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Utilization Arabica Skin Waste of Coffee as a Basic Material for Making Bioethanol in Sukorejo Village, Sumber Wringin District Bondowoso Regency

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Abstract
Sukorejo Village is a village located in Sumber Wringin District, Bondowoso Regency. Most of the residents work as agricultural laborers in the PTPN XII Plantation and a partial small as owners of the Arabica coffee plantations. The potential Arabica coffee waste belonging to the people, both solid waste and liquid waste, in each stage of the processing process is very large, but so far it is still very little used. Usually the coffee skin waste is only allowed to accumulate in the processing plant, causing an unpleasant odor and polluting the surrounding environment. The waste generated from the process of separating coffee skins from coffee beans (pulping process) in the form of biomass is very abundant, and few percent used for livestock feed and compost. One farmer group during the coffee harvest season (about 4 months) requires premium fuel of approximately 2 liters per day for the process of grinding coffee cherries into coffee powder. The waste generated from the process of separating coffee skins from coffee beans in the form of biomass is very abundant, and is only used a few percent for animal feed and compost. Therefore, to overcome the need for fuel, namely by utilizing coffee husk waste as a basic material for making bioethanol. Taking into account the above conditions, this service is carried out in Sukorejo Village, Sumber Wringin District, Bondowoso Regency, with the hope of increasing farmers' income by reducing the cost of purchasing fuel.

Keywords : Arabica Coffee, Coffee Skin Waste, Bioethanol

I. INTRODUCTION

Sumber Wringin sub-district has a hilly nature because it is located on the slopes of the Ijen mountains, has an altitude between 1050 m - 1550 mdpl and an average temperature of 180 °C. Sumber Wringin district with an area of 217.20 km2 consists of 6 villages including Sukorejo village, Sumber Gading, Sukorejo Kidul, Tegal Jati, Rejo Agung and Sumber Wringin. Ecologically, the Sumber Wringin area is very suitable for growing coffee, so most of the area is used as a coffee plantation. Sukorejo Village is a village located in Sumber Wringin District, Bondowoso Regency. This village is about 53 km from the capital city of Bondowoso regency and is the most eastern sub-district. In Sumber Wringin District, there are two large plantations, namely Kalisat Jampit and Blawan Gardens which are owned by PTPN XII.

Sukorejo Village has an elevation level of 1130 m above sea level, the area of Sukorejo Village is 15.96 Km^2 consisting of Tegal covering an area of 0.52 km^2, plantation 7.78 km^2, forest covering an area of 7.22 km^2, barren land area of 0.27 km^2, others covering an area of 0.17 km^2. Sukorejo Village consists of 5 hamlets / hamlets, 5 citizen association and 12 neighborhood units. The poverty level in Sukorejo village is still high, most of the residents work as agricultural laborers at PTPN XII Plantation and a small part as owners of Arabica coffee plantations.

The potential for Arabica coffee waste belonging to the people, both solid waste and liquid waste, is very large in each stage of the processing process, but so far it is still very minimal used.[1] Usually the coffee skin waste is only allowed to accumulate in the processing plant, causing an unpleasant odor and polluting the surrounding environment. A solution to dealing with coffee husk waste, for example, is returned to the land in the form of compost. On the other hand, during the coffee harvest season, which is about four months, for the process of grinding coffee cherries into coffee powder, farmer groups need fuel in the form of premium as much as two liters per day. So for four months the total fuel requirement is around 240 liters of premium. To overcome this fuel need, farmer groups can to take advantage of Arabica coffee husk waste, which is widely available from the processing of the coffee cherries.

This is because the waste is a source of sugar which can be used as raw material for bioethanol production because of its high reducing sugar content and abundant amounts. In addition, it can also reduce expenses for the purchase of premium fuel, so that the income of

[1] Prasetyo Harri Ariadi, Sukatiningsih, and Wiwik Siti Windrati, 'Ekstraksi Senyawa Antioksidan Kulit Buah Kopi: Kajian Jenis Kopi Dan Lama Maserasi', *Berkala Ilmiah Pertanian* 10, no. 10 (2016).

the farmer groups can increase 98% bioethanol can be used as motor vehicle fuel equivalent to Pertamax, while 80% and 96% bioethanol can be used for ethanol stove fuel. From this program, it is hoped that the community will be able to utilize Arabica coffee husk waste as raw material for making bioethanol so that it can increase farmers' income.

Bioethanol is now becoming popular as an alternative fuel derived from plants (biofeul) other than jatropha, oil palm. Now many SME entrepreneurs have started to develop it because it can be done by small-scale or home industries, with a relatively small investment capital, now bioethanol can be produced by anyone who is interested and in the future biofuels including bioethanol will develop on a populist scale and their marketing will not difficult because it can be used directly by the end user.[2]

Bioethanol is a vegetable oil fuel that has properties similar to premium oil. For premium substitutes, there is an alternative to gasohol, which is a mixture of gasoline and bioethanol.[3] As for the benefits of using gasohol in Indonesia, namely: enlarging the base of liquid fuel resources, reducing fuel imports, strengthening the security of fuel supply, increasing job opportunities, has the potential to reduce the tendency of global warming and air pollution (environmentally friendly fuels) and has the potential to encourage commodity exports.

