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The Extraction of Purslane (*Portulaca Oleracea L.*) Using Alcohol Solvents 48 % and its Utilization as a Source of Encapsulated Omega-3 Oil

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Abstract. Purslane (*Portulaca oleracea L.*) contains high omega – 3. Therefore, it can be utilized as a health supplement. In this work, omega-3 was isolated by using extraction method. Maceration extraction was chosen because of the simple process and it could extract many simplicia in 1 time extraction. The use of alcohol and water mixture as a solvent with various amount of solvent and maceration time resulted in the omega-3 extract. The omega-3 extract can be used as a reference in determining the variation for the best amount of solvents in extraction of purslane with dried leaf simplicia. Based on the Gas Chormatography-Mass Spectroscopy analysis, it was revealed that the highest concentration of omega-3 was obtained by the 20 days maceration using 1 liter solvent, resulting in 19.894 g filtrate and omega-3 concentrations of 220 mg ω-3 / 100g dried leaf simplicia. This result was better than the extraction conducted using 3 liters of solvent with the extraction time of 30 days which resulted in the highest amount of extract of 36.56 g. The extract obtained was then encapsulated using the plate drying method which could maintain the quality of the core material. The quality was characterized with phase change to become solid after the encapsulation process so the core material can be safely consumed by humans.

INTRODUCTION

The purslane (Portulaca oleracea L.) is a plant that grows wildly in the field and could grow in a sandy area and clayey soil. Purslane is one the plants which is often utilized as a herbal medicine [1]. Purslane is categorized as one of the green plants which contains high omega – 3. According to Uddin et al. [2], 100 grams of purslane leaves contain 225 - 300 mg of alpha-linoleic acid. The alpha - linoleic acid is one of the omega-3 fatty acids that plays an important role in growth and development of humans. The omega - 3 fatty acid in purslane is classified as vegetable fatty acid that can decrease the level of cholesterol and triglycerides, as well as improve the lipoprotein level in blood which is beneficial for our health. The omega-3 fatty acid (α- linoleic acid) functions to enhance the development of human's brain and intelligence especially during early childhood by improving the formation of sphingomyelin which is the structural component of the cell nerve or myelin.

Omega – 3 fatty acid is one of the polyunsaturated essential fatty acids that contain many double bonds. The first double bond is found on the third carbon atom from the methyl omega group. The next double bond exists on the third carbon atom from the previous double bond. The terms "omega" and "number three" refer to the structure of the fatty acid [3]. The Omega – 3 fatty acid cannot be synthesized by the human body. However, it is required by the body and must be ingested from food [4]. According to Hurley et al. [5], the Omega – 3 fatty acid plays an important role in the prevention of many chronic diseases such as coronary heart disease and cancer. In addition, a lack of omega - 3 in the body can cause harmful body damage including neurological abnormalities and poor growth.

Muldoon et al. [6] argues based on the results of her study that children under five who consume omega - 3 oil for one to three times a week have better nutrition level than the children who do not consume omega - 3 oil at all.

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Purslane becomes one of the alternative solutions that can be used to overcome the nutritional deficiency and as one of the solutions to improve the quality of intelligence of children at an early age. Omega-3 from purslane can be isolated using extraction process. Maceration extraction is one of the extraction methods that can be used as a reference for extracting an organic compound such as a purslane [7]. The level of polarity of the solvent type used in certain period of time influences the effectiveness in extracting an organic compound from plants [8]. Therefore, this study aims to investigate the effect of maceration extraction method on omega - 3 oil concentrations per 100 g of dried purslane simplicia. Parameters studied in this work were the volume of solvent and the maceration time.

To protect the extract from bad environmental influences, encapsulation was conducted in this work. Encapsulation is a coating process of a core material which in this study is omega-3 oil. Encapsulation provides certain benefits to maintain the viability and protection of omega – 3 oil from damages which are caused by the environmental factors such as heat, chemical substance, fungi and bacteria [9]. According to Lachman and Lieberman [10], the advantage of using the encapsulation process is with the protection from a layer of polymer wall. Therefore, the core material is protected from influence of the environment. The encapsulation is needed to maintain the active ingredient in the extract. The encapsulation process provides the protection for the core inside of the capsule from bad outside influence. The core will be released only when the surround conditions are fulfilled.

