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Manufacture of Local Microorganism (MOL) from Vegetable Waste with Nutrition Source Supply Variation

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***Abstract*—Local Microorganisms (MOL) is a bioactivator consisting of a collection of various kinds of microorganisms that function as agents for the decomposition of organic matter. Vegetable waste is a collection of various kinds of vegetables after being sorted because they are not suitable for sale. Almost all vegetable waste will undergo lactic acid fermentation carried out by lactic acid bacteria (LAB). Lactic acid bacteria (LAB) are gram-positive bacteria, do not form spores, are catalase negative, are resistant to acidic conditions, and are facultative anaerobes. The purpose of this study was to determine the correct composition of rice washing water and granulated sugar for the highest number of microbes in MOL. MOL optimization was carried out by means of anaerobic fermentation for 14 days. The results of this study indicate that the microbes contained in MOL are Bacillus subtillus, Bacillus cereus, Lactobacillus acidophilus, Spirillum, Streptoverticillium, and Leuconostoc mesenterousdes. The highest total population of microorganisms in variations in the composition of rice washing water and sugar is in sample C1 which is 91 x 105 Colonies/100 mL in MOL vegetable waste, which is 650 mL of rice washing water and 100 grams of sugar.**

***Index Terms*—About: MOL, local microorganism, rice washing water, vegetable waste.**

I. Introduction

The existence of waste as a material that is wasted or disposed of from sources resulting from human and natural activities that do not yet have economic value has become a crucial environmental problem (Sunarsih, 2018).

Organic waste is a type of waste composed mostly of organic compounds such as plant residues, animals or feces.By nature, organic waste can be classified as degradable waste, which is a type of waste with natural properties that are easy to degrade by living things, especially microbes (Waluyo, 2018). In the process of degradation or decomposition of organic matter, microbes act as inoculums or starters (activators) that accelerate the decomposition process (Manullang 2017).

Various kinds of decomposing microorganisms in nature which are often referred to as local microorganisms (MOL) can be used as bioactivators. This type of microbe can be cultured using various sources of organic matter. Vegetable waste can be a source of organic matter and a good medium for the proliferation of decomposing microorganisms, and can be used as a bioactivator (Suwatanti, 2017). In addition to being a source of organic matter which after rotting can be a source of bacteria for moles, in its manufacture, moles also require carbohydrates in rice washing water and glucose in granulated sugar which act as sources of energy or nutrition for microorganisms in mole solution (Lindung, 2015).

In a previous study conducted by Suwatanti (2017), it was not known the type and number of microbes contained in the mole solution of vegetable waste that were capable of being a bioactivator. In this study, before being used as moles, the fermented solution was only physically tested to determine whether moles were successfully formed or not.

Because of the theoretical foundations above and the results from previous research, we want to conduct research on the manufacture of moles from vegetable waste with variations in the provision of nutritional sources to determine the types of microbes contained in moles and the composition of the right nutritional sources for the results of moles with the highest number of microbes. The purpose of this study was to determine the types of microbes contained in the MOL of vegetable waste and to determine the composition of rice and sugar washing

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waterappropriate sand to yield the highest number of microbes in the MOL of vegetable waste.

II. Research Methodology

The research was carried out at the Chemical Engineering Laboratory of ITN Malang. The research phase is literature study, research preparation, research implementation, data collection, data analysis, evaluation and finally report generation.

A. Research variable

1. Controlled Variable
   - Salt Weight :45 grams
   - Vegetable Waste Weight : 500grams
   - TimeMol Fermentation :14 days
2. Independent Variable
   - Water VolumeRice Wash:600, 625, 650 ml
   - Sugar Weight :100, 125, 150, 175, 200 gram

B. Tools and Materials

The tools needed in this research include used bottles, fermentors, measuring cups and plastic hoses. Meanwhile, the materials needed include Aquadest, rice washing water, salt, sugar, and vegetable waste (cabbage, mustard greens and tomatoes).