Most of the Arabica coffee farmers in Sukorejo village in the wet system of coffee fruit processing have not optimally utilized coffee husk waste, so that it accumulates in the processing plant which can cause unpleasant odors and pollute the environment. In addition, during the Arabica coffee harvest season (about four months), farmer groups need premium fuel each day of approximately two liters per day for the process of grinding coffee cherries into coffee powder. For this reason, it is necessary to find a solution so that it can provide added value for farmers and does not pollute the environment. One solution is to use it as raw material in the manufacture of bioethanol.

Efforts to utilize coffee fruit skin waste resulting from wet processing of Arabica coffee into bioethanol as a premium blending agent are expected to be able to save on Premium usage. This is at the same time to overcome environmental pollution, especially in the coffee center area of Sukorejo Village, Sumberwringin District, Bondowoso Regency, East Java Province,

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[2] Muhammad Arsad Nasution, 'HOAX SEBAGAI BENTUK HUDUD MENURUT HUKUM ISLAM', *Yurisprudentia: Jurnal Hukum Ekonomi* 3, no. 1 (2017): 17.

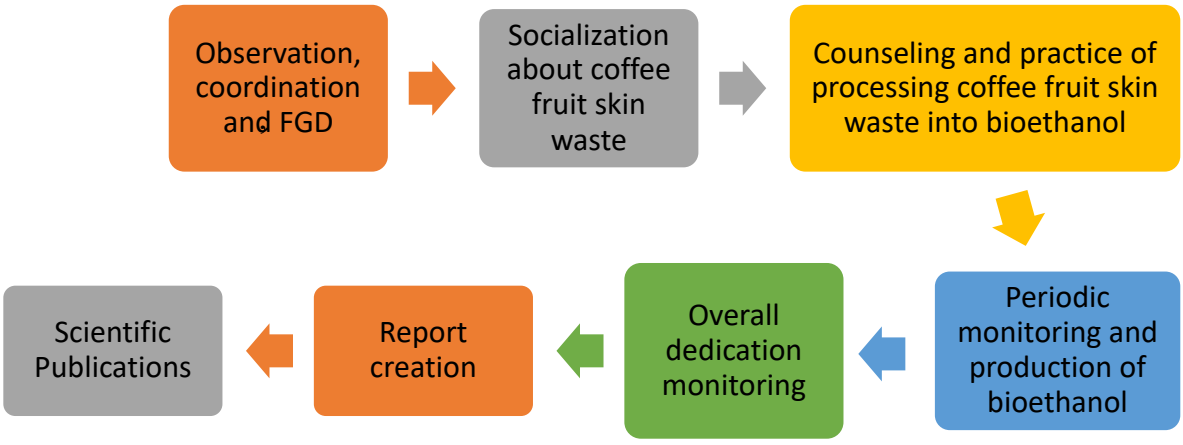
[3] P. Gunasekaran and K. Chandra Raj, 'Ethanol Fermentation Technology – Zymomonas Mobilis', *Current Science* 77, no. 1 (1999): 58.

because if the waste of Arabica coffee fruit skin is not handled properly it can pollute the surrounding environment.[4]

Taking into conditions, this service was carried out in Sukorejo Village, Sumber Wringin District. Bondowoso Regency. This service program will socialize and provide training in utilizing Arabica coffee husk waste as a basic material for making bioethanol. The purpose of this program is to utilizing the abundant waste of Arabica coffee fruit skins to be processed as a basic material for making bioethanol and reducing environmental pollution due to the bad smell of the coffee fruit skin waste. This activity is expected to reduce fuel costs in the processing of Arabica coffee cherries into coffee powder and can reduce environmental pollution in the form of a bad smell due to the accumulated waste of Arabica coffee fruit skins, so that the environment becomes clean and healthy. Through farmer groups, this program is carried out by providing training and socialization on the use of Arabica coffee fruit skin waste as a raw material for making bioethanol.

II. IMPLEMENTATION METHOD

This program, implementation uses an approach method in the form of counseling or lectures, training, and practice of making bioethanol.[5] With this method, it is hoped that this program is expected to partner coffee farmers in Sukorejo village to understand the benefits of Arabica coffee fruit skin waste as raw material for making bioethanol, and to practice independently or in groups the process of making bioethanol as an alternative energy source so that it can provide added value to farmers. In more detail, the stages of service can be seen in Figure 1.



[4] Raudah, 'PEMANFAATAN KULIT KOPI ARABIKA DARI PROSES PULPING UNTUK PEMBUATAN BIOETANOL', *Jurnal Reaksi* 10, no. 21 (2012): 5.
[5] Pudji Rahardjo, 'KOPI (Panduan Budi Daya dan Pengolahan Kopi Arabika dan Robusa)' (Penebar Swadaya, 2012), 20.

Figure 1. Flow of service

The manufacturing method requires waste material of coffee fruit skin from wet processing of Arabica coffee obtained from farmers / partner groups, yeast Saccheromyces cerevisiae, NPK, urea. The tools used consisted of: a set of fermentation equipment, distillation equipment, refractometer, pH meter and gas chromatograph. Bioethanol has advantages compared to BBM, including having a higher oxygen content (35%) so that it burns more completely, has a higher octane value (118) and more environmentally friendly because it contains 19-25% lower CO_2 gas emissions. In addition, bioethanol can be produced by microorganisms continuously. Bioethanol production in various countries has been carried out using raw materials derived from agricultural and plantation products.

