

BIOTRANSFORMATION OF AQUACULTURE RESIDUE INTO MANURE AND STUDYING ITS BIOLOGICAL APPLICATION

Submitted in partial fulfillment of the requirements for the award of Bachelor of
Science degree in Biotechnology

By

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**DEPARTMENT OF BIOTECHNOLOGY
SCHOOL OF SCIENCE AND HUMANITIES**

SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

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This is to certify that this Project Report is the Bonafide work of A. Jyothi kumari (40770020) B.sc Biotechnology Sathyabama Institute of Science and Technology, Who carried out the project entitled “**Biotransformation of aquaculture residue into manure and studying its biological application**” Under the supervision of Dr. M. V. Rajeswari, Scientist-C, Centre for Aquaculture, Col. Dr. Jeppiaar Research Park, Sathyabama Institute of Science and Technology, Chennai from January 2023 to April 2023.

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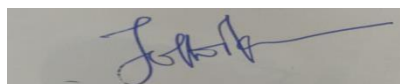
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DECLARATION

I A. Jyothi Kumari (40770020) hereby declares that the Project Report entitled “Biotransformation of aquaculture residue into manure and studying its biological application” done by me under the guidance of Dr. S. Sudha (Internal) and Dr. M. V. Rajeswari (External) at Centre for Aquaculture, Col. Dr. Jeppiaar Research Park, Sathyabama Institute of Science and Technology is submitted in partial fulfillment of the requirements for the award of Bachelor of Science degree in Biotechnology.

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ABSTRACT

In the present study, Biotransformation of aquaculture residue into manure and studying its biological application, Fish waste compost can be applied into farm, garden, vegetable production, field crops, trees and landscapes as soil amendment and fertilizer supplement to increase soil organic matter and nutrients, promote moisture holding ability, and then enhance production and quality.

Organic residue produced by Aquaculture has been gaining priority for its good source of nutrients. The study involves biotransformation of the residues for formulating manure for crop usage. The residues collected will be treated with suitable substrates and the biotransformation process will be evaluated through spectroscopic methods. The manures will be determined for concentration of nutrients. Further the manures will be evaluated for biological application.

A pot experiment will be conducted to compare the effects of compost from Fish Waste on the yield and macro and micro-elemental composition of lettuce. In addition, the Phytotoxicity degree of the compost and compost effects on seed germination and primary root growth will be determined with white mustard. Compost used in the study consisted of Fish Waste and pine bark.

This study will be conducted to evaluate the potential effects of fish waste extract on the growth, yield and quality of lettuce. Different treatments were arranged according with five replicates for each treatment. All the six (6) treatments viz; control NPK, 10 ml, 20 ml, 40 ml and 50 ml of fish waste extract were applied to the potting media.

CONTENTS

1.	INTRODUCTION	01
1.1	AQUACULTURE	02
1.2	TYPES OF AQUACULTURE RESIDUE	03
1.2.1	<i>Solids</i>	04
1.2.2	<i>Liquids</i>	04
1.2.3	<i>Gases</i>	04
1.3	SOURCES AND COMPOSITION OF AQUACULTURE RESIDUE	04
1.3.1	<i>Fish pens and cages</i>	05
1.3.2	<i>Hatchery</i>	05
1.3.3	<i>Processing plant</i>	05
1.3.4	<i>Other production facilities</i>	06
1.4	POTENTIAL IMPACTS OF AQUACULTURE RESIDUE	06
1.4.1	<i>Environment impacts</i>	06
1.4.2	<i>Human health impacts</i>	06
1.5	BIOTRANSFORMATION OF AQUACULTURE RESIDUE	07
1.5.1	<i>Anaerobic digestion</i>	08
1.5.2	<i>Biochemical conservation</i>	08
1.5.3	<i>Enzymatic hydrolysis</i>	08
1.6	CURRENT TECHNOLOGIES FOR BIOTRANSFORMATION OF AQUACULTURE RESIDUE	09
1.6.1	<i>Anaerobic digestion</i>	09
1.6.2	<i>Biochemical conservation</i>	09
1.6.3	<i>Enzymatic hydrolysis</i>	09
1.7.1	<i>Potential applications of biotransformation technologies for</i>	10

	<i>sustainable management of aquaculture waste</i>	
1.7.2	<i>Potential uses of aquaculture residue</i>	10
1.8	BIOLOGICAL APPLICATIONS OF BIOTRANSFORMED MANURE	10
1.8.1	<i>Soil amendment</i>	11
1.8.2	<i>Fertilizer</i>	12
1.8.3	<i>Animal feed supplement</i>	12
1.8.4	<i>Challenges and opportunities</i>	12
2.	LITERATURE SURVEY	13
3.	AIM AND SCOPE	17
3.1	AIM	17
3.2	SCOPE	17
4.	MATERIALS AND METHOD	
4.1	SAMPLE COLLECTION	18
4.2	EXPERIMENTAL DESIGN	21
4.3	FTIR ANALYSIS	22
4.4	STATISTICAL ANALYSIS	22
5.	RESULT AND DISCUSSION	
5.1	GROWTH OF <i>BRASSICA JUNCEA L</i>	23
5.2	FTIR ANALYSIS	25
6.	SUMMARY AND CONCLUSION	27

TABLE NO.	LIST OF TABLES	PAGE NO.
5.1	Selected parameters for plant growth <i>(brassicajuncea l.)</i> During the pot experiment.	23
5.2	FTIR band intensities of functional groups present in fish fecal organic matter from fish culture tank	26

TABLE NO.	LIST OF FIGURES	PAGE NO.
4.1	Fish fecal waste was collected from Fish culture tank.	19
4.2	Dried fecal organic matter of fish sealed in plastic cover.	20
4.3	Experimental setup: three type of group was taken and analyzed for plant growth.	21
5.1	Growth and yield of <i>Brassica juncea L.</i>	24
5.2	Length of the plant stem after Day 4, 7 and 15.	25
5.3	FTIR spectrum of fish fecal organic matter from fish culture tank.	26

CHAPTER-1

1. INTRODUCTION

Aquaculture is a growing industry in the world and it produces a large amount of residue that needs to be processed for reuse. The biotransformation of aquaculture residue into manure is a promising approach for utilizing this waste, as it provides a sustainable way to reduce the environmental impact of aquaculture waste, while simultaneously providing a valuable resource to the agricultural industry. This review paper will discuss the biotransformation of aquaculture residue into manure, the advantages and disadvantages of this process, and the potential biological applications of the resulting manure (Kang, L., & Wang, S. 2020).