C. Research procedure

The stages of the research procedure "Manufacture of Local Microorganisms (MOL) from Vegetable Waste with Nutrition Source Supply Variation " are as follows:

1. prepare vegetable waste (a mixture of cabbage, mustard greens, tomatoes) as much as 500 grams and then chop it into small pieces
2. put vegetable waste into a fermentor with a modified 1.5 liter size with a plastic intermittent cover
3. connecting a plastic hose to a 600 ml plastic bottle filled with lime water which serves to observe the presence or absence of CO2 gas
4. adding granulated sugar to vegetable waste in the fermentor as much as 100, 125, 150, 175, 200 grams respectively for fermentors 1, 2, 3, 4, 5
5. added leri water (rice washing water) from the first wash to the vegetable waste in the fermentor as much as 600 ml each for fermentors A1-A5, 625 ml for fermentors B1-B5 and 650 ml for fermentors C1-C5
6. add 45 grams of salt for each fermentor
7. anaerobically ferment vegetable wastefermentor is tightly closed) for 14 days
8. observing the presence or absence of changes in water color, physical pieces of rotting vegetable waste, and the presence or absence of CO2 gas as indicated by the presence or absence of lime deposits formed in plastic bottles filled with lime water. on
9. open the bottle cap fermentor after 14 days of fermentation and then perform an analysis of the type of microbe and the total microbe on the sample of the mole solution formed.

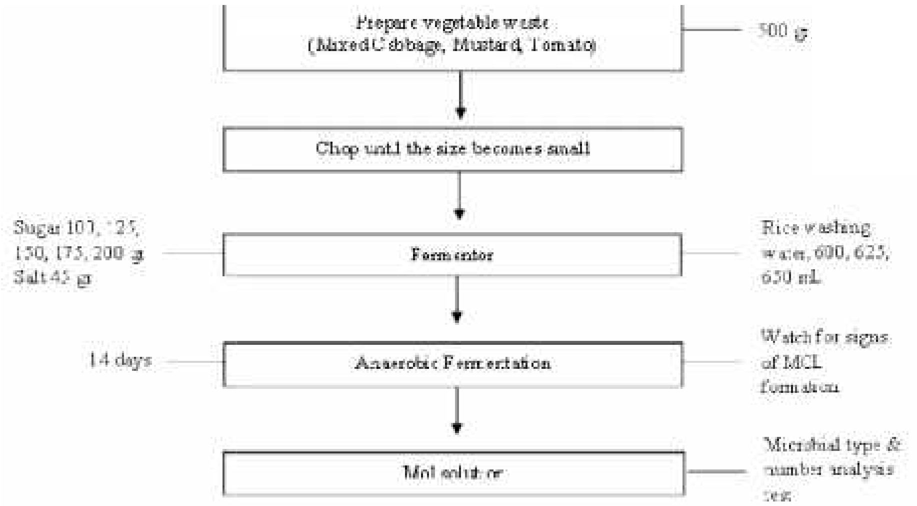

Figure 1: Research Flowchart

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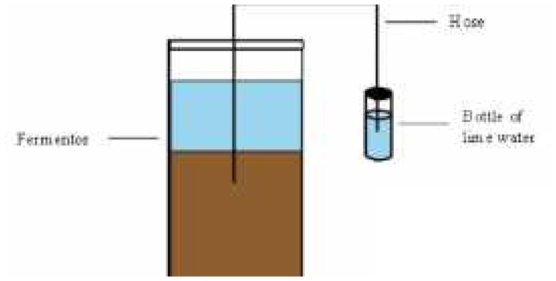

Figure 2: Fermentor Circuit

III. RESULT AND DISCUSSIONS

A. Microbial Type Analysis Results

The results of the analysis of the type of microbes carried out at the Chemical Engineering Microbiology Laboratory, ITN Malang.

Table 1
Microbial Type Analysis Results

Sample	Rice Wash Water (mL)	Sugar (grams)	Types of Microbes
A1		100	*Bacillus Subtillus, Lactobacillus Acidophilus*
A2		125	*Bacillus Cereus*
A3	600	150	*Spirillum*
A4		175	*Bacillus Subtillus, Streptoverticillium*
A5		200	*Bacillus Subtillus, Bacillus Cereus*
B1		100	*Bacillus Subtillus, Streptoverticillium, Spirillum*
B2		125	*Bacillus Subtillus*
B3	625	150	*Bacillus Subtillus*
B4		175	*Bacillus Subtillus, Spirillum*
B5		200	*Spirillum, Bacillus Subtillus*
C1		100	*Spirillum*
C2		125	*Bacillus Subtillus, LeuconostocMesenterousdes*
C3	650	150	*LeuconostocMesenterousdes, Lactobacillus Acidophilus*
C4		175	*Bacillus Subtillus, Streptoverticillium, Bacillus Cereus*
C5		200	*Bacillus Subtillus*

B. Results of Analysis of the Number of Microbes

The results of the analysis of the number of microbes carried out at the Chemical Engineering Microbiology Laboratory, ITN Malang.

