International Journal of Advanced Science and Technology
Vol. 29, No. 7s, (2020), pp. 132-143

The Effectiveness of Pumakkal Organic Waste Bioremediator

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Abstract

Pumakkal is a starter formula for decomposing bacteria of organic substances resulting from the isolation of pineapple liquid waste. The ability of decompose of Pumakkal organic substances was tested on pineapple liquid waste, coffee plantation waste and shrimp ponds. The research used a Completely Randomized Design (CRD) with 3 treatments (Consortia A: 5 bacteria, Consortia B: 10 bacteria and Consortia C: 15 Bacteria) and 6 replications, measured nitrogen content (N) as a parameter of organic fertilizer. The data were analyzed with Anava with 2020 SPSS. The analysis results show that there are significant differences in the three treatments, the highest Nitrogen content in shrimp pond sediments and the most effective consortion is KB (10) microbes, Nitrogen content (N) fulfills the Ministry of Agriculture regulations. This study provides an understanding of plantation organic waste and fisheries can be synergized to meet the nutrition of plants.

Keywords: *Pumakkal, bioremediation, pineapple liquid waste, coffee, shrimp sediment*

1. Introduction

The economic structure of Lampung Province in the third quarter of 2019 was dominated by four main business fields, namely: agriculture, plantation, forestry and fisheries (29.80%) [1]. This business produces organic waste that is potential to be used as organic fertilizer. The three dominant businesses in Lampung are the Pineapple Industry, Coffee Plantation and Shrimp Pond, these three businesses generate substantial organic waste and have the potential to be used as organic fertilizer. PT Great Giant Pineapple (GGP Factory) is the third largest pineapple industry in the world in Lampung Indonesia. On average every day 2500 tons of pineapple is processed into canned pineapple and juice for export markets to more than 63 countries from 5 continents. This production process produces about 5,000 cubic meters of liquid waste every day besides solid waste [2].

One of the problems of the pineapple industry is that pineapple liquid waste has a high average BOD (Biological Oxygen Demand) organic substance that is 338 mg / l so it does not meet the Industrial Waste Standard Quality Standards. The volume of waste every day ranges from 5,000-7,000 m^3, before being discharged the waste is managed by being accommodated in WWTP ponds (lagoon) for a period of 2-3 months, then flowed into the river [3]. This management is less efficient because it takes a long time and expensive financial to handle. Pineapple liquid waste with high acidity and organic matter content exceeding the standard quality threshold can affect the aquatic ecosystem. The nitrogen content (N) in pineapple liquid waste ranges from 1.45 to 77.20 ppm with average 26, 17 ppm [4].

Coffee is one of the plants that produces sizable waste by-products, ranging from 50-60 percent of the yield in the form of coffee husks. Most of this coffee husks waste is still discarded and has not been optimized by farmers, even though this waste still has a usability. The content of coffee husks waste is quite high and very good for plants, including nitrogen, phosphorus and potassium [5]. Besides being beneficial in agriculture, coffee husks waste can improve soil

ISSN: 2005-4238 IJAST

fertility, stimulate the growth of roots, stems and leaves, it is also useful in animal husbandry and fisheries, as additional protein and fiber nutrients in animal feed. This coffee husk solid waste has high levels of organic matter and nutrients which can improve soil structure. One effort that can be done to handle the increasing amount of coffee husks waste is by processing coffee husks waste into compost as energy for plants [6].

Shrimp ponds according to [7] feeding intensive and semi-intensive aquaculture, are suppliers of organic waste and major nutrients to the coastal waters that cause eutrophication and ecological changes in plankton, increased sedimentation, changes in productivity, and benthic community structures. Super intensive shrimp pond sediment solid waste has high nutrient content such as N total 0.67%, P_2O_5 4.78%, K_2O 1%, C-organic 17.84%, pH 6.25 and moisture content 15.60% [8]. Utilization of waste into organic fertilizer using bioactivators to accelerate the decomposition process so it needs the decomposition of organic content in the waste. The speed of the decomposition process is largely determined by the particle size of the organic material and the C / N ratio of the organic material to be overhauled [9].