RESEARCH METHODOLOGY

Materials

Materials used in this research, are purslane, ethanol, aquadest (distilled water) and maltodextrin. The purslane was obtained from local suppliers in Ungaran Market, Semarang regency, Indonesia. Chemicals used in this research are ethanol food grade with purity of 96%, and obtained from bakery supplier, Fortune, Semarang, Indonesia. Meanwhile, the maltodextrin was obtained from Indrasari chemical store, Indonesia.

Purslane Preparation

The purslane preparation as simplicia was conducted by using drying method. Purslane leaves was manually cleaned by using running water to separate purslane leaves from impurities, such as dust, dirt, etc. The purslane was dried at ambient temperature by using sunlight. Once the purslane was dried, it was sorted on the dried purslane leaves. The 100 dried simplicia can be achieved from 1.3 kg wet purslane. Purslane plant is presented in Figure 1.

FIGURE 1. The Fresh purslane plant.

Maceration Extraction

The solvent was prepared by by mixing 480 mL of 96% alcohol and 520 mL of distilled water, resulting in 1 liter of alcohol and distilled water mixture as solvent. For each experiment, the 100 grams of dried purslane leaves (simplicia) were prepared and put into the containers for the maceration extraction method. The solvent volumes were varied at 1 L, 2 L, and 3 L. It means that the variation of simplicia to solvent ratio were 1: 1, 1:2, and 1:3. The maceration purslane leaves with different ratios of simplicia to solvent were carried out for 20 and 30 days. After the

extraction time was completed, the rotary evaporator was used to concentrate the extract. The extract was stored in a vial and kept at room temperature for further testing using Gas Chromatography (GC) Shimadzu QP 5000.

Omega-3 Extract Yield Calculation

The calculation of Omega 3 oil filtrate (extract) yield was performed for the purslane extraction on each variable. The calculations were formulated using equation (1).

$$Filtrate\ \ Yield\,(g) = Overall\ \ weight\ \ (vial + extract),(g) - weight\ \ of\ \ the\ vial,(g) \qquad (1)$$

Omega – 3 Oil Composition Analysis

For the analysis of omega – 3 fatty acids composition, a set of Shimadzu QP 5000 GC-MS (Gas Chromatography-Mass Spectroscopy) was prepared. 1 µl was injected into GC-MS device which was operated using glass columns with 25 m length, 0.25 mm diameter, and 0.25 µm thickness with a stationary phase CP – Sil 5 CB and a temperature of 50 ° C - 250 ° C, with a setting of 25 ° C / minute to 200 ° C, 30 ° C / minute to 230 ° C, and 18 minutes for split ratio with helium as a carrier gas with 12 kPa of pressure. The molecular structure of Omega 3 can be seen in Figure 2.

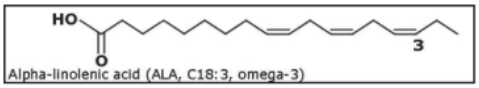

FIGURE 2. The molecular structure of Omega 3.

Quantitative Calculation of Omega – 3 Concentration

The observation table was then made based on the results of the GC-MS analysis. The results of the analysis on the content of omega-3 fatty acid were expressed in percentage (%) using Equation (2).

$$kon.\omega - 3 = \frac{[C \times Y]}{W_{simplicia}} \qquad (2)$$

Where, Kon.ω-3 is the concentration of omega 3 extract, (g / 100g); C is the concentration of omega 3 obtained from the interpretation of the GC-MS table, (%); Y means the weight in the suspension of the filtrate from the evaporation using RE (rotary evaporator) after the extraction process, (g) and W simplicia is the weight of the initial simplicia, (g).

Encapsulation of Omega-3 Oil

The encapsulation of the extracted oil was performed by using the plate drying method in Chemical Engineering Integrated Laboratory of Universitas Negeri Semarang. Gelatin capsules were used to encapsulate the oil. The results of the encapsulation were then separated for each sample.

