	4	1.00	.063	1.00	Excellent
4	3	.75	.25	.67	Good
5	5	1.00	.031	1.00	Excellent
5	4	.80	.156	.76	Excellent
6	6	1.00	.016	1.00	Excellent

6	5	.83	.094	.81	Excellent
6	4**	.67	.234	.57	fair

I-CVI, Item-level content validity index. Pc = [N! /A! (N - A) !] *.5^{N}, probability of chance occurrence, where N= number of experts and A= Number of agreeing on relevance. K*= (I-CVI - Pc) / (1-Pc). kappa designating agreement on relevance; E_K, evaluation criteria for kappa, described guideline by Cicchetti and Sparrow (1981). Fair = *K* of .40-.59. Good =*K* of .60 -.74, Excellent = *K* of >.74, ** binomial variable. (Polit et al., 2007)

Table 10 Summary of the qualitative analysis of the Expert's recommendations.

	Recommendations of the Experts
Module 1	Increase the text font size and sizes of the pictures. Use appropriate colors Replace dairy with milk, and use meals or plates instead of diet Replace milk in the suggested MyPlate for Nigeria with another source like soy products, or available substitutes

Module 2	Include a picture of a well-nourished mother with a healthy child Use a clear image to show the benefits of the fish Use appropriate child images and words, change child to infants or baby Move the "Benefits of breastfeeding to infants and mothers to Module 1,
Module 3	Use more visible, culturally appropriate, and relatable pictures Quiz #2 What are safe practices? Change TV series to Watching TV Quiz #3 Option A is too long, keep the answers or options brief and precise.
Module 4	Number the items on the slides rather than bullets for easier reference. On slide 5, remove the statement "excess salt intake may increase the risk of high blood pressure" because it is not relevant to the module. Reorder slides on fish processing and procedures (15-17) Quiz #2 keep options brief and concise. Do not trick the participants

Module 5	Increase the eligibility on slide 1, increase the spacing and the font size Label the pictures on slides 4-7. This will enhance learning Create separate slides for the biological contaminants and biological carriers of diseases. Replace iodine with antiseptics with "open wounds on your hands" and consider using forks and a spoon.
Module 6	Generally, font size should be increased. Separate sanitary requirements of fish processing premises from health requirements for fish processors Check the dilution formula and change the chlorine to water volume Quiz #1 Remove the word 'except' from the question, provide one correct option, and do not try to trick your audience with low literacy.

Module 7	Emphasize the economic benefit of a quality fish product Use a brighter color to enhance the readability of the content Slide 8 content is more relevant to food safety. Reconstruct Quiz 1 to health benefits of quality and safe fish products Change Quiz 2 to Economic benefits of quality and safe fish products include Quiz # 3 You can save money by reducing the fish waste generated a.) Yes b.) Maybe c.) I do not think so. The options are relative and subjective. Use options Yes, No, and I don't know instead.
Cover	Use culturally appropriate images to enhance acceptability and inclusiveness

b. **Objective 3.2:** Improve knowledge on the nutritional value of fish, food safety, and fish processing techniques and stimulating positive behavioral change.

The participants were mainly women (79.5%) and youth (20.5%) fish processors from the three senatorial districts (Delta North, Delta South, and Delta Central) of the Delta State in Nigeria. The program goal was to recruit forty fish processors from each of the senatorial districts for a total of 120 expected participants, at an estimated 20% dropout rate. Upon recruitment, a total of 122 participants enrolled in the training, accounting for a 0.17% increase with a zero percent dropout.

Comprehensibility Evaluation

The average cloze score was 72.1 % (10.1 ± 0.55 SD) (**Table 11**), indicating that the training material is well understood; the comprehensibility result of the newly validated material met the recommended cut-off cloze score; above 60 percent (Bastable, 2014).

Learning Evaluation

True Pre and post-test:

The average number of participants that took the pre- and post-quizzes was n = 80. The quizzes consisted of three multiple-choice questions with a score ranging from 0 - 3 points, 1 point for each correctly answered question. **Table 12** shows the mean, standard deviation, and variance of the pre-and post-quizzes at $p \leq .05$. **Table 13** shows the paired sample difference of the pre and post quizzes on each module. The result shows that the knowledge of the participants significantly improve after each module that was taught. It is important to mention that in some cases participants with higher literacy skills assisted a few others with low or no literacy skills to understand the material and training instruction. However, approximately thirty-four percent (n=42) of the participants did not participate in the pre- and post-quizzes due to either a fear of failure or a lack of literacy skills (read and understand instructions without external assistance). Oral questioning was an alternative means used to evaluate this category of participants but there are no recorded data for the evaluation.

Table 11 Cloze score for the training material

Number of participants	Score out of 14	% Score
1	10	71.4
2	11	78.6
3	10	71.4
4	10	71.4
5	9.5	67.9

Mean	10.1	72.1

Comprehensibility test of the newly developed and validated low-literacy educational material on nutrition and food safety for women fish processors, n =5.

Table 12 Frequency table for pre and post quizzes

	M1 Pre quiz	M1 Post quiz	M2 Pre quiz	M2 Post quiz	M3 Pre quiz	M3 Post quiz	M4 Pre quiz	M4 Post quiz	M5 Pre quiz	M5 Post quiz	M6 Pre quiz	M6 Post quiz	M7 Pre quiz	M7 Post quiz
n	79	81	81	81	81	80	81	81	81	79	80	80	80	80
Missing	2	0	0	0	0	1	0	0	0	3	1	1	1	1
Mean	1.91	2.54	2.74	2.91	2.54	2.78	2.04	2.49	1.14	1.83	2.46	2.76	1.98	2.41
S.D	.701	.775	.628	.394	.708	.595	.872	.709	.787	.859	.711	.484	.993	.837
Var.	.492	.601	.394	.155	.501	.354	.761	.503	.619	.738	.505	.234	.987	.701

Frequency table showing the average scores of participants pre- and post-quiz on the seven-module curricular nutrition and food safety training for women and youth fish processors.

M= Module, n=number of quiz participants, S.D = standard deviation, Var. = variance.

Table 13 Paired differences in the mean, standard deviation of the pre and post quizzes

Pair	Mean	Std. Deviation	Std. Error Mean	t	df	Sig. (2-tailed)
Module 1 Pre quiz Module 1 Post quiz	-.620	.584	.066	-9.439	78	.000
Module 2 Pre quiz Module 2 Post quiz	-.173	.519	.058	-2.995	80	.004
Module 3 Pre quiz Module 3 Post quiz	-.212	.758	.085	-2.508	79	.014

Module 4 Pre quiz Module 4 Post quiz	-0.457	.807	.090	-5.094	80	.000
Module 5 Pre quiz Module 5 Post quiz	-.718	.952	.108	-6.660	77	.000
Module 6 Pre quiz Module 6 Post quiz	-.300	.863	.096	-3.110	79	.003
Module 7 Pre quiz Module 7 Post quiz	-.437	.824	.092	-4.747	79	.000

Paired samples test with the paired differences in the mean, standard deviation of the pre and post quiz of modules 1-7, at 95 % confidence intervals.

Training Evaluation

The overall training evaluation survey reveals that the training was highly important and relevant to the target population. The training program, the overall content of the material, low literacy tools, PowerPoint presentations, group activities, the presentation and delivery of the material, and the facilitator's performances were generally rated 4 and 5 on the 5-point Likert scale and 99.1 % indicated the usefulness and relevancy of the training program. Other variables were rated on a similar scale 4; very good, and 5; excellent as detailed in Figure 4 Retrospective self-knowledge evaluation.

Self-Knowledge Evaluation

The result of the retrospective pre and post self-knowledge evaluation was rated on a 5-point Likert scale indicating a rate of 1 as not knowledgeable, and 5 as very knowledgeable on the seven modules taught in the training program. The self-rated knowledge curve suggests that most of the participants were feeling knowledgeable before the training across the seven modules and more knowledgeable with the evidence of a right-skewed knowledge curve after the training.

Self-evaluated knowledge after the training shows a positive shift in the knowledge of the participants across the training modules. Almost all the respondents indicated that they feel more knowledgeable about the seven curricular modules with 5 level ratings 93, 87, 95, 93, 86, 92, 97 representing 86.1, 80.6, 88, 86, 79.6, 85.2, 89.8 percent respectively. This indicates that the nutrition and food safety training was impactful and effective in improving the confidence in the knowledge of the target population.

c. **Objective 3.3:** Analyze the dietary diversity of women fish processors and their children under 6-24 months.

Demographic information of the participants

Table 14 presents the demographic characteristics of the fish processors who participated in this study. The mean age of the study participants was 30.8 (± 8.78 SD) years. A high percentage of the respondent 43.8% spoked the Ijaw language, 26.0% spoked Igbo and 21.9% spoke the Urhobo language. More than half, 57.5% of the participants had a minimum of 4 and a maximum of 6 people living in their households, while 30.1% had between 1-3 people. The participants are predominantly Christians, accounting for 98.6% of the respondents. Approximately 69% of the participants had completed at least secondary school education, while 4.1% had no formal education. Seventy eight percent of the study participants were married, 8.2% were never married while 6.8% were widowed. The majority of the respondents (80.8%) were neither pregnant nor lactating, 15.1 % were lactating and only 2.7% reported being pregnant during the study.

Table 15 presents the participant's knowledge or awareness of restricted foods and commonly identified restricted foods for pregnant women and children.

Dietary diversity score

Baseline MDD score shows that 47.9% of the women consumed at least 6 out of 10 food groups, and 52.1% consumed less than 6 food groups. However, the End-line survey shoed that 57.7% of the women consumed at least 6 food groups out of 10 while 42.3% consumed less than 6. There is a 9.8% increase in the dietary diversity of the target population at 12 weeks post-training evaluation.

Food group consumption

Baseline information of the food groups consumed by the participants over 24 hours. Grain, roots, and tubers are the most commonly consumed food group (81% respondents), followed by other fruits (78%) and food groups in the meat, fish, seafood, and insect group (70%). Eggs are the least consumed among the food groups followed by dark leafy green vegetables, and dairy products with 17%, 28%, and 37% of the respondents respectively. A 57% of the respondents reported having consumed vitamin A-rich vegetables and other vegetables each within the past 24 hours, while 39% and 35% respondents reported having consumed pulse or legumes and nut/seeds food groups

Information about the food consumption pattern of the respondents 12 weeks after the training intervention. The end-line data of the food groups consumed by participants over 24 hours shows that the majority representing 77% and 75% respondents consumed ‘grain’ food groups,’ root & tubers’, and ‘meats, fish, seafood, and insect’ within the past 24 hours. 67% consumed food group ‘dairy’ products. ‘Eggs’, ‘dark leafy vegetables’, ‘pulse & legumes’, and other vegetables were consumed by 54%, 48%, and 53% respectively.

The average minimum dietary diversity of women score (MDDW) for baseline and end-line was 5.8 ± 0.215 and 6.4 ± 0.2 respectively. There was no significant difference between baseline MDD and endline MDD. (p= 0.073

Table 14. Demographic information of the respondents (only female) n=73.

Characteristic	Frequency	Total (%)
Age (years)		
15-18	4	5.5
19-29	13	17.8
30-39	25	34.2
40-49	31	42.5
Language		
Igbo	19	26.0
Ijaw	32	43.8
Uhrobo	16	21.9
Itsekeri	2	2.7
Others	4	5.5
Number of Households		

1-3	22	30.1
4-6	42	57.5
7-9	9	12.3
Religion		
Christian	72	98.6
No response	1	1.4
Education		
Preschool or no formal education	3	4.1
Some primary	2	2.7
Complete primary	10	13.7
Some secondary	8	11.0
Complete secondary	31	42.5
College or higher	18	24.7
	1	1.4

Other		
Reproductive status		
Pregnant	2	2.7
Lactating	11	15.1
NPNL (not pregnant not lactating)	59	80.8
No response	1	1.4
Marital Status		
Single never married	6	8.2
Widowed	5	6.8
Divorced	1	1.4
Married	57	78.1
Separated	3	4.1
No response	1	1.4

Table 15. Restricted foods for pregnant women and children in Delta state Nigeria

	Responses	Frequency	Percent
Are there restricted foods for pregnant women?	Yes	38	52.1
	No	21	28.8
	I don't know	13	17.8
	No response	1	1.4
	Total	73	100
Are there restricted foods for children?	Yes	9	12.3
	No	46	63.0
	I don't know	16	21.9
	No response	2	2.7
	Total	73	100

List of commonly identified restricted foods in Delta State Nigeria

Pregnant women	Children

Pounded yam/yam	Pounded yam/yam
Eba/gari/fufu	Eba/Gaari/Fufu
Pepper soup/stew	Noodles?
Vegetable soup/akpu	Vegetable soup and akpu
Tea/beverages	
Meat/chicken	
Eggs	

Table 16. Pair samples T-test: paired differences of the baseline and end-line DDS at 95% CI

MDDW score	Mean	Paired difference Mean	Std Dev.	Std Error Mean	t	Sig. (2 tailed)

Baseline (pre-survey)	5.775±0.215	-0.5915	0.2733	0.3244	-1.823	.073
End-line (post-survey)	6.366±0.20		8			

d. Project indicator reporting

1. Short term training
    a. Training workshop 1 (August 2022): 122 attendees (producers); 95 female and 27 male
    b. Training workshop 2 (December 2022): 75 attendees (producers);
2. Activities/events
    a. Training workshop 1 (August 2022): 122 attendees (producers); 54 female and 21 male
    b. Training workshop 2 (December 2022):
        i. 75 attendees (producers)
        ii. 9 facilitators (governmental, non-governmental, academic, and producer stakeholders; see methods for Objective 2 for details)
3. Long-term training
    a. PhD student: 1 student; completed training at MSU
    b. MSc students: 2 students; training in progress as they are still in their academic programs at the University of Calabar
4. Technologies

a. Low-literacy tools: Developed and disseminated

b. Cost per nutrient guides: All data have been collected to develop the guides. The guides are being finalized by the MSc students as part of their academic training

Outputs and Conclusions

Development of training material for fish processors

Creating education material involves writing key points and easy-to-read words, high-quality graphic aids, and contributions of experts from relevant professions. The newly developed low-literacy seven-module flipbook on nutrition and safe fish handling and processing for fish processors in Nigeria was successfully validated and considered suitable and culturally appropriate for the target population. The flipbook has the potential to contribute to the improvement of knowledge about nutrition, healthy eating, dietary diversity, food security, and animal source food as a nutrient source to mitigate malnutrition among children, young female adolescents, and women in low- to middle-income countries. The educational material would also help to improve long-practiced fish processing methods, food safety, and food handling practices among women fish processors in Delta State, Nigeria. The newly developed and validated flipbook will be available to the public in a printable and downloadable form for teaching low-literacy fish processors nutrition, safe fish handling, and processing. The training materials developed for the second workshop focused on fish processing skills and entrepreneurship were developed in collaboration between project team members and workshop facilitators, including government and non-government stakeholders. These tools can be used for future trainings to build capacity among fish processors in Nigeria, and as a foundation for subsequent training materials.

Training of fish processors

The first workshop relied on the validity of the newly developed flipbook (Adegoye et al, 2022), the cloze score or the comprehensibility, and the delivery methodology, to determine its efficacy in improving the participant's knowledge of nutrition and food safety. The comprehensibility score of the training was > 60%. The training resulted in a significant increase in knowledge change ($p \leq 0.05$) and the retrospective self-knowledge evaluation confirmed that there was an improvement in knowledge acquisition. In conclusion, the improvement in the participants' knowledge is an outcome of several components of a strategically organized, methodological, and goal-oriented training program. The interactive, participatory training was accepted with enthusiasm. Similarly, a self-evaluation following the second workshop found that almost all participants felt they gained knowledge and skills from the training, were enthusiastic about applying the lessons learned in their business, and were open to sharing the information learned with colleagues, thereby spreading knowledge across the fish processing sector in Nigeria.

Processed fish business provides employment opportunities and income to many in Delta State, particularly women. However, the absence of improved infrastructures, facilities and equipment for processing may forfeit efforts toward improving the nutrition and safety of processed fish products. Adequate funding of the sector to promote the adoption of safe and quality improved practices along the fish processing value chain is needed. Additionally, adequate information dissemination on improved fish processing, value addition and new fish products development through workshops, lectures, seminars and sensitization programs on television, radio and social media space will aid processed fish business.

Evaluating the dietary diversity of women fish processors and their children under 6-24 months

The nutrition and food safety training improved the dietary diversity of women fish processors of reproductive age. Although the was no statistically significant difference in the paired mean DD score at $p < 0.05$. the number of participants meeting MDD increased by 10%. In addition, there was an increase in the consumption of animal source proteins including eggs, green leafy vegetables, dairy products, nuts, and legumes. Increased intake of animal source foods contributed to the increase in dietary diversity score (DDS). We suggest further longitudinal study to evaluate the food security determinants of dietary diversity among the target population using the food security survey. Emphasis should be placed on raising awareness on dietary diversification and its importance for children and women of reproductive age.

Development of cost per nutrient guides

Data were collected on the nutrient and contaminant profiles of select processed fish products as well as their respective prices with the goal of creating cost per nutrient guides to allow for comparison between fish products and other ASF. The project completed fish sample collection and analysis as well as four market surveys to capture seasonal fluctuations in price. Work is still ongoing to finalize the guides as part of the MSc students training at the University of Calabar. Once complete, the guides will allow for an informed examination of the food environment in Nigeria and will support government stakeholders as they design nutrition-sensitive programs and policies. The information can also be used to update the Nigerian Food Composition Table and national Food Based Dietary Guidelines, which are often used in the design of nutrition education content and messaging. Data on the contaminants present in the fish products can also be used by policymakers to identify and mitigate food safety issues in this sector.

Technologies/Innovations developed, and what phase was achieved

Two technologies were developed under this project. Details on each are described below:

1. **Low literacy tools: Nutrition and food safety promotional materials**

   Description: Low literacy tools (LLT) were designed by the MSU team and approved by the Nourishing Nations team of experts. The LLTs are foldable hand-fans, silicon wrist bands, and aprons. Simple nutrition and food safety instructions were printed on the tools to reinforce knowledge and remembrance. A study shows that vaccine reminder bracelets helped mothers remember vaccinating their children. This initiative was implemented to meet Objective 3 of this project and involve training the women and youth fish processors. The low literacy tools helped focus the participant's attention on the position of quality processed fish in addressing malnutrition and other nutritional deficiencies in especially infancy and pregnancy or during lactation. It also helped them to better market their products.

   Tools:

   Fabric hand fan: Foldable fabric hand fan of various attractive colors containing the nutritional information about the benefits of fish was imprinted on the fan fin. This tool was included based on the perceived and expressed needs of the fish processors to help alleviate the heat from the wood-burning during the smoking process and to serve as a manual air fan during the hot weather condition in the open market. They also use a fan to blow their charcoal to ignition during smoking. Therefore, it is considered as an essential tool for their business adventure. We decided to leverage this need to bring the nutrition information as fish consumption advocacy to their proximity.

   Silicone rubber wristband: Silicone rubber wristband (bright colors) was produced in different sizes and colors by a vendor in the host country, Nigeria. The silicone rubber waistband contained an inscription to serve as a reminder of the benefits of fish consumption. This was used in this study as an innovative strategic approach to sustain behavioral change and a healthy dietary habit beyond the training program. The wristbands were distributed to the participants to sustain the nutrition information and knowledge gained from the training and with the hope that they will share it with their customers and colleagues. Based on our findings, the silicone wristband is considered safe in terms of environmental friendliness, and it is socially acceptable among women and youth generally in Nigeria. Embossed silicone wristband containing simple nutrition information as a reminder

   Flipchart showing MyPlate for Nigeria: MyPlate is a nutrition information chat that informs eating the healthy right mix of a variety of foods. The MyPlate in this study includes fruits, vegetables, proteins, dairy, grains, and tubers/roots. Roots and tubers are staple foods in Nigeria, therefore they needed to be expressed on “MyPlate” to relate with peoples' needs, and respect cultural values, promote acceptance and belonging.

   Infographics: Infographics are easy-to-read, comprehensible, and reproducible nutrition and food safety instructional material for the fish processors that participated in the training (Mosby et al., 2015).

Apron: An apron was given to the fish processors that participated in the survey and training. A piece of fish business and nutritional promotional information with an acronym BEST; “Buy fish, Eat fish, Stay healthy and Thrive” was printed on the apron while it serves as personal protective wear at the same time. This innovation was created to foster behavioral change towards safe fish production, hygiene, and safe fish handling practices.

Phase achieved: The tools were developed and disseminated and have been utilized by fish processors.

2. **Cost per nutrient guides**

Description: Data collection was undertaken to develop cost per nutrient guides containing the nutrient and contaminant profile of select fish products and their prices in comparison to other ASF. Four market surveys were completed to collect consumer price information to examine how costs fluctuate seasonally. Fish samples were collected from local markets and analyzed for micro- and macronutrient content and contaminants, such as PAHs, parasites, and microbial pathogens. Nutrient information of other ASF were taken from the Nigerian Food Composition Table.

Phase achieved: All data needed to develop the guide has been collected, including data on the nutrient and containment profiles of fish samples as well as market price data. As part of their research projects and academic requirements, the UoC MSc students, supervised by the UoC PI, will continue to analyze the results and finalize the cost per nutrient guide.