Coffee is a plant that produces quite a large byproduct of processing waste. The coffee beans are protected by the outer skin, the mesocarp, the mucus layer, the pactin layer and the parchment. Peeling the coffee fruit skin (pulping) is one of the stages of the coffee processing process that distinguishes between wet and dry coffee processing. Wet coffee peeling machine (pulper) is used for or components of the skin of the fruit from the coffee shell. The scheme for making bioethanol can be seen in Figure 2.

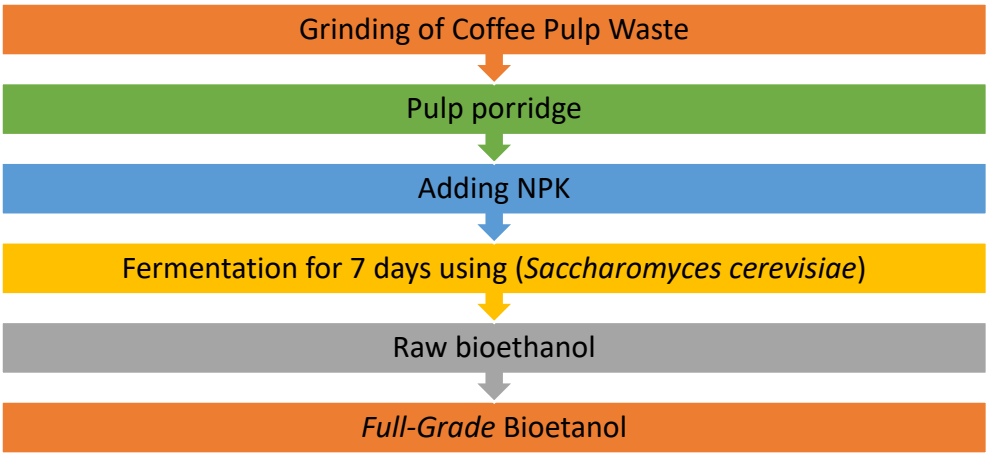


Figure 2. The Process of Making Bioethanol

In Figure 2, the process of milling the coffee pulp waste is blended until it becomes pulp pulp. In the next stage, the pulp slurry is acidified to reduce the pH of the solution to about 5 - 6 by adding 0.5 grams of Urea, 0.2 grams of NPK, and 1.5 grams of yeast, then heated to a temperature of approximately 100 degrees Celsius. The addition of NPK aims to convert cellulose into glucose. The next step, the solution is fermented for 7 days, namely aerobic fermentation. At the end of the fermentation, raw bioethanol is obtained with a brown or cream color. The next stage is the distillation process, namely the separation of bioethanol from water or a distillation process, so that a full grade or distillation result is obtained with a clear color.

Utilization of waste as bioethanol is an alternative in increasing the availability of fuel oil in Indonesia. Waste has a large proportion of utilization in producing fuel oil as substitute for BBM. The conventional fuels that are often used in the production of fuel oil mostly come from waste and looking for materials that are not yet commonly used. Making process bioethanol requires raw materials and several processes, namely: the fermentation process and the distillation process. In more detail, the process of making bioethanol is as follows:

Raw Material Preparation
1. The coffee skin from wet grinding is collected in a plastic container.
Fermentation Process
1. Coffee skin as much as 0.5 Kg from the pulping process is blended with the addition of 1: 2 distilled water 2. Put all the ingredients into the fermenter container. 3. Add 0.2 grams of NPK and 0.5 grams of Urea, 1.5 grams of yeast 4. Incubate by closing the fermenter container tightly, where the lid is connected to a hose in the shape of an inverted U-shaped 5. After the fermentation process is complete, the sample is filtered using gauze 6. The fermented waste is then distilled

Distillation Process
1. The distillation process is carried out at a temperature of 780 C **2. The distillate formed was tested for the refractive index using refractometer** **3. Concentration test using gas chromatography.**

III. IMPLEMENTATION AND RESULTS OF ACTIVITIES

A. Socialization of the Utilization of Arabica Coffee Bark Waste into Bioethanol

The first socialization was carried out to the head of the Arabica coffee farmer group in Sukorejo Village, Sumber Wringin District, Bondowoso Regency, with ouner Mr. Mat Housen. At the meeting discussed about the use of coffee fruit skin waste as a basic material for making bioethanol to reduce fuel costs. The next stage was a meeting with members of the farmer group as many as 20 participants, to socialize about the use of Arabica coffee fruit skin waste into bioethanol. The chairperson and members of the farmer group are very interested in the program offered, so it is necessary to carry out an understanding activity through counseling to members of the farmer group about the process of making bioethanol from the waste of Arabica coffee fruit skin and the tools needed in the process. The next stage was counseling on how to carry out fermentation, and finally the practice of making bioethanol was carried out.

The socialization was carried out by the head of the implementing team, is Ir. Gatot Subroto, MP as lecturer at Faculty of Agriculture, University of Jember and has sufficient experience in the field of agricultural cultivation. Some of the research and activities carried

out also focus on plantation crops such as coffee. The head researcher is also active in community service and has quite good flying hours related to the field of agricultural cultivation. One of the implementing members is Djoko Soejono, SP., MP, as lecturer at Faculty of Agriculture, Department of Social Economics and Agriculture which also has experience in the field of enterprise scale product marketing. Apart from being experts in the socio-economic field, he is also active in community service activities. The proposer team also has a lot of experience in research, especially those related to websites and marketing using E-Commerce. This activity is still in the scientific scope of the proposing team because the realization of the formation of cooperatives is closely related to the economic sector. Armed with this experience, it is hoped that this activity can be carried out well.