The biotransformation of aquaculture residue into manure starts with the collection, transport, and storage of the waste material. This is followed by the preparation of the waste, which involves the removal of any undesirable components, such as plastic, metal, and other contaminants, as well as the fractionation of the organic matter. The organic matter is then subjected to biotransformation, which includes biodegradation, composting, and anaerobic digestion (Fernando et al., 2020). The biodegradation process involves the breakdown of the organic matter by microbial activity, while the composting process involves the use of heat.

The use of aquaculture residue manure for biological applications has been studied extensively. Studies have shown that the manure can improve soil fertility and crop yields, reduce erosion and increase water-holding capacity. Additionally, the manure can be used as a feed supplement for livestock and as a source of organic carbon for composting. In addition to its biological applications, the biotransformation of aquaculture residue into manure can also reduce the environmental impacts of aquaculture production (Chen, J., & Liu, W. 2009). Studies have shown that the biotransformation of aquaculture residue can reduce the amount of organic matter released into the environment and reduce the amount of energy and resources required for the disposal of aquaculture residue. Overall, the biotransformation of aquaculture

residue into manure and its subsequent use for biological applications is an attractive option for aquaculture producers. The manure produced can be used to improve soil fertility and crop yields, reduce erosion and increase water-holding capacity. Additionally, the biotransformation of aquaculture residue can reduce the environmental impacts of aquaculture production. Further research is needed to improve the efficiency of the biotransformation process and to explore additional applications of the manure produced.

1.1 AQUACULTURE

Aquaculture is the farming of aquatic organisms such as fish, shellfish, and other aquatic animals. It is a form of agriculture that involves the rearing of aquatic organisms in a controlled environment. It is one of the fastest-growing food production sectors in the world. Aquaculture is an important source of livelihood and food security for many people in the world. Aquaculture production has increased dramatically over the past few decades, and the demand for aquatic products is expected to continue to grow (Oguri, M., & Shimada, K. 2013).

Aquaculture is an important source of protein, vitamins, and other nutrients, and has the potential to provide a sustainable source of food for an ever-growing population. However, aquaculture also generates a large amount of waste, which can cause environmental problems such as eutrophication and contamination of water bodies (Bajracharya, P., & Shrestha, M. 2008). The management of aquaculture waste is therefore essential for the sustainability of the industry.

One of the most attractive solutions to the problem of aquaculture waste management is the biotransformation of aquaculture residue into manure. Biotransformation is the process by which organic wastes are converted into biodegradable products through the action of microorganisms. This process can be used to convert aquaculture residues into organic fertilizers, which can be used to improve soil fertility and crop yields.

Aquaculture is defined as the cultivation of aquatic organisms, such as fish, crabs, mollusks, etc., within a controlled environment. The industry has grown rapidly in recent decades, with global production increasing from 18 million tons in 2006 to over 73

million tons in 2018. Along with this growth, the industry has also generated significant amounts of waste, which can have significant environmental and health impacts if not managed properly (FAO. 2020).

The biotransformation of aquaculture residue is an important process in the management of aquaculture waste. Aquaculture is an increasingly important sector of the global food system, accounting for approximately 15 percent of all food produced in the world. As a result, the amount of aquaculture residue generated is also increasing. Aquaculture residue is a complex mixture of organic and inorganic compounds, including proteins, carbohydrates, lipids, minerals, and other compounds, that are produced as a by-product of aquaculture operations. In addition to the potential for environmental contamination caused by the release of these materials into the environment, aquaculture residue also has the potential to be used as a valuable resource for the production of energy, food, and feed (Helmer, B. 2020). The biotransformation of aquaculture residue is a process by which organic compounds are broken down into simpler molecules by microorganisms. This process can be used to convert aquaculture residue into useful products, such as biofuels, biochemicals, and other valuable compounds (FAO. 2020).

2. TYPES OF AQUACULTURE RESIDUE

Aquaculture residue can be broadly categorized into three types: uneaten feed, faecal matter, and exoskeletal material. Uneaten feed is the leftover feed that is not consumed by the aquatic animals. It can comprise both plant- and animal-based feed, and can contain a variety of nutrients, such as proteins, lipids, and carbohydrates. Faecal matter is the excreta from the aquatic animals, which contains a high concentration of organic matter. Exoskeletal material is the material that is left behind after the death of aquatic organisms, such as shells and scales (FAO. 2020).

Aquaculture residues can be divided into three main categories: solids, liquids, and gases. Within these categories, there are a variety of specific subtypes of residues.

1. Solids

Solids are the most common type of residue produced by aquaculture. They include uneaten feed, faeces, algal blooms, and other debris. Uneaten feed is the most significant source of solid residues, accounting for up to 60% of all solid residues in some systems. Faeces are the second most significant source, accounting for up to 20% of all solid residues. Algal blooms and other debris account for the remaining residues (United States Environmental Protection Agency 2020).

2. Liquids

Liquids are the second most common type of residue produced by aquaculture. They include wastewater, dissolved organic matter, and other contaminants. Wastewater is the most significant source of liquid residues, accounting for up to 80% of all liquid residues in some systems. Dissolved organic matter is the second most significant source, accounting for up to 20% of all liquid residues. Other contaminants, such as chemicals and heavy metals, account for the remaining residues (United States Environmental Protection Agency 2020).

3. Gases

Gases are the least common type of residue produced by aquaculture. They include ammonia, carbon dioxide, and other gases. Ammonia is the most significant source of gas residues, accounting for up to 90% of all gas residues in some systems. Carbon dioxide is the second most significant source, accounting for up to 10% of all gas residues. Other gases, such as methane and nitrous oxide, account for the remaining residues (United States Environmental Protection Agency 2020).

