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Enriching the Bioactive Compound from White Turmeric Plant (*Kaempferia rotunda*) with Supercritical Fluid CO_2 Extraction Method

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Abstract

White turmeric or *Kaempferia rotunda* is type of rhizome plant that contained secondary metabolite with high economic value. Bio-active compounds contained in turmeric have good properties and can be used as herbal medicine ingredients, so it is necessary to develop the better extraction method to obtain the compounds with maximum results and in an efficient time. In this study, it was performed the separation of bio-active compounds that were contained in white turmeric using the extraction method of super-critical CO_2 fluid. The method was carried out by inserting the sample into the reactor, followed by 170 grams of dry ice and ethanol as a modifier. Variations were conducted in time, volume of solvent that was added and pressure, will be observed with GC-MS.

Keywords: *w*hite turmeric, super-critical extraction, carbon dioxide

Introduction

Indonesia is a tropical country that produces plants that were used as traditional medicine, hereditary. Medicinal plants are plants that contain compounds that can be used for treatment and its active compounds can be used as synthetic drugs. Medicinal plants were used by Indonesian, commonly called herbal medicine. People have a belief that herbs can be useful for health and beauty.

With its potential, Indonesia has a good asset for development of herbal medicine for the benefit of health, industrial products that targeting domestic and international markets. This herbal medicine occurred because of the lifestyle of "back to nature" which means returning to nature so as to make people realize the importance of using natural ingredients for health. With the development of the drug and food industry, Drug Chemicals are used by people have side effects that could be harmful to the body and therefore that made the traditional herbal medicine industry to re-develop natural herbal products.However, in preparing a herbal remedy that were a good, safe and economical products, was one of the obstacles in the industrial process. Traditionally, herbal medicinal plants that were

used, were extracted by various methods. The methods that commonly used in industrial processes were the method of extraction by steam distillation and solvent extraction (Hariyadi, 2007). In the extraction using distillation techniques produce essential oils. The essential oils were volatile components of the herbs, so the results that were obtained can't show the actual quality and can make components that should exist damaged by high heating. While, if using extraction method that used organic solvent, the results that were obtained, were not necessarily safe for consumption, depends on the solvent which were used. In addition, it was less economist, due to the cost of organic solvents that will be used.

Existing that weakness of extraction leads to alternative extraction techniques using CO_2 in supercritical conditions (Hariyadi, 2007). This supercritical CO_2 is a condition in which CO_2 has the solvent properties as liquid CO_2, but also has a high diffusivity as CO_2 gas. In supercritical conditions, CO_2 can act as an effective solvent. In addition, CO_2 has properties that are odorless, non-toxic, tasteless, non-flammable and safe for food and medicine. So, the using of supercritical CO_2 extraction is expected to obtain better extraction compound results and in greater quantities.

Materials and Method

A number of 5 kg white turmeric were washed, dried and peeled. After that, samples were mashed with a blender. Smoothing of white turmeric was done without water. Then the samples can be used. In supercritical CO_2 extraction, the white turmeric powders were introduced into the sample cup in the extractor. Then, dry ice was added into the reactor. Pressure and temperature of the water bath were tuned according to the desired variations. Variations were performed for extraction time, volume of solvents, and pressure. Furthermore, it was analyzed with Gas Chromatography and Mass Spectroscopy.

Results and Discussion

White turmeric that was used is white turmeric that was still fresh and was exhausted in the harvest at 7 months. Before it was used, this white turmeric washed and dried to reduce the water content in rhizomes. After a few days, the

white turmeric were rather dry and then cut as thin as possible so that the white turmeric can dry quickly and evenly. During the process of drying, the turmeric should be inverted so as not to rot. Due to the parts that do not yet dry perfectly, it can accelerate the process of decay when white turmeric were stored.