Socialization is the first step in program implementation. The socialization process greatly affects the sustainability of the program. So that a facilitator must be very careful in the socialization process, given the very heterogeneous conditions of society, both level of education, character, acceptance and understanding of the community. In the socialization process, a facilitator at least conducts socialization related to his personality, such as name, origin, purpose of coming to the area, then conducts socialization about institutions and programs. In the socialization of the institution, at least the facilitator informs about the profile of the institution, such as the name of the institution, the address of the institution, the vision and mission of the institution, the field of work of the institution and the achievements of the institution. Apart from the profile of the institution, what is no less important is the socialization of programs such as program name, program objectives, program concept, implementation period, program objectives and targets.

The processing of coffee process, it will produce 35% of coffee husk waste, which is a source of organic material with high cellulose content and is abundant in Indonesia, so that coffee husk waste can be used as bioethanol. As an alternative energy substitute for fuel, bioethanol has advantages compared to fuel, including having a higher oxygen content (35%) so that it burns more completely, has a higher octane value (118) and is more environmentally friendly because it contains 19–25% lower C_O gas emissions. The socialization of the use of Arabica coffee skin waste into bioethanol was carried out to one of the coordinators of Arabica coffee farmers in Sukorejo Village, Sumber Wringin District, Bondowoso Regency.[6]

The socialization was held at the house of one of the coffee farmers. Socialization with farmer groups has been responded very well, because it can be used as an alternative / mixture

[6] Yuli Setyo Indartono, 'Bioethanol, Alternatif Energi Terbarukan', Fisika, Kajian Prestasi Mesin Dan Implementasi Di Lapangan (Lembaga Ilmu Pengetahuan Indonesia, n.d.).

of fuel, reduce costs during the coffee processing process, reduce environmental pollution due to waste coffee fruit skin that has accumulated a lot with an unpleasant odor. Based on this, the farmer groups and several other coffee farmers responded enthusiastically.

B. Extension of Materials and Equipment Needed in Making Bioethanol

Bioethanol as an alternative fuel for the community, and has not been widely applied. Whereas in Indonesia, there are a lot of biological natural resources that can be used as raw materials for producing bioethanol. Bioethanol (C_2H_5OH) is a biofuel that is present as an alternative fuel that is environmentally friendly and has a renewable nature.

Bioethanol can be produced from various raw materials that are widely available in Indonesia, so it is very potential to be processed and developed because the raw material is very well known to the public.[7] Plants that have the potential to produce bioethanol include plants that have high carbohydrate content, such as: sugarcane, sap, sugar palm, sorghum, cassava, cashew nuts (cashew waste), arrowroot, banana stalks, sweet potatoes, maize, corncob, straw. and bagasse.[8]

National ethanol production in 2006 reached 200 million liters. National ethanol demand in 2007 is estimated at 900 million kiloliters. Bioethanol is a liquid produced from the fermentation process of sugar from carbohydrate sources with the help of microorganisms. The raw materials for making bioethanol are divided into three groups, namely: sucrose (sap, sugarcane, palm juice, sweet sargum juice, coconut juice, palm juice, and cashew juice), starchy ingredients (ingredients containing starch or carbohydrates such as sweet potato flour, canna flour, seed sorghum, corn, cantel, sago, cassava, sweet potato, etc., and cellulosic / lignocellulosic materials (plants containing cellulose / fiber such as wood, straw, banana stalks, etc. It is understood that in the community service village, coffee skin waste can also be used as an ingredient for making ethanol.

Bioethanol is ethanol produced from fermentation of glucose (sugar) followed by a distillation process.[9] The distillation process can produce ethanol with a content of 95% by volume, for use as a fuel (biofuel) it needs to be further refined until it reaches 99% which is

[7] A. Ita Juwita, Arnida Mustafa, and Risna Tamrin, 'STUDI PEMANFAATAN KULIT KOPI ARABIKA (Coffee arabica L.) SEBAGAI MIKRO ORGANISME LOKAL (MOL)', *Agrointek : Jurnal Teknologi Industri Pertanian* 11, no. 1 (5 June 2017): 3, https://doi.org/10.21107/agrointek.v11i1.2937.
[8] Evandro Galvão Tavares Menezes et al., 'Use of Different Extracts of Coffee Pulp for the Production of Bioethanol', *Applied Biochemistry and Biotechnology* 169, no. 2 (January 2013): 677, https://doi.org/10.1007/s12010-012-0030-0.
[9] Indyah Nurdyastuti, 'TEKNOLOGI PROSES PRODUKSI BIO-ETHANOL', Prospek Pengembangan Bio-fuel sebagai Substitusi Bahan Bakar Minyak, n.d.

commonly called Fuel Grade Ethanol (FGE). The purification process with the principle of dehydration is generally carried out using the Molecular Sieve method, to separate water from ethanol compounds. Ethanol is categorized into two main groups, namely: 1. Ethanol 95-96%, called "ethanol with hydrated, is divided into: a. Technical / raw spirit grade, used for spiritual fuels, beverages, disinfectants, and solvents. b. Industrial grade, used for industrial raw materials and solvents. c. Potable grade, for high quality drinks. 2. Ethanol› 99.5%, used for fuel. If further refined it can be used for pharmaceutical and solvent purposes in the analytical laboratory.