1.3 SOURCES AND COMPOSITION OF AQUACULTURE RESIDUE

Aquaculture is the farming of aquatic animals and plants, such as fish, shellfish, and aquatic plants. Aquaculture operations are found in many parts of the world and have become an important source of food. As a result, the amount of aquaculture residue generated has also increased. Aquaculture residue is a complex mixture of organic and inorganic compounds, including proteins, carbohydrates, lipids, minerals, and other compounds, that are produced as a by-product of aquaculture operations. The sources of aquaculture residue vary depending on the type of aquaculture operation. For

example, fish farming operations generate fish meal, fish oil, and fish waste, while shellfish farming operations generate shellfish waste and shellfish oil. Other sources of aquaculture residue include uneaten feed, fish processing waste, and wastewater from aquaculture operations. The composition of aquaculture residue also varies depending on the type of aquaculture operation. For example, fish meal contains proteins, carbohydrates, lipids, minerals, and other compounds, while fish oil contains primarily fatty acids, and shellfish oil contains primarily fatty acids and other compounds (Chikate, S., & Patil, S. 2015).

Aquaculture residues can come from a variety of sources, including fish pens and cages, hatcheries, processing plants, and other production facilities.

1. *Fish pens and cages*

Fish pens and cages are the most common source of aquaculture residues. They are typically constructed in shallow, sheltered areas with slow-moving or still water. The pens and cages can be made of a variety of materials, such as wood, concrete, steel, and plastic. Fish pens and cages generate solid, liquid, and gas residues, depending on the type and size of the pen or cage, the species of fish being cultured, and the feeding and management practices used (United States Environmental Protection Agency 2020).

2. *Hatchery*

Hatcheries are another common source of aquaculture residues. They are typically constructed in sheltered areas with slow-moving or still water. Hatcheries generate solid residues from uneaten feed, faeces, and algal blooms. They also generate liquid residues from wastewater, dissolved organic matter, and other contaminants.

3. *Processing plants*

Processing plants are a third common source of aquaculture residues. They are typically constructed in sheltered areas with slow-moving or still water. Processing plants generate solid residues from uneaten feed, feces, and algal blooms. They also

generate liquid residues from wastewater, dissolved organic matter, and other contaminants (Chikate, S., & Patil, S. 2015).

1.3.4 Other production facilities

Other production facilities, such as farms, nurseries, and hatcheries, are also sources of aquaculture residues. They generate solid residues from uneaten feed, faeces, and algal blooms. They also generate liquid residues from wastewater, dissolved organic matter, and other contaminants (Chikate, S., & Patil, S. 2015).

1.4. POTENTIAL IMPACTS OF AQUACULTURE RESIDUES

Aquaculture residues can have a variety of impacts on the environment and human health, depending on the type and amount of residue produced, the location of the aquaculture facility, and the management practices used (Gobbi et al., 2015).

1. *Environment impacts*

Aquaculture residues can have a variety of environmental impacts. The most significant impacts are eutrophication, water pollution, and habitat destruction. Eutrophication occurs when excess nutrients from aquaculture residues enter the water, leading to excessive algal growth, low dissolved oxygen levels, and changes in the species composition of the aquatic ecosystem. Water pollution occurs when toxic substances, such as heavy metals, enter the water from aquaculture residues. Habitat destruction occurs when aquaculture facilities, such as fish pens and cages, are constructed in areas of natural habitat (Gobbi et al., 2015).

2. *Human health impacts*

Aquaculture residues can have a variety of human health impacts. The most significant impacts are ingestion of contaminated seafood, inhalation of hazardous gases, and direct contact with contaminated water. Ingestion of contaminated seafood occurs when aquatic organisms, such as fish, are exposed to aquaculture residues and accumulate toxins in their flesh. Inhalation of hazardous gases occurs when the gases from

aquaculture residues, such as ammonia, are released into the air. Direct contact with contaminated water occurs when water is contaminated with aquaculture residues, such as wastewater, and humans come into contact with it (Gobbi et al., 2015).

5. BIOTRANSFORMATION OF AQUACULTURE RESIDUE

The biotransformation of aquaculture residue into manure involves the use of microbial cultures to convert the organic materials into biodegradable products. The process can be divided into three stages: hydrolysis, acidogenesis, and methanogenesis. Hydrolysis is the initial stage of the process, in which microbial enzymes break down the organic materials into simple molecules. Acidogenesis is the second stage, in which the simple molecules are converted into organic acids and other compounds. Finally, methanogenesis is the final stage, in which the organic acids are converted into methane and other gases (yin et al.,2008).

The biotransformation of aquaculture residue into manure can be carried out using a variety of techniques, such as anaerobic digestion, composting, and vermicomposting. Anaerobic digestion is a process in which organic matter is broken down in the absence of oxygen, resulting in the production of biogas. Composting is a process in which organic matter is broken down through the action of naturally occurring microorganisms in the presence of oxygen. Vermicomposting is a process in which organic matter is broken down through the action of earthworms (yin et al.,2008).

The biotransformation of aquaculture residue is a process by which organic compounds are broken down into simpler molecules by microorganisms. This process is important for the conversion of aquaculture residue into useful products, such as biofuels, biochemicals, and other valuable compounds. The biotransformation of aquaculture residue can be accomplished by various methods, including anaerobic digestion, biochemical conversion, and enzymatic hydrolysis (Wang et al.,2009).

1. *Anaerobic digestion*

Anaerobic digestion is a process by which organic matter is broken down by microorganisms in the absence of oxygen. This process is commonly used for the biotransformation of aquaculture residue into methane and other useful products.

During anaerobic digestion, microorganisms consume the organic compounds present in the aquaculture residue and produce methane, carbon dioxide, and other by-products. The methane produced can be used as a renewable energy source, while the other by-products can be used as fertilizer or animal feed (Chikate, S., & Patil, S. 2015).

2. *Biochemical conservation*

Biochemical conversion is a process by which organic compounds are broken down into simpler molecules by enzymes produced by microorganisms. This process can be used to convert aquaculture residue into various products, such as biofuels, biochemicals, and other valuable compounds. During biochemical conversion, microorganisms consume the organic compounds present in the aquaculture residue and produce enzymes that catalyse the breakdown of the compounds into simpler molecules. These compounds can then be used to produce valuable products (Chikate, S., & Patil, S. 2015).