Table 2
Results of Analysis of the Number of Microbes

Sample	Rice Wash Water (mL)	Sugar (grams)	Number of Microbes (Colonies / 100 mL)
A1		100	61 x 104
A2		125	36 x 105
A3	600	150	6 x 105
A4		175	93 x 104
A5		200	29 x 104
B1		100	27 x 104
B2		125	173 x 104
B3	625	150	61 x 104
B4		175	12 x 104
B5		200	12 x 104
C1		100	91 x 105
C2		125	15 x 104
C3	650	150	36 x 104
C4		175	15 x 103
C5		200	3 x 104

C. Discussion of the Results of the Analysis of Microbial Types

From the results of the analysis of the types of microbes in the sample solution, it is known that the microbes contained in local microorganisms from vegetable waste are types of *Bacillus Subtillus, Bacillus Cereus, Lactobacillus Acidophilus, Spirillum, Streptoverticillium,* and *Leuconostoc Mesenterousdes.*

Figure 3: *Bacillus Subtillus*

*Bacillus Subtillus*is a type of microbe that can be used as a decomposer because it is proteolytic so it is able to hydrolyze protein into amino acids. In its utilization, *B. subtillus* is used to increase the nitrogen and phosphorus content (Alamsjah, 2011).

In addition, according to Ruhnayat, et al. (2007), *B. Subtillus* is also widely found in bio fertilizers because it is a type of phosphate solubilizing microbe. These microbes can grow on insoluble phosphate (insoluble phosphate) and can also convert natural phosphate into a soluble form.

Figure 4: *Bacillus Cereus*

Bacillus Cereus is one type of microbe Bacillus Sp which has the ability to degrade organic matter (Khoiriyah, 2017). According to Sari, et al. (2017), besides being able to degrade organic matter, B. cereus also has the potential to degrade organic acids and decrease COD and BOD levels. With its ability to hydrolyze starch, this microbe is able to increase the average quality of nitrogen.

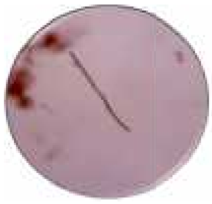

Figure 5: *Lactobacillus Acidophilus*

Lactobacillus Acidophilus is a type of microbe that in fermenting carbohydrates and sugars can produce lactic acid. In addition, *L. Acidophilus* is also able to inhibit the growth rate of pathogenic bacteria because it is a type of probiotic microbe (Adriani, 2008).

Figure 6: Spirillum

*Spirillum*is one type of denitrifying microbe that is able to reduce nitrate and nitrite to nitrogen. As a denitrifying microbe, *Spirillum* is also a facultative microbe that can live in both aerobic and anaerobic conditions (Supono, 2015).According to Kunarso (1988), Spirillum belongs to the class of reducing microbes or decomposers that are able to decompose nutrient and mineral materials into nutrient sources of energy.

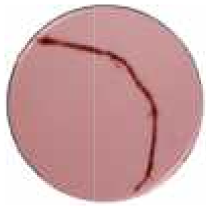

Figure 7: *Streptoverticillium*

*Streptoverticillium*is one type of microbial *Actinomycetes* that plays a role in forming humus and expanding the growth area with its long chain spores. These microbes can be found in soils with high organic matter content as well as in plant rhizoferous parts (Sektiono, 2016). According to Nugroho, et al. (2019), *Streptoverticillium* is also called Streptomyces and belongs to the microbial transglutaminase group, which is a type of microorganism capable of producing transglutaminase. In addition, *Streptomyces* is also a type of root fertilizing microbe that produces nutrients and growth hormones and as a biocontrol agent in biological organic fertilizers that can improve soil respiration (Antonius, 2011).