Utilization of waste as bioethanol is an alternative in increasing the availability of fuel oil in Indonesia. Waste has a large proportion of utilization in producing fuel oil. The conventional fuels that are often used in the production of fuel oil mostly come from waste and search for materials that are not yet commonly used.

It is necessary to introduce the materials and tools needed to make bioethanol so that partners can independently manufacture bioethanol from coffee husk waste. The counseling still applies the Covid 19 security protocol. The participants were very enthusiastic about the material provided and hoped that as soon as possible, fermentation training activities and the practice of processing Arabica coffee skin waste into bioethanol.[10]

C. Fermentation Process Fruit Skins of Arabica Coffee

Counseling and Practices for the Fermentation Process of Bu yeast or yeast is a fungus that consists of one cell, and does not form hyphae. Including the *Ascomycotina mushroom* group. Reproduction by forming buds (budding). *Saccharomyces* is a genus in the fungal kingdom that includes many types of yeast. *Saccharomyces* comes from Latin which means mushroom sugar. Many members of this genus are considered very important in food production. One example is *Saccharomyces cerevisiae*, which is used in making wine, bread and beer. Other members of this genus include *Saccharomyces bayanus*, used in wine making, and *Saccharomyces boulardii*, used in medicine. Yeast or fermen is a substance that causes fermentation. Yeast usually contains microorganisms that carry out fermentation and a culture medium for these microorganisms. This culture medium can be in the form of small granules or nutrient fluids. Yeast is generally used in the food industry to make fermented foods and drinks such as pickles, tempeh, tape, bread, and lust. Arabica coffee.[11]

[10] Nana Dyah Siswati, Mohammad Yatim, and Rachmat Hidayanto, 'BIOETANOL DARI LIMBAH KULIT KOPI DENGAN PROSES FERMENTASI', *Universitas Pembangunan Nasional "Veteran" Jawa Timur*, n.d., 4.
[11] Andi Nur Fajri Suloi, 'Pemanfaatan Limbah Kulit Kopi Sebagai Upaya Pemberdayaan Ibu-Ibu Rumah Tangga Di Desa Latimojong, Kabupaten Enrekang | Agrokreatif: Jurnal Ilmiah Pengabdian Kepada Masyarakat',

Saccharomyces cerevisiae is a genus of yeast / yeast that has the ability to convert glucose into alcohol and CO_2. *Saccharomyces cerevisiae* is a single-celled microorganism without chlorophyll, including the Eumycetes group. It grows well at 30°C and a pH of 4.8. Some of the advantages of *Saccharomyces cerevisiae* in the fermentation process are that these microorganisms reproduce quickly, are resistant to high alcohol content, are resistant to high temperatures, have stable properties and quickly adapt. This result is better than other genera such as Candida and Trochosporon. The growth of *Saccharomyces cerevisiae* is influenced by the addition of nutrients, namely element C as a carbon source, element N obtained from urea,

ZA, ammonium and peptone, minerals and vitamins. The optimum temperature for fermentation is between 28-30°C. *Saccharomyces cerevisiae* is one of the yeast species which has good sugar conversion power to bioethanol.

This microbe is commonly known as baker's yeast and its metabolism is well studied. The main metabolic products are bioethanol, CO_2 and water whereas several other products are produced in very small amounts. This yeast is facultative anaerobic. *Saccharomyces cerevisiae* requires a temperature of 30°C and a pH of 4.0-4.6 in order to grow properly. The optimum growth of yeast is at a temperature of 25-30°C and a maximum of 35-47°C. The pH value for good yeast growth is between 3-6. Changes in pH can affect the formation of fermentation byproducts. At high pH, the glycerin concentration will increase and also has a positive correlation between pH and the formation of pyruvic acid. At high pH, the lag phase will decrease and the fermentation activity will increase.d[12]

Saccharomyces cells are ovoid, 5-10 micrometers in diameter. *Saccharomyces* is a genus of yeast / yeast / yeast that has the ability to convert glucose into alcohol and CO2. Saccharomyces is a single-celled, non-chlorophyll microorganism, including the Eumycetes group. It grows well at 30 °C and a pH of 4.8. Some of the advantages of *Saccharomyces* in the fermentation process are that these microorganisms reproduce quickly, are resistant to high alcohol content, are resistant to high temperatures, have stable properties and quickly adapt to their environment.

Fermentation is the process of producing energy in cells in an anaerobic state (without oxygen). In general, fermentation is a form of anaerobic respiration, however, there is a clearer

Agrokreatif Jurnal Ilmiah Pengabdian Kepada Masyarakat 5, no. 3 (2019), https://journal.ipb.ac.id/index.php/j-agrokreatif/article/view/22078.

