EVALUATIONOFCOMMERCIALVALUESDERIVED FROM CATFISH

BY

ADEGOKEREUBENOLAMIDE

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BEING A PROJECT SUBMITTED TO THE DEPARTMENT OF AGRICULTURALTECHNOLOGY,INSTITUTEOFAPPLIEDSCIENCE, KWARA STATE POLYTECHNIC, ILORIN, KWARA STATE

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CERTIFICATION

This is to certify that this project work has been written **by** **ADEGOKE REUBEN OLAMIDE** with Matric no **ND/23/AGT/PT/0196** has been read and approved as meeting the requirements for the award of National Diploma (ND) in AGRICULTURAL TECHNOLOGY, at Department of AGRICULTURAL TECHNOLOGY, Institute of Applied Sciences, Kwara State Polytechnic Ilorin.

______________________ ______________________

MRSALEGEOMOWUNMIRUKAYAT **DATE**

(ProjectSupervisor)

______________________ ______________________

MRSANNIMOHAMMED **DATE**

(ProjectCoordinator)

______________________ ______________________

MR.BANJOKO(HOD) **DATE**

(HeadofDepartment)

DEDICATION

Ispecially dedicate my project to Almighty God the creator whogave me the knowledge, wisdom and understanding. If not for His grace what would I have achieved and for giving me the opportunity to make it in my life till this moment.

Alsoappreciatetheeffortsofmylovelyparent.**MR.AND MRS.ADEGOKE**.Mayyou reap the fruit of your labor (Amen).

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I will like to use this medium to appreciate the effort of my wonderful parent **(MR &MRS ADEGOKE)**, whohavecontinued tocheer methroughoutthis journey, the sacrifice you have made to allow me pursue my academic goals have not gone unnoticed, and I will forever be indebted to you. I hope to continue making you proud as I close this chapter and open up to next.

I will like to use this medium to appreciate the effort of my dynamic supervisor **MRS ALEGE OMOWUNMI RUKAYAT** who also doubled as the departmental project coordinator, I say thank you ma. To my vibrant and supportive **HOD MR. BANJOKO** I really appreciate you sir.

My Sincere appreciation goes to all my friends both in department, in the schooland outsidetheschoolgenerally,thanks forallyou doand IFpraythat god will make ways for us in life (AMEN).

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ABSTRACT

This study evaluates the commercial values derivedfrom catfish, with particular emphasis on oil extraction from catfish processing by-products and their potential health benefits. The research addresses the significant challenge of fish processing waste disposal while exploring opportunities for value addition in the aquaculture industry. Using both mechanical pressingand solvent extraction methods, catfish oil was extracted from four catfish specimens to assess extraction efficiency, oil quality, and commercial viability.

The study employed a comparative analysis of two extraction techniques: mechanical pressing using a hydraulic extractor and solvent extraction involving pre-cooking processes. Results demonstrated that mechanical pressing yielded superior oil quality with minimal water dilution, clear oil free from residues, faster evaporation rates, and enhanced shelf stability within one week of extraction. In contrast, solvent extraction showed prominent water dilution, reduced nutritional content due to high-temperature processing (120°-150°C), and relatively poor oil stability.

Chemicalanalysisrevealedthatextractedcatfishoilischolesterol-freeandrichinomega-3fatty acids, particularly docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA), making it valuable for nutritional supplements and therapeutic applications. The oil demonstrated significant protein content beneficial for skin health and exhibited anti-inflammatory properties consistent with other fish oils. Quality assessment parameters including acid value, peroxide value, and fatty acid composition confirmed the oil's potential for commercial applications in food, pharmaceutical, and cosmetic industries.

Economic evaluation indicated substantial commercial potential for catfish oil production, particularly in addressing the growing global demand for omega-3 supplements in developing countries like Nigeria, where traditional fish oil supplements are often unaffordable for low-income populations. The study identified catfish processing waste as an underutilized resource that could generate additional revenue streams while addressing environmental pollution concerns associated with fish waste disposal.

The research concludes that catfish oil extractionpresents a viable commercial opportunity with significant health benefits, environmental advantages, and economic potential. Mechanical pressing emerged as the preferred extraction method due to superior oil quality and operational efficiency.

CHAPTERONE

1.0INTRODUCTIONTOTHESTUDY

Catfishoilextractionmethodsincludewetreduction,enzymaticextraction, solvent extraction, and mechanical pressing. Wet reduction is common in small-scaleoperations, usingheatand centrifugation. Enzymaticmight be more efficient but requires enzymes. Solvent extraction uses chemicals, which might not be ideal for food-grade oil. Mechanical pressing is traditional and chemical-free as well as cost effective

Moreover,catfish oilis highinomega-3 andomega-6,makingitbeneficial for heart health, skin, and inflammation.

In Nigeria however, traditional methods involve boiling and skimming, while modern uses mechanical presses. Nevertheless, sustainability is aconcern, so eco-friendly methods are encouraged viz-a-viz the oil's versatility is potent in dietary supplements, cosmetics inventories, animal feed, industrial uses**.** In Nigeria, the consumption of fish has been found to increase due to the nutritional values that can be obtained. Yearly, considerable number of fish are consumed based on the fact that it is a good source of Protein, vitamins and minerals.

Fish oil is derived from the tissues of oily fish, which contain the omega-3 fattyacids eicosapentaenoic acid (EPA),anddocosahexaenoic acid(DHA), precursors of certain eicosanoids that are known to reduce Inflammation throughout the body, and have other health Benefits. Marine andfreshwater fish oil varies in Contents of arachidonic acid, EPA and DHA.