Figure 8: *Leuconostoc Mesenterousdes*

*LeuconostocMesenterousdes*is one type of lactic microbe that has the ability to remodel complex compounds into simpler compounds that produce lactic acid (Aliya, 2015). In addition, according to Kusmiati, et al. (2002), *L. Mesenterousdes* can change the quality of fermented products.

D. Discussion of the results of the analysis of the number of microbes

The results of the analysis of the number of microbes from the mole solution of vegetable waste showed the highest results for the number of microbes in sample C1 which was 91 x 105 Colonies/100 mL and the smallest results for the number of microbes in sample C4 was 15 x 103 Colonies/100 mL.

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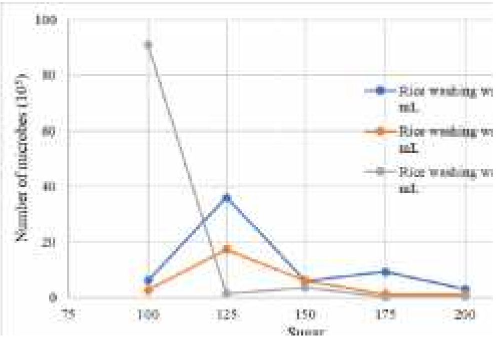

Figure 9: Graph of Relationship Between Amount of Sugar and Number of Microbes in Various Amounts of Rice Washing Water

To increase the amount of rice washing water, it was shown that there was an increase in the number of microbes in treatment 1 while in treatments 2, 3, 4, and 5 there was a decrease in the number of microbes.

This increase is because the carbohydrate content in rice washing water is a source of nutrients needed by microbes to grow (Budiyani, 2016). Carbohydrates are a type of staple food for anaerobic microbes as a source of energy (Indriani, 2013). According to Marsiningsih, et al. (2015), the amount of nutrients available in the mole solution is a factor that affects the availability of the number of microbes in the mole. So with the increasing number of nutrients, the number of microbes present in the mole solution also increases.

While the decrease in the number of microbes occurs because in the early stages of fermentation, certain types of microbes break down carbohydrates or starch to produce glucose, so that glucose increases but carbohydrate or starch levels decrease. The decrease in starch content as an energy source for certain types of microbes results in a decrease in the number of surviving microbes.

To increase the amount of granulated sugar, it was shown that there was an increase and decrease in the number of microbes in treatment A, B, and a decrease in the number of microbes in treatment C.

This increase is because sugar as a food source provides energy which causes optimal microbial growth. The increase was also because the microbes were in the growth log phase which caused the microbial cell defense to multiply.

While the decrease in the number of microbes because there are microbes that die in the competition for nutritional sources. Competition as an interaction that occurs affects the ability of microbes to grow and live.

In addition, the decrease in the number of microbes also occurs because some microbes are in a static phase then the death phase (Irpan, 2018).

According to Budiyani, et al. (2016), in addition to sources of nutrition or energy for microbial growth, there are several other factors regarding operating conditions that affect microbial growth in the fermentation process, namely temperature, pH and oxygen. The decrease in the number of microbes that occurred was suspected because the anaerobic fermentation process was not maintained so that there was a leak in the fermentor cover which resulted in oxygen entering and making the microbes die.

In the fermentation process, carbohydrates will break down into simpler sugars, namely dextrose, mannose and sucrose which are used by lactic acid bacteria as an energy source and produce acidic compounds such as lactic acid and other volatile compounds that cause an acidic atmosphere. low product pH (Azizah, 2014). This causes bacteria to work more extra in the process of breaking down carbohydrates into simpler sugars so that bacteria have an excess of energy sources or carbohydrates, where excess carbohydrates can cause death in fermentor microorganisms, this is due to the results of too much alcohol so that it can damage microorganisms (Hidayah, 2019).).

IV. Conclusion

From the research results of Making Local Microorganisms (MOL) from Vegetable Waste with Variations in Provision of Nutrient Sources, the following conclusions are obtained:

The types of microbes found in local microorganisms in vegetable waste are the types of *Bacillus subtillus, Bacillus cereus, Lactobacillus acidophilus, Spirillum, Streptoverticillium,* and *Leuconostocmesenterousdes.*

The correct composition of rice washing water and sugar for the highest number of microbes in sample C1 is 91 x 105 Colonies/100 mL in MOL of vegetable waste, which is 650 mL of rice washing water and 100 grams of sugar.