[12] Author Anna Poedjiadi, 'Dasar-Dasar Biokimia', Universitas Indonesia Library (UI-Press, 1994), https://lib.ui.ac.id.

definition that defines fermentation as respiration in an anaerobic environment with no external electron acceptors. Sugar is a common ingredient in fermentation. Some examples of fermentation products are ethanol, lactic acid, and hydrogen. However, several other components can also be produced from fermentation such as butyric acid and acetone.[13]

Bioethanol fermentation can be defined as the process of breaking down sugars into bioethanol and carbon dioxide caused by enzymes produced by microbial cell masses. The changes that occur during the fermentation process are glucose into bioethanol by tape yeast cells and bread yeast. In the fermentation process, the capacity of microbes to oxidize depends on the number of last usable electron aceptors. Cells carry out fermentation using enzymes - enzymes that change the result of an oxidation reaction, in this case, an acid into a compound that has a positive charge, so that it can capture the last electron and produce energy.

Fermentation is a process of breaking complex compounds into simple compounds. In the microbiological process, fermentation is carried out by microbes that produce or have enzymes that are in accordance with the process. Based on the resulting product, fermentation is classified into two types, namely as follows:[14] 1. Alcoholic fermentation, namely fermentation which produces alcohol as an end product in addition to other by-products. For example making wine, cider and tape. 2. Non-alcoholic fermentation, namely fermentation that does not produce alcohol as a final product other than other ingredients. For example, in the manufacture of tempeh, antibiotics and etc.

After peeling the skin of the coffee fruit, the next step is to dry the fruit skin of the coffee, after drying it is blended to be crushed until smooth. Once smooth, then the hydrolysis process is carried out with the aim of changing the cellulose in fruit skin of the coffee to become glucose. Furthermore, the glucose is fermented for about 3 days by adding yeast with a concentration of 8-12% so that glucose turns into bioethanol. After fermentation, the fermented liquid is tested using a plastic tube that is inserted at one end into the closed fermentation liquid, the other end of the tube is put into the water. If the end of the hose that is inserted into the water appears water bubbles, it can be interpreted that the fermented liquid contains Bioethanol. Based on the test results, then proceed to the next process, namely the distillation process.[15]

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[13] Agriyani Marcelinda, Ahmad Ridhay, and Prismawiryanti Prismawiryanti, 'Aktivitas Antioksidan Ekstrak Limbah Kulit Ari Biji Kopi (Coffea Sp) Berdasarkan Tingkat Kepolaran Pelarut', *Natural Science: Journal of Science and Technology* 5, no. 1 (23 March 2016), http://jurnal.untad.ac.id/jurnal/index.php/ejurnalfmipa/article/view/5547.

[14] N Z Kosaric et al., 'Ethanol', *Ullmann's Encyclopedia of Industrial Chemistry* A9, no. 5 (1993): 5 87-653.

[15] Rahardjo, 'KOPI (Panduan Budi Daya dan Pengolahan Kopi Arabika dan Robusa)'.

Figure 3. Activities of Counseling and Practices of the Fermentation Process Fruit Skins of Arabica Coffee

D. Counseling and Processing Fruit Skin Waste of Arabica Coffee into Bioethanol

The fermented liquid obtained put into the distillation tank, then closed tightly and then the cooling water is opened by the tap so that the water flows upward on the condenser or cooler and comes out through the top, until the distillation process is complete, then the water is turned off. Distillation or distillation is a method of separating chemicals based on differences in velocity or volatility of materials or a chemical separation technique based on differences in boiling points. In distillation, the mixture is brought to a boil so that it evaporates, and this vapor is then cooled back down to a liquid form. The substance which has a lower boiling point will evaporate first. This method is a mass transfer type chemical operation unit. The application of this process is based on the theory that in a solution, each component will evaporate at its boiling point. The distillation process aims to separate ethanol from the ethanol-water mixture. The boiling point of ethanol is 78^0C and the boiling point of water is 100^0C so that by heating at 78^0C with the distillation method, ethanol can be separated from the ethanolair mixture. The maximum level of ethanol that can be obtained by ordinary distillation is 96% and is an azeotropic solution.[16]

To heat a tank that has been filled with fermented liquid. The heating temperature of the stove is maintained at around 80^0C. During the process, the fermented liquid is evaporated so that the water and bioethanol are separated by means of the distillation tool. The results of the distillation in the form of bioethanol are collected in a measuring cup container. To test

[16] Andi Nurul Rahmayani et al., 'PEMBUATAN BIOETANOL SEBAGAI BAHAN BAKAR RUMAH TANGGA', *PROGRAM STUDI D3 TEKNIK KIMIA*, 2018, https://www.academia.edu/36788751/PEMBUATAN_BIOETANOL_SEBAGAI_BAHAN_BAKAR_RUMAH_TANGGA.

the presence or absence of Bioetanal in the measuring cup, it is measured with an Alcoholmeter.

Based on the results that have been done from the distillation process, it was found that from 30 liters of fermentation fluid after the distillation process was obtained 8 liters of bioethanol with a content of 20-30%. The practice of making bioethanol is followed by around 20 coffee farmers, and they are very enthusiastic about the process of making bioethanol, which is shown by the many questions that arise during the process of making bioethanol.

From this process, it is hoped that farmers will be able to independently carry out the process of making bioethanol, so that the distillation tool donated to farmers through farmer groups can be used continuously so that coffee fruit skin waste can be used optimally and can reduce the cost of spending fuel in the fruit processing process. coffee until it becomes ground coffee. In addition, it can also reduce environmental pollution caused by waste coffee fruit skins that have accumulated and are not used optimally.[17]

Figure 4. Counseling Activities and Processing Fruit Skin of Coffee Waste to be Bioethanol

[17] RIDWANSYAH, 'PENGOLAHAN KOPI' (Universitas Sumatera Utara, n.d.).