Key Beneficiaries

With a focus on building capacity in the fish processing sector and improving the quality of processed fish products, the key beneficiaries for this project were fish processors in Delta State, Nigeria. The project focused on engaging women and youth fish processors to empower them through collective action and business strengthening, and to improve knowledge on the nutritional value of fish in the diet. Other populations that were engaged in the research included fish market vendors and women of reproductive age in Delta State.

How the scientific results were disseminated

The team has begun disseminating scientific results, with the plan to share results from all project Objectives with study participants (i.e., fish processors from Delta State, Nigeria), policymakers in Nigeria, and the broader scientific community through conference presentations and publications. Results from Objective 3 were presented at the American Public Health Association annual meeting in November 2022. The team is currently working on preparing and submitting manuscripts to peer-reviewed journals for publication. The articles listed below are currently in preparation or under review.

DEVELOPMENT AND VALIDATION OF NUTRITION AND FOOD SAFETY EDUCATIONAL MATERIAL FOR FISH PROCESSORS IN NIGERIA

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Status: This article was submitted to *Nutrients* and is currently under review.

IMPLEMENTING NEWLY DESIGNED FOOD SAFETY AND NUTRITION TRAINING FOR FISH PROCESSORS IN NIGERIA

Adegoye, A . Grace[1,2], Tolar-Peterson, Terezie[1,3*], Ene- Obong, Henrietta[4]; Nuntah, Joseph Nkem[5]; Pincus, Lauren [6]; Pasqualino, Monika [7]; Mathews, Rahel[1]; Silva Juan[1], Cheng, Wen-Hsing[1]; Marion W. Evans Jr[8].

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Status: This article is going through final revisions and will be submitted in Journal of Society of Nutrition Education and Behavior.

FISH PROCESSORS' PERCEPTION ON FISH BUSINESS IN DELTA STATE, NIGERIA

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Status: This article is currently under review of the first author.

NUTRITION AND FOOD SAFETY TRAINING IMPROVE THE CONSUMPTION OF ANIMAL SOURCE FOODS AND DIETARY DIVERSITY AMONG WOMEN FISH PROCESSORS IN DELATA STATE NIGERIA.

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Status: This article is in preparation.

Appendices

Appendix 1

QUESTIONNAIRE FOR FISH CONSUMPTION PATTERN OF WOMEN OF REPRODUCTIVE AGE WRA) AND THEIR INFANT AND YOU CHILDREN (6-23MONTHS) I DELTA STATE.

Code: -----/------/------

IDENTIFICATION

1. Senatorial District
   (1) Delta North
   (2) Delta Central
   (3) Delta South
1.

2. L.G.A of residence……
2.

3. Town of residence……..
3.

4. Home Address……..
4.

5. Name of Respondent (optional)…….
5.

Section 1 Demographic and Socio-economic Information

6.

6. What is your age (in years)?.....

Age category of respondent in years

(1) 15-19

(2) 20-35
(3) 35-49
(4) 50 and above

7.

7. Marital Status
   (1) Single
   (2) Married
   (3) Separated
   (4) Divorced
   (5) Widowed

8.

8. Ethnic Group (Tribe)
   (1) Delta-Igbo
   (2) Ijaw
   (3) Urhobo
   (4) Isoko
   (5) Itsekiri
   (6) Others (specify)……

9.

9. Religion
   (1) Christianity
   (2) Islam
   (3) Traditional
   (4) Others (specify)……

10.

10. What is your highest level of education?
    (1) No formal education
    (2) Primary
    (3) Secondary
    (4) Tertiary
    (5) Others (specify)…….

11.

11. What is the highest level of education of your spouse?

(1) No formal education
(2) Primary
(3) Secondary
(4) Tertiary
(5) Others (specify)……

12.

12. What is your occupation?
(1) Teacher
(2) Housewife
(3) Civil servant
(4) Trader
(5) Other (specify)…….

13.

13. What is your household monthly income?
(1) Less than 50,000 Naira
(2) 51,000-100,000 Naira
(3) 101,000-200,000 Naira
(4) Above 200,000 Naira
(5) Not sure/do not know

14. How many people live and eat in your household?
(1) Less than 4
(2) 4-6
(3) 7 and Above

14.

15. Household distribution: how many of the household members belong to the following age categories?
(1) 0 -5 months
(2) 6 – 23 months
(3) 24 – 59 months
(4) 6 – 9 years
(5) 10 – 19 years
(6) 20 and above

15.

16.

Section 2A Consumption Patterns of Fish and Other Animal-source Foods

17.

16. The following are various animal source foods. How often do you consume them and how much do you spend on them per week?

S/N	Animal source food	Consume	Cost/week	Frequency of consumption			
			1.less than ₦2000 2. ₦2000-5000 3. more than ₦5000 4. Others (specify)…	Less than 2 times/week	2-3 times/week	More than 3 times/week	Occasionally
1	Beef						
	Kidney						
	Heart						
	Liver						
2	Fish (all types)						
3	Pork						
4	Chicken						
5	Turkey						
6	Snail						
7	Insect						
8	Goat meat						
9	Dog meat						
10	Egg						
11	Milk (Powder)						
	Milk (Liquid)						
12	Others (specify)……						

17. Which of these fish species do you consume and how often?

S/N	Fish species	Consume	Frequency of consumption			
			< 2 times/week	2-3 times/ week	> 3 times/week	Occasionally
1	Sardine					
2	Bonga					
3	Catfish					
4	Tilapia					
5	Clupeids					
6	Mackerel					
7	Shine nose					
8	Crayfish					
9	Cover pot					
10	Croaker					
11	Tongue sole					
12	Stock fish					
13	Others (specify)…… ……..					

18. Reason for your choice of fish in no. 17.

Fish species	1. Availability	2. Taste	3. Cost	4. Others (specify)
Sardine				
Bonga				
Catfish				

Tilapia				
Clupeids				
Mackerel				
Shine nose				
Crayfish				
Cover pot				
Croaker				
Tongue sole				
Stockfish				
Others (specify)…….				

19. In what form do you consume these species?

Forms / Species	Fresh	Barbecue	Boiled	Smoked	Canned	Dried	Powdered	Fried
Sardine								
Bonga								
Catfish								
Tilapia								
Clupeids								
Mackerel								
Shine nose								
Crayfish								
Cover pot								
Croaker								
Tongue sole								
Stockfish								
Others (specify)……,,								

20. What is the main problem experienced with respect to obtaining fish for consumption?

(1) Poor availability of fish

(2) High cost of fish

(3) Distance to point of purchase

(4) Others (specify)……..

SECTION 2B: Maternal nutrition knowledge and perception of fish

	Strongly agree	**Agree**	**Undecided**	**Disagree**	**Strongly disagree**
21. Proper nutrition is important for the growth and development of a child.					
22. Mother's nutrition affects infant health					
23. Breast milk provides adequate nutrition for a baby in the first six months of life					
24. Fish is a healthy source of animal protein					
25. Fish is food for the poor					
26. Fish is very good for the development of the child's brain					
27. It is relatively cheap compared to beef, chicken and goat meat					

28. People only eat fish on special days					
29. If there is only a small portion of fish in the meal to be shared among household members, the child should be given priority					
30. Fish supports good vision					
31. Fish can be given to a baby once he/she is up to 6 months old.					
32. Fish should be used in complementary feeding of infants					

Section 3A: Fish in complementary feeding

33. How old is this/your baby (in months)?

18. (1) 6 - 8

19. (2) 9 - 12

20. (3) 13 - 23

21.

34. Are you still breastfeeding this child?

(1) Yes
(2) No

22.

35. If No, when did you stop?.....months

36. Have you started giving your baby solid, semi-solid or soft foods?

23. (1) Yes

24. (2) No *(if No, move to the next section)*

25.

37. If yes, at what age did you start? …….months

26.

38. Do you add fish to your child's food?
(1) Yes

27. (2) No

28.

39. If No, why?
(1) Fish is not affordable

(2) The child is allergic to fish

(3) The child does not like it

(4) Others (specify)…….

40. If yes, what fish species do you give your child and how often?

29.	Fish species	Consume	Frequency of consumption			
			< 2 times/week	2-3 times per week	>3 times/week	Occasionnally
1	Sardine					
2	Bonga					
3	Catfish					
4	Tilapia					
5	Clupeids					
7	Mackerel					
8	Shine nose					
9	Crayfish					
10	Cover pot					
11	Croaker					

12	Tongue sole					
13	Stockfish					
14	Others (specify)… …….					

41. What form is the fish given to the child?

Forms / Species	Fillet (flesh)	Boiled and mashed	Flake	Powdered	Others (specify)
Sardine					
Bonga					
Catfish					
Tilapia					
Clupeids					
Mackerel					
Shine nose					
Crayfish					
Cover pot					
Croaker					
Tongue sole					
Stockfish					
Others (specify)……,,					

(1) Powder
(2) Fillet (flesh)

(3) Flake
(4) Boiled and mashed
(4) Others (specify)

Section 3B: Measuring infant dietary diversity

DIETARY DIVERSITY QUESTIONNAIRE 1

Please describe the foods (meals and snacks) that you gave your child yesterday during the day and night, whether at home or outside the home. Start with the first food eaten in the morning. Write down all food and drinks mentioned by the respondent. When the respondent has finished, probe for meals and snacks not mentioned.

Time block	Food	Description
6 - 9 am		
9 - 12 am		
12 - 3 pm		
3 - 6 pm		
6 - 9 pm		
9 - 12 am		
12 - 3 am		

3 - 6 am		

Estimation of the quantity of fish consumed

S/N	**Food**	**Type of fish consumed**	**Estimate of the actual amount consumed (g)**
1.	Fish		

When the respondent recall is complete, fill in the food groups based on the information recorded above. For any food groups not mentioned, ask the respondent if a food item from this group was consumed.

	Food categories	**Locally available foods**	**Consumed within the Past 24 hours? 1=Yes or 0=No**
1	**Breast milk**	Breast milk	
2	**Grains, Roots & tubers**	Wheat, oats, maize, rice, sorghum (guinea corn), millet, spaghetti, macaroni, noodles, bread, *pap*, *agidi,* other foods made from cereal grains,Yam, *amala*, water yam, cocoyam, irish potato, *garri, fufu, abacha*, tapioca, sweet potato, and other food products made from roots and tubers	
3	**Legumes and Nuts**	White beans, Brown beans, Soyabeans, Mucuna beans, Bambara nut, Kidney beans akara, moi-moi.	

	Food categories	Locally available foods	Consumed within the Past 24 hours? 1=Yes or 0=No
		Beniseed, melon seed (*egusi*), pumpkin seeds, sunflower seeds, walnuts, groundnuts, shea nut, cashew nuts, bush mango seeds (*ogbono*), african oil bean seed (*ugba/ukpaka*), bread fruit seed (*ukwa*), *ibaba/ukpo, achi, ofor, akparata*	
4	**Dairy Products**	Milk, sour milk (*nono*), yogurt (*kindirmo*), cheese (*wara*), powdered milk, condensed milk, evaporated milk, goat milk, camel milk	
5	**Meats or poultry, seafood and snails, Insects**	Beef, Chicken, Goat meat, Pork, Mutton Shrimp, Prawn, Oysters, Crab, Snail Yam beetle, Grasshopper, Termites, Cricket and other edible insects.	
6	**Fish**	All species of fish	
7	**Eggs**	Chicken eggs, Quail eggs, Duck eggs, Guinea fowl eggs	
8	**Vitamin A rich vegetables, fruits and Red Palm oil**	Orange, pumpkin, carrot, Red pepper Ripe pawpaw, Ripe mango, Ripe passion fruit, locust bean, red palm fruit, ripe cantaloupe, musk melon, monkey cola (*ndiya*) Red oil added to any food	

	Food categories	Locally available foods	Consumed within the Past 24 hours? 1=Yes or 0=No
9	**Other vegetables**	Cabbage, cucumber, cauliflower, fresh tomato, onion, green beans, green pepper, radish, okro, garden egg, eggplant, green peas, boiled or roasted fresh corn, beets, mushroom, Apple, banana, watermelon, tangerine, avocado pear, oranges, pears, dates (*dabino*), guava, pineapple, grapefruit, coconut, African cherry/African star apple (*agbalumo/udara/udala*), breadfruit, cashew fruit, soursop, golden melon, baobab fruit (*ose/nonkuku*), figs.	

Section 3C: Measuring maternal dietary diversity

DIETARY DIVERSITY QUESTIONNAIRE 2

Please describe the foods (meals and snacks) that you ate yesterday during the day and night, whether at home or outside the home. Start with the first food eaten in the morning. Write down all food and drinks mentioned by the respondent. When the respondent has finished, probe for meals and snacks not mentioned.

Time block	Food	Description
6 - 9 am		
9 - 12 am		
12 - 3 pm		
3 - 6 pm		
6 - 9 pm		
9 - 12 am		
12 - 3 am		
3 - 6 am		

Estimation of the quantity of fish consumed

S/N	**Food**	**Type of fish consumed**	**Estimate of the actual amount consumed (g)**
1.	Fish		

When the respondent recall is complete, fill in the food groups based on the information recorded above. For any food groups not mentioned, ask the respondent if a food item from this group was consumed.

	Food categories	**Locally available foods**	**Consumed within the past 24 hours?** **1.Yes** **2. No**
1	**Grains, Roots & tubers**	Wheat, oats, maize, rice, sorghum (guinea corn), millet, spaghetti, macaroni, noodles, bread, *pap*, *agidi,* other foods made from cereal grains Yam, *amala*, water yam, cocoyam, irish potato, *garri, fufu, abacha*, tapioca, sweet potato, and other food products made from roots and tubers	
2	**Legumes**	White beans, Brown beans, Soyabeans, Mucuna beans, Bambara nut, Kidney beans akara, moi-moi.	
3	**Nuts and Seeds**	beniseed, melon seed (*egusi*), pumpkin seeds, sunflower seeds, walnuts, groundnuts, shea nut, cashew nuts, bush mango seeds (*ogbono*), african oil bean seed (*ugba/ukpaka*), bread fruit seed (*ukwa*), *ibaba/ukpo, achi, ofor, akparata*	
4	**Dairy Products**	Milk, sour milk (*nono*), yogurt (*kindirmo*), cheese (*wara*), powdered milk, condensed milk, evaporated milk, goat milk, camel milk	

	Food categories	Locally available foods	Consumed within the past 24 hours? 1.Yes 2. No
5	**Meats or poultry, Seafood and snails Insects**	Beef, Chicken, Goat meat, Pork, Mutton Shrimp, Prawn, Oysters, Crab, Snail Yam beetle, Grasshopper, Termites, Cricket and other edible insects.	
6	**Fish**	All fish species	
7	**Eggs**	Chicken eggs, Quail eggs, Duck eggs, Guinea fowl eggs	
8	**Dark leafy green vegetables**	Spinach, Wild Lettuce, Bitter leaves, African Spinach, Water leaf , Eggplant leaves *(efo igbo),* African basil/scent leaf (*Efinrin*), a*fang/okazi,* Fluted pumpkin leaf (*Ugu), zogale* (moringa), *ewedu*, sweet potato leaves, cassava leaves, cocoyam leaves, *oha* leaf, *atama, editan*, scent leaf and any other edible green leaves	
9	**Vitamin A rich vegetables , fruits and Red Palm oil**	Orange, pumpkin, carrot, Red pepper Ripe pawpaw, Ripe mango,Ripe passion fruit, locust bean, red palm fruit, ripe cantaloupe, musk melon, monkey cola (*ndiya*) Red oil added to any food	
10	**Other vegetables**	Cabbage, cucumber, cauliflower, fresh tomato, onion, green beans, green pepper, radish, okro, garden egg, eggplant, green peas, boiled or roasted fresh corn, beets, mushroom	

	Food categories	Locally available foods	Consumed within the past 24 hours? 1.Yes 2. No
11	**Other fruits**	Apple, banana, watermelon, tangerine, avocado pear, oranges, pears, dates (*dabino*), guava, pineapple, grapefruit, coconut, African cherry/African star apple (*agbalumo/udara/udala*), breadfruit, cashew fruit, soursop, golden melon, baobab fruit (*ose/nonkuku*), figs,	

Thank you for your cooperation!

Signature…… Date…….

Enumerator's name……

Appendix 2

World Fish Project (Delta State, Nigeria)
Nourishing Nations
Market Survey - Price Determination Form

Period of visitation…….

Date of visit……

Senatorial district……

L.G.A…….....

Name of market……..

Fish species/ASFs	fish form	vendor 1		vendor 2		vendor 3		vendor 4		vendor 5		average		cost/kg
		weight	cost	weight	cost	weight	cost	weight	cost	weight	cost	weight	cost	
Bonga	Smoked													
	Smoked-dried													
	Sun-dried													
	Fried													
	Roasted													
Cat fish	Smoked													
	Smoked-dried													
	Sun-dried													
	Fried													
	Roasted													

Fish species/ASFs	fish form	vendor 1		vendor 2		vendor 3		vendor 4		vendor 5		average		cost/kg
		weight	cost	weight	cost	weight	cost	weight	cost	weight	cost	weight	cost	
Clupeids	Smoked													
	Smoked-dried													
	Sun-dried													
	Fried													
	Roasted													
Crayfish	Smoked													
	Smoked-dried													
	Sun-dried													
	Fried													
	Roasted													
Horse Mackerel	Smoked													
	Smoked-dried													
	Sun-dried													
	Fried													
	Roasted													
Atlantic mackerel	Smoked													
	Smoked-dried													
	Sun-dried													
	Fried													
	Roasted													
Tilapia	Smoked													
	Smoked-dried													
	Sun-dried													
	Fried													
	Roasted													

Fish species/ASFs	fish form	vendor 1		vendor 2		vendor 3		vendor 4		vendor 5		average		cost/kg
		weight	cost	weight	cost	weight	cost	weight	cost	weight	cost	weight	cost	
	Smoked													
	Smoked-dried													
	Sun-dried													
	Fried													
	Roasted													
	Smoked													
	Smoked-dried													
	Sun-dried													
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	Smoked-dried													
	Sun-dried													
	Fried													
	Roasted													
	Smoked													
	Smoked-dried													
	Sun-dried													
	Fried													
	Roasted													

Fish species/ASFs	fish form	vendor 1		vendor 2		vendor 3		vendor 4		vendor 5		average		cost/kg
		weight	cost	weight	cost	weight	cost	weight	cost	weight	cost	weight	cost	
	Smoked													
	Smoked-dried													
	Sun-dried													
	Fried													
	Roasted													
	Smoked													
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	Smoked													
	Smoked-dried													
	Sun-dried													
	Fried													
	Roasted													

Appendix 3

Summarized methodology for Objective 3.2

Objective	Intervention	Methods	Statistical Analysis
Primary objective Objective 1: Improve knowledge on the nutritional value of fish, food safety, and fish processing techniques in stimulating positive behavioral change. n =122 Research Questions: i. Training intervention improves knowledge and ii. There is a positive behavior change after training Hypothesis: Ho: There is no difference in mean pre and post quiz scores	Participatory training for the women and youth fish processors Baseline and Post survey. Pre and post quizzes	1. Participatory or interactive training, using “Train the trainer’s approach” in a face-to-face setting. 2. The validated training material contained seven modules and three multiple-choice questions to evaluate the knowledge acquired. 3. Administer the pre-and post-quiz of the 7 nutrition education modules before and after each module training. 4. Give the low literacy tool to reinforce retention and remembrance. Low literacy tools; infographics, wristband, and hand fans containing nutrition information. 5. Administer Post survey 3 months after the training.	Paired T-test, $P \leq 0.05$. Compute test scores for the pre-and post-quiz of the 7 nutrition education modules for each participant. Compute the average (mean) and the standard deviation (SD) and use paired t-test to compare the means of a pre-and-post quiz to determine the improved knowledge. Compute the mean difference of the baseline and post-survey using the paired-sample t-test to determine the behavioral change. SPSS Version 27 (IBM) For data analysis

Ha: There is a difference in mean pre and post quiz scores Ho: There is no difference in mean baseline and post-survey data Ha: There is a difference in mean baseline and post-survey data			

Summarized methodology for objective 3.1

Objective	Instrument	Methods	Analysis
Secondary objective: Objective 3.2: Validate the relevancy and test the acceptability of newly developed low literacy materials and tools on nutrition and food safety.	1. Content validity index form. 2. Comprehensibility test (cloze procedure) 3. Post survey session A3 (3.1- 3.5 and 3.9) Nutrition Information and Communication.	1. Content validity: the training materials (Flipbook; Nutrition education, food safety and safe fish handling practice guide for fish processors, and the Pre and post quizzes) were evaluated and validated by 6-panel experts using the content validation index (CVI) form. 2. non-participants (5) took the comprehensibility test on the training material before it was used for the training. 3. Other low literacy tools (wristband, hand fan) were tested for acceptability by the training participants.	Compute the content validity index (CVI) and the concordance rate. Compute item-level; I-CVI, Scale-level; S-CVI and Modified kappa index. Compute the mean of comprehensibility scores for the low literacy training material. Compute descriptive analysis for A3.1- 4, and Compute the Likert scale scoring for the participant's view on the acceptance, attractiveness, and effectiveness of the tools Questions A 3.5 and 3.9

Summarized methodology for objective 3.3

Objective	Instrument	Methods	Statistical Analysis	
Secondary objective: Objective 3: Analyze the dietary diversity of women of reproductive age (15-49 years) and their Children between 6-24 months. n =73 Hypothesis: Ho: Women fish processors have a high dietary diversity score ≥ 6 Ha: Women fish processors have a low dietary diversity score < 6	1. MDD-W 10 survey MDD Survey Baseline and Post survey. Section C (24-hour Dietary recall for women and children) Attached to Appendix 3 2. Formula: MDD Score for WRA 15-49 years old. MDD Score for Children 6-23 months old (See chapter 2)	1. Enumerators will administer the baseline and post-survey 3 months after training. MDD-W 10 & MDD survey	Data on MDD-W & MDD were analyzed Compare the means of the baseline and post-survey MDD-W and WDDS-10 score 2. Use MDD-W as the dichotomous variable 3. Use WDDS-10 score as the continuous variable (0-10) 4. Use MDD-W cut off 6 food groups out of 10, as an indicator of Dietary diversity (DD) for women. 5. Use MDD cut-off food groups out of 10, as an indicator of Dietary diversity (DD) for a child.	P ≤ 0.05 Descriptive analysis will be used for dichotomous and ordinal continuous variables, respectively. Determine and compare the means of the WDDS-10 score for women, and the MDD score for children from the baseline and post-survey will be done using paired T-test. SPSS Version 27 (IBM) for data analysis

Ho: Children of women fish processors have a high dietary diversity score ≥ 5 Ha: children of women fish processors have a low dietary diversity score < 5				

Minimum Dietary Diversity for Women (MDD-W), Minimum Dietary Diversity for children (MDD), Women Dietary Diversity Score (WDDS-10), Dietary Diversity (DD), Women of Reproductive Age (WRA)

Nutrition education and food safety training curriculum and content

Sessions, Topics, and Objectives	Lesson Outline	Teaching techniques

Nutrition education Healthy Eating Habits Objectives: i)understand the importance of eating healthy ii) identify better food choices and combination Discussion Points: (see facilitators guide)	1. Pre quiz 2. What is healthy eating? 3. Importance of eating healthy: prevent macro and micronutrient deficiencies, promote growth, and improve health. 4. Choose MyPlate My Plate: · Fruits · Vegetables · Proteins · Grains · Roots and Tuber · Dairy 5. Nutrient and Dietary Diversity 6. Summary 7. Post quiz	Module 1 · Simple and brief introduction · Introduce the topic and focus on the key learning area. · Key learning area: Healthy eating, eating a variety of food sources to prevent malnutrition. · Establish rapport to give the participants a sense of inclusiveness · Use the approved low-literacy educational tool and materials · Use simple, clear sentences. Make recommendations using voice (action verbs) · Make sure that the participants are comfortable and free from distractions. · Use appropriate visuals e.g., flipchart showing Myplate.org · Encourage active participation, asking questions, and small group (4-5 people) discussion using prompt questions and activities using the social cognitive theory. · Practical advice will be provided in a way that encourages the positive aspect of the trainee's diet while drawing attention to areas of improvement without being critical or judgmental.