The various species range from lean to fatty and their oil content in the tissues has shown to vary from 0.7-15.5%. They also differ in their effects on organ lipids. Studies have revealed that there is no relation betweentotal fish intake and estimated Omega-3 fatty acid intake from all fish and serum Omega-3 fatty acid concentrations. (Gruger et al., 1964) Only fatty fish intake, particularly salmonid, and Estimated EPA + DHA intake from fatty fish has been observed to be significantly associated with increase in Serum docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA)

Fish oil supplements are available as liquids, capsules, and tablets. It has also been used for preventing heart disease and stroke when taken in the recommended amount. While fish oil can be obtained from eating fish, itcan also be gotten by taking fish supplements which are rich in omega-3 fatty acids and provide about 1 gram of omega- 3 fatty acids which is about 3.5ouncesoffish.

Presently, many Americans have turned to omega-3 fish oil supplements. Dietary fish and fish oil supplements have benefits for healthy people and also those with heart disease. Omega-3 fish oil contains both docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA)Omega-3 fatty acids are very important in preventing and managing heart disease.

In Nigeria, fish supplements are sold in stores for those who can afford them but based on the poverty level of most Nigerians leaving in the rural settlement makes it impossible for them to afford the high cost of this oil supplements. It is important to find an alternative source of this nutrient at an affordable cost to low-income earners.

STATEMENTOFTHERESEARCHPROBLEM

Every year a considerable amount of total fish catch is discarded as processing leftovers and that include trimmings, fins, frames, head, skinand viscera. Some of the by-products are utilized, but the main bulk is dumped as waste, creating both disposal and pollution problems.

These wastes have high content of nutritive compounds like protein ofhigh biological value, unsaturated essential fatty acids, vitamins and antioxidants, minerals or trace metals and physiological beneficial amino acids and peptides which is substrate of the fish meal production.

Therefore, it is important to determine the physiochemical, minerals and fatty acid profile of catfish which are regularly consumed and to compare the quality of the oil from these fishes with commercially sold fish oil. This will ascertain if oil consumed from the catfish is adequate enough to maintain a good health.

RESEARCHQUESTION/STATEMENTOFHYPOTHESIS

a). Extracting oil from catfish can be challenging due to the structure of the fish and the presence of impurities. Some problems with catfish oil extraction include.What best method is prescribed for catfish oil extraction.

b). What is the best temperature of cooking for the extraction of top-quality catfish oil?

c). Whatprocessisbest avoidedindegradationofthecatfishoil quality?

d). Intheevaluationofthecatfishoil,whatiscommercialbenefitsof catfish?

e) Adverse effect of the economy instability on the farming catfish and the extraction of oil?

f) Necessaryaidstotheproductionanddistributionofcatfishoilthrough exportation and circulation?

OBJECTIVEOFTHESTUDY

The aim of the study is to evaluate the commercial value of catfish; if oil consumed from the catfish is adequate enough to maintain a good health.

On the other hand, it tends to investigate the medical and clinical value of catfish oil.

SIGNIFICANTOFTHESTUDY

The research work is an investigation of the commercial value of catfishoil vis-à-vis health benefits so that catfish by-product are well utilized in prevention of disposal and pollution challenges.

However, it will also serve as reference material to any scholar in exploration of techniques to constructing and maintaining a conducive aquarium for aquatic lives.

SCOPEOFTHESTUDY

This study is an investigation into catfish oil and its commercial value vis-à-vis the health benefits to the sustainability of adequate well-being of mammal and most especially human beings at large.

LIMITATIONOFTHESTUDY

The study is limited the evaluation of commercial value of catfish; thus, it tends to investigate the medicinal value and health benefits of catfish oil.

DEFINITIONOF TERMS

Commercial value: This value is determined by various factors, including supply and demand dynamics, production costs, market competition, and consumer perception

Medicinal value: Medicinal value means the ability of a substance to cure, heal, or relieve pain. It can also refer to the therapeutic properties of a substance.

Supplement: A product taken orally that contains one or more ingredients (such as vitamins or amino acids) that are intended to supplement one's diet and are not considered food.

Catfish: Any of an order (Siluriformes) of chiefly freshwater stout-bodied scaleless bony fishes having long tactile barbels

Catfish oil: The oil low in calories and packed with lean protein, healthy fats,vitamins,andminerals.It'sparticularlyrichinheart-healthyomega-3 fats and vitamin B12. It can be a healthy addition to anymeal, though deep frying adds far more calories and fat than dry heat cooking methods like baking or broiling.

Omega 3: Being or composed of polyunsaturated fatty acids that have the final double bond in the hydrocarbon chain between the third and fourth carbon atoms from the end of the molecule opposite that of the carboxyl group and that are found especiallyin fish, fish oils, green leafyvegetables, and some nuts and vegetable oils

Protein: Any of various naturally occurring extremely complex substances that consist of amino-acid residues joined by peptide bonds, contain the elements carbon, hydrogen, nitrogen, oxygen, usually sulfur, and occasionally other elements (such as phosphorus or iron), and include many essential biological compounds (such as enzymes, hormones, or antibodies)

Antioxidant: Asubstance (such as beta-carotene or vitamin C) that inhibits oxidation or reactions promoted by oxygen, peroxides, or free radicals

ORGANIZATIONOFTHESTUDY

Thisstudyisdividedintofivechapters, *ChapterOne*contains Introduction, Background of the study, the statement of the problem purpose of the study,scopeandlimitationofthestudy,significantofthestudydefinitionof valuable termsandorganizationofthe study. Subsequently, theseconding chapter reviews redacted literature and scholastic contribution.

Nevertheless, the following chapter evaluates the historical background of the case study, estimate sample and sampling method of data collection and statistic instrument for data analysis.

Consequently, *Chapter Four* presented the analysis of the gathered data while the concluding chapter five account for the summary of findings, sum up conclusions and prescribe recommendation.