In extraction of supercritical fluid CO_2, it was found three compounds, i.e. pentadecane, benzyl benzoate and crotepoxide. These three compounds were the highest composition and quality that were found in the maceration results. The differences in the number of compounds obtained using maceration method and CO_2 of supercritical fluid was due to the selectivity of CO_2.This selectivity occurred because extraction was done at temperatures and pressure that was above the critical point of the CO_2. This condition cause it was indistinguishable from gas and liquid phase. The CO_2 density and solubility resemble fluid properties and high diffusivity and low viscosity resemble the nature of the gas so that the solvent was easier to enter into the pore or cell wall of the raw material. Therefore, this supercritical fluid CO_2 solvent has higher solubility and good selectivity.

In this supercritical extraction, when compared with the maceration method showed that the role of CO_2 was more prominent to separate the compound from the raw material of white turmeric. In addition, when compared with the results that were obtained were shown in the following figure:

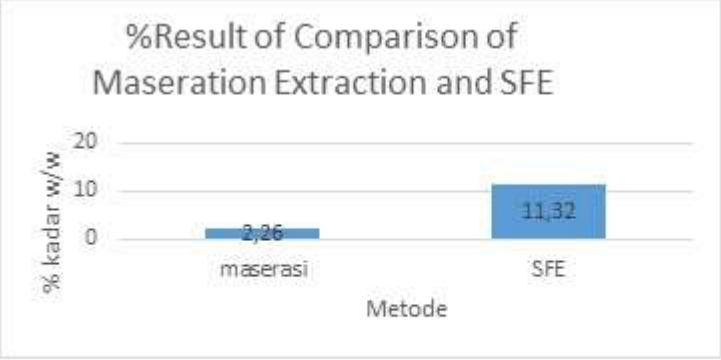

Fig. 1. Comparison of maceration extraction and SFE

From the figure it can be seen that the results by supercritical method generated % more levels than the maceration.

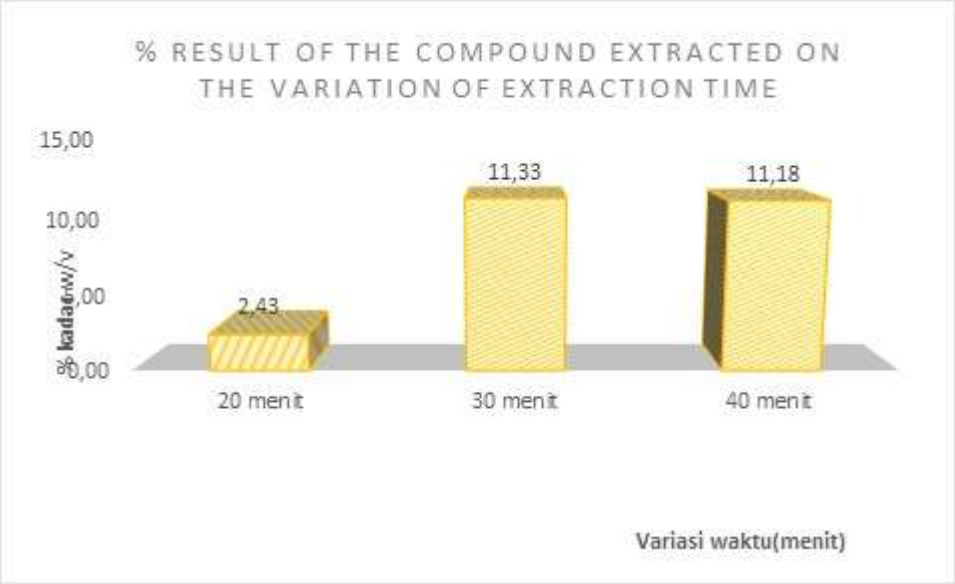

Fig. 2. Results of the compound extracted on the variation of extraction time

Figure 2. shown the samples produced in different of extraction time. In this variation, there was an increase and it was optimal in 30 minutes. Because ethanol and CO_2 mixture can increase polarity, so that with increasing duration of extraction, the polar compounds that were produced, increased. However, within 40 minutes, there are decreasing due to the compounds that were contained in the white turmeric were limited so that it cannot be extracted again and other than that it could also be due to the inability of solvent to dissolve the compound.