Animal Source Food Fish nutrition Objectives: i)Explain the benefits of eating fish ii)Mention a variety of foods that are good for growth and healthy living. Discussion Points: (see facilitators guide)	1. Identify animal source foods (ASF)- Aquatic or seafood 2. Nutritional value of Fish · Vitamins · Minerals · Protein · Carbohydrates · lipids 3. Health benefits of fish consumption to: · Infants and Children · Pregnant and breastfeeding women · Adults: Eating fish for a healthy heart. 4. Summary of key learnings 5. Assessment/evaluation	Module 2 Introducing Animal sources of protein but focusing on fish as an affordable and rich source of protein Key learning area: the potential of fish nutritional composition and consumption in reducing the prevalence of micronutrient deficiencies among children and WRA. · Make sure that the participants do not get overwhelmed during the sessions. · Sustain the trainee's attention, make the session interesting, and be conscious of verbal and nonverbal communications. · Use the training handout and any additional educational aid to enhance your teaching. · Encourage active participation, asking questions, and small group discussion using prompt questions and activities using the SCT. · Provide practical advice in a way that encourages the positive aspect of the trainee's diet, while drawing attention to areas of improvement without being critical or judgmental. · Make recommendations using voice (action verbs)

Food safety Fish safety and handling Objectives: i)understand the concept of food safety. ii) understand the consequence of poor food handling Discussion Points: (see facilitators guide)	1. Define food safety 2. Why food safety? 3. Foodborne illnesses 4. Safe fish handling rules and practices 5. Fish preservatives and additives 6. Fish storage 7. Fish transportation 8. Summary and evaluation	Module 3 Introduce food safety but focus on fish safety and handling. Key learning area: why is food safety important? · Make participants feel included and welcome. · Make sure that the participants do not get exhausted during the sessions. · Sustain the trainee's attention, make the session interesting, and watch out for verbal and nonverbal communications. · Use the training handout and any additional educational aid · Use active methods e.g., discussion instead of passive · Encourage active participation, ask questions, and create small group (4-5 people) discussions using leading questions and exercises. Monitor small group discussions and activities. · Return to a full group for general review and round up the session.

Fish Processing Fish Processing Techniques Objectives: i)Learn a better and safer method of fish processing ii) know the benefits of new methods on the quality of fish products Discussion Points: (see facilitators guide)	Fish Processing Methods Traditional Methods Modern methods · Salting · Solar drying · Smoking · Oven baking · Canning · Cold storage New Fish products · Powdered fish · Fish Paste · Canned fish · Barbequed fish The implication of Fish processing methods Summary of key learnings	Module 4 Introduce food processing but focus on improved (safe) fish processing techniques and outcome on quality, safe, and nutritious fish products. Key learning area: safe and quality fish processing technique. · Make participants feel included and welcome. · Make sure that the participants do not get exhausted or discouraged during the sessions. · Sustain the trainee's attention, make the session interesting, and watch out for verbal and nonverbal communications. · Use the training handout and any additional educational aid · Use active methods e.g., discussion instead of passive · Encourage active participation, asking questions, and · Apply the concept of social cognitive theory · Create small group (4-5 people) discussions using leading questions and activities. Monitor small group discussions and activities. · Return to a full group for general review and round up the session. · Make recommendations using voice (action verbs)

Food Poisoning Fish Poisoning and contamination Objectives: i)Identity fish contaminants & health risks. ii) understand the need for prevention. Discussion Points: (see facilitators guide)	1. Define food poisoning 2. Identify fish contaminants 3. Sources of fish contamination · Water: biological (E. coli, salmonella, cysts) & chemical (BPA, methane, heavy metals) physical (wastes, runoff) · Air: soot, dust · Soil: sand, grit, · Human (dirty hands) · Animals; pets, pests, and insects 4. Pesticide use & application 5. Health implications of fish poisoning & contamination 6. Preventive measures 7. Summary and evaluation	Module 5 Introduce food poisoning but focus on how to prevent or avoid food poisoning and contamination Key learning area: Preventive measures · Make participants feel included and welcome. · Make sure that the participants do not get exhausted during the sessions. · Sustain the trainee's attention, make the session interesting, and watch out for verbal and nonverbal communications. · Use the training handout and any additional educational aid · Use active methods e.g., discussion instead of passive · Encourage active participation, asking questions, and · Apply the concept of social cognitive theory (SCT) · Create small group discussions using leading questions and activities. Monitor small group discussions and activities. · Return to a full group for general review and round up the session.

Hygiene and Good practices Hygiene rules for fish handlers Objectives: i) Know the importance of hygiene and sanitation ii) Apply good practices in fish processing Discussion Points: (see facilitators guide)	1. Hygiene rules 2. Personal hygiene - handwashing, Cleanliness, hygiene & Sanitation 3. Good Practices: Good Hygienic Practices, Good Aquacultural Practices, Good Harvest Practices Good Transport Practices Good Processing Practices Good Handling and Packaging Practices Good Storage Practices, etc.) 4. Summary and evaluation	Module 6 Introduce food safety rules but focus on safe fish handling, food hygiene regulations, and practices. Teaching method: all method but mainly Discussion Key learning area: Good practices; emphasis on personal and improved food hygiene practices of fish processors. · Make participants feel included and welcome. · Make sure that the participants do not get exhausted during the sessions. · Sustain the trainee's attention, make the session interesting, and watch out for verbal and nonverbal communications. · Use the training handout and any additional educational aid · Use active methods e.g., discussion instead of passive · Encourage active participation, asking questions, and · Create small group (4-5) discussions using leading questions and activities. Monitor small group discussions and activities bearing in mind the concept of social cognitive theory (SCT).

Economic benefits of quality and safe fish products. Nutrition and economic benefits of processed fish Objective: i). Understand the economic benefits of quality and safe fish products to an individual and country. Discussion Points: (see facilitators guide)	1. Fish Quality 2. Fish loss and waste in the value chain 3. Poverty reduction 4. Economic empowerment 5. Improve nutrition and dietary diversity. 6. Improve health and wellbeing 7. Summary and evaluation	Module 7 Introduce Economic benefits of quality, nutritious and safe fish products. Key learning area: Economic empowerment through quality production. · Make participants feel included and welcome. · Make sure that the participants do not get exhausted during the sessions. · Sustain the trainee's attention, make the session interesting, and watch out for verbal and nonverbal communications. · Use the training handout and any additional educational aid · Use active methods e.g., discussion instead of passive · Encourage active participation, asking questions. · Create small group discussions using leading questions and activities. Monitor small group discussions and activities.

Content Validity Index Form

Items	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. Objective					
1.1 Consistency with knowledge need on the module					
1.2 Promotion of positive behavior and attitude changes					
1.3 Promotion of thought on the topic					
1.4 Practicability for the training					
Subtotal					
2. Content					

2.1 Appropriateness for target audience					
2.2 Clear and objective text					
2.3 Highlights on subject matters					
2.4 Informative					
2.5 Logical sequence					
2.6 Achievement of objective					
2.7 Scientific correction					
2.8 The content covered presents relevant information					
Subtotal					
3. Relevancy					

3.1 Key points portrayed					
3.2 Potential of knowledge transfer					
3.3 Scope					
3.4 Suitability for training					
3.5 Applicability					
Subtotal					
4. Language					
4.1 Literacy adequacy to the target group					
4.2 Clearness and intelligible					
4.3 Spelling Correctly					
4.4 Well organized or structured					

4.5 Comprehensible					
Subtotal					
5. Infographics					
5.1 Relevance to content					
5.2 Expression of needed information					
5.3 Motivates understanding of the content					
5.4 Appropriateness of Characters' charisma					
5.5 Sufficiency					
5.6 Similitude with real life					
5.7 Suitable designs for adults					

Subtotal					
6. Design					
6.1 Attractiveness					
6.2 Color contrast					
6.3 Font size					
6.4 Number of pages					
6.5 Style					
6.6 Text wrapping					
Subtotal					
7. Motivation					
7.1 Attractiveness of the content					
7.2 Enthusiasm for readers					

7.3 Sustain reader's interest					
Subtotal					
8. Culture					
8.1 Appropriateness for sociocultural level of the target audience					
8.2 Culturally appropriate and acceptable					
8.3 Reflection of the cultural needs of the target audience.					
Subtotal					
9. Methodology (participatory)					
9.1 Appropriateness of teaching method to the target group					

9.2 Relevant teaching aids					
9.3 Appropriateness of key message					
9.3 Duration; sufficient time allocation					
Subtotal					
10. Pre and post quizzes					
10.1 Clearness & comprehensibility					
10.2 Measures knowledge					
10.3 Suitability for the target group					
10.4 Well structured					
10.5 Relevance					
Subtotal					

Panelist Recommendations

Likert rating and corresponding relevance rate

Items rated 4 and 5 (agree and strongly agree) = 4 relevant and essential

Items rated 3 (Neutral) = 3 item requires minimal further review

Items rated 2 (Disagree) = 2 item requires further review

Items rated 1 (Strongly disagree) = 1 item is not relevant and must be removed.

CVI was calculated as the number of judges giving a rating of 4 and 5 (agree and strongly agree) divided by the total number of judges.

Appendix 4

Results from nutrient and contaminant analysis of fish samples

AFLATOXIN RESULT

Concentration is in ng/ul

S/NO	SAMPLE ID	G2	G1	B2	B1	TOTAL	S/NO	SAMPLE 1D	G2	G1	B2	B1	TOTAL
1.	**NN-CAE**	0.00426468	-	0.841103	0.00599347	**0.851361**	**2.**	**NN-NQE**	0.0104019	-	0.841424	0.00331416	**0.855141**
3.	**NN-CBZ**	-	-	-	-	**0.00000**	**4.**	**NN-NTE**	0.00977070	-	-	-	**0.00977070**
5.	**NN-CDW**	0.00499949	0.0114588	-	-	**0.0164582**	**6.**	**NN-NXE**	0.00300690	-	0.842652	-	**0.845659**
7.	**NN-CHE**	-	-	-	0.00685318	**0.00685318**	**8.**	**NN-NYE**	-	0.0104897	-	0.00325886	**0.0137485**
9.	**NN-CIW**	0.00917261	-	0.844541	-	**0.853714**	**10.**	**NN-SBW**	0.00335488	0.0195936	-	0.00351535	**0.0264638**
11.	**NN-CJW**	-	-	-	0.847112	**0.847112**	**12.**	**NN-SBZ**	-	0.00558826	0.844409	0.00389903	**0.853896**
13.	**NN-CKE**			0.841821	0.0116726	**0.853493**	**14.**	**NN-SHE**	-	-	-	0.00330399	**0.00330399**
15.	**NN-CLE**	-	-	0.842932	-	**0.842932**	**16.**	**NN-SOW**	-	-	0.840833	-	**0.840833**
17.	**NN-CME**			0.841596	0.0125635	**0.854160**	**18.**	**P-SHE**	-	0.00357775	0.841194	0.00488672	**0.849659**
19.	**NN-COW**	0.0115633	-	0.843343	0.00419804	**0.859104**	**20.**	**NN-CBF**	-	0.00307321	0.843176	-	**0.846249**
21.	**NN-CPW**	-	0.00789618	0.845574	0.00479857	**0.858269**	**22.**	**P-NVZ**	0.00394124	0.00868361	0.841112	0.00689647	**0.860633**
23.	**NN-CRF**	-	0.00926296	-	0.00327066	**0.0125336**	**24.**	**P-NVF**	0.00802930	0.00922060	-	0.00462163	**0.0218715**
25.	**NN-CRW**	-	0.0142734	-	0.0102741	**0.0245474**	**26.**	**P-CVZ**	0.00320185	0.00680179	-	-	**0.0100036**
27.	**NN-CTE**	0.00852051	0.00499146	-	0.0119789	**0.0254908**	**28.**	**NN-CMG**	0.00641788	-	0.842857	0.00650405	**0.855779**
29.	**NN-CUE**	0.00909848	-	-	0.00315502	**0.00122535**	**30.**	**NN-SYG**	0.00526577	0.00761076	0.849458	0.00621508	**0.868550**
31.	**NN-CUW**	-	-	-	-	**0.00000**	**32.**	**NN-CQE**	0.00853179	-	0.843985	0.00565653	**0.858174**
33.	**NN-CVE**	-	0.00834713	0.844751	0.0175548	**0.870653**	**34.**	**NN-SXG**	0.00886864	-	0.841376	0.00738008	**0.857625**
35.	**NN-CXE**	0.00721110	0.00449360	-	0.00495104	**0.0166557**	**36.**	**NN-NHE**	-	-	0.841354	-	**0.841354**
37.	**NN-CXG**	0.00749266	0.00749142	-	-	**0.0149841**	**38.**	**NN-NOW**	0.0173864	0.0217039	-	0.00647555	**0.0455658**
39.	**NN-NBF**	0.00668959	0.0118627	0.845193	0.00581400	**0.869559**	**40.**	**NN-NRF**	0.00357060	-	0.841005	0.00445133	**0.849027**
41.	**NN-NBZ**	-	-	0.847662	-	**0.847662**	**42.**	**NN-SJW**	-	-	-	0.00926779	**0.00926779**
43.	**NN-NKE**	-	0.00524145	0.847879	0.00305612	**0.856176**	**44.**	**NN-SLE**	0.0112810	0.0105123	0.840605	0.00305344	**0.865451**
45.	**NN-NME**	-	-	0.845937	-	**0.845937**	**46.**	**NN-SVG**	0.0102380	-	0.843383	-	**0.853621**
47.	**NN-NMF**	0.00355403	0.00691001	-	-	**0.0104640**	**48.**	**NN-SXE**	0.00411644	-	-	0.00605053	**0.0101670**
49.	**P-CAW**	0.00375005	0.00682023	0.846942	0.00576094	**0.863273**	**50.**	**P-COW**	-	0.0108312	-	-	**0.0108312**
51.	**P-CVW**	0.00789060	0.00739260	-	0.00362493	**0.0189081**	**52.**	**P-CVF**	-	0.00671447	-	0.00429861	**0.0110131**
53.	**P-NRE**	0.0108791	-	-	0.00768754	**0.0185666**	**54.**	**P-NVW**	-	0.00791634	-	0.0112941	**0.0192104**
55.	**P-SBE**	-	0.0158939	0.841172	-	**0.857066**	**56.**	**P-SDE**	0.00509032	0.00670461	0.841729	0.00923911	**0.862764**

57.	**P-SIW**	-	-	0.848262	0.00622469	**0.854487**	**58.**	**P-SVF**	-	-	-	-	**0.00000**
59.	**NN-CHG**	-	-	0.845909	0.0203040	**0.866213**	**60.**	**NN-CQG**	-	0.00866213	0.841067	0.00816893	**0.855236**
61.	**NN-CVG**	0.00602346	0.00539595	-	0.00328650	**0.0147059**	**62.**	**NN-NHG**	0.00992567	-	0.841518	0.0126370	**0.864081**
63.	**NN-NIW**	-	-	0.840794	0.0113782	**0.852172**	**64.**	**NN-NLE**	0.00458331	0.00511476	0.841565	0.00490225	**0.856165**
65.	**NN-NMG**	0.00856165	0.00595577	0.844648	-	**0.854894**	**66.**	**NN-NXG**	0.00588889	0.00459215	0.846452	-	**0.856933**
67.	**NN-NRW**	-	0.0105251	-	0.00461646	**0.0151415**	**68.**	**NN-NYG**	-	-	-	0.0117332	**0.0117332**
69.	**NN-SAE**	-	-	-	0.00358688	**0.00358688**	**70.**	**NN-SDW**	-	-	0.845568	-	**0.845568**
71.	**NN-SHG**	-	-	-	-	**0.00000**	**72.**	**NN-SKE**	-	-	0.841266	-	**0.841266**
73.	**NN-SLG**	-	-	0.844535	-	**0.844535**	**74.**	**NN-SMG**	-	-	-	0.00406585	**0.00406585**
75.	**NN-SPW**	0.00369969	-	0.842896	0.00335951	**0.849955**	**76.**	**NN-STE**	-	-	-	0.00748246	**0.00748246**
77.	**NN-SVE**	0.00606341	0.00627222	0.841091	-	**0.853426**	**78.**	**NN-SYE**	0.00581290	0.0111135	-	-	**0.0169264**
79.	**NN-CBW**	-	-	0.841043	0.00581161	**0.846855**	**80.**	**NN-CLG**	0.00453084	0.0122690	0.843178	-	**0.859978**
81.	**NN-CYE**	0.0177790	0.00887115	-	-	**0.0266502**	**82.**	**NN-CYG**	0.00430576	-	0.843959	0.00430110	**0.852566**
83.	**NN-NAE**	0.00356516	-	0.842032	-	**0.845597**	**84.**	**NN-NQG**	0.00560585	0.0182118	0.848989	-	**0.872807**
85.	**NN-SBF**	-	0.00342457	-	0.0105296	**0.0139542**	**86.**	**NN-SIW**	0.0135543	0.00496098	-	0.00605804	**0.0245733**
87.	**NN-SME**	-	0.00751674	0.851947	0.00351647	**0.862981**	**88.**	**NN-SQE**	0.00738585	-	0.843766	0.00584653	**0.856998**
89.	**NN-SQG**	0.00860372	-	-	-	**0.00860372**	**90.**	**NN-SRF**	-	-	-	-	**0.00000**
91.	**NN-SRW**	-	-	-	-	**0.00000**	**92.**	**NN-SUE**	0.00564822	-	0.840889	0.00773768	**0.854275**
93.	**NN-SUW**	-	-	-	-	**0.00000**							
94.	**P-SVZ**	-	-	0.842062	-	**0.842062**							