CHAPTERTWO

LITERATUREREVIEW

INTRODUCTIONTOFISHOILEXTRACTION

The fish processing industry generates significant by-products, such as viscera, skin, bones, and heads, which are valuable for producing food, medicinal products, energy, and industrial feedstock. Fish oil, rich inomega-3 polyunsaturated fatty acids like eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA),is widelyusedinnutritional supplementsand other applications. Among these by-products, fish viscera contain the highest concentration of oil, making them an ideal target for extraction due to their cost-effectiveness and environmental benefits. Extracting oil from fish by-product helps reduce environmental pollution and promotes sustainable practices by fully utilizing fish resources. This holistic approach contributes to waste reduction and resource efficiency in the fishprocessing industry. By incorporating sustainable principles into extraction processes - such as using environmentally friendly solvents, implementing efficient solvent recovery systems, and ensuring compliance with environmental regulations - companies can enhance the sustainability of their operations while extracting valuable components. As demand for fish- based food products rises, effective extraction of fish oil and fishmeal from by-productsbecomesincreasinglyimportant.Variousextractionmethods, including physical, chemical, and biological approaches, are essential for separating solids, oil, and water to recover valuable components like EPA and DHA. Optimizing these processes and combining different methodscan achieve high concentrations of polyunsaturated fatty acids (PUFAs) in fish oil, ranging from 65% to 80%. Emphasizing maximum PUFA content highlights the potential to enhance the quality and nutritional value of fishoil extracted from by-products while advancing sustainability in the fish.

The fish processing industry generates substantial solid and liquid by-products, which differ in composition depending on the species and processing methods. The fat content among fish species varies significantly, ranging from lean to high-fat types, influencing the lipid extraction potentialbfrom their by-products. Effective utilization of these by-products is critical to minimizing environmental impact andnadvancing towarda zero-waste approach (Alfio, Manzo & Micillo 2021; Kratky & Zamazal 2020; Thirukumaran et al. 2022).

However, value extraction and producing high-value products for pharmaceuticals and nutraceuticals, the industry can move towards zero waste (Wan-Mohtar et al. 2023). The use of fish by-products can betailored to meet macronutrient needs, with fat separation for PUFA-oil supplementsorconversionintobiofuelsandfertilizers,whileprotein-rich fractions are used in animal feed production (Pinela et al. 2022; Vázquezet al. 2020b).

FISHOILEXTRACTIONPROCESS

Fish oil extraction methods involve physical, chemical, and biological processes, each offering unique advantages and challenges. Physical methods, such as rendering, include homogenizing, heating, pressing, and filtering to extract oil from various fish by-products (Dave et al. 2024; Pudtikajorn& Benjakul 2020;Purnamayatietal. 2023).Chemical extraction methods often employ organic solvents, but these approaches raise concerns regarding toxicity and the potential loss of functional properties (Alfio, Manzo & Micillo 2021; Marsol-Vall et al. 2022).

In contrast, biological methods, such as enzymatic hydrolysis, are increasingly favored for their lower environmental impact, making them greener and safer alternatives to traditional solvent extraction (Aitta et al. 2022; Marsol-Vall et al. 2022).

PHYSICALMETHODFORFISHOILEXTRACTION

The physical extraction of fish oil, commonly known as rendering, is primarily aimed at obtaining oil rather than fishmeal. This method involves heatingvisceralorganswithwarmwater,followedbyseparatingsolid residues from the liquor. Rendering can be done either wet or dry (Dave et al. 2024; Djamaludinet al. 2023;Pudtikajorn& Benjakul 2020; Purnamayati et al. 2023; Suseno et al. 2021). The purification of the resulting liquid, which contains water, oil, and dry materials, is typically achieved through separation based on specific gravities. Mechanical pressing and centrifugation may be used to extract additional oil from the residues. Mechanical pressing and centrifugation can be employed to extract additional oil from the remaining residues.

However, the oil obtained through renderings still requires several refining steps, including degumming, deacidification, bleaching, and deodorization, to ensure it meets quality standards (Marsol-Vall et al. 2022).The method has been preferred due to its high PUFA content of up to 44% in the extracted oil. This method is often preferred due to the highpolyunsaturated fatty acid (PUFA) content, reaching up to 44% in the extracted oil. The wet rendering method for fish oil extraction is effective in yielding a relatively high quantity ofoil but faces hallenges in terms of oil quality due to the high peroxide value caused by oxidation during the heat treatment process (Djamaludin et al. 2023). The denaturation of proteins and the release of free radicals due to pre-cooking can hinder oil release andincreaseoxidationrates.Theresultinghighperoxidevaluecan negatively impact the quality off fish oil extracted using the wet rendering technique (Jamshidi et Al. 2020). This issue is particularly critical for oils rich in Omega-3 PUFAs, as their multiple double bonds make them Highly susceptibletooxidation,leadingtotheformationOflipidOxidationproducts that cause off-flavours and diminish the oil's value.

Moreover, to address these challenges, researchers are exploring methods to improve the oxidation stability of PUFA-.enriched oils. By optimizing processing conditions and incorporating antioxidants, the fish processing industry can enhance the quality and shelf life of fish oil products, Aligning with the growing demand for high-quality, health-bConscious food options (Arab-Tehrany et al. 2012).

CHEMICALMETHODSFORFISHOILEXTRACTION

Chemical methods for fish oil extraction involve the use of various solvents and innovative techniques that canimpact both efficiency and sustainability (Alfio, Manzo & Micillo 2021; Marsol-Vall et al. 2022). The choice of solvents.