Bioethanol is ethanol which is mainly derived from plants and generally uses a fermentation process. Ethanol or ethyl alcohol C_2H_5OH, is a clear liquid that is colorless, soluble in water, ether, acetone, benzene, and all organic solvents, has a distinctive odor of alcohol and is biodegradable, low toxicity and does not cause major air pollution when leaking. Ethanol burns to produce carbon dioxide (CO_2) and water. The chemical and physical properties of ethanol are highly dependent on the hydroxyl group. At pressures› 0.114 bar (11.5 kPa) ethanol and water can form azeotropic solutions.

Ethanol is widely used as a solvent, germicide, beverage, anti-freeze agent, fuel, and intermediate compounds for the synthesis of other organic compounds. Ethanol as a solvent is widely used in the pharmaceutical, cosmetics, and resin industries as well as in laboratories.

The distillation process is a bioethanol processing process associated with increasing ethanol content by using the temperature in the evaporation tank and controlling the temperature of the distillation column. Meanwhile, dehydration is related to an increase in ethanol content through the use of hydrates (3 Å synthetic zeolite) which have the ability to absorb water. contained bioethanol in a closed process system. This process aims to break lignin bonds, remove lignin and hemicellulose content, damage the crystalline structure of cellulose and increase the porosity of the material (Sun and Cheng, 2002). The destruction of the cellulose crystal structure will facilitate the breakdown of cellulose into glucose. In addition, hemicellulose also breaks down into simple sugar compounds: glucose, galactose, mannose, hexose, pentose, xylose and arabinose. Furthermore, these simple sugar compounds will be fermented by microorganisms to produce ethanol. Although there are various hydrolysis methods for lignocellulosic materials, acid hydrolysis and enzymatic hydrolysis are the two main methods which are widely used especially for lignosellulosic materials from agricultural waste and wood chips. Enzymatic hydrolysis of cellulose gives a slightly higher ethanol yield than the acid hydrolysis method. However, the enzymatic process is the most expensive process. Higher temperatures will make it easier to decompose simple sugars and lignin compounds. At high temperature and pressure, glucose and xylose will be degraded into furfural and hydroxymethylfurfural.

Distillation is a method of separating chemicals based on differences in boiling points or volatility. The factors that influence the distillation process are the type of material being distilled, temperature, volume of material and time of distillation. However, the most influential factor is temperature. In distillation, the mixture of substances is boiled so that it evaporates, and this vapor is then cooled back into a liquid form. The substance which has a

lower boiling point will evaporate first. This method is a mass transfer type chemical operation unit. The application of this process is based on the theory that in a solution, each component will evaporate at its boiling point. The mass transfer process is one of the most important processes.

Mass transfer is an event that is encountered in almost every operation in chemical engineering activities. One of these processes is distillation, which is the process of separating a liquid-liquid mixture into its components based on the difference in the ability / ability of the components to evaporate. The difference in evaporation ability between these components is known as relative volatility. The distillation column is a means of carrying out the operation of separating the components of the liquid-phase mixture, especially those having quite a large difference in boiling point and vapor pressure. The difference in vapor pressure will cause the vapor phase in equilibrium with the liquid phase to have a significant difference in composition. The vapor phase contains more components that have a lower vapor pressure, while the liquid phase contains more components that have a high vapor pressure.

Hydrolysis is a chemical reaction that breaks a molecule into two parts by adding a water molecule (H_2O), with the aim of converting polysaccharides into simple monomers. One part of the molecule has a hydrogen ion (H^+) and the other part has a hydroxyl ion (OH^-). Generally this hydrolysis occurs when a salt of weak acid or weak base (or both) dissolves in water. However, under normal conditions only a few reactions can occur between water and organic components. The addition of acids, bases, or enzymes is generally done to make the hydrolysis reaction possible when the addition of water does not have a hydrolysis effect. Acids, bases and enzymes in hydrolysis reactions are called catalysts, which are substances that can accelerate the reaction.

E. Monitoring the Performance of Bioethanol Making by Partners

The activity of making bioethanol which has been practiced by farmer groups in Sukoreja Village, Sumber Wringin District does not stop there, but is still carried out periodically during the coffee harvest season, to monitor the implementation and use of distillation tools to process the fruit skin waste of Arabica coffee into Bioethanol can be carried out independently by these farmer groups and lasts during the Arabica coffee harvest season. Monitoring can also be done at any time by using telephone communication.

[18] Siswati, N.D., M. Yatim, dan R. Hidayanto, *Bioetanol Dari Limbah Kulit Kopi Dengan Proses Fermentasi*(Jurusan Teknik Kimia, Fakultas Teknologi Industri, Universitas Pembangunan Nasional "Veteran" Jawa Timur. 2010).