3. *Enzymatic hydrolysis*

Enzymatic hydrolysis is a process by which proteins, carbohydrates, and lipids are broken down into simpler molecules by enzymes. This process can be used to convert aquaculture residue into various products, such as biofuels, biochemicals, and other valuable compounds. During enzymatic hydrolysis, enzymes produced by microorganisms break down the proteins, carbohydrates, and lipids present in the aquaculture residue into simpler molecules. These molecules can then be used to produce valuable products (Chikate, S., & Patil, S. 2015).

1.6 CURRENT TECHNOLOGIES FOR BIOTRANSFORMATION OF AQUACULTURE RESIDUE

Various technologies are available for the biotransformation of aquaculture residue. These technologies can be used to convert aquaculture residue into useful products, such as biofuels, biochemicals, and other valuable compounds. The current technologies available for the biotransformation of aquaculture residue include anaerobic digestion, biochemical conversion, and enzymatic hydrolysis (Chikate, S., & Patil, S. 2015).

1. *Anaerobic digestion*

Anaerobic digestion is a process by which organic matter is broken down by microorganisms in the absence of oxygen. This process is commonly used for the biotransformation of aquaculture residue into methane and other useful products. During anaerobic digestion, microorganisms consume the organic compounds present in the aquaculture residue and produce methane, carbon dioxide, and other by-products. The methane produced can be used as a renewable energy source, while the other by-products can be used as fertilizer or animal feed (Chikate, S., & Patil, S. 2015).

2. *Biochemical conversion*

Biochemical conversion is a process by which organic compounds are broken down into simpler molecules by enzymes produced by microorganisms. This process can be used to convert aquaculture residue into various products, such as biofuels, biochemicals, and other valuable compounds. During biochemical conversion, microorganisms consume the organic compounds present in the aquaculture residue and produce enzymes that catalyse the breakdown of the compounds into simpler molecules. These compounds can then be used to produce valuable products (Chikate, S., & Patil, S. 2015).

3. *Enzymatic hydrolysis*

Enzymatic hydrolysis is a process by which proteins, carbohydrates, and lipids are broken down into simpler molecules by enzymes. This process can be used to convert aquaculture residue into various products, such as biofuels, biochemicals, and other valuable compounds. During enzymatic hydrolysis, enzymes produced by microorganisms break down the proteins, carbohydrates, and lipids present in the aquaculture residue into simpler molecules. These molecules can then be used to produce valuable products (Chikate, S., & Patil, S. 2015).

1.7.1 Potential applications of biotransformation technologies for sustainable management of aquaculture waste

The biotransformation of aquaculture residue can be used to convert the waste into useful products, such as biofuels, biochemicals, and other valuable compounds. The use of biotransformation technologies for the sustainable management of aquaculture waste can help reduce the environmental impacts associated with the disposal of aquaculture residue. Additionally, the use of these technologies can help to reduce the amount of aquaculture waste that is released into the environment, thus reducing the potential for water contamination and other negative environmental impacts (yin et al.,2008)

1.7.2 POTENTIAL USES OF AQUACULTURE RESIDUE

Aquaculture residue has the potential to be used as a valuable resource for the production of energy, food, and feed. The proteins, carbohydrates, lipids, and minerals present in aquaculture residue can be used to produce various products, such as biofuels, biochemicals, and animal feed. The potential for the use of aquaculture residue as a resource is further enhanced by its abundance and availability. For example, the United Nations Food and Agriculture Organization estimates that up to 5 billion tons of fish waste is produced annually worldwide.

1.8 BIOLOGICAL APPLICATIONS OF BIOTRANSFORMED MANURE

The Bio-transformed manure can be used in a variety of biological applications. It can be used as a soil amendment to improve soil fertility and crop yields. It can also be used as an animal feed supplement. In addition, it can be used to produce biogas, which is a renewable energy source. Finally, it can be used to produce fertilizers and bio-pesticides (Zhang, et al 2009).

Manure from aquaculture residue has been used in agriculture for centuries to improve soil fertility and support crop growth. In recent years, biotransformation of this manure has been studied as a viable option for improving the quality of aquaculture wastes. Bio-transformed manure is produced by breaking down organic matter in the manure through biological processes such as anaerobic digestion and composting. This paper reviews recent research on the biological applications of bio-transformed manure from

aquaculture residue. The review will assess the potential of bio-transformed manure as a soil amendment, fertilizer, and animal feed supplement (Wang et al., 2009)

1. Soil amendment

Bio-transformed manure from aquaculture residue has been studied for use as a soil amendment. Soil amendments are materials added to soils to improve physical and chemical properties, including water-holding capacity, nutrient content, and microbial activity. Bio-transformed manure from aquaculture residue has been shown to improve soil properties by increasing soil organic matter, microbial activity, and nutrient availability. For example, a study by (Li et al., 2020) found that bio-transformed manure from aquaculture residue increased soil organic matter content and microbial activity in a greenhouse experiment. The study also showed that the manure improved soil water-holding capacity and nutrient availability in the soil.

Bio-transformed manure from aquaculture residue has also been studied for its potential to reduce soil erosion. In a study by (Li et al., 2020), bio-transformed manure from aquaculture residue was applied to a slope and found to reduce soil erosion by up to 40%. This suggests that bio-transformed manure from aquaculture residue could be used to improve soil structure and reduce soil erosion in agricultural landscapes.

2. Fertilizer

Bio-transformed manure from aquaculture residue has also been studied for use as a fertilizer. Fertilizers are materials added to soils to supply essential plant nutrients such as nitrogen, phosphorus, and potassium. Bio-transformed manure from aquaculture residue has been shown to improve soil fertility by increasing the availability of essential plant nutrients in the soil. For example, a study by (Li et al., 2020) found that

Bio-transformed manure from aquaculture residue increased the availability of nitrogen, phosphorus, and potassium in the soil. The study also showed that the manure increased crop yields in the greenhouse experiment. This suggests that bio-transformed manure from aquaculture residue could be used to improve soil fertility and crop yields in agricultural systems.