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REFERENCES

1. Adriani L, Indrayati N, U. H T, Mayasari N. Activity of Lactobacillus acidophillus and Bifidobacterium on Yogurt Quality and Its Inhibition on Helicobacter pylori, Journal ofBionatura, 2008, Vol. 10(2).
2. Alamsjah MA, Christiana RF, Subekti S. Effect of Fermentation of Seaweed Waste Gracilaria sp. With Bacillus subtilis Against Chlorophyceae Plankton Population, Journal of Fisheries and Marine Sciences, 2011, Vol. 3(2)
3. Aliya H, Maslakah N, Numrapi T, Buana AP, Hasri YN. Utilization of Lactic Acid from Fermentation of Cabbage Waste as a Wine and Strawberry Preservative. Bioeducation Journal of Biology Education, 2016, Vol. 8(2).
4. Antonius S, Agustiyani D. Effect of Biological Organic Fertilizer Containing Beneficial Microbes on Growth and Yield of Watermelon Plants and Soil Biochemical Properties in Field Experiments in Malinau-East Kalimantan. Berk Biological Research, 2011,Vol. 16(2).
5. Budiyani N, Soniari N, Sutari N. Analysis of the Quality of Solutions of Local Microorganisms (MOL) Banana Weevil. E-Journal of Trop Agroecotechnology, 2016, Vol. 5(1).
6. Hersoelistyorini, Wikanastri; Dewi SS. Identification of Probiotic Bacterial Proteins from Cabbage and Mustard Waste Based on Electrophoresis SDS-PAGE. Published Online, 2012.
7. Hidayah TM. Differences in the Chemical Quality of Cow's Milk Kefir, Soy Milk, And Red Bean Milk. Sainstech Innovation Journal, 2019,Vol. 2.
8. Indriani F, Utrisno E, Sumiyat S. Study of the Effect of Adding Fish Waste to the Process of Making Liquid Fertilizer from Cow Urine on Macro Nutrients (CNPK). Journal of Environmental Engineering, 2013, Vol. 2(2).
9. Irpan I, Caronge MW, Fadilah R. Water Mole Test of Siwalan (Borassusflabellifer) with the addition of various types of fruit based on the duration of fermentation. Journal of Agricultural Technology Education, 2018.
10. Khoiriyah, Ma’rifatul; Sutanto, Agus; Sulistiani WS. Effect of Indigenous Bacterial Consortia on the Quality of Cow Urine Liquid Fertilizer. Proceedings of the National Education Seminar, 2017.
11. Kunarso; Djoko H. The Role of Heterotrophic Bacteria in Marine Ecosystems, 1988.
12. Kusmiati; Malik A. Bacteriocin Activity of LeuconoctocmesenteroidesPbacl Bacteria on Various Media, Health, 2002,Vol. 6 No.1.
13. Manullang RR, Rusmini R, Daryono D. Combination of Local Microorganisms as Compost Bioactivator. Tropical Forest Journal, 2018Vol. 5(3).
14. Marsiningsih N, Suwastika A, Sutari N. Quality Analysis of MOL (Local Microorganisms) Solution Based on Tofu Dregs. E-Journal of Tropical Agroecotechnology, 2015, Vol. 4(3).
15. Moeksin R, Sari W, Eni. Making Bioethanol From Rice Washing Wastewater Using Enzymatic Hydrolysis And Fermentation Methods. Journal of Chemical Engineering, 2015, VOl. 21(1).
16. MP LW. EM4 And MOL . Microorganism Technology. BPP Jambi, 2015.
17. Nugroho, HerbudhiCahyo; Amalia, Ulfah; Rianingsih L. Physicochemical Characteristics of Shredded Fish Meatballs With The Addition Of Transglutaminase At Different Concentrations. Journal of Fisheries Science and Technology, 2019, Vol. 1 No.2.
18. Nuraini A, Ibrahim R, Studi P, Hasil T, Diponegoro U, Merah G. The Effect of Addition of Different Concentrations of Carbohydrate Sources from Rice and Brown Sugar to the Quality of Red Tilapia Fish (OreochromisNiloticus). Fisheries Saintek, 2014,Vol. 10(1).
19. Nurhadianty VCC. Introduction to Industrial-Scale Fermentation Technology UB Press, Malang, 2018.
20. Palupi NP. Chemical Characteristics of Compost With Decomposers of Local Microorganisms from Vegetable Waste, 2015, Vol. 40 (1).