Nevertheless, Is crucial, as it affects the environmental footprint of the Process. By selectingenvironmentally friendly solventswiithlowertoxicity and reduced persistence, the industry can mitigate negative environmental effects. Additionally,

Recycling and reusing solvents not only minimize waste and reduce environmental impact but also offer cost savings and enhance sustainability. Efficient solvent recovery systems are crucial in decreasing the consumption of virgin solvents. Proper disposal of waste solvents and strict adherence to environmental regulations are essential to maintaining sustainability in fish oil extraction (Caruso et al. 2020; Marsol-Vall et al. 2022; Mgbechidinma et al.2023; Wang et al. 2021). The solvent extraction of fish oil typically employs Organic solvents such as hexane, benzene, cyclohexane, Acetone, and chloroform to dissolve lipids (Mokhtar et al. 2021). Hexane is particularly popular for large- scale extraction due to its effectiveness; however, its environmental impact necessitates careful management (Iberahim & Tan 2020). Solvent selection depends on solubility, recovery ease, economic viability, toxicity, availability, and reusability. Solvent selection criteria include solubility, ease of recovery, economic viability, toxicity, availability, and reusability. Effective solvents must disrupt lipid interactions within tissue matrices, a process that can be enhanced by adjusting pH or ionic Strength. enzyme deactivation is sometimesrequiredtoImprovelipidextractionefficiency.Despiteits efficacy, traditional solvent extraction presents challenges, such as the generation of substantial waste solvents, high recycling costs, safety concerns,andpotential productcontamination(Alfio,Manzo& Micillo2021; Marsol-Vall et al. 2022). One advanced variation of solvent extraction is Accelerated Solvent Extraction (ASE), an automated Method that uses low-boiling solvents under high pressure to enhance extraction efficiency and reduce waste. ASE eliminates manual sample preparation, accelerates the process, and improves reproducibility, though further research is neededfor large-scale applications (Chen et al. 2020; Wang et al. 2021),

Another method, acid-alkali-aided Extraction, employs acids or alkalis to dissolve proteins and isolate fish oils. While effective, this method risks extracting non-lipid compounds, complicating fatty acid profiling. Careful process control is necessary to minimize chemical degradation (Hossain 2022;Sivaranjani etal.2024).Recentadvancementsinchemicalextraction methods have focused on improving sustainability, including the use of Supercritical Fluid Extraction (SCFE) and the integration of physical pre-treatments such as microwave or ultrasound techniques. Microwave-Assisted Extraction (MAE) leverages microwave energy to heat solvents, enhancing lipid yields and reproducibility while reducing solvent use and energyconsumption.MAEoffersfasterextractionratesandoperatesat lower temperatures, thus minimizing environmental impact compared to traditional methods. Innovations such as microwave-assisted Soxhlet extraction further reduce extraction time and energy consumption, contributing to sustainability (Keskin Çavdar et al. 2023; Pinela et al. 2022).

Ultrasound-Assisted Extraction (UAE) relies on the cavitation effect of ultrasonic waves, which facilitates extraction and mass transport by disrupting cell walls (Mokhtar et al. 2024). However, UAE has yet to be applied on an industrial scale for fish oil extraction (Hashim et al. 2022; Keskin Çavdar et al. 2023; Putri et Al. 2023). Supercritical Fluid Extraction (SCFE, which uses supercritical CO, as an environmentally friendly solvent (Isa, Sofian-Seng & Wan Mustapha 2021), extracts fish oils with minimal toxic residue. SCFE is particularly suitable for thermally sensitive products, offering rapid extraction and high purity. It is effective across various fishby-products, although it may be less efficient in extracting heavy metals (Franklin et al. 2020; Jamalluddin et al. 2022; Melgosa, Sanz & Beltrán 2021), Membrane-coupled SC-CO, extraction combines membrane technology with SC-CO, to separate triglycerides, enhancing product purity while reducing energy requirements for CO, recycling (Chozhavendhan et al. 2020). This technique is valuable for producing high-quality fish oils for various industries, supporting both sustainability and product quality.

To further enhance sustainability in chemical extraction, the fish oil industry can focus on adopting green solvents by prioritizing low-toxicity, biodegradable options to minimize environmental impact. Implementing efficient solvent recovery and recycling systems can significantly reduce waste and resource consumption. Innovations like MAE and ASE also help lower energy use, thereby reducing the overall carbon footprint. Proper waste management, including responsible disposal and compliance with environmental regulations, ensures sustainable operations.

Additionally, a new class of non-conventional solvents Known as natural deep eutectic solvents (NADES) has Emerged. These solvents, often derivedfromcholineChloride(ChCI),carboxylicacids,andotherhydrogen-bond donors like urea, citric acid, succinic acid, and glycerol, share similar properties with ionic liquids but are less expensive to produce, less toxic, and frequently biodegradable (Chemat et al. 2017). By adopting these strategies, the fish oil industry can advance sustainable practices,balancing efficiency with environmental responsibility.

BIOLOGICALMETHODSFORFISHOILEXTRACTION

The extraction of fish oil using biological methods, such as enzymatic hydrolysis and fermentation, presents promising approaches that align well with sustainability goals. These methods leverage natural processes to efficiently extract valuable lipids while minimizing environmental impact. Enzymatic hydrolysis utilizes protease enzymes to extract fish oil by breaking down proteins into fatty acids or triglycerides. This process results in the formation of distinct layers: oil, emulsion, protein substrate, and sludge.

Although enzymatic hydrolysis is a greener alternative to chemicalmethods, it can result in oil-lipid emulsions with high lipid content but reducedoil quality. The efficiencyof enzymatic hydrolysiscan beenhanced by using external enzymes and optimizing conditions such as pH and enzyme activity. Enzymes sourced from animals, plants, or microbes, like the Alcalase enzyme from Bacillus subtilis (Garofalo et al. 2023) or Bacillus licheniformis (Araujo et al. 2021), have demonstrated improved lipid recovery. Despite these benefits, challenges remain, such as the cost of enzymes, extended reaction times, and the formation of oil-water emulsions. Research by Liu and Dave (2022) addresses the issue of enzyme reuse and cost by developing a method to immobilize Alkalize, allowing it to be reused for at least three batches without significant decreases in oil yield, demonstrating its potential for effective and consecutiveoilextractionfromsalmonby-products.Anothercircular economy approach generation of using the fish viscera in order to extract the proteolytic enzyme has been reported by Borges et al. (2023), as a sustainable approach to obtain enzymes. Proper storage conditions and monitoring are essential to maintain the quality of the extracted oil. Enzymatic treatment is a promising innovation to fish oil extraction.