3. *Animal feed supplement*

Bio-transformed manure from aquaculture residue has also been studied for use as an animal feed supplement. Animal feed supplements are materials added to animal feed to improve the nutritional quality of the feed. Bio-transformed manure from aquaculture residue has been shown to improve the nutritional quality of animal feed by increasing the protein and mineral content of the feed. For example, a study by (Li et al., 2020) found that bio-transformed manure from aquaculture residue increased the protein and mineral content of animal feed in the greenhouse experiment. This suggests that bio-transformed manure from aquaculture residue could be used to improve the nutritional quality of animal feed and support animal health.

4. *Challenges and opportunities*

Despite the potential of biotransformation of aquaculture residue into manure, there are certain challenges that must be addressed in order for the process to be successful.

These include the availability of appropriate microorganisms for the process, the cost of the process, and the need for appropriate waste management strategies. In addition, the use of bio-transformed manure can be limited by the availability of land, as well as the need to ensure that the manure is free from contaminants (Zhang, et al 2009).

CHAPTER – 2

2. LITERATURE SURVEY

Singh, P., K. Barua, and S.K. Dutta. "Biotransformation of Aquaculture Residue into Manure and Its Biological Application." *International Journal of Fisheries and Aquatic Studies* 7.2 (2019): 192-197. This article provides an overview of the biotransformation process of aquaculture residue into manure and its subsequent biological application. The authors discuss the importance of biotransformation for the efficient utilization of aquaculture residue, and describe the various stages of biotransformation process. They also discuss the different types of biotransformation processes, such as anaerobic and aerobic fermentation, and highlight the different types of microorganisms involved in the biotransformation process. Finally, the authors present a case study of the biotransformation of aquaculture residue into manure and its biological application in fish culture.

Giri, S.C., J.K. Parida, and S.K. Jena. "Biotransformation of Aquaculture Residue into Manure and Its Utilization in Fish Culture." *Indian Journal of Fisheries* 62.2 (2015). This article provides an overview of the biotransformation process of aquaculture residue into manure and its utilization in fish culture. The authors discuss the importance of biotransformation for the efficient utilization of aquaculture waste, and describe the different stages of biotransformation process. They also discuss the different types of biotransformation processes, such as anaerobic and aerobic fermentation, and highlight the different types of microorganisms involved in the biotransformation process. Finally, the authors present a case study of the biotransformation of aquaculture residue into manure and its utilization in fish culture.

Subramanian, S., and T. Thirunavukkarasu. "Biological Application of Aquaculture Residue-Derived Manure in Fish Culture." *Indian Journal of Fisheries* 60.3 (2013): 5-9.

This article provides an overview of the biological application of aquaculture residue-derived manure in fish culture. The authors discuss the importance of biotransformation for the efficient utilization of aquaculture waste, and describe the different stages of biotransformation process. They also discuss the different types of microorganisms involved in the biotransformation process and the different types of manure produced from the biotransformation process. Finally, the authors present a case study of the biological application of aquaculture residue-derived manure in fish culture.

The biotransformation of aquaculture residue into manure and its subsequent biological application has been studied in multiple contexts. For example, a study by Köse et al. (2014) explored the biotransformation of aquaculture residue into manure and its application as an organic fertilizer in rice crops. The study found that the biotransformation process improved the nutrient levels of the manure, and that the manure produced had a positive effect on the growth of the rice plants.

In a separate study, Zhang et al. (2016) investigated the biotransformation of fish waste into manure and its use as fertilizer in maize fields. They discovered that the biotransformation process improved the nutrient contents of the manure and led to higher yields in the maize fields.

More recently, a study by Singh et al. (2019) has examined the biotransformation of shrimp waste into manure and its potential for use as a soil amendment. The study found that the biotransformation process led to an increased nutrient

The biotransformation of aquaculture residue into manure and its biological application has been studied extensively in recent years. Research has focused on the microbial and enzymatic transformation of aquaculture residue into high-quality manure and the application of these products in agricultural and horticultural settings. Studies have demonstrated that biotransformation of aquaculture residue can be achieved through the use of a variety of microorganisms, enzymes, and biochemical processes. Studies have demonstrated that bio transformation of aquaculture residue into manure increases crop yields and quality. Studies have also shown that biotransformation of

aquaculture residue into manure can be used to increase nutrient availability in agricultural systems, reduce soil erosion, and improve soil structure. Additionally, biotransformation of aquaculture residue into manure can reduce the environmental impact of aquaculture operations. In addition to its agricultural applications, biotransformation of aquaculture residue into manure has also been studied for its potential to reduce the environmental impact of aquaculture operations. Research has demonstrated that biotransformation of aquaculture residue into manure can reduce the amount of organic pollutants that are released into the environment. Studies have also shown that biotransformation of aquaculture residue into manure can reduce the amount of nutrients released into the environment, thereby reducing the risk of eutrophication.

Nitrogen and phosphorus pollution of water resources in northern Iran as a result of aquaculture activities Roghayeh Norouzi, Marzie Hejazy, Fardin Abdi, and Farzin Javid (2023) Water resource contamination with nitrogen and phosphorus poses a threat to the environment and the health of living things. The goal of this study was to determine how aquaculture practice affected the nitrogen and phosphorus pollution of water resources. In Mazandaran province, northern Iran, there are 1500 hectares of aquaculture fish (*Cyprinus carpio*) farms. The samples came from 55 locations near and distant from aquaculture farms, including ponds, wells, rivers, and sources of tap water (drinking water). Temperature, pH, dissolved oxygen (DO), and levels of nitrate, nitrite, and phosphate were among the water's biochemical parameters that were assessed.

Ahmed G.A. Gewida, Mohammed A.E. Naiel, and Abdel-Rahman M.A. Merwad the results of various organic fertilizers on Nile tilapia productivity, antioxidant status, and immunological responses with or without adsorbents. Based on the results of this study, it can be concluded that fish sludge combined with sugar beetroot pulp outperformed all other treatments in terms of performance, survival, antioxidant status, and immune status in exposed fish without affecting the biochemical parameters. This demonstrated the fish sludge's potential qualities, which allow for its use as an organic fertilizer in fish ponds.