Pumakkal (Biang, starter in Lampung language) is a consortia of indigenic bacteria of Pineapple Liquid Waste (PLW), is a bacterium that has potential to decompose and can be used as a starter in waste recovery [10]. The treatments of PLW bacterial consortia that have 15 kinds of bacteria are grouped into 3 consorsia, namely Consortia A (CA), Consortia B (CB) and Consosrsia C (CC). CA has 5 types of potential bacteria, namely Bacillus careus and Bacillus subtilis. CB has 10 types of bacteria, namely *Bacillus careus, Acinobacter baumanni,* and *Bacillus subtilis.* CC has 15 types of potential bacteria, namely *Bacillus careus, Acinobacter baumani, Bacillus subtilis,* and *Pseudomonas pseudomallei*. This research applies Pumakkal to remediate organic waste from pineapple liquid waste, coffee husks waste and shrimp pond sediment. Is Pumakkal able to decompose the organic matter of the three wastes? What is the content of Nitrogen (N) after undergoing bioremediation? From the three treatments, how feasible for organic fertilizer?

2. Methodology

This research used an experimental method of variations of Pumakkal with pineapple liquid waste, husks and coffee leaf waste, whiteleg shrimp (vannamei shrimps) pond sediment waste. The study design used a completely randomized design (CRD) with 3 treatments, 1 control and 6 repetitions. Consumables of pumakkal bacteria used in each treatment are CA 5 bacteria, CB 10 bacteria, and CC 15 kinds of bacteria. The media was fermented for one month and then analyzed the content of Nitrogen (N) in the Chemistry Laboratory of the University of Muhammadiyah Malang, the data were analyzed quantitatively using the Anava test.

3. Results and Discussion

3.1. Pumakkal's Ability to Remediate Pineapple Liquid Waste

The variation of Pumakkal of CA, CB and CC consortium treatments on pineapple liquid waste results are as follows.

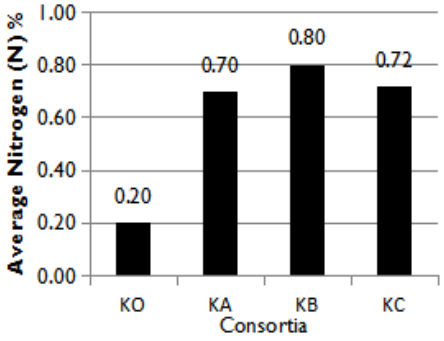

Figure 1. Content of Nitrogen (N) Pineapple Liquid Waste with Variation Treatment Pumakkal Consortia

Pineapple liquid waste has a BOD (Biological Oxygen Demand) value of 296-20,042 ppm with an average of 338 ppm, pond Nitrogen content of 1.45-77.20 ppm averaging 26.17 ppm [3]. This shows the content of organic substances and high Nitrogen content so that it is potential for plant nutrients. Anava test results of the three treatments were significantly different, Consortia B (10) bacteria had the highest Nitrogen content of 0.80%. According to [11] Decree of the Minister of Agriculture of the Republic of Indonesia Number: 261 / KPTS / SR.310 / M / 4/2019 concerning Minimum Technical Requirements for Organic Fertilizer, Biofertilizer and Soil Improvement requires that the content of N + P2O5 + K20 is 2-6 (w / v), N: (0.80) + P2O5 (0.65) + K20 (0.63) = 2.28. During bioremediation, the process of chemical transformation takes place from pollutants that have larger (complex) molecules into simpler forms. Organic compounds contained in wastewater are a source of nutrients for microbes. Microbes will break down these compounds into simpler and more stable forms so that the levels of pollutants contained in the wastewater are decreased [12].

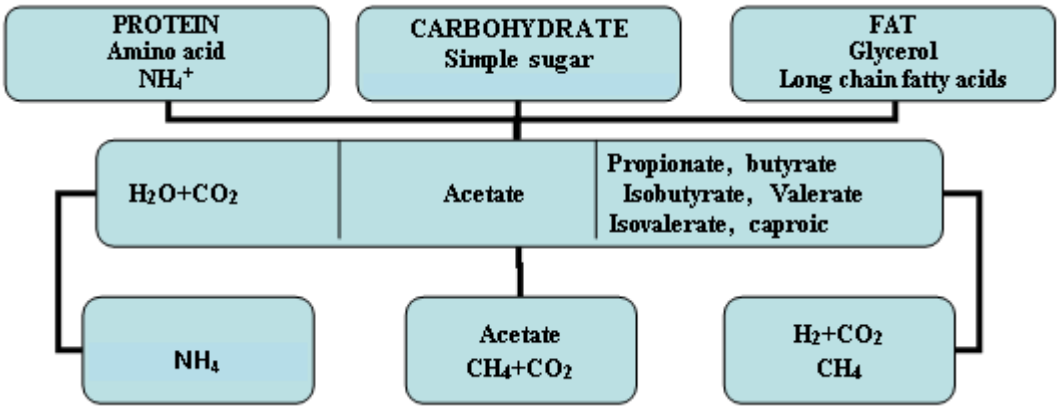

Figure 2. Decomposition of substances Available in Waste [12]