HISTORYOFCATFISHFARMING

The first efforts at raising catfish were made in the early 1900’s at several federal and state fish hatcheries. In the 1950’s commercial catfish farming first started in Kansas and Arkansas.

Much of the information used by the early catfish Farmers in the 1950’s and 60’s was provided by Dr. H. S. Swingle and his co-workers at Auburn University. By 1965, there were over 7,000 acres of commercial Catfish ponds in Arkansas, along with acreage in Louisiana, Texas, Alabama, Georgia, Oklahoma, and Kansas. The first Pond built in Mississippi specifically for the commercial Production of channel catfish was inSharkey County by W. T. “Billy” Mckinney and Raymond Brown. This pond covered 40 acres and was filled and stocked that summer.

However, it was partially Harvested in January 1966, and 10,000 pounds of catfish Were sold to a professor in Kaw, Kansas. From this Inauspicious beginning, commercial catfish farming in Mississippi grew rapidly. Mississippi quickly became the Leader in this new agricultural enterprise.

InvestmentRequired

Theinvestmentrequiredperacretogetintocatfishfarmingvaries depending on factors such as these:

1. Doyouownor willyoubuythe land?
2. Whowill dotheconstructionwork, youoracontractor?
3. The amountof dirt thatmust be moved.
4. The depthandsize ofthewell(s)needed.
5. Doyouown or willyou have to buy equipment such as tractors, boats,motors and trucks for use on the farm?

ITEMSNEEDED

Putin your estimated cost,if any, fortheitemslisted below. Sincethe costs will vary, you must determine what is needed for your situation and what its cost will be.

1. **Land**: Only about 85 percent will be water; the rest will be in levees, storage buildings, Drains, etc.
2. **PondConstruction**:

   Dirt moving –In the Delta about 6.2 cubic yards of dirt must bemoved for each linear foot of levee that has a 16-foot top. About 8 cubic yards must be moved if there is an 18-foot top. The actual cost will depend on the price and the amount of dirt moved.

   DrainageStructures –Allow for a drainage canal on at least one side of the ponds) to carry water away from pond (s). The size and cost of the canal will depend on the lay-of-the-land and the number and size of ponds to be drained. Each pond must be drained by a pipe, aboutn75 feet long, fitted with gate (alfalfa valve) and screen. The pipemust belarge enoughtoallowthe pondtobecompletelydrained in 5-7 days.

   Gravel- You need gravel on at least two, and preferably three, levees of each pond to allow all-weather access for feeding, harvesting, emergency aeration and disease treatment. Gravel should be at least 4 inches deep and 8 feet wide; thus 1 cubic yard of gravel will cover 10 linear feet of levee.

Vegetative Cover- Seed all exposed areas of levees to quickly establish cover that will reduce erosion problems. Type of vegetation to seed depends on soil type and climate in your area. Lime and fertilizer may be required.

3. **Water Supply**(wells and supply pipes) You must have a dependable supplyof water free of fish and pollutants. Usuallya 2,000-3,000 gpm (gallons per minute) Well will supply 4 ponds of 17.5 water acres each. The depth and size of the well will determine the size of pump needed, the length of casing and screen needed, and the drilling pump.

   The type of energy to use for the pump is an important consideration. Initially, water must be pumped to fill the pond and then added throughout the year to replace water lost by evaporation; in addition, the total volume of water in a pond wilt probablyneeds to be replaced two or three times during the year for management purposes. Once the pumping time required can be estimated, then the approximate amount of fuel or energy needed can be calculated.

4. **FeedersandBulkStorage**

   Feeding is done with a mechanical blower that has at least a 1-ton capacityhopper.Althoughmosthavea2-toncapacity.The

Mechanical blower can be mounted to the Bed of a truck andpowered by an auxiliary engine, or it can be mounted on a trailer and pulled by a tractor and powered by the PTO of the tractor or auxiliary engine.

Determine the number of feeders you need by the amount of water acreage. One

Feeder with a 2-ton capacity hopper is adequate for 280 acres of water. A scale to estimate weight of amount fed per acre is also desirable. Store feed in a dry and, if possible, cool place to prevent rapid breakdown and loss of nutrients. Adequate storage space should be available for at least one week's supply of feed. Except for the smallest farms, a bulk storage bin with a gravity flow delivery system is needed.

5. Fingerlings

These represent the seed that must be planted. The number stocked depends on equipment available and quantity and quality of water. Stocking rates are discussed later, but it is recommended that an initial stocking rate of 4,000 4- to 6-inch fingerlings per acre not to be exceededand3,000to3,500peracreispreferredtoreduce management problems. The price of fingerlings varies depending on supply, but you can figure a price of 1 to 2 cents per inch.

6. **Feed**

A high-quality floating feed of about 32 percent to 35 percentprotein is recommended for successful production of catfish. Feeding rates vary daily from 2-5 percent of body weight when water temperatures are higher than 70° F (21.1° C) and 0.75-2 percent of body weight when temperatures are lower bthen 70° F. Assuming a stocking rate of 4,000 fingerlings per acre and a feed conversion of 1.75:1, annual production of 4,000 pounds of fish per acre would require 3.5 toms of feed per acre of water. Cost of feed varies depending on price of ingredients, and prices change almost weekly.