AMINO ACID ANALYSES ON 69 FISH SAMPLES

Concentration is in ng/ul

34	SAMPLE ID	L-Aspartic Acid	L-Glutamic acid	L-Asparagie	L-Serine	L-Glutamine	L-Histidine	Glycine	L-Threonine	L-Arginine	L-Alanine	L-Tyrosine	L-Cystine	L-Valine	L-Methionine	L-Norvaline	L-Tryptophan	L-Phenylalanine	L-Isoleucine	L-Leucine	L-Lysine	L-4-Hydroxyproline	L-Sarcosine	L-proline	TOTAL
	NN-COW	9.95312	7.58889	-	-	-	8.72754	-	-	27.61739	11.56741	10.47765	14.95146	20.31066	9.27881	22.36798	10.29957	-	-	15.37342	-	10.61954	13.43164	-	**192.56509**
	NN-CRF	8.80953	8.79935	-	-	-	-	-	-	35.20530	35.20530	36.50049	-	12.89393	7.65904	7.81818	17.33746	-	1.73421	16.15526	-	3.48229	8.33215	14.51757	**191.31012**
	NN-CTE	-	10.14753	-	-	-	-	-	18.44903	-	18.44903	-	-	25.49114	21.35427	23.40187	6.14982	-	-	10.00646	-	2.24467	15.87258	-	**133.11738**
	NN-NAE	13.08079	10.75351	5.557955	13.25346	-	11.96702	-	6.83195	57.58033	28.10320	-	-	28.10320	28.10320	23.57915	5.85492	-	-	-	74.29068	4.33817	11.58294	-	**332.70520**
	NN-NIW	11.69135	10.50206	7.60334	10.77178	-	10.39116	-	1.71594e-1	6.24928	16.92308	12.86287	7.74907	-	11.66589	21.31590	15.99017	-	-	-	10.94700	17.82631	9.28518	21.43801	**203.32945**
	NN-NLE	9.83653	11.14880	7.05149	13.27643	-	11.26556	-	6.91568	54.78751	27.06913	-	-	-	24.02569	21.47081	7.29709	-	-	-	82.19318	3.72790	10.13858	-	**290.2044**
	NN-NMF	10.70839	9.05123	-	-	-	-	-	-	54.89926	11.99694	9.41878	-	22.18133	16.08616	21.42721	5.58668	-	-	58.61022	-	4.52295	6.36262	-	**230.8518**
	NN-NRE	11.13276	10.23148	-	-	-	-	-	-	-	18.72519	-	27.65168	20.49581	10.81026	20.96699	5.15980	1.44221	1.91805	6.64483	-	3.17922	14.56659	-	**152.9249**
	NN-NVM	15.20188	10.24763	-	-	-	-	-	-	-	18.91364	-	-	19.84097	13.17701	20.31211	5.84206	-	-	44.94078	-	1.94773	15.50679	-	**163.9829**

	NN-SAE	11.2114 6	12.8026 4	9.1016 7	13.1855 8	-	14.3058 6	4.73989	-	-	30.6158 5	-	-	-	21.9372 2	8.77157	9.37024	-	-	-	4.1899 1	6.70127	14.2270 4	23.3312 6	**1.94773**
	NN-NXE	9.37081	8.57548	8.3094 3	10.3798 5	-	9.63113	-	-	1.90710	17.6132 7	9.14440	-	24.7342 5	11.2987 5	23.5028 7	5.94451	-	2.30883	-	3.3597 1	4.41947	25.3155 0	-	**184.4915**
	NN-SBF	9.49149	9.09324	-	-	-	-	-	-	22.8752 5	33.1808 3	-	-	27.6133 8	15.8189 1	28.6469 0	5.66607	--	-	42.3743 9	-	2.89724	8.34629	-	**175.8154**
	NN-SDW	16.3313 5	10.8848 2	6.8646 5	8.81149	10.1841 1	3.42371	-	-	45.5324 7	19.6760 9	-	--	10.4632 7	10.9526 6	14.0997 4	-	-	-	-	6.4637 2	7.20600	11.1914 5	23.3478	**206.004**
	NN-SIW	12.8660 5	10.9708 8	10.058 29	10.7183 3	-	10.7640 8	3.53227	3.53227	6.50577	15.9314 6	15.9314 6	4.97565	-	11.0305 7	8.55139	14.5945 0	-	-	-	9.7065 1	8.35171	5.75874	32.1923 6	**205.4203**
	NN-SJW	10.1823 6	11.5017 2	7.7631 2	13.5289 8	-	11.1925 5	-	7.15333	44.8180 0	24.1711 2	-	-	32.5652 9	21.7738 8	21.9615 5	7.56884	-	-	-	84.33605	4.72571	8.55404	-	311.7965
	NN-SLE	11.7377 5	11.3646 8	8.1894 3	12.8528 0	-	14.3730 4	-	5.40900e-1	36.5969 8	28.7605 1	-	-	-	20.5797 5	22.2230 3	5.82241	-	-	-	90.08248	8.35884	9.16554	-	280.6481
	NN-SKE	12.8999 8	8.79287	-	-	-	-	-	-	74.0246 8	29.2369 9	-	-	30.0269 6	15.6775 1	11.1720 6	4.46249	-	2.66577	114.27600	-	5.74850	24.8137 7	-	333.7976
	NN-SME	13.0143 1	9.15924	-	-	-	-	-	-	84.1920 0	16.2871 7	-	34.0381 7	6.55007	8.13527	5.15782	4.67550	-	-	110.18227	-	3.39534	18.3702 0	-	**311.7965**
	NN-SOW	9.91616	10.6636 5	7.7050 8	10.8321 9	-	10.1279 9	-	3.40696	12.0217 8	13.3688 4	12.9067 1	10.3184 4	15.5163 2	10.5395 1	6.74522	13.4558 5	-	-	-	25.58241	4.76715	7.53260	51.5891 6	**280.6481**
	NN-SQE	14.1537 6	12.9626 1	6.1197 2	12.8846	-	10.1453 6	4.63338	-	-	34.2861 9	10.2021 2	-	-	13.3957 0	8.63611	18.2132 8	-	-	-	1.9765 0	165.64793	10.8663 1	-	**313.1574**
	NN-SRF	11.7222 5	7.62588	-	-	-	-	-	-	37.9429 8	13.2046 2	32.0535 5	-	29.8487 9	16.6497 7	26.2342 1	15.7423 9	-	-	19.9180 7	-	4.11849	9.10749	11.8811 6	**236.996**
	NN-	13.1266 1	7.67876	-	-	-	-	-	-	82.6526 0	11.7438 9	12.5945 8	-	5.41971	13.7723 7	5.85490	6.49997	-	-	9.32059	-	6.67434	14.3772 9	-	**243.8815**

	SRW																								
	NN-STE	10.94211	11.31627	-	-	-	-	-	55.57893	-	-	8.52379	-	-	-	-	-	3.36710	-	-	17.33559	13.86964	27.90526	-	**10.78437**
	NN-SUE	11.67769	10.63866	-	-	-	11.49781	-	5.98687	28.09666	24.89314	-	-	44.33961	24.28947	23.40573	5.27653	-	1.91056	-	10.10500	3.47141	13.17980	-	**305.346**
	NN-SVE	15.00549	15.49717	-	-	-	-	4.92988	-	-	-	13.19492	-	-	-	-	-	4.43873	-	59.37654	-	15.33190	25.28363	-	**18.78147**
	P-CAW	10.43314	8.10599	5.41416	12.33134	-	8.04249	-	-	-	-	11.09414	-	23.50298	12.87139	-	-	8.83276e-1	-	7.30285	-	-	23.36563	-	**236.0497**
	P-CVW	8.85945	8.99048	-	-	-	-	-	-	65.32655	35.24349	-	-	44.87353	22.09827	29.86652	6.24839	-	3.47842	48.92378	-	2.37759	10.69981	-	**172.7163**
	P-NVF	9.49774	9.03663	-	-	-	-	-	-	40.20953	34.18226	-	-	43.09518	15.44921	28.66638	5.96846	-	-	44.23409	-	3.16162	8.91602	-	**16.99935**
	P-SDE	8.84518	8.90606	-	-	-	-	-	-	82.56486	34.78574	-	-	41.15202	18.90789	27.04632	5.99389	-	-	17.61701	-	6.48515	11.71399	11.69764	**148.8387**
	P-SIW	11.73444	9.26682	-	-	-	-	-	-	46.69355	19.08902	-	-	24.64502	22.25279	24.06461	5.65347	-	-	30.11510	-	3.30798	9.13673	-	202.6516
	P-SVW	9.13673	8.94319	-	-	-	-	-	-	-	-	19.83544	-	20.50052	13.79481	-	-	9.25724e-1	-	6.37597	-	1.14986	9.87285	-	**218.7689**
	NN-CAE	11.08292	8.73528	-	-	-	-	-	-	-	-	-	32.02696	20.76107	12.19550	-	-	-	-	68.82202	-	10.48929	23.81648	-	**187.92953**
	NN-CBF	2.57291e-2	-	-	-	-	-	-	-	111.00942	-	-	47.47062	2.77092	-	-	-	-	-	-	-	2.13035	2.65739	-	**166.06443**
	NN-CBW	-	7.06251	-	-	-	-	-	-	-	16.01124	7.56139	-	-	13.99308	32.76363	-	4.61813	9.46352	-	-	9.46352	44.33444	-	**137.63275**
	NN-CDW	-	-	-	-	21.57802	-	-	-	45.72046	-	-	12.99844	24.52291	3.87411	-	-	8.70568e-1	2.23239	-	-	-	4.41511	-	**116.21201**

	NN-CHE	-	-	-	6.03212	-	8.96635	-	-	-	18.95294	-	-	14.27211	-	-	-	-	6.58402	-	-	4.23276e-1	1.88292	-	**57.11375**
	NN-CIW	9.40588	8.41790	-	-	-	-	-	-	-	-	-	-	22.01069	15.57004	-	13.97320	-	-	18.99242	-	-	18.99242	7.18517	**105.98361**
	NN-CJW	-	1.34999e-1	-	-	-	-	-	-	-	-	-	18.73478	49.76878	-	-	-	-	24.53555	-	-	1.11178	25.48585	5.42127e-1	**120.31386**
	NN-CKE	-	-	-	-	-	-	-	-	-	-	-	57.85408	-	-	4.18444	-	-	10.31882	-	-	7.47554e-1	5.98136	-	**79.08626**
	NN-CPW	-	-	-	-	-	1.12650	-	-	-	2.82444	6.58152	-	-	-	7.81717	7.55857	-	368.52542	-	-	-	7.30180e-1	1.82952e-1	**395.34676**
	NN-CME	-	-	3.65250	-	7.93910	-	-	-	-	17.67392	-	-	-	-	-	-	17.67392	437.37896	-	-	2.25731	-	-	**491.49865**
	NN-CLE	-	-	-	2.98699	7.36661	-	-	-	-	14.78971	32.25781	-	-	-	-	-	2.00835	379.12673	-	-	1.92455	-	-	**440.46074**
	NN-CQE	1.58624e-2	-	-	4.50462	-	5.99423e-1	4.11742	-	-	-	45.60050	-	-	-	-	-	-	9.62424	-	-	3.82293e-1	-	-	**64.84435**
	NN-CRW	-	-	-	-	5.37295	-	-	-	22.84495	155.57471	4.03578	-	6.12404e-1	-	12.17064	51.72362	-	-	-	-	2.10894	11.38733	-	**265.83131**
	NN-CUE	1.52743e-2	-	-	1.88669	1.42077	5.50734	-	-	-	18.38061	-	106.08631	-	-	-	-	-	164.25164	-	15.59711	-	43.78719	-	**356.93294**
	NN-CVE	10.26424	8.57266	-	-	-	-	-	-	-	-	-	14.74424	20.27726	9.62600	-	-	-	-	75.48117	-	-	8.70834	-	**147.67391**
	NN-CXE	-	1.55730e-1	1.45745	-	7.39415	-	-	-	-	17.89799	5.44596	-	-	1.57637e-1	-	-	23.88779	-	-	-	2.25032	-	-	**58.64702**

	NN-CYE	-	6.64922	-	-	-	-	-	-	-	6.69803	-	-	12.38976	-	-	-	-	10.84479	-	-	4.24766e-1	10.14811	-	**47.15467**
	NN-NBF	-	-	1.41634	-	8.36529	-	-	-	-	11.78339	8.04781	-	-	2.17897e-1	-	-	8.63496	368.32889	-	1.86213	2.44592	-	-	**411.10263**
	NN-NBW	3.59231e-2	-	-		1.81338	-	6.24729	5.18618e-1	-	-	4.23992	64.30487	-	-	-	-	-	11.27713	-	-	7.11398	-	-	**95.55112**
	NN-NHE	-	2.15274	6.10947	-	-	8.83940	-	5.27913	-	18.10813	-	-	16.16637	-69.0651469.06514	-	-	-	69.06514	6.36878	-	1.81953	17.55382	-	**151.46252**
	NN-NKE	-	-	5.74657	7.09734e-1	-	8.57851	-	-	-	19.47969	-	-	13.57604	-	-	-	-	7.90947	-	-	4.54083e-1	7.84443	-	**7.84443**
	NN-NME	-	2.38014	-	-	-	9.60970	-	-	-	21.54391	-	-	10.48149	-	-	-	-	6.67263	-	-	0.861618	7.88110	-	**59.43060**
	NN-NOW	-	0.212397	1.74203	-	-	-	-	4.15144	-	27.58355	3.21851	-	-	0.0599673	-	-	27.90418	-	-	-	1.66322	-	-	**66.53530**
	NN-NQE	-	-	1.74774	-	6.94586	0.237300	-	-	-	27.93458	3.93135	-	-	0.296965	-	27.07299	21.15417	-	-	-	1.66196	2.39195	-	**93.37486**
	NN-NXG	-	0.370033	-	-	-	1.64061	-	-	-	-	-	38.43562	-	-	1.53806	-	-	503.11896	-	-	-	4.24125	-	**549.34453**
	NN-NYE	0.173277	-	-	1.85685	-	4.50655	0.640397	-	-	8.96194	-	62.74192	-	-	-	-	-	13.39974	-	-	13.20509	-	-	**105.32981**
	NN-SBW	-	-	-	5.87446	-	4.69196	-	-	-	18.90911	-	-	14.28319	-	-	-	-	7.80942	-	-	0.230316	2.44134	-	**54.23979**
	NN-SHE	-	-	-	-	-	-	-	-	0.976009	43.23379	15.36467	-	-	-	27.02874	-	-	379.22940	-	-	-	0.317139	0.258934	**466.40868**

	NN-SXE	0.01545572	-	-	2.24510	0.644499	4.46534	0.05777769	-	-	3.14442	-	69.65745	-	-	-	-	-	27.33050 3	-	1.54546	-	15.80267	-	**124.88320**
	NN-SYE	-	-	-	-	6.06553	0.896061	-	2.86376	-	-	12.51592	-	-	-	28.68813	-	-	289.07626	-	-	-	-	1.99562	**342.10130**
	NN-NRW	10.47909	7.89485	-	-	-	-	-	-	31.44638	13.21658	13.90512	-	33.82441	19.61600	25.15170	17.23449	-	-	45.13723	-	-	14.32467	13.52792	**245.75842**
	P-NTE	-	-	-	-	-	-	-	-	-	-	-	-	-	23.85332	-	-	-	10.94982	4.65188	-	-	10.22565	-	**49.68066**
	NN-SPW	10.78437	10.62630	4.97138	13.15862	-	10.88343	-	7.04594	45.25721	26.49747	-	-	30.37584	20.65764	22.11147	8.37172	-	-	9.13938	21.97913	-	5.36142	7.44450	**254.66581**
	P-CVF	10.56341	8.69799	-	-	-	-	-	-	-	-	-	33.42614	22.60110	13.07237	-	-	-	1.41095	101.30636	-	-	10.81452	-	**201.89285**
	P-SBE	8.83022	8.59325	-	-	-	-	-	-	-	-	-	32.25985	7.50962	9.37410	-	-	-	-	63.78679	-	-	26.14923	-	**156.50306**
	P-SHE	11.59275	8.40679	-	-	-	-	-	-	-	-	-	31.42693	22.61605	12.94491	-	-	-	-	46.33166	-	5.14772	10.09205	-	**148.55887**
	P-SVF	8.43079	8.66223	-	-	-	-	-	-	-	-	-	32.49918	22.39320	14.51303	-	-	0.995743	-	6.66304	-	2.03954	16.75022	-	**112.94698**
	NN-NRF	0.03238 7	-	-	**6.98726**	-	**0.499734**	**3.19836**	-	-	-	**37.90563**	-	-	-	-	-	-	**9.62424**	-	-	0.696589	-	-	**58.94420**

FATTY ACID RESULT

Concentration is in ng/ul

35.	SAMPLE ID	Butyric acid methyl ester	Caproic acid methyl ester	Caprylic acid methyl ester	Capric acid methyl ester	Undecanoic acid methyl ester	Lauric acid methyl ester	Tridecanoic acid methyl ester	Myristic acid methyl ester	Myristoleic acid methyl ester	Pentadecanoic acid methyl ester	Cis-10-Pentadecenoic acid methyl ester	Palmitic acid methyl ester	Palmitoleic acid methyl ester	Heptadecanoic acid methyl ester	Cis-10-Heptadecanoic acid methyl ester	Stearic acid methyl ester	Elaidic acid methyl ester	Oleic acid methyl ester	Linolelaidic acid methyl ester	Linoleic acid methyl ester	Arachidic acid methyl ester	g-linolenic acid methyl ester	cis-11-Eicosenoic acid methyl ester	Linolenic acid methyl ester	Heneicosanoic acid methyl ester	Cis-11,14-Eicosadienoic acid methyl ester	Behenic acid methyl ester	Methyl cis-8,11,14-eicosatrienoate	Erusic acid methyl ester	cis-11-14-17-Eicosatrienoic acid methyl ester	Arachidonic acid methyl ester	Tricosanoic acid methyl ester	Cis-13,16-Docosadienoic acid methyl ester	Lignoceric acid methyl ester	Cis-5,8,11,14,17-Eicosapentaenoic acid methyl	Nervonic acid methyl ester	Cis-4,7,10,13,16,19-Docosahexaenoic acid	TOTAL
	NN/NHE	-	-	-	-	233.97	-	-	92.72	-	30.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	357.31
	NN/NXG	-	-	-	-	947.51	4706.14	-	399.33	-	275.85	340.45	-	-	-	-	-	-	-	-	550.69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7219.96
	NN/SHE	-	-	42.24	-	323.93	8003.63	-	433.20	-	341.37	-	-	-	-	-	-	-	-	-	262.52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9406.88
	NN/SIW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	88.07	127.82	-	-	-	215.82
	NN/SJW	-	-	-	-	5.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.01
	NN/SOW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	78.90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	78.90

	NN/SRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23.73	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23.73
	NN/SUE	-	-	-	-	223.25	3037.56	43.76	326.52	-	140.08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3771.16
	P/COW	-	-	-	-	435.90	4005.07	64.98	476.17	28.20	318.001	13.332	13.307	160.4	22.14	40.89	3697.20	43.558	37.557	21.117	45.664	49.24	71.885	77.114	39.443	95.551	47.113	48.117	53.449	37.116	532.663	173.117	43.229	222.711	162.68	-	299.52	-	1.12e4
	P/CVW	-	-	-	-	604.76	5233.76	-	221.13	-	220.44	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6280.09e4
	P/NMF	19.08	79.199	-	92.50	1075.93	3.62e4	-	731.17	-	367.36	-	-	-	-	-	-	-	-	-	244.68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.88e4
	P/NRE	-	-	-	-	404.53	5045.56	-	181.60	-	122.09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5753.78
	P/SBE	-	84.86	89.45	-	1163.46	1.32e4	16.30	713.23	27.81	1003.50	-	7.997	157.52	91.28	3827.95	-	14.09	6.38	17.36	801.39	-	--	-	-	-	-	-	-	73.97	-	-	34.65	87.339	109.95	326.81	1873.18	1097.77	2.48000000
	P/SDE	-	-	-	-	397.60	3389.93	-	192.36	-	79.65	-	-	-	29.40	-	-	-	11.999	-	14.211	12.64	31.993	-	-	-	66.82	-	-	20.400	653.611	96.222	90.000	122.777	212.74	121.41	-	-	5543.40
	P/SHE	-	-	-	-	69.53	1.48e4	-	840.36	-	499.18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.62000000
	P/SOW	4704.62	-	-	1.02e4	2006.97	-	1.28e4	1248.74	220.98	1608.21	-	-	-	-	-	-	-	-	-	1462.85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9.29e4	-	1.27000000
	P/SVW	-	-	-	-	975.80	7933.35	-	385.59	110.04	286.883	13.340	7.36	23.70	57.87	6800.82	41.33	39.223	-	-	304.55	-	-	-	29.45	-	-	-	33.57	-	-	144.57	603.666	921.39	-	415.37	442.84	1.94000000

	NN/CAE	-	37.83068	-	-	422.14683	6759.09704	-	277.96138	-	91.24692	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7588.28286
	NN/CBF	24.15183	120.66109	74.35433	121.66672	5983.83733	1.098160000	125.46022	1926.26757	67.69233	3987.99195	299.93873	-	127.56541	-	-	-	-	-	2760.66900	675.83728	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.727770000
	NN/CBW	66.29303	84.67365	109.09965	26.60857	279.08413	5409.98570	17.96014	216.09076	14.32079	109.24391	22.64377	17.44015	27.10348	19.19712	2866.21673	-	-	-	-	-	-	-	-	-	-	-	29.52126	-	52.66504	364.15710	96.91694	90.77894	73.37513	-	134.03880	497.44167	-	1.065210000
	NN/CDW	43.65058	92.22441	56.61184	475.04766	563.92011	1.655520000	77.29954	309.83681	-	896.70031	-	-	-	-	-	-	-	-	10.01435	-	-	-	-	-	-	-	-	-	-	-	50.87900	-	85.71375	-	-	-	396.80913	1.961390000
	NN/CIW	43.76476	105.00818	152.46483	122.62807	1658.93545	2.579480000	240.50264	2046.06252	78.47093	2492.83102	-	-	-	-	-	-	-	-	-	3365.72213	813.39598	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.691460000
	NN/CJW	46.41927	-	-	-	-	-	493.55155	41.85348	1307.87570	40.71775	26.29484	42.55271	51.22126	-	5.143330000	1633.71453	67.25023	-	74.59351	337.08337	583.38249	-	-	27.55673	-	-	180.59354	92.98925	-	-	-	-	-	1279.95885	-	-	-	5.776090000
	NN/CKE	-	-	-	-	481.49473	7175.95171	-	613.98172	-	1251.981	379.79109	-	-	-	-	-	-	-	-	1439.725	-	25.71529	41.09396	19.92698	17.72911	-	-	27.51534	-	-	-	-	-	-	-	-	-	1.147490000