The increase in nitrogen levels is thought to be caused by an overhaul of organic substances by the bacterium Konsosia B (10) consisting: B*acillus careus, Acinobacter baumanni*, and *Bacillus subtilis. Acinetobacter baumanni* is dominant as a nitrifying bacterium that converts ammonia to nitrate at the end of the fermentation process. In addition, microorganisms also contribute a number of single cell proteins obtained during the fermentation process, after the decomposition process is completed, nitrogen will be released again as one of the components contained in compost. This is reinforced by [13] which states that various types of nutrients, especially N as a result of the description will be bound in the bodies of microorganisms and will come back after the micro-organisms die. The following is a reaction for the formation of nitrogen according to [14]:

Organic Protein Substances $\xrightarrow{\text{Aminization reaction}}$ Amino acid
Amino acid $\xrightarrow{\text{Aminization reaction}}$ Ammonia NH_3 and Ammonium NH_4 +.

Ammonia Nitrification Reaction by the bacteria Nitrosomonas and Nitrcoccus Nitrate.

Nitrogen is an element needed by plants in vegetative growth and protein formation, if the plant is deficient in nitrogen it will cause plants to become stunted, leaves turn yellow and fall, and root growth is limited. The nitrogen content contained in pineapple liquid waste with Pumakkal starter treatment has met the specified Quality Standards.

3.2. Pumakkal's Ability to Remediate Coffee Waste

The variation of the Pumakkal CA, CB and CC consortium treatments on coffee waste obtained the following results.

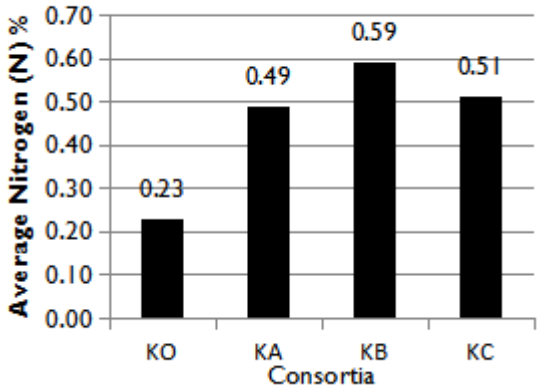

Figure 3. Nitrogen (N) content of coffee waste by the Consortia Variation Treatment on the Pumakkal

Anava test results of the three treatments were significantly different, Consortia B (10) the bacteria had the highest Nitrogen content of 0.60%. According to [11] Decree of the Minister of Agriculture of the Republic of Indonesia Number: 261 / KPTS / SR.310 / M / 4/2019 concerning Minimum Technical Requirements for Organic Fertilizer, Biofertilizer and Soil Improvement requires that the content of solid organic fertilizer is N + P_2O_5 + K_20 is a minimum of 2 (w / v), in coffee compost N: (0.60) + P_2O_5 (85) + K_20 (97) = 182. The results of the study of CA, CB and CC Nitrogen content (N) met these criteria, and the highest in CB treatment is 0.50%. Actually the coffee bean husks contain 1.0-2.3% per dry weight, [15] and the leaves contain 4.61% Nitrogen [16], making it potential to be compost rich in nitrogen, especially the Lampung Province Robusta coffee production in 2019 is estimated reaching 104,716 tons [17].

Organic farming and plantation activities cannot be used directly by plants because the ratio of C / N content in these materials does not match the C / N of the soil. The C / N ratio is the ratio between carbohydrates (C) and nitrogen (N). The soil C / N ratio ranges from 10-12. If organic matter has a C / N ratio close to or equal to the soil C / N ratio, then the material can be used by plants. But in general, fresh organic substances have a high C / N ratio (straw 50-70; plant leaves 50-60; wood> 400; etc.). The method of composting is to reduce the C / N ratio of organic substances to the same as the C / N of the soil (<20). The higher the C / N ratio of organic substances, the longer the composting process is. The time needed varies from one month to several years depending on the basic substances. The process of overhaul of organic substances occur biofisico-chemically, involving the biological activity of microbes and mesophuna. Naturally the decomposition process can be in an aerobic state (with O_2) or anaerobically (without O_2). The aerobic and anaerobic decomposition process are as follows:

Organic substances + $O_2 \xrightarrow[N, P, K]{\text{Microbes aerob}}$ H_2O+CO_2 + nutrient + humus + E (487-674 kcal/mol glucose)

Organic substances $\xrightarrow[N, P, K]{\text{anaerobic microbes}}$ CH_4 + CO_2+NH_3+H_2S+ nutrient + humus + E (26 kcal/mol glucose)

The process of refurbishment, both aerobic and anaerobically will produce nutrients and humus, the process can take place if available N, P, and K. Decomposition can take place quickly if the ratio between the levels of C (C-organic): N: P: K in the substances decomposes the equivalent of 30: 1: 0.1: 0.5. This is due to N, P, and K needed for metabolic activity of decomposer microbial cells [18]. Therefore, the use of fresh organic material (not undergoing the

decomposition process) Organic Fertilizer and Biofertilizer (C/N value> 25) directly mixed / immersed in the soil will undergo an aerobic decomposition process (provision of organic substances in dry land) or anaerobes (the provision of organic substances in paddy fields) for the first. This causes the availability of soil N, P, and K nutrients to decrease, because it is absorbed and used by microbial decomposers for decomposition of organic substances. As a result, there is competition between plants with decomposer microbes in the extraction of elements N, P, and K. In addition to competition in taking nutrients, aerobic decomposition process also produces energy / temperature so that soil temperature increases. Both of these can cause plants to be lack nutrients (stunted in growth) or even the plants die, therefore the use of organic materials which have high levels of C but low levels of N, P, and K, should be used before being processed before the organic substances becomes compost. In organic substances that has been decomposed (composted) there has been a process of nutrient mineralization and humus formation which is very beneficial for soil fertility and health. In the open environment, compost can occur by itself. The decay process occurs naturally but not in a short time, but gradually. Through natural processes, grass, foliage, and animal waste and other waste gradually rot because of the cooperation between microorganisms and the weather. The duration of the decay process is more or less about 5 weeks to 2 months. But if we want a shorter period of time, 2 weeks, the process can be accelerated by using bioactivators to remodel organic material, such as Trichoderma sp. The main component of agricultural solid waste is cellulose. Cellulose is a compound that is naturally difficult to decompose. This causes farmers to prefer burning straw on farmland rather than returning it back to the soil in the form of compost, because composting naturally takes a long time (4-5 months), especially in organic lignin in plantations such as leaf fronds and coconut empty fruit bunches palm containing high lignin. Lignin is a phenylpropane structural polymer in vascular plants that makes plant rigidity and binds to cell wall fibers, serves to reduce water permeation across the xylem tissue wall and makes wood resistant to microbial attack.

In the soil, lignin from dead plants is degraded by microbes into humus, water and carbon dioxide. Humus on the topsoil is important for soil structure, increasing aeration and moisture-holding capacity. Humus functions as a basic ion exchange and is able to store and release nutrients around plants [19]. Although the benefits of using organic substances is to increase the chemical, physical and biological fertility of the soil have been well understood by agricultural experts and practitioners, it is still difficult for farmers to re-use crop residues to fertilize their land. This is because naturally changing agricultural waste requires a long time, whereas when using compost that has become ready in addition to the high costs required is also needed because energy is needed compost in large quantities (bulky). The largest constituent component of plant structure after cellulose is hemicellulose (xylan) which is a complex carbohydrate polymer with xylan and glucomannan as the main components. Hemicellulose is a polymer of pentose and hexose sugar units in which the fibrilfibrils form an amorphous arrangement. The most studied hemicellulose structure is from the xylan group because it occupies 7-30% of the plant weight. The enzymatic degradation of hemicellulose requires an enzyme complex capable of hydrolyzing xylan and glucomannan skeletons. Hemicellulose is generally relatively easy to decompose and is a polysaccharide that is first decomposed by microbes in nature, so that the shrinkage of plant weights in a decomposition process occurs because of the decomposition of hemicellulose. The composting process is also useful for converting hazardous waste, such as feces, garbage, and other liquid waste into safe and useful materials. Pathogenic organisms will die due to high temperatures during the composting process. Based on this description, it can be concluded that compost is a source of organic material and plant nutrients. The possibility of compost containing 15-40% cellulose, minerals (ash) 3-5%, in addition there are hot and cold water-soluble substances (sugar, starch, amino acids, urea, and ammonium salts) as much as 2-30%, and 1-15% fat soluble in ether and alcohol, oil and wax. This organic component undergoes a decomposition process under mesophilic and thermophilic conditions. Composting by landfill methods, soil dug pits, the Indore system produces dark-humidified material after 3-4 months and is a source of organic substances for sustainable agriculture.