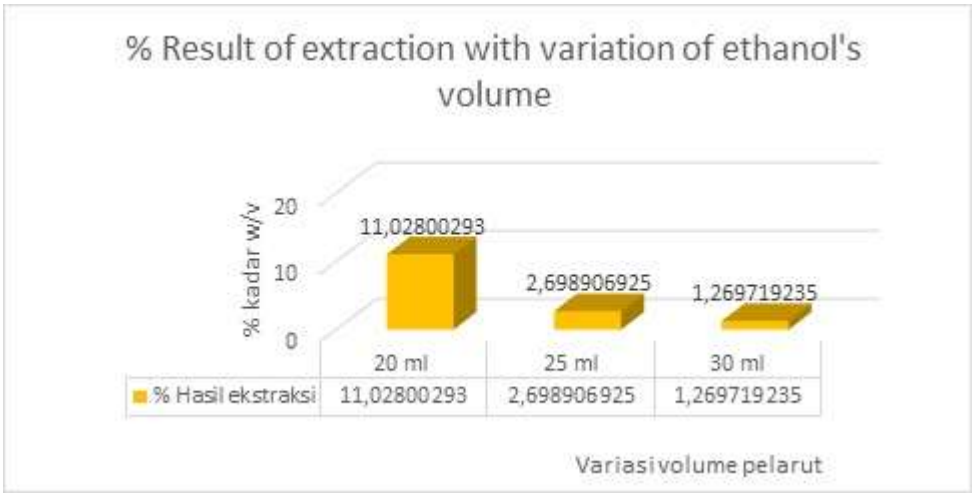

Fig. 3. The total extraction with variation of ethanol's volume

From Figure 3, it was seen that the addition of ethanol's volume decreased the extraction results. The optimum volume of ethanol was 20 mL.

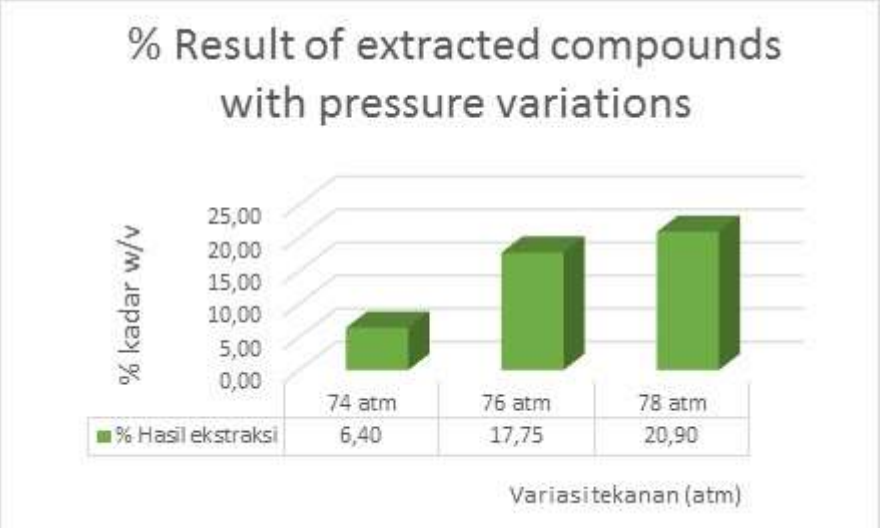

Figure 4. Graph of % yield extracted compounds with pressure variations

Figure 4 hasbeen showed that the higher of pressure increased yield of each compound this due to the density of the CO_2 was increasingly resembling the liquid properties so as to increase the solubility, low viscosity and high diffusivity cause the solvent resembles the nature of the gas because it can enter into the pore and the cell wall of the white turmeric, forcing the solute inside to diffuse and dissolve in the solvent. Therefore, a large extraction was obtained at high pressure.

Conclusion

White turmeric or *Kaempferia rotunda* has a crotepoxide compound that served as a potential anti-cancer drug. Extraction with this supercritical fluid CO_2 method results higher yield of extraction with a shorter time and used less amount of solvent. Using this method, the bioactive compounds obtained have higher concentration than the maceration method.

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