											29										73																		
	NN/CLE	26.50373	196.13139	28.57726	87.94886	3246.23675	6.346060000	-	2220.08810	59.77230	1053.39913	99.60310	86.51867	-	-	-	-	-	-	-	1825.96335	173.96564	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.256530000
	NN/CME	-	52.61732	84.31168	254.29726	842.36669	1.504010000	-	766.97846	-	1078.48955	382.86897	-	-	-	-	-	-	-	-	1666.77393	-	-	-	-	-	-	-	-	-	-	-	-	-	-	96.90359	221.67904	-	2.048730000
	NN/COW	-	107.77332	80.71334	64.19571	344.72981	1.365880000	19.37792	492.75720	7.12681	196.66659	-	42.86470	10.91627	8.82471	-	11.29012	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.504610000
	NN/CPW	63.91937	57.90863	94.03431	67.54425	1222.98942	5.447280000	-	2925.06859	-	2103.93984	-	-	-	-	-	-	-	-	-	5171.82841	-	-	-	-	-	849.87069	-	-	-	-	-	-	-	-	-	-	-	6.702990000
	NN/CQE	-	58.60494	-	-	1784.45639	7497.32091	51.14151	366.53834	-	1286.76331	658.02074	-	-	-	-	-	-	-	-	1853.41888	-	-	-	84.92640	76.37655	-	-	-	-	-	-	-	-	-	-	383.96569	364.80882	1.446630000
	NN/CRF	-	42.69637	-	-	-	2795.57736	-	8.38727	40.13398	26.55321	12.82499	157.05017	60.9632	1032.03210	2996.57938	16.47065	41.51595	12.15759	473.02783	346.16470	15.74020	12.75834	-	-	-	-	-	-	-	3926.88399	-	-	-	-	-	-	-	1.201760000
	NN/C	-	-	-	-	-	-	-	-	61.52	27.94	73.83	-	352.04	62.3512	859.89	8.130	1214.	290.2	49.08	-	741.2	-	37.39	-	-	36.37	121.2	-	-	-	-	-	-	-	1140.9	313.48	-	5389.9

	RW									199	473	037		041		642	65	29825	65733	400		7041		609			978	1066								4490	554		3506
	NN/CTE	-	118.592466	77.704133	88.236766	640.936144	7264.389 62	-	339.013911	-	510.047411	-	-	-	-	-	-	-	-	-	632.617335	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9671.537777
	NN/CVE	46.060065	32.740994	130.206250	104.120800	488.636354	4014.519 40	42.158587	389.502022	-	254.769 83	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	29.549000	-	-	-	-	-	5532.261631
	NN/CXE	-	-	-	-	26.466637	-	71.077768	1711.933115	5.732488	-	19.353389	162.009097	1.08012000 00	404.545244	2.88802300 00	144.475119	14.494500	5151.119888	2999.334438	12.888135	153.869061	1117.699889	77.271225	38.912775	-	44.859599	335.100400	-	912.875221	-	33.599924	-	-	-	-	-	-	5.150110000
	NN/CYE	-	-	-	-	-	2601.234 54	7.631192	74.163115	11.046 35	135.297888	24.887191	70.079700	1710.7 54 14	105.51303	1149.9 8666	24.531447	46.799700	1058.652007	917.499008	-	-	35.269445	71.255334	60.166886	-	-	269.750 75	-	-	-	-	-	98.111188	-	-	-	-	8472.615 87
	NN/NAE	-	-	-	-	136.40379	-	-	205.589 08	-	161.024 73	-	-	-	-	-		-	-	-	-	-	-	-	-	-	27.003 83	-	-	54.262 219	684.045 72	77.245 81	81.104 44	133.452 65	243.599 04	126.775 79	499.892 31	167.923 26	2598.3 22 63
	NN/NBF	-	64.716 37	-	56.072 58	418.45 062	7804.0 01 57	9.39561	257.127 36	-	361.951 90	-	-	-	-	-	-	-	-	-	90.324 65	36.717 28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9098.7 57 95
	NN/N	25.90	-	56.27	43.76	592.81	4321.0	-	237.8	-	263.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5541.6

	BW	777		081	475	800	8122		4074		8765																																7094
	NN/NIW	25.744408	115.292667	82.209599	56.653665	1533.133392	4.2131700000	-	1609.169055	-	2775.913066		-	-	-	-	-	-	-	-	2852.392887	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.1182200000
	NN/NKE	-	57.741922	-	25.032226	665.543431	1.2317800000	-	691.759225	-	1732.007221	442.313196	-	-	-	-	-	-	-	-	2007.271554	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.7939500000
	NN/NOW	-	-	-	-	-	-	-	-	78.630117	484.493300	10.544558	183.363244	63.837388	6.7850900000	1308.529259	10.458586	31.724496	10.158668	8.688733	2532.705556	-	-	-	-	23.222351	-	-	-	-	-	241.137100	-	-	-	-	-	-	-	-	7.2402400000
	NN/NQE	-	-	-	-	-	3059.391994	13.901884	30.766651	8.730331	20.592996	15.259584	1161.887850	99.115101	-	1.4852700000	4163.396220	33.710700	23.013004	27.967791	2144.589887	-	-	-	-	816.158447	162.734559	-	-	-	-	-	-	138.776003	-	-	-	-	-	-	1.604447
	NN/NRW	57.513988	106.032661	7.331992	57.962265	1055.420207	4.7084000000	-	1688.097822	-	1473.062005	101.672122	-	-	-	-	-	-	-	-	548.786334	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.2249900000
	NN/NTE	19.094220	77.818889	60.121178	71.771114	489.211467	3.0585700000	-	1108.143033	50.247221	1144.710091	-	-	-	-	-	-	-	-	-	2430.136488	759.105568	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.6796100000

	NN/NXE	27.19462	-	105.10650	-	550.87084	1.019160000	-	1050.55911	-	1869.52572	1118.59723	-	-	-	-	-	-	-	-	3707.15835	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.862060000
	NN/NYE	56.05528	40.21237	-	106.72052	226.23822	4213.51904	36.19101	430.44656	-	112.51566	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5221.89866
	NN/SAE	24.63498	104.26579	66.45721	36.12333	870.40465	2.415070000	148.27669	1277.87500	50.33985	951.70776	-	-	-	-	-	-	-	-	-	503.36476	672.32485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.885650000
	NN/SBW	-	72.82490	-	-	1522.09519	6701.71467	-	476.56641	-	616.49433	-	-	-	-	-	-	-	-	-	393.92080	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9783.61630
	NN/SDW	35.02244	99.75732	103.05182	114.25021	1673.86469	5.909720000	-	1463.76108	89.55595	1929.40290	165.20398	-	-	-	-	-	-	-	-	383.49107	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	305.09436	6.545970000
	NN/SLE	-	53.86208	-	-	1087.04648	1.403750000	141.79495	1037.38032	-	409.25105	-	-	-	-	-	-	-	-	-	602.23932	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.736910000
	NN/SME	160.61046	127.54041	270.35862	571.45093	2096.73831	1.661890000	31.56452	698.12408	8.59062	364.62069	502.25623	-	-	-	-	-	-	-	-	281.28169	-	-	-	-	-	-	-	-	-	-	-	-	-	-	220.71645	215.88602	-	2.216860000

	NN/SRW	240.4240406	87.3152528	158.7973131	84.700078	735.6498987	4.0827800000	-	1070.1686867	55.229664	1318.4266060	231.5247471	-	-	-	-	-	-	-	-	-	704.8398987	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.5514900000
	NN/SVE	24.6349849	104.2665721	66.4572133	36.12333	870.404655	2.4150700000	148.2766969	1277.8750076	50.339855	951.7077676	-	-	-	-	-	-	-	-	-	-	503.3647676	672.3248485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.8856500000
	NN/SXE	-	47.8573321	43.812221	-	279.04098	6147.182771	28.1502222	405.1451513	-	589.7263633	314.5926266	8.199559	10.2.29148	18.8.42452	34.5.31444	3482.0619898	40.736665	32.9637171	27.1607575	469.9503232	53.0017575	59.1597777	54.2204444	103.4744422	101.1300000	107.391443	117.9301010	88.2445453	126.5824243	211.5.144436	196.330096	184.5055559	251.1832327	454.4443437	166.1906061	2571.2.11197	728.4281313	1.9459100000
	NN/SYE	38.1480000	92.9802525	200.3912125	105.4340405	381.833337	5042.797962	66.1132020	1313.5594848	-	274.6782525	132.9467474	-`	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7648.882221
	P/CAW	209.5225581	63.7422522	-	223.6400779	350.0926261	4714.909005	134.5119443	1228.8383885	-	792.6967474	-	-	-	-	-	-	-	-	-	-	1577.3523230	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	157.199988	-	-	9452.518107
	P/CVF	-	54.819886	38.8539519	78.0351519	327.666581	9146.265625	-	386.6319192	-	441.1563434	-	-	-	-	-	-	-	-	-	-	725.9129797	-	-	9914.9894545	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.1114343
	P/SIW	26.0144	-	103.8911616	36.11616	526.0822288	1.5047300000	-	445.383	-	366.0900	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.6550900000

		58		92	10				88		87																													
	P/NVF	78.240228	95.769611	109.5441443	187.8885113	1416.481767	1.00433000000	16.337336	522.1346363	24.603229	537.4449491	178.9816989	7.8141413	14.617441	30.975545	2633.797004	13.045900	-	10.801163	17.043225	80.991886	12.131135	17.824566	28.406449	90.876551	585.581022	230.723312	37.320588	41.145538	-	239.292885	90.599965	58.085733	256.567700	232.251110	371.223511	541.313600	611.822221	1.9465000000
	P/SVF	72.912799	112.994088	95.241700	-	1.8995300000	3.622090000	411.443911	6046.939315	103.251900	-	121.920434	382.99905	1150.201 98	-	-	-	-	-	-	5761.931131	4217.726800	-	-	19.825116	-	-	-	-	-	-	-	-	-	-	-	-	1495.686846	7.6306650000
	NN/SBF	32.928229	-	66.380113	57.312116	877.724111	1.26595000000	135.791776	1140.188796	-	688.543335	-	-	-	-	-	-	-	-	-	613.769669	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3121.706665	-	-	1.9393900000
	NN/CUE	36.917559	70.059500	77.059005	-	2175.949363	1.75867000000	158.572208	1901.805244	54.351337	1985.274412	654.562236	-	-	-	-	-	-	-	-	2480.832966	1226.637881	-	-	2062.768777	-	-	-	-	-	-	-	-	-	-	-	-	5282.926279	3.5754400000
	NN/CHE	78.240228	95.769611	109.5441443	187.8885113	1416.481767	1.00433000000	16.337336	522.1346363	24.603229	537.4449491	178.9816989	7.8141413	14.617441	30.975545	2633.797004	13.045900	-	10.801163	17.043225	80.991886	12.131135	17.824566	28.406449	90.876551	585.581022	230.723312	37.320588	41.145538	-	239.292885	90.599965	58.085733	256.567700	232.251110	371.223511	541.313600	611.822221	1.9465000000
	NN/SPW	-	189.926144	-	-	1333.933347	6.11425000000	-	2746.197977	-	1926.794211	-	-	-	-	-	-	-	-	-	4057.911143	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.1397200000
	NN/STE	-	78.1663	119.700	184.111	895.8589711	1.1783870	-	488.09	25.6033	384.866	-	-	-	-	-	-	-	-	-	390.75	-	-	-	-	45.591	-	-	-	-	-	-	-	-	-	-	-	-	9.9581 80	-	1.1397 80

			62	436	779		000		928	83	031										814					78											000		0000
	NN/NLE	-	99.45355	76.31796	116.60193	327.82272	1.466960000	-	654.36348	-	315.58477	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.625980000
	NN/NRF	98.20483	-	107.29325	64.97122	1978.81942	3.633100000	23.98425	1275.83818	-	1939.15698	119.82135	-	-	-	-	-	-	-	-	1164.84245	-	-	-	-	-	-	-	-	-	-	-	-	-	431.51006	3.434300000	-	-	7.787850000
	NN/SKE	-	-	-	-	2529.19639	4089.13190	-	679.46775	-	1963.08290	1264.02025	-	-	-	-	-	-	-	-	3579.26333	-	-	-	1726.40421	-	-	-	-	-	-	-	-	-	-	-	-	-	1.583060000
	NN/SQE	22.25859	45.15453	-	131.28236	2041.75295	7076.68419	61.48331	583.09760	67.06583	2389.74687	478.90532	-	35.35187	-	-	-	-	-	-	3420.00042	31.88416	14.26954	53.16503	36.16954	173.45312	118.92550	71.66728	-	-	-	-	-	-	-	72.33686	1825.86708	-	1.875050000

HEAVY METALS ANALYSIS IN FISH SAMPLE

Concentration is in ppm

S/N	SAMPLE ID	Pb	Cu	Ni	Zn	Cd	Hg
1.	NN/CYG	1.425	0.582	4.611	0.997	0.0065	<0.001
2.	NN/CLG	1.428	0.716	4.183	0.993	0.0061	<0.001
3.	NN/SVW	1.415	0.595	4.297	0.990	0.0023	<0.001
4.	NN/NYG	1.415	0.631	4.552	0.997	0.0033	<0.001
5.	NN/CHG	1.309	0.868	2.513	1.111	0.0022	<0.001
6.	NN/CVG	1.415	0.513	4.036	1.000	0.0060	<0.001
7.	NN/SMG	1.435	0.425	4.379	0.993	0.0052	<0.001
8.	NN/SXG	1.412	0.451	4.180	0.990	0.0057	<0.001
9.	NN/CBZ	1.418	0.359	4.569	0.997	0.0060	<0.001
10.	NN/SYG	1.422	0.376	4.039	1.007	0.0067	<0.001
11.	NN/SHG	1.408	0.373	4.023	1.000	0.0099	<0.001
12.	NN/CXG	1.399	0.382	4.026	0.990	0.0038	<0.001
13.	NN/NHQ	1.382	0.337	4.271	0.990	0.0054	<0.001
14.	NN/CQG	1.415	0.412	4.399	0.990	0.0080	<0.001
15.	NN/NQG	1.389	0.386	4.029	0.990	0.0072	<0.001
16.	NN/SQG	1.382	0.363	4.582	0.987	0.0059	<0.001
17.	NN/SVG	1.382	0.327	4.376	0.990	0.0096	<0.001
18.	NN/CMG	1.386	0.366	4.386	0.993	0.0017	<0.001
19.	NN/NMG	1.288	0.886	2.606	1.102	0.0065	<0.001
20.	NN/NLG	1.392	0.346	4.356	0.990	0.0024	<0.001
21.	NN/SLG	1.408	0.330	5.278	0.997	0.0061	<0.001
22.	NN/NXG	1.395	0.428	4.281	0.980	0.0082	<0.001
23.	NN/SBZ	1.389	0.431	4.395	0.993	0.0056	<0.001
24.	NN/CUW	1.402	0.340	4.791	0.990	0.0060	<0.001
25.	NN/NBZ	1.389	0.487	4.291	0.987	0.0064	<0.001
26.	NN/SME	0.980	0.131	4.291	0.984	0.0092	<0.001
27.	NN/SYE	0.993	0.108	5.003	0.987	0.0078	<0.001
28.	NN/NAE	1.090	0.704	2.650	1.108	0.0026	<0.001
29.	NN/SXE	1.013	0.301	3.971	0.993	0.0035	<0.001
30.	NN/SUE	0.987	0.373	3.990	0.987	0.0050	<0.001
31.	NN/SHE	0.971	0.418	4.807	0.993	0.0066	<0.001
32.	NN/SKE	0.990	0.330	4.134	0.990	0.0050	<0.001
33.	NN/SLE	1.042	0.176	6.438	0.984	0.0064	<0.001
34.	NN/SRF	1.036	0.255	4.020	0.993	0.0067	<0.001
35.	NN/NYE	1.023	0.150	3.859	0.987	0.0051	<0.001
36.	NN/SVE	1.026	0.225	4.291	0.993	0.0040	<0.001

37.	NN/SQE	1.033	0.356	4.340	0.984	0.0061	<0.001
38.	NN/SOW	1.016	0.418	3.912	0.993	0.0082	<0.001
39.	NN/STE	1.036	0.441	4.333	0.984	0.0073	<0.001
40.	NN/SJW	1.033	0.137	3.980	0.993	0.0056	<0.001
41.	NN/NIW	1.036	0.275	4.529	0.987	0.0081	<0.001
42.	NN/SBF	1.130	0.791	2.932	1.108	0.0086	<0.001
43.	NN/SRW	1.042	0.307	4.265	0.987	0.0094	<0.001
44.	NN/SAE	1.059	0.386	3.801	0.993	0.0044	<0.001
45.	NN/SPW	1.039	0.288	4.709	0.980	0.0090	<0.001
46.	NN/SBW	1.056	0.167	4.304	0.980	0.0051	<0.001
47.	NN/NLE	1.020	0.163	4.428	0.977	0.0038	<0.001
48.	NN/SDW	1.039	0.245	3.765	0.984	0.0045	<0.001
49.	NN/NBW	1.046	0.203	4.395	0.980	0.0091	<0.001
50.	NN/SIW	1.062	0.320	4.288	0.987	0.0042	<0.001
51.	P/SVF	0.353	0.556	3.866	0.961	0.0069	<0.001
52.	P/NVF	0.350	0.337	4.621	0.961	0.0034	<0.001
53.	P/CVF	0.356	0.428	4.366	0.964	0.0035	<0.001
54.	P/NRE	0.356	0.448	4.356	0.964	0.0072	<0.001
55.	P/SBE	0.815	0.913	2.689	1.093	0.0084	<0.001
56.	P/SHE	0.363	0.428	4.569	0.961	0.0078	<0.001
57.	P/SDE	0.353	0.376	5.435	0.967	0.0021	<0.001
58.	P/NMF	0.356	0.284	5.317	0.967	0.0035	<0.001
59.	P/COW	0.363	0.559	4.696	0.967	0.0028	<0.001
60.	P/SIW	0.350	0.190	4.294	0.977	0.0051	<0.001
61.	P/CAW	0.353	0.415	4.255	0.971	0.0085	<0.001
62.	P/CVW	0.843	0.359	4.366	0.967	0.0042	<0.001
63.	P/CVZ	0.843	0.248	4.614	0.974	0.0071	<0.001
64.	P/NVW	0.837	0.343	4.549	0.971	0.0044	<0.001
65.	P/NVZ	0.843	0.431	4.634	0.974	0.0095	<0.001
66.	P/SVW	0.840	0.275	4.441	0.974	0.0073	<0.001
67.	P/SVZ	0.820	0.523	4.693	0.967	0.0098	<0.001
68.	NN/CLE	1.098	0.353	4.075	1.039	0.0054	<0.001
69.	NN/NKE	1.095	0.350	4.301	1.039	0.0050	<0.001
70.	NN/CKE	1.105	0.369	4.454	1.033	0.0050	<0.001
71.	NN/NHE	1.098	0.379	4.219	1.033	0.0082	<0.001
72.	NN/NXE	1.153	0.826	2.456	1.124	0.0046	<0.001
73.	NN/CYE	1.092	0.366	4.510	1.039	0.0061	<0.001
74.	NN/CVE	1.092	0.366	4.915	1.036	0.0028	<0.001
75.	NN/CPW	1.095	0.359	3.814	1.029	0.0048	<0.001

76.	NN/CRW	1.082	0.291	4.131	1.003	0.0071	<0.001
77.	NN/NOW	1.101	0.369	4.154	1.016	0.0095	<0.001
78.	NN/CRF	1.092	0.291	4.252	1.016	0.0047	<0.001
79.	NN/NBF	1.085	0.386	4.160	1.033	0.0085	<0.001
80.	NN/NRE	1.148	0.815	2.557	1.126	0.0051	<0.001
81.	NN/NTE	1.101	0.350	4.340	1.026	0.0076	<0.001
82.	NN/NQE	1.101	0.359	4.101	1.026	0.0031	<0.001
83.	NN/CUE	1.088	0.304	4.239	1.033	0.0044	<0.001
84.	NN/CIW	1.088	0.275	3.954	1.029	0.0060	<0.001
85.	NN/CHE	1.085	0.369	4.013	1.029	0.0022	<0.001
86.	NN/CPW	1.105	0.366	4.804	1.033	0.0033	<0.001
87.	NN/NME	1.098	0.340	4.337	1.023	0.0074	<0.001
88.	NN/CBF	1.101	0.307	4.873	1.026	0.0048	<0.001
89.	NN/CQE	1.075	0.376	4.474	1.039	0.0082	<0.001
90.	NN/CME	1.095	0.386	4.422	1.026	0.0058	<0.001
91.	NN/COW	1.105	0.353	4.526	1.033	0.0060	<0.001
92.	NN/CTE	1.095	0.307	4.222	1.033	0.0058	<0.001
93.	NN/CJW	1.105	0.337	3.954	1.042	0.0036	<0.001
94.	NN/CAE	1.163	0.824	2.708	1.126	0.0065	<0.001
95.	NN/CBW	1.095	0.304	3.954	1.042	0.0066	<0.001
96.	NN/CDW	1.101	0.386	4.232	1.033	0.0040	<0.001
97.	NN/CXE	1.105	0.363	4.467	1.036	0.0026	<0.001