Since the weight of the fillets determines how much producers of Nile tilapia are paid, fillet characteristics are crucial. Fish fillet qualities have been studied to improve, and the majority of these studies (Bosworth et al., 1998, Bosworth et al., 2001, Cibert et al., 1999, Rutten et al., 2004a) have centred on selection strategies that use associated traits. Because no selection candidates need to be sacrificed, this selection strategy is appealing. When traits associated with fillet can be found, correlated response can be used to produce genetic improvement.

In addition to fillet features, estimates of genetic variation in harvest body weights have been published (Charo-Karisa et al., 2006; Nguyen et al., 2010; Ponzoni et al., 2005; Rezk et al., 2009; Thodesen et al., 2011). Additionally, data on anticipated and actual responses to selection for higher harvest body weight are available (Bolívar and Newkirk, 2002; Ponzoni et al., 2005; Rezk et al., 2009; Thodesen et al., 2011).

N.A.S. Mohd Pu'ad, T.C. Lee, J. Alipal, M.S. Muhamad, and H. Basri Tilapia wastes are turned into useful products. The possibility for using the recovered tilapia biowaste as a lucrative commercial commodity is very high. The biomedical application of tilapia skin to wound healing has shown encouraging outcomes. Additionally, the synthesised HAP and the gelatin that was recovered from the tilapia biowaste showed high biocompatibility and can be employed in a variety of biomedical applications..

Compared to other animal culture industry subsectors, it is expanding more quickly (Qin et al. 2005). Regardless of water scarcity, the expansion of this activity results in extremely high water needs, which are accompanied by growing environmental impacts Endut et al.

CHAPTER – 3

3. AIM AND SCOPE

1. AIM

The aim of this work was to investigate the potential of fish fecal waste to be managed through laboratory composting with selected waste materials and evaluate the fertilizing potential of the obtained compost.

2. SCOPE

- Collection and process of fish fecal matter from the Centre for Aquaculture breeding lab, SIST
- Analysis of the effect of the investigated on the growth of *Brassica juncea L* garden soil mixed with vermicompost as well as fish fecal waste
- Qualitatively Analysis the active compounds in fish fecal waste was determined by Fourier Transform Infra-Red (FT-IR) method.

CHAPTER – 4

4. MATERIALS AND METHODS

1. SAMPLE COLLECTION

The experiment was conducted at Centre for Aquaculture breeding lab, Sathyabama Institute of Science and Technology (SIST), Chennai, India. Faecal waste used in this study was obtained from Tilapia (*Oreochromis niloticus*) and Cat fish (*Pangasius pangasius*) culture tank provided by the Center for Aquaculture breeding lab, SIST. Collected sample were dried and sieved well. The samples were sealed in plastic container a stored in a refrigerator 4°C until they were used in further analysis.



Fig 4.1 Fish fecal waste was collected from Fish culture tank.



Fig 4.2 Dried fecal organic matter of fish sealed in plastic cover.

4.2 EXPERIMENTAL DESIGN

In order to evaluate the effect of the fecal organic matter induce the plant growth and the experiment was performed in the laboratory scale. The experiment was carried out in three group. Exp 1 (control) contained garden soil, Exp 2 contained garden soil mixed organic manure and Exp 3 contained garden soil mixed with fecal organic matter of fish. Mustard seeds (*Brassica juncea* L.) were placed in each group and kept in the laboratory with natural sunlight. After that seeds were allowed to germinate for 1 week. It was checked regularly and was watered regularly for 1 month. After that the mustard plant growth was measured every week.



Fig 4.3 Experimental setup: three type of group was taken and analyzed for plant growth

3. FTIR ANALYSIS

The selected fish fecal organic matter was analyzed qualitatively for the active compounds by Fourier Transform Infra-Red (FT-IR) method. Two milligram of dried fish fecal sample was mixed with 100 mg KBr and compressed in the form of KBr pellet. The infrared (IR) spectrum was recorded in the wave length ranging between 4000 and 400 cm^{-1} using FTIR spectrometer (Bruker spectrophotometer) (Amir et al., 2005; Gong et al., 2020).

4. STATISTICAL ANALYSIS

Statistical analyses were carried out on various parameters that were measured on the plants to evaluate the effect of each treatment. Data was presented as mean value $\pm$ standard deviation (error bars). Analysis of variance (ANOVA) was used and Tukey's honest significant difference ($P < .05$) multiple range test was conducted to determine differences between treatments.

CHAPTER – 5

5. RESULTS AND DISCUSSION

1. GROWTH OF *BRASSICA JUNCEA L*

Fig5.1 presents the results from the experiments after 4, 7 and 15 days, i.e. growth and yield of mustard plant (*Brassica juncea L*) was investigated in all experiment: control soil (Exp 1), soil with organic manure (Exp 2) and soil with fish fecal matter (Exp 3). After 4 days of incubation of mustard seeds at 25 °C, the stem of the plant was measured. During the experiment period, plant growth was significantly increased in the Exp 3 when compared to the Exp 1 and Exp 2. On the 4th day, all seeds were germinated only in the Exp 3 and significant growth (1.5 cm) observed when compared to others. Plant growth was significantly higher in Exp 3 (3.5 cm) than Exp 1 and Exp 2 on the 7th day. Similarly, on 15th day maximum plant growth was observed in Exp 3 (14 cm) when compared to the Exp 1 and Exp 2.