ISSN: 2005-4238 IJAST

Heterotropic groups of microorganisms such as bacteria, fungi, actinomycetes, and protozoa represent the types of plants and animals [20]. Organic Fertilizer and Biofertilizer During the composting process, qualitative and quantitative changes occur, at an early stage due to environmental changes, some flora species become active, develop more quickly, and then disappear to provide opportunities for other populations to replace. In the second and third week, physiology groups that have an active role in the composting process can be identified, namely 106-107 bacteria, ammonification bacteria (104), pectinolytics (103), and nitrogen-fixing bacteria (103). Starting on the seventh day the microbial groups increased and after day 14 there was a decrease in the number of groups. Then another population increase occurred during the fourth week, as microorganisms that have role in; is cellulopathic and lignolytic microorganisms, and fungi.

Aerobic composting: In this system, approximately two-thirds of the carbon (C) element evaporates (becomes CO_2) and the remaining; one-third part reacts with nitrogen in living cells. During the aerobic composting process, no bad odor arises. During the composting process an exothermic reaction occurred heat due to the release of energy. An increase in temperature in a pile of organic substances results in a favorable temperature for themophilic microorganisms. However, if the temperature exceeds 65-70^o C, the activity of microorganisms will decrease due to organism death due to high heat.

Consortia is a combination of pure culture commonly called mixed inoculums. It is a mixture of various species of decomposing microorganisms. Utilization of the consortia method of decomposing microorganisms is used so that the degradation process is more effective and efficient, for example the breakdown of compounds such as carbohydrates and proteins [21]. Collaboration among bacteria accelerates the process of degradation of complex compounds to become simpler. The process takes place because of an enzymatic (extracellular) process remodeling the compounds present in the coffee husks so that it provides nutrients needed by plants, especially Nitrogen (N). Nitrogen has a complex cycle in an environment, the presence or absence of nitrogen content depends on the symbiosis between microorganisms, animals and plants, but the most important role in the process of degradation that produces nitrogen in a fertilizer is the ability of bacteria that have the potential to fix the element nitrogen (N) which in the environment [22]. Bacteria have the ability to increase the efficiency of the use of N-available in the soil. These bacteria use free nitrogen for protein cell synthesis where in the protein will undergo a process of mineralization in the soil after the bacterium has died, thus the bacteria play a role in the nitrogen content in the soil needed by plants [23]. The existence of high nitrogen nutrient content is caused by the large amount of carbon in coffee husks waste so that microbes are used as an energy source to degrade organic matter that turns into CO_2 + H_2O + Nutrients + humus + CO_2 energy produced will evaporate into the air so that carbon decreases and activate the nitrogen element content [24]. Based on the statement that microorganisms can degrade organic substances so that it provides nutrients in the coffee skin compost needed by plants such as nitrogen (N). Compost is the result of the weathering process of organic materials due to interactions between the decomposing microorganisms that work in it. In other words, compost is one type of organic fertilizer because it comes from weathered organic material. Besides compost, there are still several other types of organic fertilizers, namely manure, humus, green manure, and microbial fertilizer [25]. The principle of composting is to reduce the value of the C / N ratio of organic substances to the same as the C / N ratio of soil. The C / N ratio is the result of a comparison between carbohydrates and nitrogen contained in the substance. The C / N ratio value for land is 10-20. Organic material which has the same C / N ratio as the soil allows the material to be absorbed by plants. In the composting process changes occur such as 1) carbohydrates, cellulose, hemicellulose, fat, and wax into CO_2 and water 2) egg white substance becomes ammonia, CO_2 and water 3) decomposition of organic compounds into compounds that can be absorbed by plants. With these changes carbohydrate levels disappear or decrease. As a result of these changes the weight of compost decreases as some of the lost charcoal compounds

evaporate into the air. The level of dissolved N compounds will increase. This increase depends on the C / N ratio of the original substances. The lower the C / N ratio, the closer it is to the soil C / N ratio [26].

