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学位論文の要旨

Coffee is an agricultural commodity that is in great demand by peoples. Coffee has become widespread throughout the world as a favorite beverage. This is because coffee has a special taste and often has an addictive effect for the drinker. In addition, there are many health benefits of coffee. That is the main reason researchers are competing to do research on coffee. In producing countries, fruit cultivated in coffee trees harvested, subjected to dry refining or wet refining, and then exported as raw beans. Dry refining involves sun drying the harvested fruits and removing the raw beans from a completely dry state. In wet refining, the peel and pulp are mechanically peeled off and immersed in water to decompose the sticky substances that adhere to the raw beans due to the action of microorganism. In consuming countries, raw beans are roasted to make roasted beans. To produce good quality coffee flavor, researchers work hard to carry out processing engineering, such as optimization of the coffee processing method where the main key to taste is the fermentation process.

Therefore, in this doctoral thesis study, fermentation processing engineering was also studied, which is a relatively new technique, namely the coffee bean refermentation technique to improve the taste quality of coffee. In addition, we also studied the utilization of Spent Coffee Ground (SCG). The term referenced which means re-fermenting dry coffee beans that have not been fermented or the market term is inferior coffee bean. The purpose of this refermentation technique is to improve the taste quality of the inferior coffee beans that are already on the market. From dry coffee beans that have low flavor quality, we can still improve their quality with this technique. Usually in the market, the inferior coffee is sold so low price that it is very detrimental to farmers.

The fermentation process usually requires a medium as nutrients for the growth of microorganisms. In coffee, coffee fermentation techniques are usually carried out on coffee cherries, which are fruit that are still intact

or coffee beans that have been peeled or dipped and still contain mucilage as a medium or nutrition for microorganisms to carry out the fermentation process. Whereas in the refermentation technique, because the fermentation process is carried out on dry coffee beans, it is necessary to recondition the beans so that they are ready for fermentation. The coffee beans are soaked in water until the water content is around 60%, then a starter is added and fermented at temperature of about 21, 37, and 47^0 Celsius in a controlled reactor. In this study we use kefir or fermented milk beverage containing lactic acid bacteria and yeast as starter cultures. In addition, in this study, lactose was added to increase nutrition for microorganisms and improve flavor. The dried beans were roasted and crushed to extract coffee, and sensory test and chemical analysis were performed. The pyrazine and aldehyde components increased to more than 20% each. These were factors that made smell of chocolate and nuts by expert panelist. In addition, this study will add references to coffee fermentation techniques. The results of the analysis using this technique were able to increase the score by about 4 due to the change in these chemical composition.

One of the positive effects of fermentation apart from taste is nutritional. Coffee fermentation techniques are proven, can reduce caffeine levels in coffee beans. Likewise with coffee refermentation techniques. In Robusta coffee, caffeine drops from around 2-3% to around 1%. As we know, excessive amounts of caffeine in the body will actually have an effect that is not good for health. Although indeed some antioxidant compounds also go down, such as polyphenol compounds which actually have health effects for the body. However, because in the refermentation technology with kefir starters and combined with the use of a reactor with temperature control so that the fermentation process is faster, around 18 hours with produce 23 volatile compound, the decrease in these antioxidant compounds can be minimized. In this study we also analyzed the total polyphenol content in fermented coffee beans.

Coffee grounds from the results of this refermentation technique, with the minimum content of caffeine and polyphenols, have potential if implemented for plant growth. Apart from of course the potential content in it, such as almost 99%, is organic matter, carbon, 2% nitrogen, 0.2% phosphoric acid and 0.3% potassium which is very good for plants. This is also the background of our study in chapter 3, namely regarding the use of coffee grounds as organic compost as well as the addition of a starter. Previous research, using coffee grounds directly to plants requires a long time for plant growth. This is because coffee grounds contain germination inhibitors such as caffeine and polyphenols. The composting process using starter fungi (*Aspergillus* and *Penicillium*) and combination with the optimum temperature of 30^0 Celsius can reduce carbon and increase nitrogen, decompose macromolecule content such as lignocellulose and protein. The decrease in lignin is said to be correlated with the increase in humic acid in the compost. In addition, the composting process can take place faster. In this study, the composting process for a month can produce compost that is in accordance with the standards. Finally, in this chapter we also analyze the germination index of radish plants to see the toxicity of compost. The resulting values are in the range of 180-190%. Previous research said that if compost has a germination index above 80%, it means that the compost is ripe and not toxic to plants.

In the next chapter, chapter 4, we studied the effect of SCG compost on mustard plant seedlings. The analysis of the total number of microbes showed that the number of microorganisms, especially fungi in the compost, was still very large, around 6.94 log cfu / ml (compost with the addition of starter fungi / C2). These fungi can function as PGPF (Plant growth Promoting Fungi) which has been proven in vitro on mustard plants to

stimulate plant root growth and germination in plant seeds. To further deepen the effect of SCG compost on plants, we did pot treatment then carry out physical and chemical or nutritional analysis in the plants. Such as stem length and leaf width, as well as macro mineral content such as phosphorus, potassium, nitrogen, magnesium, and calcium. We compare our compost samples with commercial compost, both in the form of solids (organic compost) and commercial compost in the form of liquid (inorganic compost).