NOURISHING NATIONS MICROBIAL ANALYSIS RESULT
BATCH ONE (1)

37.	Sample Code	THBC (cfu/g)	TFC (cfu/g)	T.SC (cfu/g)	TCC (cfu/g)
1.	NN/SRF		4.0×10^3	-	1.0×10^2
2.	NN/NKE		2.2×10^3	-	5.0×10^3
3.	NN/SXE		3.0×10^3	-	-
4.	NN/CQE		1.8×10^3	1.8×10^3	3.4×10^2
5.	NN/SDW		6.0×10^3	2.4×10^2	-
6.	NN/NIW		-	3.0×10^2	-
7.	NN/SYG		2.0×10^3	TNTC	-
8.	NN/NTE		4.0×10^2	2.0×10^2	-
9.	NN/SYE		6.0×10^3	2.4×10^3	-
10.	NN/CUW		1.4×10^2	-	7.0×10^3
11.	NN/NAE		3.0×10^3	4.0×10^3	-
12.	NN/SME		1.8×10^3	4.0×10^2	2.8×10^2
13.	NN/CBF		4.4×10^2	1.48×10^3	-
14.	NN/NXG		2.0×10^3	5.0×10^3	-
15.	NN/CPW		5.0×10^3	6.0×10^2	1.0×10^2
16.	NN/NQE		2.0×10^3	2.0×10^3	-
17.	NN/SLG		3.1×10^2	1.8×10^3	-
18.	NN/CLE		1.2×10^2	2.1×10^3	3.0×10^2
19.	NN/NHE		1.6×10^2	1.6×10^2	1.0×10^3
20.	NN/NME		3.0×10^3	4.4×10^2	2.0×10^3
21.	NN/CJW		2.7×10^2	4.0×10^3	1.8×10^2
22.	NN/CHG		-	1.0×10^2	-
23.	NN/SAE		4.0×10^3	TNTC	-
24.	NN/SLE		5.0×10^3	3.8×10^2	-

BATCH TWO (2)

38.	Sample Code	THBC (cfu/g)	TFC (cfu/g)	T.SC (cfu/g)
25.	NN/SBF	1.76×10^4	2.3×10^2	-
26.	NN/CYE	-	1.0×10^3	2.0×10^3
27.	NN/NLG	4.0×10^4	2.8×10^2	2.0×10^3
28.	NN/CAE	4.0×10^3	2.4×10^2	4.0×10^3
29.	NN/SRW	6.0×10^4	3.0×10^3	-
30.	NN/NBS	1.4×10^4	1.0×10^3	-
31.	NN/CTE	1.0×10^3	-	-
32.	NN/CME	2.0×10^4	3.0×10^3	-
33.	NN/COW	-	-	-
34.	NN/NQG	3.0×10^3	-	-
35.	NN/NHG	2.8×10^4	1.7×10^3	-
36.	NN/SVE	1.0×10^5	-	5.0×10^3
37.	NN/CLW	-	$1.7.0 \times 10^2$	-
38.	NN/CVG	6.0×10^3	-	-
39.	NN/SXG	-	2.0×10^3	-
40.	NN/SMG	-	3.0×10^3	-
41.	NN/SVG	2.4×10^3	-	-
42.	NN/SJW	3.2×10^3	1.0×10^2	-
43.	NN/CQG	1.0×10^2	2.1×10^2	-
44.	NN/NXE	2.0×10^3	3.3×10^2	-
45.	NN/SUW	5.0×10^3	2.8×10^2	-
46.	NN/SBS	-	3.0×10^2	-
47.	NN/CHE	3.0×10^4	1.4×10^2	-
48.	NN/SHE	4.1×10^2	5.2×10^3	-
49.	NN/NYE	2.0×10^3	8.0×10^2	1.0×10^5
50.	NN/CMG	3.0×10^3	6.0×10^2	-
51.	NN/SIW	TNTC	2.9×10^2	5.0×10^3
52.	NN/NYG	3.5×10^4	1.2×10^2	-
53.	NN/SQG	1.0×10^4	1.6×10^2	-

54.	NN/NKA	1.0×10^3	4.5×10^2	-
55.	NN/CDW	1.2×10^3	3.0×10^2	-
56.	NN/CLG	2.2×10^3	2.3×10^2	-
57.	NN/CBS	4.0×10^3	1.9×10^2	-
58.	NN/NMG	1.0×10^3	5.3×10^2	-
59.	NN/CVE	1.0×10^3	3.0×10^2	-
60.	NN/STE	5.0×10^4	2.0×10^3	-
61.	NN/NLE	8.0×10^3	2.2×10^2	4.0×10^4
62.	NN/NRW	5.0×10^4	2.8×10^2	-
63.	NN/SGH	-	3.1×10^2	-
64.	NN/SOW	4.6×10^4	2.2×10^3	-

BATCH THREE (3)

39.	Sample Code	THBC (cfu/g)	TFC (cfu/g)	T.SC (cfu/g)
65.	NN/CKE	-	6.0×10^3	-
66.	NN/CRF	-	TNTC	-
67.	NN/CRW	2.0×10^4	-	-
68.	NN/CXE	1.8×10^4	8.0×10^3	-
69.	NN/CXG	TNTC	-	-
70.	NN/CYG	-	TNTC	-
71.	NN/NBF	-	-	-
72.	NN/NOW	TNTC	-	-
73.	NN/NRF	6.0×10^4	2.0×10^3	-
74.	NN/SPW	-	1.1×10^2	-
75.	NN/SQE	-	-	-
76.	P/CAW	-	-	-
77.	P/COW	-	-	-
78.	P/CVF	-	-	-
79.	P/CVS	-	-	-
80.	P/NMF	-	-	-
81.	P/NRE	-	-	-
82.	P/NVF	TNTC	TNTC	-
83.	P/NVS	-	-	-
84.	P/SBE	-	1.0×10^3	-
85.	P/SDE	TNTC	4.0×10^3	-
86.	P/SHE	-	3.0×10^3	-
87.	P/SIW	-	-	-
88.	P/SVF	TNTC	3.0×10^3	-
89.	P/SVS	-	-	-

FUNGI IDENTIFICATION

NN/CME - *Penicillium* spp & *Mucor* spp

NN/CYE - *Penicillium* spp & *Mucor* spp
NN/SXG - *Penicillium* spp & *Rhizopor* spp
NN/NBS - *Rhizopor* spp
NN/NHG - *Penicillium* spp & *Mucor* spp
NN/SVE - *Penicillium* spp & *Mucor* spp
NN/CMG - Yeast
NN/CLG - Yeast
NN/NLG - *Penicillium* spp
NN/SRW - *Penicillium* spp & *Mucor* spp
NN/NQG - *Rhizopus* spp
NN/NYE - *Penicillium* spp
NN/NLE - *Penicillium* spp
NN/COW - *Penicillium* spp
NN/SHE - *Penicillium* spp & *Mucor* spp
NN/NYG - *Penicillium* spp & *Mucor* spp

FISH SAMPLES OCP RESULT
N/B: concentration is in ng/ul

S/NO	SAMPLE ID	Heptachlor epoxide (isomer B)	Endosulphan I	DDE	Dieldrin	Endrin aldehyde	Endosulphan II	DDD	Endosulphan sulphate	Endrin ketone
1.	NN/CBW	-	-	-	-	-	-	-	-	-
2.	NN/CXE	-	-	-	-	-	-	-	-	-
3.	NN/CYE	-	-	-	-	-	-	-	-	-
4.	NN/NBW	-	-	-	-	-	-	-	-	-
5.	NN/NXE	-	-	-	-	-	-	-	-	-
6.	NN/NYE	-	-	-	-	-	-	-	-	-
7.	NN/SBW	-	-	-	-	-	-	-	-	-
8.	NN/SXE	-	-	-	-	-	-	-	-	-
9.	NN/SYE	-	195.29773	-	-	-	-	-	-	-
10.	P/NMF	-	106.74224	-	92.76404	186.50267	-	-	41.08837	83.02205

PAH RESULT
Concentration is in ng/ul

S/N	SAMPLE ID	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Anthracene	Phenanthrene	Fluoranthene	Pyrene	Benz (a) anthracene	Chrysene	Benzo (b)fluoranthene	Benzo (k)fluoranthene	Benzo (a)pyrene	Diben(a,h) anthracene	Indeno (1,2,3-cd) pyrene	Benzo (g,h,1) perylene	TOTAL
	NN/CAE	-	-	-	-	0.29	-	-	-	-	-	-	-	-	-	-	-	**0.29**
	NN/CBF	-	-	-	3.06	28.21	0.76	-	11.31	-	-	-	-	-	-	-	-	**43.34**
	NN/CBW	0.76	0.82	0.57	-	0.71	0.65	1.38	-	-	-	-	-	81.29	-	-	-	**86.16**
	NN/CDW	-	-	-	1.21	7.46	-	19.86	21.15	-	-	-	-	-	-	-	-	**49.67**
	NN/CHE	-	-	-	-	-	-	-	-	8.12	28.90	-	-	-	-	-	-	**37.02**
	NN/CIW	-	2.49	0.86	1.34	25.54	0.64	1.20	6.21	-	-	44.35	-	-	40.97	-	-	**123.61**
	NN/CJW	-	-	2.27	4.55	0.80	-	-	-	-	-	85.15	-	-	234.42	-	-	**327.20**
	NN//CKE	-	-	-	-	-	-	-	-	-	-	32.18	-	-	-	-	-	**32.18**
	NN/CLE	-	-	-	-	-	-	-	-	22.23	-	-	-	211.26	-	-	-	**233.49**
	NN/CME	-	-	-	-	-	-	-	-	-	-	623.44	1211.10	1033.09	2286.60	299.76	75.74	**5529.73**
	NN/COW	-	-	-	0.21	0.44	-	-	-	-	-	-	-	-	-	-	-	**0.66**
	NN/CPW	-	-	-	0.81	0.45	4.88	53.97	-	108.01	85.13	-	-	-	-	-	-	**253.26**
	NN/CQE	-	0.99	-	1.40	10.37	8.94	35.93	-	451.01	1829.96	651.65	-	1601.21	2413.22	-	206.99	**7211.67**
	NN/CRF	-	0.54	-	-	-	0.73	7.98	-	-	-	-	-	-	-	-	-	**9.25**
	NN/CRW	-	0.74	-	-	0.50	4.34	1.30	10.36	-	-	29.04	-	-	-	7.28	-	**53.56**
	NN/CTE	-	-	-	1.02	0.87	0.72	-	-	-	-	52.09	-	-	-	-	-	**54.72**
	NN/CUE	3.75	100.67	4110.52	893.65	89.66	109.58	33.23	15.69	-	-	-	-	-	89.60	-	-	**5446.35**
	NN/CVE	-	-	-	-	0.54	-	1.53	-	-	-	-	-	68.57	-	-	-	**70.64**
	NN/CXE	-	-	4.15	-	2.05	-	1.11	-	-	60.03	83.98	-	-	-	-	-	**151.33**
	NN/CYE	-	-	-	-	0.54	-	1.53	-	-	-	-	-	1.53	-	-	-	**3.61**

	NN/NAE	-	-	1.22	-	2.10	1.25	-	-	-	-	51.58	-	-	91.65	-	-	**147.80**
	NN/NBF	-	1.91	-	-													**1.91**
	NN/NBW	-	1.91	-	-	2.45	0.51	-	-	25.85	-	-	-	-	-	-	-	**30.73**
	NN/NIW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0.00**
	NN/NKE	-	-	0.64	-	-	-	-	-	10.47	-	-	-	-	-	-	-	**11.11**
	NN/NLE	47.60	-	23.79	73.00	-	126.35	29.50	23.00	1034.28	2010.26	885.64	-	1260.20	396.35	7.90	10.16	**5928.01**
	NN/NME	-	-	-	5.08	-	-	-	0.70	26.04	-	-	-	29.44	21.03	4.07	-	**86.37**
	NN/NOW	-	0.94	-	1.85	1.77	0.49	38.51	-	-	-	-	-	-	-	-	-	**43.55**
	NN/NQE	-	-	-	2.58	14.73	0.47	-	-	-	-	-	-	-	-	-	-	**17.79**
	NN/NRF	-	-	0.61	1.95	2.93	-	11.09	9.24	-	-	-	-	-	21.09	-	-	**46.91**
	NN/NRW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0.00**
	NN/NTE	0.93	-	-	-	0.75	-	6.99	-	-	-	-	-	-	-	-	-	**8.67**
	NN/NXE	-	-	4.40	-	0.53	-	1.61	-	100.21	39.04	218.74	-	-	-	-	-	**364.52**
	NN/NXG	-	0.30	-	0.79	1.38	-	0.76	-	-	-	378.43	-	-	-	-	-	**381.65**
	NN/NYE	0.62	3.14	3.85	1.63	3.43	3.40	4.06	-	-	-	-	-	-	-	-	-	**20.14**
	NN/SAE	-	-	-	0.88	-	-	-	-	-	-	-	-	-	-	-	-	**0.88**
	NN/SBF	-	-	-	40.40	-	-	-	-	-	-	-	-	-	-	-	-	**40.40**
	NN/SBW	1.10	0.67	-	0.78	0.69	1.13	-	-	-	-	-	67.55	-	-	-	-	**71.91**
	NN/SDW	-	-	-	1.40	1.67	0.98	17.40	-	-	-	21.05	-	-	-	-	-	**42.49**
	NN/SIW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0.00**
	NN/SKE	-	-	-	10.95	2.38	-	-	-	-	-	-	-	-	-	-	-	**13.33**
	NN/SLE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0.00**
	NN/SME	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0.00**
	NN/SOW	0.34	1.16	0.27	5.29	6.04	1.95	5.12	-	-	271.96	288.83	-	-	-	-	-	**580.95**
	NN/SPW	-	-	-	-	-	-	0.28	-	-	23.94	-	-	-	-	-	-	**24.22**

	NN/SQE	-	-	-	-	-	-	3.66	-	-	-	-	-	-	-	1.07	-	**4.73**
	NN/SRF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0.00**
	NN/SRW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0.00**
	NN/STE	-	-	0.68	-	0.17	-	-	-	-	-	-	-	-	-	-	-	**0.85**
	NN/SVE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0.00**
	NN/SVW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0.00**
	NN/SXE	0.73	2.63	-	-	1.16	-	2.42	-	105.25	-	-	-	73.03	-	-	-	**185.23**
	NN/SYE	1.11	0.54	-	-	2.12	0.56	3.27	-	-	-	-	-	-	-	-	-	**7.60**
	P/CAW	0.21	1.31	1.07	0.98	1.25	0.52	-	-	-	-	8.29	-	-	-	-	-	**13.63**
	P/CVW	0.44	-	0.53	0.66	0.11	-	-	-	-	-	-	-	-	-	-	-	**1.74**
	P/NMF	-	1.57	0.21	6.00	3.62	0.31	2.24	-	-	-	499.37	-	-	-	-	-	**513.32**
	P/NRE	-	0.22	-	0.63	1.25	-	0.98	-	-	-	2522.91	-	-	-	-	-	**2525.99**
	NN/NHE	-	1.13	-	2.72	2.31	0.72	0.38	-	-	-	-	-	-	-	4.39	-	**11.65**
	NN/SHE	0.10	5.08	1.20	14.16	8.05	0.27	2.12	0.43	-	-	-	-	-	-	-	-	**31.42**
	NN/SJW	1.08	7.34	1.05	23.84	18.80	0.29	3.05	0.87	12.62	32.76	24.05	28.66	13.44	8.76	1.72	0.45	**178.78**
	NN/SUE	-	0.55	1.98	2.56	0.74	0.81	0.65	0.23	15.54	-	495.96	-	22.44	32.09	3.45	4.14	**581.16**
	P/COW	-	1.65	0.16	3.15	3.60	0.13	1.60	-	-	-	127.14	185.33	22.28	7.28	3.82	0.64	**356.78**
	P/NVM	0.19	45.61	0.20	28.33	0.99	1.19	10.30	0.58	-	-	344.44	1516.13	29.12	-	-	-	**1977.10**
	P/SBE	-	5.42	1.19	13.89	0.53	0.91	3.84	0.16	-	-	264.08	74.67	8.08	-	-	-	**372.78**
	P/SDE	-	0.52	0.23	1.21	1.64	-	0.69	-	-	-	700.11	-	-	-	-	-	**704.40**
	P/SHE	0.72	4.41	1.40	31.43	78.49	6.62	32.99	2.17	-	-	522.94	-	-	-	-	-	**681.18**

SAMPLE	Ca (1) (mg/100g	Ca (2) (mg/100g	Mg (1) (mg/100g)	Mg (2) (mg/100g)	P (1) (mg/100g)	P (2) (mg/100g)	Na (1) (mg/100g)	Na (2) (mg/100g)
1. NN/CAE	1402.8	1442.2	668.8	669.1	127.23	126.92	19.59	19.4
2. NN/CBF	1503	1510.4	608	610.2	337.19	337.53	11.64	14.64
3. NN/CKE	1603.2	1603.2	486.4	503.6	536.87	537.13	15.06	15.79
4. NN/CJW	2404.8	2411.8	1094.4	1068	282.35	282.66	16.79	17.75
5. NN/CTE	1514.2	1503	486.4	398.1	200.62	220.93	10.58	13.04
6. NN/CRW	2610.2	2605.4	1102.9	1094.4	269.5	273.89	14.97	12.5
7. NN/CUM	2710.4	2741.2	1337.6	1216.8	208.71	210.58	9.84	10.36
8. NN/CXE	2404.8	2512	1094.46	668.8	146.63	147.6	13.79	11.97
9. NN/CYE	1903.8	1904.2	729.6	668.8	49.2	49.83	113.4	96.29
10. NN/NAE	2605.2	2605.2	1033.6	1094.4	112.5	112.82	12.05	12.14
11. NN/NBZ	2284.8	2404.8	1216	1337.6	255.09	250.7	9.25	7.23
12. NN/NHE	1803.6	1800.2	729.6	730.6	212.78	211.53	10.15	9.43
13. NN/NOW	800.2	801.2	486.4	608	301.78	289.57	9.47	7.98
14. NN/NYE	2114.1	2104.2	547.2	486.4	150.73	150.73	24.29	27.63
15. NN/NQE	1402.8	1503	486.3	486.3	229.52	217.41	3.35	2.75
16. NN/SIW	3607.2	3806.4	1520	1580.8	219.68	219.89	6.6	5.11
17. NN/CBW	3000.6	2905.8	1094.4	1216	151.16	142.48	32.9	22.73
18. NN/CBZ	2414	2404.8	1033.6	1102.9	221.67	223.12	5.08	4.98
19. NN/CDW	4108.2	4110	1276.8	1337.6	43.58	39.06	15.94	15.96
20. NN/CPW	3807.6	3670.4	1337.6	1459.2	104.15	101.07	17.98	19.05
21. NN/CQE	910.4	901.8	304	212.8	243.9	241.41	119.17	114.7
22. NN/CXG	4810	4809.6	1641.6	1459.2	474.83	295.19	8.4	6.61
23. NN/NBF	1002	909.2	364.8	503.6	292.51	294.9	11.38	8.54
24. NN/NBW	4910	4909.8	1884.8	1924.1	237.77	230.52	14.3	13.15
25. NN/NKE	901.8	701.4	243.26	304	259.3	248.07	9.31	9.8
26. NN/NLE	1000.5	1002	243.2	243.2	259.65	260.58	5.57	5.69
27. NN/NTE	2004	2404	668.8	670.4	88.96	81.88	11.56	10.55
28. NN/NXE	4809.7	464.8	1520	1614.6	242.47	244.52	7.48	8.04