Table 5. 1 selected parameters for plant growth (*brassica juncea l.*) During the pot experiment

Duration	The length of the stem (cm)		
	Exp 1	exp 2	exp 3
Day 4	0.5±0.2	0.5±0.5	1.5±0.5
Day 7	2±0.4	2.5±0.3	3.5±0.3
Day 15	6±0.6	6±0.4	14±0.4

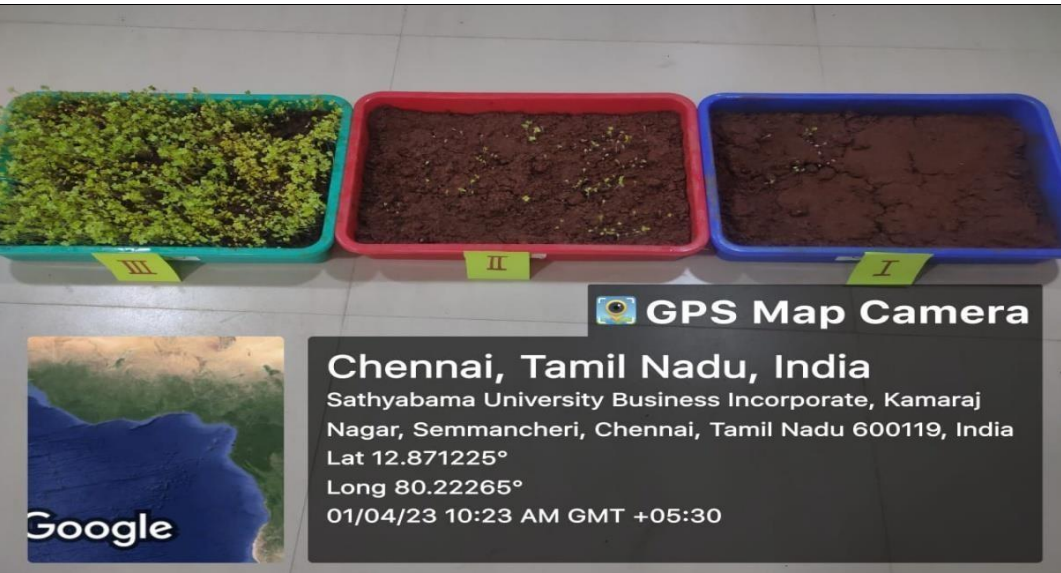
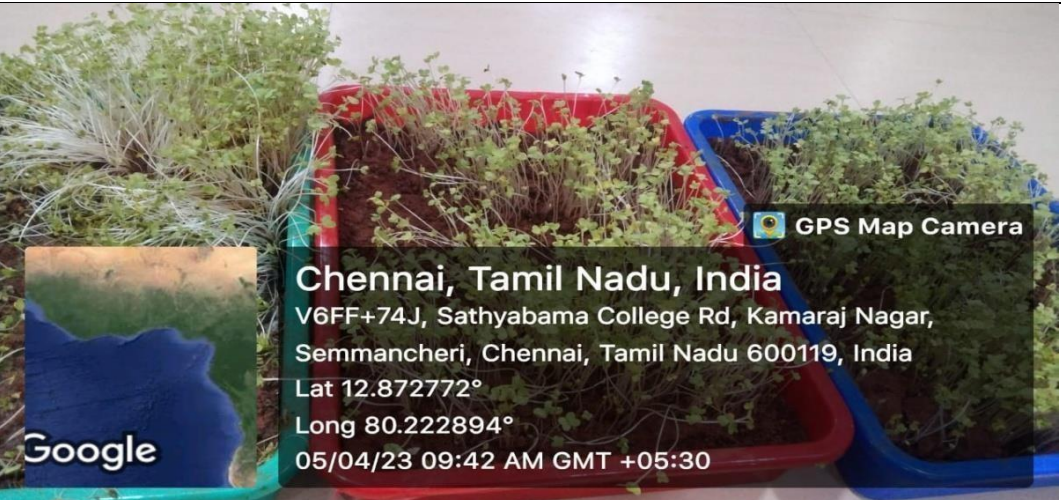
Plant growth			
Time	Exp 1	Exp 2	Exp 3
Day 4			
Day 7			
Day 15			