p-ISSN 2622-2027
e-ISSN 2622-2035

21. Prayitno, S.H.; Widiyanto Dan Utama C. Use Of Waste Vegetable Extracts In Combination Rumen Fluid As A Starter On Total Fungi With Existence Molds And Yeasts. AnimAgric Journal, 2014, Vol. 3(4).
22. PurnamaWb. Glucose Antibacterial Activity Against Bacteria*Staphylococcus aureus, Pseudomonas aeruginosa, bacillus subtilis, dan Escherichia coli*, 2013.
23. Ruhnayat A. Utilization of Bio Fertilizers and Natural Fertilizers to Support Organic Cultivation of Pepper and Vanilla Plants. Published Online, 2007.
24. Sari, Dwi Riana; Santoso, Handoko; Zen S. The Effect of Types of Indigenous Bacterial Consortia Lcn on the Quality of Tofu Waste Liquid Fertilizer. Proceedings of the National Seminar on Education. Proceedings of the National Education Seminar. Published Online, 2017.
25. Sektiono, AntokWahyu; Kajariyah, SitiNur; Djauhari S. Test of Antagonism of Actinomycetesrhizhosphere and Root Endophytes of Chili Plants (Capsicum frutescens L.) Against the Fungi Colletotrichumcapsici(Syd.)BultEtBisby. HPT, 2016,Vol. 4(1).
26. Sulistiyono. Determination of Carbohydrate Types By Qualitative Test Using Reagents on Instant Noodle Samples. Biology Journal. Published Online, 2010.
27. Sunarsih LE. Waste Management. Deepublish, Yogyakarta, 2018.
28. Supono. Environmental Management For Aquaculture. ISBN 978-602-6912-04-6. Published Online, 2015.
29. Suprihatin, SuciPerwitasari D. Making Lactic Acid From Cabbage Waste. Faculty of Technology Indonesia East Java. Published Online, 2010.
30. Suwarno S, Ratnani R, Hartati I. The Process of Making Invert Sugar From Sucrose With Citric Acid, Tartaric Acid And Hydrochloric Acid Catalysts. Unwahas Momentum Journal, 2015, Vol. 11(2).
31. Suwarno; Perwitasari; Dyah S. Utilization of Vegetable Waste Moles in the Compost Making Process. MIPA Journal, 2017, Vol. 40(1).
32. Syahrizal. EfektivitasDosage of Em4 (Effective Microorganism) In Making Liquid Fertilizer From Organic Waste. Journal of Health Sciences Nasuwakes, 2015, Vol. 8 No.1.
33. Utama, Cs; Mulyanto A. The Potential of Vegetable Market Waste to Become a Fermentation Starter. Health Journal. Published Online, 2009.
34. Utama N. Growth And Yield Of Lettuce Plant (Lactuca Sativa) That Were Given Organic Chicken Manure Plus Some Bioactivators. Agricultural Empowerment Journal. Published Online, 2014.
35. W Amalia, Deasy; Widiyaningrum P. The Use of EM_4And MOL Tomato Waste As Bioactivators In Compost Making. Published Online, 2016.
36. Waluyo L. Waste Bioremediation.UMM Press, Malang, 2018.
37. Widowati, Tri Wardani; Malahayati N. Effect of Addition of Salt on Chemical and Microbiological Characteristics of Pickled Mustard (Brassica juncea) During Fermentation With Coconut Water Medium. National Seminar on Suboptimal Land. Published Online, 2016.
38. Wignyanto; Hidayat N. Bioindustri. Ub Press, Malang, 2017.
39. Wijayanto A, Lani A. Optimizing Vegetable Products Alternatives and On-Line-Based Marketing. Pambudi, 2018, Vol. 1(1).