29. NN/NXG	1202.4	1002.6	486.4	608	95.65	93.84	18.16	16.54
30. NN/SAE	501	512.2	182.4	188.4	40.68	41.04	15.5	18.4
31. NN/SBF	2404.8	2405.1	547.2	425.6	110.48	111.02	14.18	14.2
32. NN/SHE	501	601.2	164.2	182.4	242.11	238.31	9	8.14
33. NN/STW	2404.8	2500.2	608	547.2	197.99	196.86	13.84	12.35
34. NN/SKE	1000	901.8	304	243.2	271.4	267.78	13.79	13.97
35. NN/SLE	601.2	702.4	182.4	158.1	171.95	174.32	13.99	14.1
36. NN/SME	480.9	491.6	1824	1884.8	260.37	261.09	22.18	18.62
37. NN/SOW	501	406.6	148.09	182.4	215.48	218.96	13	11.93
38. NN/SQE	1102.2	1002	181.2	182	117.17	115.36	9.71	13.09
39. NN/SRF	4008	4108	425.6	442.56	231.44	234.01	15.92	12.89
40. NN/SRW	901.8	804.6	1702.4	1824	222.58	226.01	10.64	10.99
41. NN/CHE	801.6	801.6	243.2	221.6	154.51	156.91	16.56	17.5
42. NN/CIW	2705.4	2711	790.4	729.6	174.56	171.52	11.09	12.56
43. NN/CLE	701.4	701.4	243.2	248.1	206.59	205.96	11.36	10.66
44. NN/CRF	1000.1	901.8	182.4	188.6	170.98	169.43	6.01	4.97
45. NN/CUE	1503	1510.2	729.6	790.4	162.75	164.15	9.99	6.95
46. NN/CVE	2008	2404.8	851.2	901.8	187.46	177.67	32.5	33.6
47. NN/NIW	3001.4	2905.8	1216	1226.4	179.2	182.99	16.33	15.63
48. NN/NME	400.8	420.2	1216	1216	188.7	181.02	13.54	14.09
49. NN/SBW	3810.6	3807.66	1216	1155.2	185.44	186.22	10.12	9.59
50. NN/SBZ	1803.6	1603.2	668.8	608.01	198.99	195.08	10.57	10.76
51. NN/SDW	3507	3510.2	1155.2	1033.6	159.79	159.64	15.19	13.94
52. NN/SKE	1530	1408.8	547.21	550.4	188.86	189.41	11.78	12.11
53. NN/SPW	1002	1000.2	364.8	206.73	213.73	214.66	17.48	17.88
54. NN/STE	1320.6	1280.6	243.2	364.8	180.93	181.55	11.04	10.45
55. NN/SUE	2705.4	2910.2	486.4	486.4	233.63	234.89	4.1	5.54
56. NN/SVE	5410.5	5400.6	1033.6	1216	177.88	178.13	30.49	19.6
57. NN/CHG	3808.6	3807.8	2067.2	1580.8	239.68	241.31	8.6	9.85
58. NN/CLG	2444	2404.8	1033.6	1033.6	195.08	195.85	9.65	9.69

59. NN/CMG	3002.2	2905.8	1216	1033.66	333.07	322.64	8.69	8.55
60. NN/CQG	2805.6	2807.2	1155.2	1094.4	189.33	189.79	10.09	9.9
61. NN/CYG	1830.1	1804	729.6	547.2	199.27	197.59	8.2	9.8
62. NN/NHG	5410.8	5400	1763.2	1824	200.62	201.3	16.45	14.05
63. NN/NLG	4408.8	4008	1580.8	1580.8	181.55	182.02	7.96	6.39
64. NN/NMG	2705.4	2808.2	1216	1033.6	192.75	194.15	9.87	8.11
65. NN/NQG	1803.6	1880.3	608.06	668.8	162.28	166.79	7.85	8.96
66. NN/NRF	1534.6	1603.2	547.36	608.8	149.38	150.4	8.59	8.7
67. NN/NRW	5310.6	5313.2	1763.2	1580.82	118.91	119.32	13.08	12.91
68. NN/NYG	2340.6	2444.6	1094.4	1033.6	201.82	209.6	6.09	6.9
69. NN/SHG	2404.8	2510.2	1033.6	1216	142.87	192.01	8.05	9.14
70. NN/SLG	5004.1	4809.6	1702.4	1702.4	203.94	204.05	10.55	9
71. NN/SMG	3006	3106.2	1094.4	1155.2	210.16	219.87	3.68	4.34
72. NN/SVG	5611.2	5506.4	2553.6	2128	105.23	105.54	4.14	4.69
73. NN/SXG	5210.4	4810.8	1457.2	1337.6	191.5	192.12	6.38	6.93
74. NN/SYG	3206.4	3302.6	1337.6	1216	155.29	155.1	8.3	7.55
75. P/CAW	3210.2	3108.4	1094.4	1102.9	211.57	211.73	14.1	13.7
76. P/COW	2805.6	3911.2	1337.6	1337.6	314.53	214.69	15.88	12.91
77. NN/CUZ	3006	3101.4	1033.6	987.5	233.89	224.36	8.4	8.85
78. P/CVF	803.4	811.2	304	255.36	300.96	266.36	17.38	16.99
79. P/CVW	5010	5120.1	2128	1903.8	211.26	211.57	12.04	15.34
80. P/NRE	1202.4	1002	425.6	503.6	212.35	212.66	7.47	7.27
81. P/NMF	908.4	1002	364.8	304.01	192.32	192.38	18.5	17.48
82. P/NVW	2854.6	2902	1033.6	1094.4	231.85	232.16	3.48	4.17
83. P/NVF	601.2	611	243.2	212.8	208.92	209.38	18.83	20.1
84. P/SBE	701.4	508.8	182.4	133.76	177.24	177.09	10.4	10.27
85. P/SDE	601.2	601.2	212.8	182.4	211.41	211.57	16.5	15.06
86. P/SHE	1712.3	1703.4	608	503.6	200.49	200.8	14.35	19.1
87. P/SIW	1903.8	2000	668.8	668.8	198.46	198.77	6.52	8.14
88. NN/SQG	1808.2	1903.8	912	1033.6	215.47	215.94	17.5	19.03

89. P/SVF	806.1	814.2	304	255.36	212.35	212.66	20.32	18.5
90. P/SVG	4818.9	4903.8	1580.8	580.5	225.3	225.61	7.59	8.2
91. P/SVW	2556.6	2805.6	851.2	1102.96	216.87	217.03	7.7	7.91
92. P/SVZ	2708.1	2545.6	1033.6	1094.4	217.63	217.81	10.32	12.04
93. P/NVZ	1603.2	1713.9	972.8	729.6	234.82	234.82	15.56	14.85

SAMPLE	K(1) (mg/100g	K(2) (mg/100g	Fe(1) mg/100g	Fe(2) mg/100g	I(1) (mg/100g)	I(2) (mg/100g)	Zn(1) (mg/100g)	Zn(2) (mg/100g)	Se(1) (mg/100g)	Se(2) (mg/100g)
1. NN/CAE	87.75	81.4	44.6	44.63	52.53	45.23	9.2	9.23	3.325	3.2
2. NN/CBF	48.65	48.4	2.075	3.43	ND	ND	0.65	0.38	1.48	1.75
3. NN/CKE	62.925	62.93	9.9	10.28	8.98	5.53	1.625	1.75	0.25	0.025
4. NN/CJW	70.175	70.18	38.325	38.1	37.63	38.3	7.925	8.18	ND	ND
5. NN/CTE	44.225	45.35	1.275	1.375	ND	ND	1.3	1.38	5.075	5.08
6. NN/CRW	52.225	50.9	6.575	7.35	1.35	3.13	1.475	1.55	10.03	10.03
7. NN/CUM	52.75	52.48	9.225	6.5	1.4	2.83	0.475	0.25	8.275	6.75
8. NN/CXE	57.58	53.75	ND	ND	ND	ND	0.45	0.3	7.28	6.75
9. NN/CYE	59.45	60.1	11.775	10.8	17.6	15.93	2.25	2.15	20.03	17.4
10. NN/NAE	51.15	50.38	0.15	ND	0.63	0.25	ND	0.05	ND	ND
11. NN/NBZ	69.25	67.73	32.125	32.15	38.03	38.85	6.93	7.15	ND	ND
12. NN/NHE	59.15	60.43	2.25	2.75	5.83	3.7	0.45	0.88	ND	ND
13. NN/NOW	45.75	44.83	ND	ND	0.175	1.025	0.43	0.48	ND	ND
14. NN/NYE	52.75	52.95	ND	ND	1.88	1.05	1.05	1.03	ND	ND
15. NN/NQE	51.68	50.9	8.55	8.997	11.15	11.7	2.28	2.23	ND	ND
16. NN/SIW	53.3	52.75	0.2	0.2	2.55	1.68	0.125	0.5	14.13	14.5
17. NN/CBW	50.58	51.1	4.995	4.2	3.925	3.9	1	0.53	0.35	0.26
18. NN/CBZ	50.83	49.8	7.775	6.725	4.08	5.9	0.6	0.93	1.025	0.68
19. NN/CDW	66.65	64.48	1.95	3.195	ND	ND	0.475	0.48	ND	ND
20. NN/CPW	65.9	65.55	1.35	2.95	0.425	0.475	0.925	0.95	ND	ND
21. NN/CQE	49.5	52.98	0.975	1.425	2.225	2.295	0.1	0.15	0.625	0.625
22. NN/CXG	35.13	34.58	2.425	2.3	ND	ND	0.15	0.25	ND	ND
23. NN/NBF	47.8	46.83	3.45	3.83	ND	ND	0.53	0.68	3.325	3.525
24. NN/NBW	59.78	60.1	3.66	4.75	0.325	0.225	0.825	0.75	0.825	0.725
25. NN/NKE	49.86	52.08	2.75	2.98	5	4.425	0.05	0.25	7.28	7.33
26. NN/NLE	52.33	53.9	2.975	2.58	ND	ND	ND	ND	0.9	0.55
27. NN/NTE	56.68	55.83	1.175	1.05	3.93	3.33	ND	ND	1.025	2.275
28. NN/NXE	46.28	46.5	1.975	1.73	4.25	4.38	0.25	0.075	ND	ND

29. NN/NXG	49.08	47.43	1.9	2.1	2.43	2.65	0.225	0.23	ND	ND
30. NN/SAE	64.98	64.1	1.28	1.53	0.35	0.34	ND	ND	ND	ND
31. NN/SBF	63.78	63.75	1.26	2.7	1.85	2.2	ND	0.05	ND	ND
32. NN/SHE	49.08	47.43	5.1	4.9	2.43	2.13	0.175	0.175	ND	ND
33. NN/STW	53.66	52.8	1	1.98	3	3.25	1.925	1.78	1.525	1.43
34. NN/SKE	59.38	59.7	ND	ND	1.13	1.48	ND	ND	0.025	0.025
35. NN/SLE	50.98	53.08	1.8	1.8	1	1.15	0.15	0.25	1.275	1.275
36. NN/SME	53.08	53.33	5.775	4.88	6.43	6.1	1.375	1.625	7.55	7.28
37. NN/SOW	46.13	47.75	0.025	0.025	0.175	0.165	0.025	ND	0.025	0.05
38. NN/SQE	54.7	54.7	ND	ND	ND	ND	ND	0.025	ND	ND
39. NN/SRF	48.73	48.23	0.1	0.1	0.53	0.98	0.1	0.075	ND	ND
40. NN/SRW	46.58	46.35	ND	ND	ND	ND	0.25	0.35	0.075	0.075
41. NN/CHE	50.68	50.95	ND	ND	2.1	2.63	0.7	0.33	ND	ND
42. NN/CIW	47.58	47.1	0.825	0.475	0.075	0.2	0.525	0.78	ND	ND
43. NN/CLE	51.65	53.33	0.375	0.37	2.2	3.68	0.6	0.6	2.35	2.4
44. NN/CRF	49.9	50.43	ND	ND	ND	ND	0.575	0.48	ND	ND
45. NN/CUE	50.15	49.1	ND	ND	2.825	3.3	0.65	0.65	ND	ND
46. NN/CVE	47.325	46.33	ND	ND	1.375	3.13	0.65	1.027	0.025	0.05
47. NN/NIW	46.33	45.63	ND	ND	1.375	3.475	2.08	2.1	2.66	1.87
48. NN/NME	53.45	49.38	3.92	3.9	9.4	12.95	3.15	1.88	13.73	11.35
49. NN/SBW	42.33	44.3	0.05	0.075	1.025	0.975	0.575	0.63	1.376	1.175
50. NN/SBZ	44.2	44.05	0.425	0.45	2.93	2.9	1.1	1.1	0.025	0.005
51. NN/SDW	57.8	59.13	2.05	2.03	0.925	1	0.525	0.5	3	2.88
52. NN/SKE	50.63	50.35	ND	ND	2.15	2.2	1.075	1.1	1.5	1.26
53. NN/SPW	41.85	44.13	4.65	4.72	5.9	5.98	1.05	1.1	8.25	8.28
54. NN/STE	49.06	46.15	3.78	3.85	0.48	0.55	0.03	0.65	ND	ND
55. NN/SUE	64.075	64.08	1.53	1.75	1.9	1.95	2.2	2.08	1.083	1.475
56. NN/SVE	56.85	56.56	5.95	5.88	6.23	6.45	0.975	1.125	7.88	7.55
57. NN/CHG	36.55	36.78	17.25	17.05	15.25	15.53	2.125	2.2	20.13	20.08
58. NN/CLG	40.1	38.3	1.33	2.15	3.9	3.55	1.45	1.4	3.83	3.85

59. NN/CMG	36.35	29.42	0.375	0.43	4.93	3.63	0.475	0.43	8	6.15
60. NN/CQG	40.33	41.25	13.5	11.55	11.83	14.53	3.025	3.05	14.4	13.33
61. NN/CYG	35.1	35.93	5.85	5.2	7.3	7.35	1.75	1.85	5.075	5.3
62. NN/NHG	36.98	37.63	2.45	2.15	6.2	6.25	0.8	1.3	3.08	2.68
63. NN/NLG	33.28	35.3	2.028	2.38	5.68	5.78	1.63	1.52	5.05	6.35
64. NN/NMG	41.25	40.55	3	4.53	4.63	4.45	0.59	0.45	5.28	5.05
65. NN/NQG	37.45	37.28	4.075	4	4.68	4.25	1.25	1.15	6.1	6.23
66. NN/NRF	35.9	35.9	ND	ND	ND	ND	0.475	0.5	ND	ND
67. NN/NRW	38.15	38.38	ND	ND	ND	ND	0.025	0.05	ND	ND
68. NN/NYG	28.85	29.05	ND	ND	ND	ND	0.275	0.3	ND	ND
69. NN/SHG	35.25	37.45	0.05	0.05	0.075	0.075	1.15	1.2	ND	ND
70. NN/SLG	36.13	34.4	5.6	3.98	5.33	5.38	0.7	0.925	ND	ND
71. NN/SMG	38.15	57.93	8.4	8.63	7.58	7.83	1.775	1.98	1.68	1.45
72. NN/SVG	39.78	41.73	2.53	2.53	10.2	10.35	1.225	1.3	1.75	2.2
73. NN/SXG	26.7	24.93	0.075	0.08	ND	ND	0.075	0.075	0.4	0.45
74. NN/SYG	35	34.6	0.05	0.075	ND	ND	0.05	0.075	ND	ND
75. P/CAW	33.83	35.1	2.9	3.15	1.95	2.05	0.975	1.1	1.6	1.53
76. P/COW	37.3	38.23	2.88	3.2	1.7	1.9	0.25	0.33	0.98	1.38
77. NN/CUZ	34.45	34.68	0.775	1.205	0.25	0.5	0.38	0.45	0.05	0.025
78. P/CVF	41.6	42.38	2.6	2.8	1.83	1.98	0.425	0.475	0.375	0.45
79. P/CVW	28.13	28.68	ND	ND	ND	ND	0.225	0.3	0.175	0.15
80. P/NRE	37.08	36.85	4.625	4.825	3.93	4.23	2.23	2.28	2.425	0.27
81. P/NMF	41.85	41.85	2.925	3	3	3.08	0.35	0.38	0.275	0.3
82. P/NVW	34.88	35.1	0.95	0.95	ND	ND	0.75	0.8	0.05	0.05
83. P/NVF	45.08	44.83	ND	ND	0.05	0.025	0.056	0.1	0.5	0.875
84. P/SBE	44.58	44.35	3.125	3.275	5.28	5.3	0.475	0.625	3.8	3.93
85. P/SDE	39.5	39.95	ND	ND	0.05	0.025	ND	ND	0.025	0.025
86. P/SHE	34.35	33.98	2.67	2.8	7.05	7.2	1.1	1.15	1.675	1.75
87. P/SIW	36.15	35.55	ND	ND	0.025	0.05	0.33	0.35	0.025	0.025
88. NN/SQG	42.83	42.43	9.725	9.875	13.33	13.45	1.7	1.75	15.58	16.98

89. P/SVF	48.65	48.43	ND	ND	1.85	1.93	0.375	0.45	1.53	1.6
90. P/SVG	31.42	31.53	0.05	0.025	1.48	1.6	0.5	0.525	0.2	0.225
91. P/SVW	42.43	41.75	10	13.02	10.58	11.48	1.325	1.1	11.55	9.75
92. P/SVZ	43.13	43.6	4.025	6.03	6.25	6.25	0.45	0.45	0.78	0.98
93. P/NVZ	37.25	37.03	9.25	9.73	7.6	4.05	0.78	1.15	14.75	14.9

FAT-SOLUBLE VITAMINS RESULT
Concentration is in ng/ug

40.	SAMPLE ID	VITAMIN A	VITAMIN D2	VITAMIN D3	TOTAL
1.	NN/CBW	-	-	-	-
2.	NN/CVG	-	-	-	-
3.	NN/CYE	-	-	-	-
4.	NN/NAE	-	-	-	-
5.	NN/NIW	-	-	-	-
6.	NN/NLE	0.424124	-	623.95964	624.38376
7.	NN/NXG	0.114519	-	130.61169	130.72621
8.	NN/SAE	-	-	-	-
9.	NN/SDW	-	-	-	-
10.	NN/SME	-	-	-	-
11.	NN/SOW	1.03029	-	329.50924	330.53953
12.	NN/SPW	0.262457	-	-	0.262457
13.	NN/SQE	1557.30657	-	-	1557.30657
14.	NN/SRF	-	-	-	-
15.	NN/SRW	0.192648	-	-	0.192648
16.	NN/STE	0.292152	-	-	0.292152
17.	NN/SUE	859.29680	-	-	859.29680
18.	NN/SUW	-	-	-	-
19.	NN/SVE	0.283679	-	-	0.283679
20.	P/CVF	-	-	-	-
21.	P/CVW	-	-	-	-
22.	P/NMF	-	-	-	-
23.	P/SVW	-	-	112.50030	112.50030
24.	P/SVZ	-	-	326.25976	326.25976
25.	P/NVW	-	-	-	-
26.	NN/NLG	-	-	-	-
27.	NN/NHG	-	-	-	-
28.	NN/SIW	-	-	-	-
29.	NN/CLG	-	-	-	-

30.	NN/SLG	-	-	-	-
31.	P/SDE	-	-	-	-
32.	NN/SQG	-	-	-	-
33.	NN/CLE	-	-	142.41001	142.41001
34.	P/CAW	-	-	-	-
35.	NN/SLE	-	-	-	-
36.	P/CVZ	-	-	-	-
37.	NN/CTE	-	-	-	-
38.	NN/NQE	-	-	-	-
39.	NN/NTE	-	-	-	-
40.	NN/NKE	-	-	-	-
41.	NN/NBF	0.0152317	-	-	0.0152317
42.	NN/CRF	-	-	-	-
43.	NN/CRW	-	-	-	-
44.	NN/COW	0.0557937	-	-	0.0557937
45.	NN/CUE	-	-	-	-
46.	NN/CJW	0.601706	-	-	0.601706
47.	NN/CAE	-	-	-	-
48.	NN/SHE	0.0347254	-	-	0.0347254
49.	NN/CIW	-	-	-	-
50.	NN/SMG	-	-	-	-
51.	NN/SXG	0.700929	-	-	0.700929
52.	NN/NME	-	-	-	-
53.	NN/NYE	-	-	-	-
54.	NN/NRW	-	-	-	-
55.	NN/CXE	-	-	299.83441	299.83441
56.	NN/NYG	-	-	-	-
57.	NN/CBF	-	-	-	-
58.	NN/CBZ	0.437499	-	-	0.437499
59.	NN/CHE	-	-	-	-
60.	NN/CHG	-	-	-	-
61.	NN/CKE				
62.	NN/CME	0.0335776	-	-	0.0335776
63.	NN/CPW	-	-	-	-

64.	NN/CQG	-	-	107.89762	107.89762
65.	NN/CUW	-	-	-	-
66.	NN/CVE	0.908928	-	-	0.908928
67.	NN/CXG	3.15478	-	-	3.15478
68.	NN/NBW	-	-	-	-
69.	NN/NBZ	-	-	-	-
70.	NN/NMG	0.595220	-	-	0.595220
71.	NN/NQG	-	-	264.34941	264.34941
72.	NN/NRF	0.868179	-	-	0.868179
73.	NN/SBF	-	-	-	-
74.	NN/SBW	-	-	-	-
75.	NN/SBZ	-	-	-	-
76.	NN/SVG	1.48037	-	136.00271	137.48308
77.	NN/SXE	-	-	-	-
78.	P/NRE	-	-	-	-
79.	P/SVF	-	-	-	-
80.	P/SBE	-	-	385.08729	385.08729
81.	NN/NXE	0.508690	-	70.03853	70.54722
82.	NN-NOW	0.85875	-	-	0.85875
83.	NN-SJW	0.74543	-	-	0.74543
84.	NN-CQE	0.64145	-	-	0.64145
85.	NN-CYG	0.58594	-	-	0.58594