[19] Thamrin S, Slamet H, Dwijono HD, Jamhari. "Efisiensi Teknis Usaha Tani Kopi Arabika di Kabupaten Enrekang" (2015) Jurnal Ilmu Pertanian. 18(2): 92–97. https://doi.org/10.22146/ ipas.9090

IV. CONCLUSION

Partner farmers are very enthusiastic about participating in this activity because the waste that was initially only thrown away, can now be used to become bioethanol which has economic value. Partners can independently process Arabica Coffee Fruit Skin Waste into Bioethanol properly and correctly, so that it can reduce the cost of processing Arabica coffee fruit to become coffee powder, and can reduce environmental pollution due to accumulation of Arabica coffee fruit skins that are not used optimally. This service needs to be done more intensively and continuously so that the partner farmer groups can actually produce Bioethanol independently and sustainably.

V. REFERENCES

Anna Poedjiadi, Author. 'Dasar-Dasar Biokimia'. Universitas Indonesia Library. UI-Press, 1994. https://lib.ui.ac.id.

Ariadi, Prasetyo Harri, Sukatiningsih, and Wiwik Siti Windrati. 'Ekstraksi Senyawa Antioksidan Kulit Buah Kopi: Kajian Jenis Kopi Dan Lama Maserasi'. *Berkala Ilmiah Pertanian* 10, no. 10 (2016).

Gunasekaran, P., and K. Chandra Raj. 'Ethanol Fermentation Technology – Zymomonas Mobilis'. *Current Science* 77, no. 1 (1999): 56–68.

Indartono, Yuli Setyo. 'Bioethanol, Alternatif Energi Terbarukan'. Fisika. Kajian Prestasi Mesin Dan Implementasi Di Lapangan. Lembaga Ilmu Pengetahuan Indonesia, n.d.

Juwita, A. Ita, Arnida Mustafa, and Risna Tamrin. 'STUDI PEMANFAATAN KULIT KOPI ARABIKA (Coffee arabica L.) SEBAGAI MIKRO ORGANISME LOKAL (MOL)'. *Agrointek : Jurnal Teknologi Industri Pertanian* 11, no. 1 (5 June 2017): 1–8. https://doi.org/10.21107/agrointek.v11i1.2937.

Kosaric, N Z, A Duvnjak, H Farkas, S Sahm, O Bringer-Meyer, and Goebel. 'Ethanol'. *Ullmann's Encyclopedia of Industrial Chemistry* A9, no. 5 (1993): 5 87-653.

Marcelinda, Agriyani, Ahmad Ridhay, and Prismawiryanti Prismawiryanti. 'Aktivitas Antioksidan Ekstrak Limbah Kulit Ari Biji Kopi (Coffea Sp) Berdasarkan Tingkat Kepolaran Pelarut'. *Natural Science: Journal of Science and Technology* 5, no. 1 (23 March 2016). http://jurnal.untad.ac.id/jurnal/index.php/ejurnalfmipa/article/view/5547.

Menezes, Evandro Galvão Tavares, Juliana Ribeiro do Carmo, Aline Galvão Tavares Menezes, José Guilherme Lembi Ferreira Alves, Carlos José Pimenta, and Fabiana Queiroz. 'Use of Different Extracts of Coffee Pulp for the Production of Bioethanol'. *Applied Biochemistry and Biotechnology* 169, no. 2 (January 2013): 673–87. https://doi.org/10.1007/s12010-012-0030-0.

Nasution, Muhammad Arsad. 'HOAX SEBAGAI BENTUK HUDUD MENURUT HUKUM ISLAM'. *Yurisprudentia: Jurnal Hukum Ekonomi* 3, no. 1 (2017).

Nurdyastuti, Indyah. 'TEKNOLOGI PROSES PRODUKSI BIO-ETHANOL'. Prospek Pengembangan Bio-fuel sebagai Substitusi Bahan Bakar Minyak, n.d.

Rahardjo, Pudji. 'KOPI (Panduan Budi Daya dan Pengolahan Kopi Arabika dan Robusa)'. Penebar Swadaya, 2012.

Rahmayani, Andi Nurul, Sutri Yulianti, Insan Kamil H, and Alfiani Wildasari. 'PEMBUATAN BIOETANOL SEBAGAI BAHAN BAKAR RUMAH TANGGA'. *PROGRAM STUDI D3 TEKNIK KIMIA*, 2018. https://www.academia.edu/36788751/PEMBUATAN_BIOETANOL_SEBAGAI_BAHAN_BAKAR_RUMAH_TANGGA.

Raudah. 'PEMANFAATAN KULIT KOPI ARABIKA DARI PROSES PULPING UNTUK PEMBUATAN BIOETANOL'. *Jurnal Reaksi* 10, no. 21 (2012).

RIDWANSYAH. 'PENGOLAHAN KOPI'. Universitas Sumatera Utara, n.d.

Siswati, Nana Dyah, Mohammad Yatim, and Rachmat Hidayanto. 'BIOETANOL DARI LIMBAH KULIT KOPI DENGAN PROSES FERMENTASI'. *Universitas Pembangunan Nasional "Veteran" Jawa Timur*, n.d., 4.

Suloi, Andi Nur Fajri. 'Pemanfaatan Limbah Kulit Kopi Sebagai Upaya Pemberdayaan Ibu-Ibu Rumah Tangga Di Desa Latimojong, Kabupaten Enrekang | Agrokreatif: Jurnal Ilmiah Pengabdian Kepada Masyarakat'. *Agrokreatif Jurnal Ilmiah Pengabdian Kepada Masyarakat* 5, no. 3 (2019). https://journal.ipb.ac.id/index.php/j-agrokreatif/article/view/22078.