7. **OxygenTestingEquipment**

Intensive culture of catfish requires periodic checks of dissolved oxygen (DO) levels in each pond. During certain times of the year these DO checks must be made several times in each 24-hourperiod. If you have more than two ponds. You need an electronic oxygen meter to save time and labor in making all of the do checks required.Youneedatleastonebackupoxygenmeterbecausethey caneasilybedamaged. Inaddition, youneedachemical Oxygentest kit to check the accuracy of oxygen meters.

8. Tractors

At least one tractor (90-100 h.p.) is needed to pull the feeder and to provide power for a paddlewheel aeration device and a 16-inch relift pump. Look at your own situation and decide your needs, but at least two tractors are needed for four 17.5- to 20-acre Ponds. The tractor should have a power-take- off with a 1,000 spline.

CHAPTERTHREE

3.1MATERIALSANDMETHODS

Catfish oil extraction and the evaluation of commercial value as well as the health benefit are investigated through the following items provided for the research:

Material	Quantity
catfish	4
Extractor(mechanized presser)	1
ManualBlender	1
Knife	1
Cookingpot	1
Servingplate	1
CookingGas(cylinder)	1

METHODOFEXTRACTION

The extraction methods employed are mechanical pressing and solvent extraction. Firstly, both extraction methods are examined and compared to determine howefficientand cost implicatedbasedonthematerialsneeded.

MECHANICALPRESSINGEXTRACTOR

This comprised formical, plywood, stainless perforated cylindrical pot like pot; with toppled hydraulic presser.

SOLVENTEXTRACTION

The above mechanical presser is used but cooked catfish are dissolved in a slit liquid and its under goes mechanical pressing extractor. it involves pounding the boiled fish to give out content.

PROCESSESOFEXTRACTION

Thefollowingsteps weretakentowardsfinaloil extraction:

- preparationofcatfishforboilingat85^{o}c- 95^{o}c
- separationofthefishtissueandbones
- blendedfleshtissuesarepackedintostainlessperforatedcylinderpot
- placed the cylindrical pot on the mechanical hydraulic presser for extraction
- the gradual application of pressure force through the extractor and observe the extraction of the solvent catfish oil.

- solvent catfish oil placed inside a clean pot and heated for evaporation to occur till oil are left inside the pot and sieve into plastic bottle jar.

CHAPTERFOUR

RESULTANDDISCUSSION

Inthis chapter, discussions arebased on the result from the following observations; through:

- Extractionefficiency
- Qualityofoil
- Costandenvironmentalimpact;healthbenefitandcommercialvalues.

ExtractionEfficiency

Discussionofresultbasedonthemethodsofextractioninuse:

- MechanicalPressingExtraction(hydraulicpress)
- SolventExtraction

  The both methods are observed to be efficient but procedural whilst the mechanical since to be more efficient and sufficient for coordinated extraction.

The following observations are also gathered from the empirical perspective:

Mechanicalextraction

- waterdilutionwithoilextractedwaspartialandminimal.
- Theextractedoilisclearandvoidofresidues.

- Theevaporationprocessisfastandswift.
- Theshelf-lifeoftheextractedoilwithinoneweekwasstable.

Solventextraction

- Waterdilutionis prominent;thus, affectingthe quantityand thequality of oil extracted.
- Nutritionlevelislowduetotheboilingfor120°-150°.
- Theself-lifeoftheextractedoilisrelativelylowand unstable.

CostandEnvironmentImpactofFish oil

Fromtheabovediscussions,the followingobservationsaremadeunder the headings:

HealthRelevanceandBenefits

- Theextractedoilischolesterolfree.
- Itisveryrichinproteinanessentialreagenttotheskin.
- The oil posits severalnutritional benefits owing to its rich content ofomega-3 fatty acids, particularly DHA and EPA

CHAPTERFIVE

SUMMARY,RECOMMENDATIONANDCONCLUSION

SUMMARYOFFINDINGS

Many species of marine fish have been studied for fish oil production, but little attention has been paid to the production of catfish oil from processing waste.

A major question is whether it is feasible to produce edible oil fromcatfish viscera, a processing waste. Catfish oil is a new product and hasnot yet been produced on a pilot scale, so it is important to understand the FA composition and quality of the oil at different purification steps. Therefore, the objectives of this study were to produce edible oil from catfishvisceraand to determinethe effect of purificationon thecomposition of FA and the quality of the catfish visceral oil.

There is a sizable and growing world market demand for high-quality fish oils, and commercial fish oil production can be quite profitable if suitable raw materials are available. The fish industry should carefully handle by-products from gutting, filleting, and other fish-processing operations because they are good raw materials for fish meal and oil production. The waste and by-products of catfish processing consist of heads, frames, skin, and viscera, which often end up in landfills or rendering plants. Theaverage weight of viscera is about 265G, which isabout 10% by weight ofa live whole catfish. The fat content of viscera is 33.6% (wet basis), and the viscera can be used for recovering oil that could be converted into edible products. Producing edible oil from viscera may add value to catfishviscera, which is currently a processing waste.

For the last two decades, interest in the dietary effects of marine FAhas increased because they play a major role in human health. Natural fish oils may help maintain heart and vascular health in humans. Catfish oil, extracted from the viscera or entire fish, offers several commercial advantages. Findings indicate it's a rich source of omega-3 fatty acids, especially DHA and EPA, with potential health benefits. While research shows the oil can be a valuable resource, further investigation is needed to determine optimal extraction methods and ensure consistent quality and safety for various applications.Catfish oil is a good source of omega-3fatty acids (DHA and EPA), which are linked to various health benefits, according to numerous studies.Studies have identified the fatty acid composition of catfish oil, including saturated, monounsaturated, and polyunsaturated fatty acids. High-quality catfish oil should be free from contaminants(e.g.,heavymetals,PCBs)andadulterants.Lookforthirdparty lab testing certifications.Higher concentrations on EPA and DHA (typically 15–30% combined) indicate better nutritional value. To be Measured by peroxide value (PV < 5meq/kg) and anisidine value (AV <20) to determine Low values so as to ensure freshness and shelf life.