The advantage of this coffee skin compost is its nitrogen content is quite high around 6%, so it can substitute nitrogen-containing fertilizers. The problem is that the C / N ratio is high enough that it takes a long time to decompose or the solution is to add nitrogen and decomposer sources to accelerate decomposition. According to [27], efforts to utilize coffee solid waste have been carried out decades ago, especially the use of coffee pulp into animal feed, vinegar, biogas, caffeine extracts, pectin, pectate enzymes, proteins, and compost. One effort to support sustainable agriculture through soil improvement is the maximum utilization of waste from the coffee production process. Coffee pulp waste has high levels of organic substances and nutrients which make it possible to improve the soil. The results showed that the coffee pulp C-organic content was 45.3%, nitrogen content 2.98%, phosphorus 0.18%, and potassium 2.26%. In addition, coffee pulp also contains elements of Ca, Mg, Mn, Fe, Cu, and Zn. Coffee pulp is rich in fiber, carbohydrates, protein, minerals and some pectin.

3.3 Pumakkal's Ability to Remedy Shrimp Pond Sediments

The variation of the Pumakkal CA, CB and CC consortium treatments on Shrimp Pond Sediments. obtained the following results.

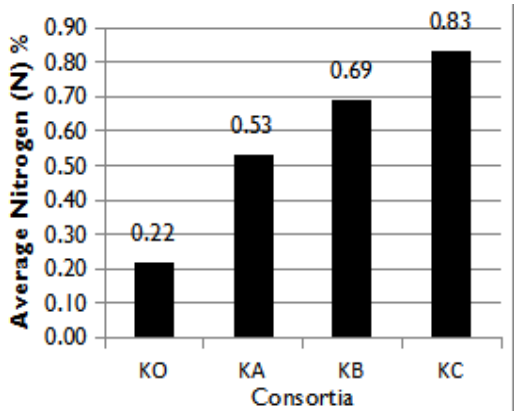

Figure 4. Nitrogen (N) Content of Shrimp Pond Sediments by Variation Treatment Pumakkal Consortia

Anava test results of the three treatments were significantly different, Consortia B (10) bacteria had the highest Nitrogen content of 0.83%. According to [11] Decree of the Minister of Agriculture of the Republic of Indonesia Number: 261 / KPTS / SR.310 / M / 4/2019 concerning Minimum Technical Requirements for Organic Fertilizer, Biofertilizer and Soil Improvement requires that the content of solid organic fertilizer is N + P_2O_5 + K_20 is a minimum of 2 (w / v), in coffee compost N: (0.83) + P_2O_5 (0.67) + K_20 (0.51) = 2.01. The results of the study of CA, CB and CC treatments Nitrogen (N) content meet these criteria, and the highest in the CC treatment is 0.83%. Figure 4. shows that nitrogen levels in the CA, CB and CC treatments have increased. This is thought to be due to the use of Pumakkal and sediments from shrimp ponds which are rich in protein. From these data it can be seen that the highest nitrogen content is in the CC treatment that is equal to 0.90%. The increase in nitrogen levels is thought to be caused by an overhaul of organic material by the bacterium Acinetobacter baumanni as a nitrifying bacterium that converts ammonia to nitrate at the end of the fermentation process. In addition, microorganisms also contribute a number of single cell proteins obtained during the fermentation process, after the decomposition process is completed, nitrogen will be released again as one of the components contained in compost. This is reinforced by [28] which states that various types of nutrients, especially N as a result of the description will be bound in the body of

microorganisms and will return later after the micro-organisms die. The following are the reactions of nitrogen formation according to [29]:

Oganic substances Protein $\xrightarrow{\text{Aminization reaction}}$ Amino acid
Amino acid $\xrightarrow{\text{Reaksi Amonifikasi}}$ Ammonia NH_3 and Ammonium NH_4^+
Ammonia $\xrightarrow{\text{Nitrification reaction by the bacteria Nitrosomonas and Nitrcoccus}}$ Nitrate

Nitrogen is an element needed by plants in vegetative growth and protein formation, if the plant is deficient in nitrogen it will cause plants to become stunted, leaves turn yellow and fall, and root growth is limited. Nitrogen content contained in shrimp pond sediment compost with Pumakkal starter treatment has met the standard