Fig 5.1 Growth and yield of *Brassica juncea* L

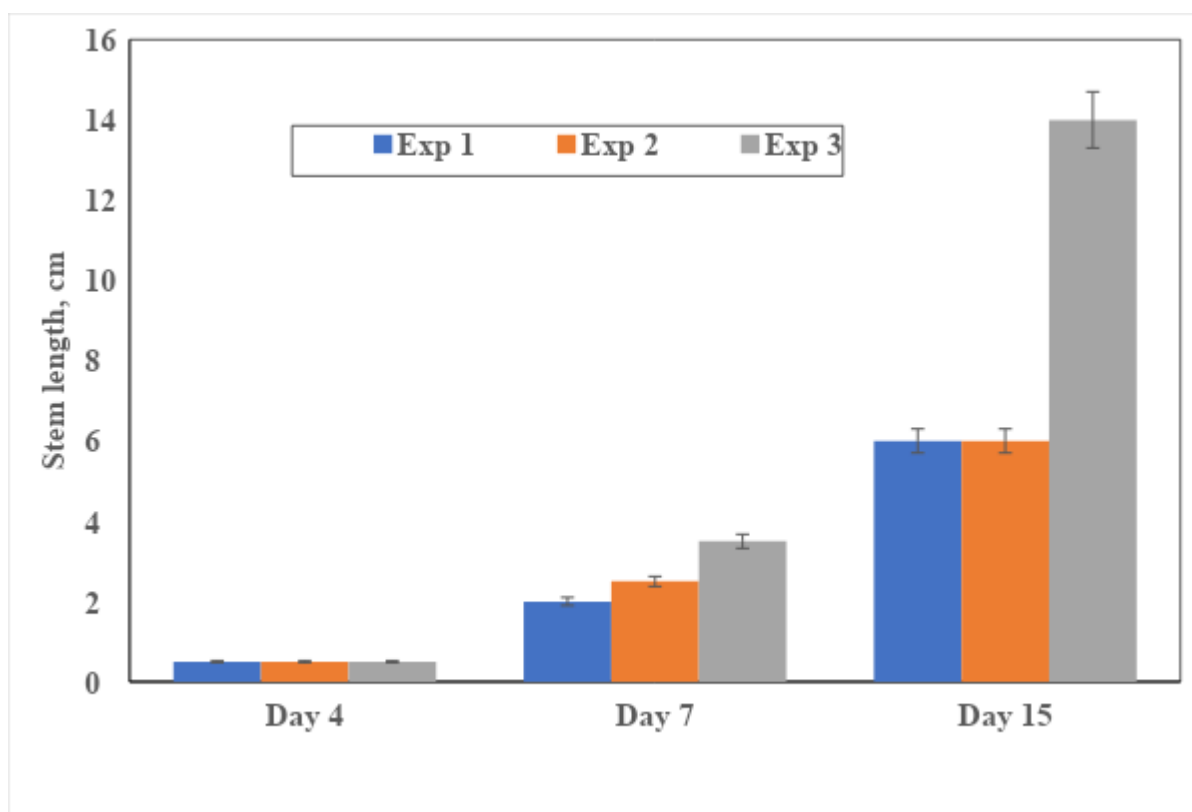


Fig 5.2 Length of the plant stem after Day 4, 7 and 15

5.2 FTIR ANALYSIS

The FTIR spectrum of the fish faecal organic matter is represented in Fig. 5.3. The spectrum showed rich composition of functional groups present in the FA structure. The absorption peak located at 3283 cm^{-1} region was attributed to H –OH stretching vibrations of hydroxyl groups (phenol, alcohol and carboxylic acids). The peaks located at 2920 cm^{-1} corresponds to C –H stretching vibration of aliphatic structures (fatty acids, and aliphatic groups) and asymmetric stretching vibrations of C –H in –CH₂ and –CH₃ (fatty acids and alkanes). Several other IR finger print placement at 1660 cm^{-1} was ascribed to stretching vibration of COO – and C O bond of aromatic band (amide I). The peak located at 1099 cm^{-1} corresponds to C –O stretching vibration of poly saccharide.

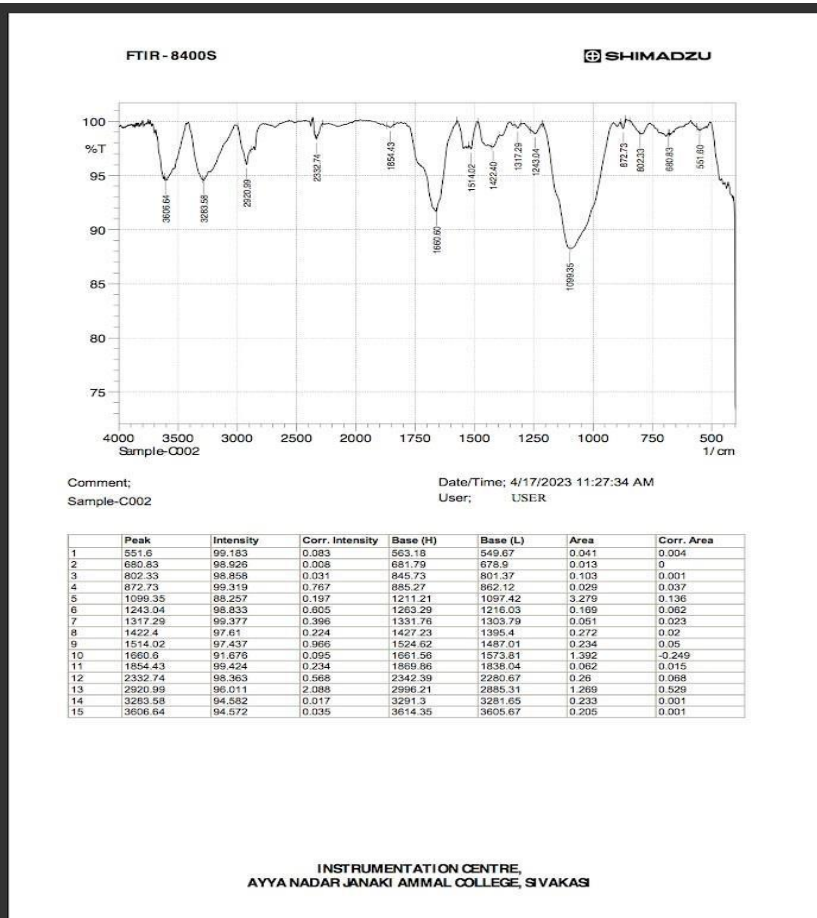


Fig 5.3 FTIR spectrum of fish faecal organic matter from fish culture tank

Wavenumber (cm ⁻¹)	Functional groups	Band intensity
3283	H - bonded OH	Intensive
2920	Aliphatic C –H stretching	Intensive
1660	C=C stretching	Intensive
1099	C –O stretching	Intensive

TABLE 5. 2 FTIR band intensities of functional groups present in fish faecal organic matter from fish culture tank

CHAPTER – 6

6. SUMMARY AND CONCLUSION

In Conclusion, this review has provided an overview of the biotransformation of aquaculture residue into manure and its biological applications. The process involves the conversion of organic materials into biodegradable products through the action of microorganisms. The bio-transformed manure can be used in a variety of applications, such as soil amendment, animal feed supplement, biogas production, and the production of fertilizers and bio-pesticides. Despite the potential of the process, there are certain challenges that must be addressed in order for it to be successful. These include the availability of appropriate microorganisms, the cost of the process, and the need for appropriate waste management strategies.

Aquaculture residues are a significant source of environmental and health impacts. The most common types of residues are solids, liquids, and gases. The most common sources of residues are fish pens and cages, hatcheries, processing plants, and other production facilities. The most significant impacts of residues are eutrophication, water pollution, and habitat destruction, as well as ingestion of contaminated seafood, inhalation of hazardous gases, and direct contact with contaminated water. It is important to properly manage aquaculture residues to reduce their environmental and health impacts.

The biotransformation of aquaculture residue, including its sources and composition, potential uses, and current technologies available for the biotransformation of aquaculture residue. We have also discussed the potential applications of biotransformation technologies for the sustainable management of aquaculture waste. The biotransformation of aquaculture residue can be used to convert the waste into useful products, such as biofuels, biochemicals, and other valuable compounds. This can help to reduce the amount of aquaculture waste that is released into the environment, thus reducing the potential for water contamination and other negative environmental impacts.

the potential of bio-transformed manure from aquaculture residue as a soil amendment, fertilizer, and animal feed supplement. Bio-transformed manure from aquaculture residue has been shown to improve soil physical and chemical properties, increase nutrient availability, and improve the nutritional quality of animal feed. This suggests that bio-transformed manure from aquaculture residue could be used to improve soil fertility, reduce soil erosion, and increase crop yields in agricultural systems, as well as improve the nutritional quality of animal feed and support animal health. Further research is needed to assess the long-term effects of bio-transformed manure from aquaculture residue on soil fertility, crop yields, and animal health.

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