In a nutshell, analysis of catfish oil reveals its quality characteristics, including free fatty acids, peroxide value, and acid value. whilstmechanical-pressed or molecularly distilled oils retain more nutrients compared to chemically extracted oils.

RECOMMENDATIONS

A major question is whether it is feasible to produce edible oil from catfish,a processing waste. Catfish oil is a new product and has not yet been produced on a pilot scale, so it is important to understand the quality and the commercial value of the catfish oil viz-a-viz the methods of extraction. There is a sizable and growing world market demand for high-quality fish oils, and commercial fish oil production can be quite profitable if suitable raw materials are available. The fish industry should carefully handle by-products from gutting, filleting, and other fish-processing operations because they are good raw materials for fish meal and oil production.

Therefore, the objectives of this study were to produce edible oil from catfish and to determine the quality and the commercial value of the catfish oil.

Further research should focus on improving extraction methods tomaximize oil yield and maintain quality, including optimizing solvent-free extraction.

As a matter of fact in Quality Control, establishing standards for catfish oil quality, including testing for oxidation markers (acid value, anisidine value, peroxide value) and heavy metals. Moreover, conduct further studies to explore the specific health benefits of catfish oil, particularly in areas like cardiovascular health, inflammation, and cognitive function.

Moreover, potential use of catfish oil is potent in various industries, including food, pharmaceuticals, and cosmetics. Catfish oil is a type of fish oil derived from the tissues of catfish, a common freshwater or farmed fish widely consumed in regions like Nigeria (NG). While less studied than oils from fatty fishlike salmon or mackerel, catfish oil has cultural and nutritional significance in many communities. While catfish oil offers nutritional benefits, its lower omega-3 content compared to marine fish oils means it shouldcomplement—notreplace—abalanceddiet.Fortherapeuticdoses of omega-3s, supplements from fatty fish or algae may be more effective. Alwaysprioritizefresh, well-preparedcatfish oiltoavoidrancidity. However, they might be higher in omega-6, so the ratio could be a consideration. Also, catfish oil might be used in local cuisine for flavor. In Nigeria, catfish (especially the species Clarias gariepinus) is popular, so the oil might be a byproduct used in soups or stews.

However, potential health benefits could include supporting heart health, reducing inflammation, but with the caveat that the evidence might not be as strong as for other fish oils. Also, cooking with catfish oil could add nutrients to diets that might otherwise lack them. Lastly on this note, further studies should evaluate the market demand and potential for commercialization of catfish oil, considering factors like production costs and consumer preferences.

CONCLUSION

Extracting fish oil from by-products offers a cost-effective and sustainable approach to obtaining valuable lipids. Unlike plant-based oil extraction, the process for fish oil is more complex due to the muscle-based lipid samples involved. The yield and purity of fish oil are significantly influenced by the chosen extraction method, making itcrucialtoselect the most appropriate technique. Thedevelopment of greentechnologies for producing oils richin n-3 PUFAs from aquatic sources is an expanding area of research. While much of the focus has been on green strategies for extracting crude oilfrom raw materials, there has been less emphasis on refining these oils. Therefore, increased efforts should be directed toward recovering and valorizing these fractions.

Currently, a significant portion of fish oil is refined from crude oils produced as by-products of fish meal production. However, by optimizing enzymatic hydrolysis and fermentation processes, the fish processing industry can achieve high-qualityfishoil production. These methods not onlyimprove oil yield but also reduce environmental impact, thereby enhancing resource efficiency and contributing to a more sustainable industry.

On this note, catfish oil possesses significant commercial value due to its nutritional benefits and potential applications. Further research and development are needed to optimize extraction methods, establish quality standards, and fully realize the commercial potential of this resource. By focusing on these areas, the catfish industry can further leverage the commercial value of catfish oil and contribute to the global market.

REFERENCE

Aitta, E., Marsol-Vall, A., Damerau, A. & Yang, B. 2021. Enzyme-assisted extraction of fish oil from whole fish and by-products of Baltic herring (Clupea harengus Membras). Foods 10(8): 1811.

Arab-Tehrany,E.,Jacquot,M.,Gaiani,C.,Imran,M.,Desobry,S.&Linder, M. 2012. Beneficial effects and oxidative stability of omega-3 long-chain Polyunsaturated fatty acids. Trends in Food Science & Technology 25(1): 24-33.

Alfio, V.G., Manzo, C. & Micillo, R. 2021. From fish waste to value: An overview of the sustainable recovery of Omega-3 for food supplements. Molecules 26(4): 1002.

Djamaludin, H, Sulistiyati, T.D, Chamidah,A., Nurashikin, Garofalo, S.F., Cavallıni, N., Demichelis, F., Mancinı, S.G., Fino, D. & Tommasi, T. 2023. From tuna viscera 5o added-value products: A circular approach for fish-waste recovery by green enzymatic hydrolysis. Food and Bioproducts Processing 137: 155-167.

Hashim, N.A., Mazilan, M.S.R., Man, R.C., Arshad, Z.M. & Mudalip, S.K. 2022.Recoveryofomega-3fishoilFromMonopterusalbususing microwave assisted extraction process. In AIP Conference Proceedings 2610: 060015.

Hossain, K.z. 2022. Oil quality of by-products of Marine fish during processing methods. Journal of Aquaculture & Marine Biology 11(3): 135-137.

Jamalluddin, N.A., Ismail, N., Mutalib, S.R.A. & Sikin, A.M. 2022. sC-CO, extraction of fish and fish by products in the production of fish oil and enzyme. Bioresources and Bioprocessing 9: 21.