According to [30] based on the calculation results, the total amount of organic waste in the form of suspended solids (TSS) released by intensive shrimp ponds to coastal waters in one shrimp rearing season is 2,277 kg TSS / 3,500 m^2 / MT or if converted to an area of 1 ha pond is 6.506 kg TSS / ha / MT. Lampung Province has a large sediment potential, Lampung contributes 60% to the national shrimp with an area of 38,062.32 Ha and 31,801.78 Ha of untapped area. [31]-[32] stated that the productivity of whiteleg (Vaname) shrimp cultivation reaches 1,000 shrimp per stocking per square meter and the results can be up to 12 tons per 1,000 m^2, but the total pond sediment is up to 20 tons of dry weight. Sediment from wastewater produces 325 kg nitrogen, 253 kg phosphorus d kg organic carbon sediment. The remainder of shrimp feed and faeces left at the bottom of the pond is a key factor that triggers a decrease in water quality and needs to be discarded immediately to keep the water at the threshold of the feasibility of the carrying capacity of shrimp to grow optimally. Super intensive ponds are very high stocking ponds. High stocking density so that it relies on feed input in the form of pellets at 60 - 70%. According to [33], high stocking densities in super intensive aquaculture systems have consequences on the burden of waste that can affect the viability of shrimp habitat and the environment of fisheries around the cultivation area. The amount of sediment waste generated in shrimp ponds with a density of 1,250 m^{-2} shrimps was 21.9 tons and in ponds with shrimp densities of 1,000 m^{-2} and 750 m^{-2} shrimps each were 20.3 tons and 18.2 tons with a pond area of 1000 m^{-2}. The types of waste generated in aquaculture activities are metabolic waste or shrimp material residues in the form of fases and urine originating from the decomposition process of organic material and leftover feed which is not consumed as well as dead plankton populations. According to [34] feeding on intensive and semi-intensive aquaculture, it is a major supplier of organic matter waste and nutrients to the coastal waters environment which causes eutrophication and ecological changes in plankton, increased sedimentation, changes in productivity, and benthic community structure. Super intensive shrimp pond sediment solid waste has high nutrient content such as N total 0.67%, P_2O_5 4.78%, K_2O 1%, C-organic 17.84%, pH 6.25 and moisture content 15.60%. Utilization of waste into organic fertilizer using a bioactivator Pumakkal consorsia B (10) bacteria to accelerate the decomposition process so it is necessary to decompose the organic content in the waste. The speed of the decomposition process is largely determined by the particle size of the organic substances and the C / N ratio of the organic material to be overhauled [35]. The increase in N content is caused by the occurrence of the N cycle during the fermentation process. According to [36] microorganisms can convert ammonia to nitrate which can increase the percentage of N-total. The weathering that occurs on the fermentation media is pond waste, so that organic substances can be said to be able to increase the availability of P through weathering to form humic P which is easily absorbed by plants, can cover sesuiuioxide and can support the binding of P by soil, and increase ion exchange P with humic ions. The C / N ratio indicates the perfect decomposition of fermentation media. The reduced C / N ratio in pond waste after fermentation shows that the pond waste has been decomposed [37].

3.4 Potency of Nitrogen (N) With Pumakkal Treatment Utilizes Pineapple Liquid Waste, Coffee Waste and Shrimp Pond Sediments

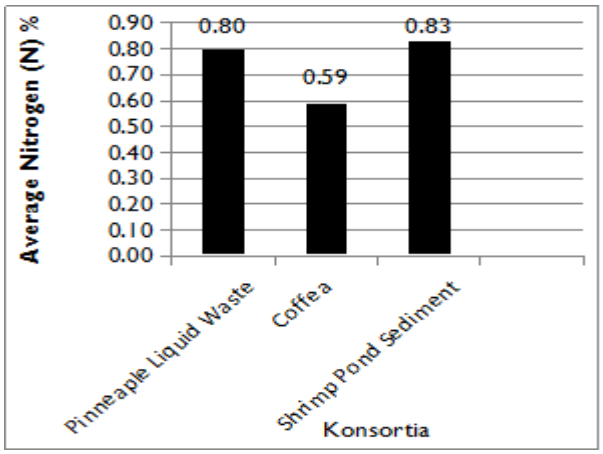

Figure 5. Nitrogen Content (N) Pumakkal Application in remediating Liquid Waste; Pineapple, Coffee Waste and Shrimp Pond Sediment

The picture above shows the content of Nitrogen (N) results of Pumakkal remediation of pineapple liquid waste 0.80%, coffee waste 0.59% and shrimp pond sediment 0.83%. The three media producing Nitrogen (N) meet the Ministry of Agriculture standards, so they can be used as organic fertilizer that is suitable for plants. The use of the Pumakkal is able to decompose organic matter into simple compounds that plants can utilize. Utilization of this waste as well as overcoming the problem of waste itself which has not been optimally utilized. Food industry waste treatment methods constitute a series of activities that include reduction, collection, storage, transportation, reuse, recycling, treatment, and / or disposal. After minimization efforts have been made through process modification and utilization (with the principle of clean production), the next step that must be taken is to treat / treat the waste to avoid environmental pollution. The main criteria for waste treatment in general are the fulfillment of applicable quality standards with a minimum cost. The following describes the techniques for processing small-scale food industry waste, including the treatment of liquid waste, solid waste and waste gas. Food industry liquid waste is one source of environmental pollution. The amount and characteristics of industrial wastewater varies according to the type of industry. Most of the liquid waste of the food industry can be handled easily with biological systems, because the main pollutants are in the form of organic substances, such as carbohydrates, fats, proteins, and vitamins. The pollutant is generally in a suspended or dissolved form. In general, wastewater treatment can be divided into triangles, namely primary treatment, secondary treatment, and tertiary processing. Primary processing is physical processing to set aside floating objects or seltleable solids. This primer processing is in the form of coarse screening, and primary deposition to separate inert materials such as grains of sand / soil. Coarse filters are used to filter large-sized relatively large objects.