SAMPLE	B2 (1) Mg/100g	B2(2) mg/100g	B6 (1) mg/100(g)	B6(2) mg/100g)	B1(1) Mg/100g	B1(2) mg/100g(1)
1. NN/NYE	37.78461	37.42292	10.5238	12.91824	0.13191	0.132017
2. NN/SLE	35.41028	37.26362	12.99994	14.43695	0.027017	0.029536
3. NN/NHE	2.02658	2.121317	8.760104	7.903061	0.032774	0.030648
4. NN/SIW	11.54273	5.387025	20.02685	19.65027	0.048325	0.047831
5. NN/NAE	8.640531	10.07335	8.647757	8.427588	0.016623	0.016941
6. NN/CJW	4.568024	4.593584	8.905425	9.03455	0.01509	0.015005
7. NN/NQE	5.996672	6.355786	ND	ND	0.027817	0.028034
8. NN/COW	19.9795	20.63161	1.146225	1.146225	0.034841	0.037754
9. NN/NBZ	5.757233	5.513135	ND	ND	0.022808	0.022409
10. NN/CTE	2.945288	3.249379	ND	ND	0.024809	0.036946
11. NN/CXE	4.288339	4.718939	ND	ND	0.02053	0.024315
12. NN/SYE	36.00781	37.53732	6.853424	7.263124	0.036911	0.037092
13. NN/NOW	29.67257	30.11395	19.98585	19.70381	0.07462	0.072698
14. NN/CRW	29.42377	28.04828	19.75211	19.40792	0.07757	0.085302
15. NN/CUW	17.67039	17.78199	5.146342	8.021681	0.019299	0.019546
16. NN/SAE	33.95904	33.56612	1.625084	1.386238	0.080069	0.078892
17. NN/NXG	36.70079	37.14186	1.986489	3.226531	0.016077	0.015962
18. NN/SUW	33.22932	33.35201	7.620882	7.389186	0.073281	0.073379
19. NN/CAE	78.71854	77.25426	16.70285	16.69337	0.017184	0.014814
20. NN/CYE	25.22386	24.94023	18.59027	18.12863	0.010997	0.011803
21. NN/CKE	99.42088	98.82632	8.735008	8.88135	0.009296	0.009379
22. NN/SBF	36.61808	36.41889	1.241209	1.283667	0.121231	0.120332
23. NN/CPW	52.96304	52.09926	6.800753	6.165339	0.040577	0.039426
24. NN/CME	34.34775	33.80147	16.07108	16.09414	0.015508	0.01808
25. NN/CXG	24.32898	23.34518	8.925268	10.42911	0.03496	0.038098
26. NN/SKE	24.56785	23.84274	13.14949	12.79568	0.1088	0.106724
27. NN/SHE	25.58449	25.91613	8.120167	8.567218	0.216949	0.217833
28. NN/SBZ	22.85095	25.04286	0.29604	0.502349	0.103376	0.105132

29. NN/CRF	25.7062	25.05103	15.80393	15.26832	0.028207	0.028043
30. NN/NME	21.60978	21.83746	3.442616	3.085296	0.12032	0.120968
31. NN/NIW	23.94072	23.41871	5.903586	6.036943	0.019973	0.011976
32. NN/SRF	32.99099	31.47954	2.283697	2.311564	0.024354	0.02486
33. NN/STE	26.49814	26.31132	0.533864	0.471855	0.074964	0.07509
34. NN/SDW	24.18127	24.32082	13.26096	13.17153	0.008523	0.009003
35. NN/CLE	27.23132	28.44387	2.879425	2.916776	0.069471	0.069293
36. NN/SME	20.85437	20.48558	1.877645	1.617643	0.045952	0.046246
37. NN/SVE	28.44791	30.63059	1.021039	0.098048	0.023142	0.023375
38. NN/NBF	22.82322	22.92159	0.774899	0.834428	0.08661	0.08604
39. NN/CIW	21.59216	21.61688	3.348653	3.802416	0.017014	0.017074
40. NN/SBW	22.38512	23.76868	3.112434	3.896525	0.077326	0.077758
41. NN/CVE	21.40708	22.6258	0.342438	0.268026	0.057069	0.058376
42. NN/CQE	36.96716	36.41946	2.519186	1.782077	0.071318	0.068796
43. NN/CBW	31.91889	32.85388	5.561878	5.782486	0.138225	0.140551
44. NN/NTE	34.65713	35.71486	5.376434	5.504975	0.048025	0.049144
45. NN/NLE	25.53177	25.44564	7.702151	7.97222	0.059613	0.058885
46. NN/SQE	27.80409	28.14515	6.6067	6.228953	0.1698	0.167991
47. NN/CHE	22.03337	21.08435	ND	ND	0.024546	0.027041
48. NN/CBZ	24.40433	24.31527	ND	ND	0.078181	0.078633
49. NN/SXE	21.91667	22.19773	3.047361	2.909335	0.028743	0.028683
50. NN/NBW	30.60414	29.7129	ND	ND	0.011881	0.012482
51. NN/CUE	22.04264	22.06332	1.180367	1.307596	0.070717	0.071752
52. NN/SUE	26.58458	26.53971	1.724737	1.44781	0.055493	0.055749
53. NN/NKE	1.023429	1.047346	ND	ND	0.010449	0.010495
54. NN/SXG	0.728967	0.696397	5.276635	5.198722	0.019256	0.019167
55. NN/NYG	1.720181	1.963747	6.890484	9.39902	0.02635	0.028638
56. NN/SPW	3.576633	3.380857	ND	ND	0.089495	0.097899
57. NN/SJW	2.438898	2.245119	12.45032	11.43395	0.123794	0.127847

58. NN/NQG	3.137247	2.763711	14.60183	13.5163	0.038518	0.036901
59. NN/SRW	6.263711	6.221069	8.005632	8.869095	0.092034	0.099291
60. NN/NXE	3.249556	3.322107	ND	ND	0.087014	0.090008
61. NN/NRW	8.074459	7.980431	4.63947	4.296886	0.192981	0.027035
62. NN/CBF	28.72968	28.57251	3.837725	4.674925	0.026143	0.340049
63. NN/SOW	8.501908	9.261803	22.476	22.24605	0.12507	0.089
64. NN/NMU	1.865327	1.911564	3.068517	3.115498	0.008685	0.008835
65. NN/NHG	1.723687	1.693734	6.544691	7.206513	0.008638	0.008985
66. NN/NRF	1.049831	1.113507	1.922583	2.331553	0.025742	0.026388
67. NN/SMG	1.043619	1.007455	6.314016	5.673203	0.013339	0.013362
68. NN/SVG	4.353745	3.621583	7.00604	1.79054	0.007489	0.007894
69. NN/NLG	0.839856	0.801651	6.828912	6.898947	0.012462	0.013056
70. NN/SQG	13.8738	13.80334	6.303656	6.211445	0.011147	0.011142
71. NN/SLG	3.419595	3.365149	1.100411	0.756515	0.01087	0.01091
72. NN/NYG	5.63667	5.915202	6.311097	5.878053	0.013946	0.013922
73. NN/CQG	4.102325	3.970181	0.598792	0.793137	0.008512	0.008503
74. NN/CHG	10.55777	10.51504	6.753334	6.887566	0.010077	0.010019
75. NN/CVG	1.454872	1.15513	7.945811	6.6922	0.01259	0.010888
76. NN/CYG	9.722178	9.701012	9.743646	9.486562	0.013955	0.014113
77. P/NMF	10.10707	9.063454	101.9875	104.8433	0.011429	0.010358
78. P/SVF	3.314341	3.042732	4.951706	4.736351	0.018885	0.018639
79. NN/CLG	4.412939	5.027778	6.674837	5.810791	0.020854	0.019867
80. P/CVF	1.778266	1.494586	ND	ND	0.062384	0.063139
81. P/SIW	0.948616	1.170705	2.161283	2.993668	0.022166	0.022184
82. P/CAW	4.759762	4.622426	0.674954	0.218273	0.174165	0.02505
83. P/NRE	1.596335	1.528621	2.170767	2.641308	0.061485	0.06107
84. P/CVZ	10.20004	10.41942	ND	ND	0.033944	0.034068
85. P/SBE	ND	ND	28.88967	29.1005	0.344792	0.345011
86. P/NVW	ND	ND	0.429835	0.30246	0.031328	0.030352

87. P/SDE	1.806621	1.95962	ND	ND	0.014272	0.013116
88. P/CVW	3.912673	3.701322	ND	ND	0.12811	0.128573
89. P/SVZ	3.147542	3.014333	ND	ND	0.031541	0.033391
90. P/SHE	12.74592	13.06665	0.196387	0.368992	0.020338	0.023595
91. P/COW	ND	ND	1.009951	1.003531	0.204568	0.208266
92. P/SVW	4.205316	3.869098	0.009922	0.184131	0.124646	0.118126

SAMPLE	B9 (1) mg/100g	B9 (2) mg/100g	B3 (1) mg/100g	B3 (2) mg/100g	B1 (1) mg/100g	B1 (2) mg/100g(1)
1. NN/NYE	4.929134	5.766995	4.54317	5.526965	0.13191	0.132017
2. NN/SLE	4.08589	4.045025	3.869348	3.109771	0.027017	0.029536
3. NN/NHE	2.648999	8.475114	12.49291	12.04697	0.032774	0.030648
4. NN/SIW	14.21314	15.61895	2.258382	2.07582	0.048325	0.047831
5. NN/NAE	1.396613	1.447756	14.19547	13.87535	0.016623	0.016941
6. NN/CJW	14.28018	13.62903	2.000478	2.019978	0.01509	0.015005
7. NN/NQE	1.259825	1.259825	10.72042	12.43606	0.027817	0.028034
8. NN/COW	3.944208	3.97088	7.5547	7.984698	0.034841	0.037754
9. NN/NBZ	2.806587	2.946802	24.29754	25.07837	0.022808	0.022409
10. NN/CTE	ND	ND	7.267999	6.975719	0.024809	0.036946
11. NN/CXE	3.441834	2.924289	3.901015	4.265129	0.02053	0.024315
12. NN/SYE	12.92086	10.82915	6.014133	6.02476	0.036911	0.037092
13. NN/NOW	17.06416	16.15167	1.259497	1.203284	0.07462	0.072698
14. NN/CRW	4.499437	4.585572	5.804102	5.819191	0.07757	0.085302
15. NN/CUW	3.601135	3.740371	1.282982	1.288295	0.019299	0.019546
16. NN/SAE	ND	ND	1.74725	1.656501	0.080069	0.078892
17. NN/NXG	ND	ND	1.722066	1.735668	0.016077	0.015962
18. NN/SUW	ND	ND	1.468094	1.483449	0.073281	0.073379
19. NN/CAE	ND	ND	2.627544	2.559163	0.017184	0.014814
20. NN/CYE	ND	ND	2.483662	1.693162	0.010997	0.011803
21. NN/CKE	ND	ND	3.644493	3.653419	0.009296	0.009379
22. NN/SBF	ND	ND	12.25068	11.11684	0.121231	0.120332

23. NN/CPW	7.609602	7.833505	1.610435	1.629403	0.040577	0.039426	
24. NN/CME	8.733519	4.475946	2.66649	2.230009	0.015508	0.01808	
25. NN/CXG	1.833162	1.833162	3.865523	3.78083	0.03496	0.038098	
26. NN/SKE	1.767337	1.767337	2.271877	2.361777	0.1088	0.106724	
27. NN/SHE	1.421818	1.504038	2.820095	2.995909	0.216949	0.217833	
28. NN/SBZ	3.516468	3.94225	1.534616	1.413315	0.103376	0.105132	
29. NN/CRF	27.56164	27.43048	49.23755	51.74194	0.028207	0.028043	
30. NN/NME	16.92174	15.6006	16.97242	20.39807	0.12032	0.120968	
31. NN/NIW	96.59751	92.65781	54.6243	59.75735	0.019973	0.011976	
32. NN/SRF	1.901434	2.096706	49.61001	49.48217	0.024354	0.02486	
33. NN/STE	6.012186	6.677531	26.87992	26.34254	0.074964	0.07509	
34. NN/SDW	84.27994	85.90158	4.712715	4.603475	0.008523	0.009003	
35. NN/CLE	8.177067	8.120296	64.97604	65.56846	0.069471	0.069293	
36. NN/SME	13.19322	12.99574	10.04973	10.20435	0.045952	0.046246	
37. NN/SVE	5.752802	5.818871	33.83779	33.12226	0.023142	0.023375	
38. NN/NBF	1.445309	1.578916	9.33351	9.30721	0.08661	0.08604	
39. NN/CIW	37.68791	36.48666	35.57903	35.08129	0.017014	0.017074	
40. NN/SBW	3.260021	3.00137	32.86388	32.07502	0.077326	0.077758	
41. NN/CVE	1.84295	1.452405	35.07199	36.7845	0.057069	0.058376	
42. NN/CQE	2.640435	2.382763	34.38792	35.12401	0.071318	0.068796	
43. NN/CBW	9.350658	8.595752	5.423463	5.113278	0.138225	0.140551	
44. NN/NTE	5.934616	5.920178	3.129005	3.196111	0.048025	0.049144	
45. NN/NLE	7.66882	6.968482	1.462675	1.599118	0.059613	0.058885	
46. NN/SQE	1.450448	1.541232	3.113543	4.014558	0.1698	0.167991	
47. NN/CHE	9.260363	9.913229	2.594177	2.291695	0.024546	0.027041	

48. NN/CBZ	2.002251	2.061469	6.341852	7.063918	0.078181	0.078633	
49. NN/SXE	16.94426	17.09499	33.09633	32.68264	0.028743	0.028683	
50. NN/NBW	ND	ND	6.10212	6.590245	0.011881	0.012482	
51. NN/CUE	1.589928	1.491802	10.00027	9.855959	0.070717	0.071752	
52. NN/SUE	1.503548	2.086184	29.20275	29.36045	0.055493	0.055749	
53. NN/NKE	4.71918	4.899281	37.56012	38.02981	0.010449	0.010495	
54. NN/SXG	1.955024	1.582098	1.210563	1.219329	0.019256	0.019167	
55. NN/NYG	9.155386	9.123575	5.847351	5.376866	0.02635	0.028638	
56. NN/SPW	10.37939	9.922527	3.322778	4.686839	0.089495	0.097899	
57. NN/SJW	70.75721	71.9746	17.07784	17.72828	0.123794	0.127847	
58. NN/NQG	96.21602	103.9851	5.475639	5.429361	0.038518	0.036901	
59. NN/SRW	280.2338	314.0262	1.773391	1.603794	0.092034	0.099291	
60. NN/NXE	121.992	314.036	5.406195	4.987142	0.087014	0.090008	
61. NN/NRW	1.791807	1.774923	3.649487	4.352213	0.192981	0.027035	
62. NN/CBF	122.4234	26.74801	4.594867	5.009086	0.026143	0.340049	
63. NN/SOW	77.18284	76.23976	4.661229	4.153339	0.12507	0.089	
64. NN/NMU	1.416434	1.403954	4.019446	5.008554	0.008685	0.008835	
65. NN/NHG	8.967455	9.206284	1.206259	1.220445	0.008638	0.008985	
66. NN/NRF	13.97357	12.62159	1.443653	1.463472	0.025742	0.026388	
67. NN/SMG	15.68918	15.83576	1.555656	1.534881	0.013339	0.013362	
68. NN/SVG	7.860911	5.647335	1.394719	1.364274	0.007489	0.007894	
69. NN/NLG	16.37508	14.20506	5.374954	6.025769	0.012462	0.013056	
70. NN/SQG	9.651153	10.35173	1.40832	1.40051	0.011147	0.011142	
71. NN/SLG	6.334459	4.634268	1.240157	1.248499	0.01087	0.01091	
72. NN/NYG	13.92096	12.83718	1.201955	1.255512	0.013946	0.013922	

73. NN/CQG	10.66324	9.293887	1.313055	1.401626	0.008512	0.008503	
74. NN/CHG	8.056673	8.057652	1.609479	1.777483	0.010077	0.010019	
75. NN/CVG	11.425	11.18715	3.071569	2.9771	0.01259	0.010888	
76. NN/CYG	15.51422	14.6815	2.365496	1.752351	0.013955	0.014113	
77. P/NMF	3.237263	2.967112	2.575793	2.043143	0.011429	0.010358	
78. P/SVF	5.991142	6.382665	1.238245	1.217098	0.018885	0.018639	
79. NN/CLG	5.021876	5.305242	1.22629	1.245205	0.020854	0.019867	
80. P/CVF	4.425048	4.456859	1.392912	1.38728	0.062384	0.063139	
81. P/SIW	10.58689	9.58753	1.170554	1.194357	0.022166	0.022184	
82. P/CAW	19.78892	18.57324	1.641358	1.48669	0.174165	0.02505	
83. P/NRE	16.39857	16.38242	2.707667	1.857978	0.061485	0.06107	
84. P/CVZ	7.656096	7.191651	1.183625	1.216088	0.033944	0.034068	
85. P/SBE	11.73577	14.32105	1.958823	1.867542	0.344792	0.345011	
86. P/NVW	26.07385	27.73342	1.152861	1.164922	0.031328	0.030352	
87. P/SDE	3.55611	3.103901	4.81765	4.63817	0.014272	0.013116	
88. P/CVW	15.95052	11.37337	1.164019	1.167685	0.12811	0.128573	
89. P/SVZ	35.88665	35.06372	2.189257	2.242017	0.031541	0.033391	
90. P/SHE	4.490139	4.250575	1.682907	1.731151	0.020338	0.023595	
91. P/COW	14.50874	14.27113	1.15844	1.161309	0.204568	0.208266	
92. P/SVW	26.84638	26.46097	1.822379	1.662398	0.124646	0.118126	

SAMPLE	B12(1) mg/100g	B12 (2) mg/100g
1. NN/NYE	4.929134	5.766995
2. NN/SLE	8.245828	4.045025
3. NN/NHE	2.648999	8.475114
4. NN/SIW	14.21314	15.61895
5. NN/NAE	1.396613	1.447756
6. NN/CJW	14.28018	13.62903
7. NN/NQE	1.259825	1.259825
8. NN/COW	3.944208	3.97088
9. NN/NBZ	2.806587	2.946802
10. NN/CTE	ND	ND
11. NN/CXE	3.441834	2.924289
12. NN/SYE	11.92086	10.82915
13. NN/NOW	17.06416	16.15167
14. NN/CRW	4.499437	4.585572
15. NN/CUW	3.601135	3.740371
16. NN/SAE	ND	ND
17. NN/NXG	ND	ND
18. NN/SUW	ND	ND
19. NN/CAE	ND	ND
20. NN/CYE	ND	ND
21. NN/CKE	ND	ND
22. NN/SBF	ND	ND
23. NN/CPW	7.609602	7.833505

24. NN/CME	8.733519	4.475946
25. NN/CXG	1.833162	1.833162
26. NN/SKE	1.767337	1.767337
27. NN/SHE	1.421818	1.504038
28. NN/SBZ	3.516468	3.94225
29. NN/CRF	27.56164	27.43048
30. NN/NME	16.92174	15.6006
31. NN/NIW	96.59751	92.65781
32. NN/SRF	1.901434	2.096706
33. NN/STE	6.012186	6.677531
34. NN/SDW	84.27994	85.90158
35. NN/CLE	8.177067	8.120296
36. NN/SME	13.19322	12.99574
37. NN/SVE	5.752802	5.818871
38. NN/NBF	1.445309	1.578916
39. NN/CIW	37.68791	36.48666
40. NN/SBW	3.260021	3.00137
41. NN/CVE	1.84295	1.452405
42. NN/CQE	2.640435	2.382763
43. NN/CBW	9.350658	8.595752
44. NN/NTE	5.934616	5.920178
45. NN/NLE	7.66882	6.968482
46. NN/SQE	1.450448	1.541232
47. NN/CHE	9.260363	9.913229
48. NN/CBZ	2.002251	2.061469

49. NN/SXE	16.94426	17.09499
50. NN/NBW	ND	ND
51. NN/CUE	1.589928	1.491802
52. NN/SUE	1.503548	2.086184
53. NN/NKE	4.71918	4.899281
54. NN/SXG	1.955024	1.582098
55. NN/NYG	9.155386	9.123575
56. NN/SPW	10.37939	9.922527
57. NN/SJW	70.75721	71.9746
58. NN/NQG	96.21602	103.9851
59. NN/SRW	ND	ND
60. NN/NXE	121.992	314.036
61. NN/NRW	1.791807	1.774923
62. NN/CBF	122.4234	26.74801
63. NN/SOW	77.18284	76.23976
64. NN/NMU	1.416434	1.403954
65. NN/NHG	8.967455	9.206284
66. NN/NRF	13.97357	12.62159
67. NN/SMG	15.68918	15.83576
68. NN/SVG	7.860911	5.647335
69. NN/NLG	16.37508	14.20506
70. NN/SQG	9.651153	10.35173
71. NN/SLG	6.334459	4.634268
72. NN/NYG	13.92096	12.83718
73. NN/CQG	10.66324	9.293887

74. NN/CHG	8.056673	8.057652
75. NN/CVG	11.425	11.18715
76. NN/CYG	15.51422	14.6815
77. P/NMF	3.237263	2.967112
78. P/SVF	5.991142	6.382665
79. NN/CLG	5.021876	5.305242
80. P/CVF	4.425048	4.456859
81. P/SIW	10.58689	9.58753
82. P/CAW	19.78892	18.57324
83. P/NRE	16.39857	16.38242
84. P/CVZ	7.656096	7.191651
85. P/SBE	11.73577	14.32105
86. P/NVW	26.07385	27.73342
87. P/SDE	3.55611	3.103901
88. P/CVW	15.95052	11.37337
89. P/SVZ	35.88665	35.06372
90. P/SHE	4.490139	4.250575
91. P/COW	14.50874	14.27113
92. P/SVW	39.81559	26.46097

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