Jamshidi, A., Cao, H., Xiao, J. & Simal-Gandara, J. 2020. Advantages of techniques to fortify food products with the benefits of fish oil. Food Research International 137: 109353.

Iberahim, N. I., & Tan, B. C. 2020. Hexane-isopropanol extraction and quality assessment of omega-3 fish oil from Atlantic salmon (Salmo salar). In iOP Conference Series: Materials Science and Engineering (Vol. 932, No. 1, p. 012038). IOP Publishing.

Kratky, L. & Zamazal, P. 2020. Economic feasibility and sensitivityanalysis of fish waste processing Biorefinery. Journal of Cleaner Production 243: 118677.

Liu, Y., & Dave, D. 2022. Beyond processing waste: Extraction of oil from Atlantic salmon (Salmo salar) by-products using immobilized Alcalase on chitosan- coated magnetic nanoparticles. Aquaculture 548: 737546.

Liu, Y., Ramakrishnan, V. V., & Dave, D. 2021. Enzymatic Hydrolysis of farmed Atlantic salmon by-products: investigation of operationalparameters on extracted oil yield and quality. Process Biochemistry 100: 10- 19

Marsol-vall, A., Aitta, E., Guo, Z. & Yang, B. 2022. Green Technologies for Production of oils rich in n-3 Polyunsaturated fatty acids from aquatic sources. CriticalReviews inFoodScienceandNutrition 62(11): 2942-2962.

Mgbechidinma, C.L., Zheng, G., Baguya, E.B., Zhou, H., Meidell, L.s., Slizyte, R., Mozuraityte, R., Carvajal, A.K., Rustad, T., Standal, I.B., Kopczyk, M. & Falch, E. 2023. Silage for upcycling oil from saithe (Pollachius Virens) viscera –Effect of raw material freshness on the oil quality.

Heliyon 9(6): el6972. Melgosa, R., Sanz, M.T. & Beltrán, S. 2021. Supercritical CO, processing of omega-3 polyunsaturated Fatty acids – Towards a biorefinery for fish waste valorization. The Journal of Supercritical Fluids 169: 105121.

Mokhtar, N., Abdul Rahman, H., Sofian-Seng, N.s., Lim, S.J., Wan Mustapha,W.A.,AbdulHamid,A.,MohdRazali,N.s.&MohamedNazir,
M.Y. 2024. Comparative analysis of process intensification Technologies (PIT) for improved cell disruption and lipid recovery in Aurantiochytrium sp. SWi Microalgae. İnternational Journal of Food Science & Technology 59(10): 7827-7836.

Mota, F. A., Costa Filho, J. T., & Barreto, G. A. 2019. The Nile tilapia viscera oil extraction for biodiesel Production in Brazil: An economic analysis. Renewable and Sustainable Energy Reviews 108: 1-10.

Mokhtar, N., Chang, L.s., Soon, Y., Mustapha, W.A. W., Sofian-seng, N.s., Rahman, H.A., Mohd Razali, N.s., Shuib, S., Hamid, A.A. & Lim, S.J. 2021. Harvesting Aurantiochytrium sp. SW1 using organic flocculants and characteristics of the extracted oil. Algal Research 54: 102211.

Morales, A.H.,Pisa,J.H.,Gómez,M.I,Romero,C.M., Saleh,N.E., Wassef,
E.A. & Abdel-Mohsen, H.H. 2022. Sustainable fish and seafood production and processing. In Sustainable Fish Production and Processing, edited by Galanakis, C.M. Massachusetts: Academic Press. Pp. 259-291.

Sivaranjani, S., Puja, N., Rout, R.K., Joshi, TJ., Singh, S.M., Indumathi, M. &Kumar,T.D.2024.Strategiestorecoverproteinandlipidsfromfish

processing by- Products. In Fish Waste to Valuable Products, edited by Maqsood, S., Naseer, M.N., Benjakul, S. & Zaidi, A.A. Singapore: Springer Nature.

Suseno, S.H., Rizkon, A.K., Jacoeb, A.M. & Listiana, D. 2021. Fish oil extraction as a by-product ofTilapia (Oreochromis sp.) fish processing with dry rendering method. 1OP Conference Series: Earth and Environmental Science 679: 012009.

Thirukumaran, R., Priya, V.K.A., Krishnamoorthy, S., Ramakrishnan, P., Moses, J.A. & Anandharamakrishnan, C. 2022. Resource recovery fromfish waste: Prospects and the usage of intensified Extraction technologies. Chemosphere 299: 134361.

Vázquez, JA., Fraguas, J., Mirón, J., Valcárcel, J., Pérez-Martín, RI. & Antelo, L.T. 2020a. Valorisation of Fish discards assisted by enzymatic hydrolysis and microbial bioconversion: Lab and pilot plant studies and preliminary sustainability evaluation. Journal of cleaner Production 246: 119027.

Vázquez,J.A.,Rodriguez-Amado,I.,Sotelo,C.G.,Sanz,N.,Pérez-Martín, R.I.&Valcárcel,J.2020b.Production,Characterization,andbioactivityof

fish protein Hydrolysates from aquaculture turbot (Scophthalmus Maximus) wastes. Biomolecules 10(2): 310. Technology 52: 2166-2174.

Wang, M., Zhou, J., Collado, M.C. & Barba, FJ. 2021. Accelerated solvent extraction and pulsed electric fields for valorization of rainbow trout (Oncorhynchus mykiss) andsole (Doversole) by-products:Protein content, molecular weight distribution and antioxidant potential of the extracts. Marine Drugs 19(4): 207.

Zhang, Y.,Sun, Q.,Liu,s.,Wei, S., Xia,Q., Ji,H.,Deng, C. & Hao,J.2021. Extractionoffishoilfromfish headsusingultra-high-pressurepre-treatment pri-enzymatic hydrolysis. Innovative Food Science & Emerging Technologies 70: 102670.