The management of fresh organic waste and pineapple canning waste as an ingredient of Ultisol soils can be a solution to this problem. The use of various combinations of fresh organic waste substances and canning pineapple on the thickness of the soil is expected to increase soil fertility. The results of the study [39] showed the use of various combinations of fresh pineapple waste and canning proved to be able to increase the carbon content (C) in the soil from less than 1 percent to 2 percent. Through the provision of fresh organic substances can increase soil carbon content from 20 percent to 28.40 percent at a thickness of 0-15 cm in Ultisol pineapple plantations. While soil carbon content in the lysimeter system is open and closed more than 1.70 percent. Other findings show that the use of a combination of fresh organic waste in the form of 200 tons / ha tanans litter, 40 tons/ha tapioca waste, 40 tons / ha of weevil, 2 tons / ha pineapple mill juice, and 2 tons/ha liquid cow manure mixed with thickness of 0-30 cm with decomposition for 3 months is the best treatment in improving soil fertility. Agricultural waste as a source of organic substances and soil nutrients, agricultural waste including plantations and livestock such

as jeramai, crop residues or shrubs, pet dung and the like are sources of organic material and plant nutrients. The waste can be directly placed on agricultural land or immersed. For more effective results, processing should be done first. Weathering these wastes naturally takes more than 3-4 months, so that conservation efforts with the use of organic substances on agricultural lands are hampered. It will be more complicated if faced with an urgent planting period, so that it is often considered less economical and inefficient. One method of accelerating weathering of agricultural waste to immediately function in improving soil properties and nutrient availability is by making compost. While composting is the process by which organic substances decomposes biologically, especially by microbes that utilize organic substances as an energy source. Making compost is managing and controlling the natural process so that compost can be formed more quickly. This process involves making a balanced mixture of ingredients, providing adequate water, regulating aeration, and adding composting activators. Garbage consists of two parts, namely the organic and inorganic parts. The average percentage of organic waste substances reaches ± 80%, so composting is an appropriate alternative treatment. Agricultural wastes that can be composted are straw and rice husks, weeds, corn stalks and cobs, all vegetative parts of plants, banana stems and coconut coir. Compost is like a multi-vitamin for agricultural land. Compost will increase soil fertility and stimulate healthy roots Compost improves soil structure by increasing soil organic substances content and will increase the ability of soil to maintain soil water content. The activity of soil microbes that are beneficial to plants will increase with the addition of compost. This microbial activity helps plants to absorb nutrients from the soil and produce compounds that can stimulate plant growth. Plants that are fertilized with compost also tend to be better quality than plants that are fertilized with chemical fertilizers, for example: yields are more resistant to storage, heavier, fresher, and more 40]. Pumakkal is a bioactovator resulting from the isolation of pineapple liquid waste, so that the indigenic / local bacteria are more adaptable and have been tested to remediate various agricultural, plantation and fishery wastes. The bacteria contained have the ability of organic and specific waste substances capable of breaking down acidic compounds, thereby raising the pH.

4. Conclusion

The treatment of three Pumakkal consortia is able to decompose organic substances, Pineapple Liquid Waste, Coffee Waste and Shrimp Pond Sediment, Consortia B (10 bacteria) most effectively produce Nitrogen (N). Nitrogen (N) content after bioremediation with Pumakkal consortia Pineapple Liquid Waste 0.59%, Coffee Waste 0.83% and shrimp pond sediment 0.83%. All three treatments have Nitrogen (N) content suitable for organic fertilizer.

Acknowledgments

Thank you to the Ministry of Research and Technology of Higher Education who have funded this research through the Campus Intellectual Product Development Program Scholarship Grant Program and Muhammadiyah University of Metro for conducting research activities.

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