RESULTS AND DISCUSSION

Effect of the Maceration Method on Omega-3 Extract Yield

The purslane leaves was extracted using alcohol-water solvent for 20 and 30 days maceration with 1, 2, and 3 L of solvent. After the extraction process, samples were subsequently concentrated using rotary evaporator to obtain omega-3 filtrate. The omega-3 extract (filtrate) yield was calculated using equation 1. Figure 3 shows the correlation between solvent volumes to the omega-3 filtrate yield.

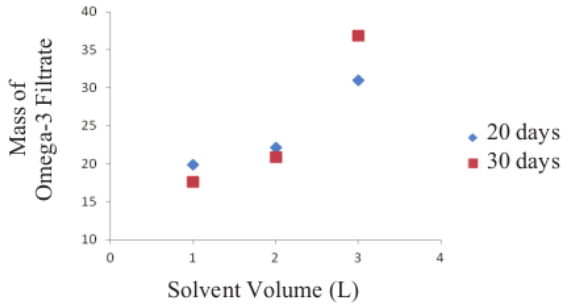

FIGURE 3. The Omega-3 Extract Yield for the Extraction at the Different Maceration Times and Solvent Volumes

Based on the experimental result, it was found that the amount of extract (filtrate yield) increased directly proportional to the amount of solvent used. The amount of simplicia mass for all the experiment were fixed at 100 grams. It was revealed that maceration of purslane leaves which were conducted for 30 days with the solvent volume of 1 L resulted in 17.627 g omega-3 extract. Furthermore, the 30 days maceration using 2 L and 3 L solvents produced the omega-3 extract yields of 22.089 g and 36.856 g, respectively. On the other hand, the extract yield for the 20 days purslane leaves maceration using 1 L, 2 L, and 3 L solvents were 19.894 g, 22.087 g, and 30,937 g, respectively. It can be concluded that the optimum condition for 100 gram purslane leaves extraction using the mixture of 48% alcohol-52% water as solvent was 30 days with 3 L volume of solvent, which resulted in 36.856 g omega-3 extract.

The Analysis of Extract Composition and Omega -3 Concentration

All the samples of the experiments at various maceration times and solvent volumes were analyzed using GC-MS to determine the composition of the extract and omega-3 concentration of each sample. It was found that the best quality of omega-3 was provided by the maceration conducted for 20 days using 1 L solvent. Figure 4 shows the fatty acid composition of pursalane leaves extract, which was achieved the 20 days maceration using 1 L solvent, based on the by GC-MS analysis.

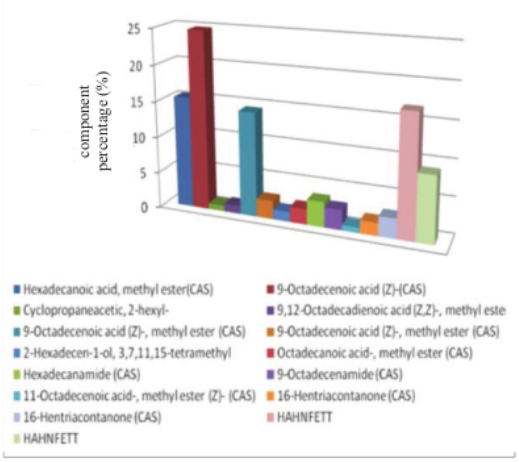

FIGURE 4. Diagram Block based on GC Reading of Extracted Filtrate.

The results of the GC-MS identification exhibited that the main omega-3 component found in the extract was ALA in the form of Octadecadienoic acid, which had percentage of 1.11%. On the other hand, the other main omega-3

components of DHA and EPA were not detected in the extract. Besides, fatty acids, some other compounds were also appeared in the extract. It occurred due to the polarity of water in the solvent mixture which caused the components other than omega-3 were extracted.

Omega-3 concentration in the purslane leaves was subsequently calculated using equation (2). It was revealed that the amount of omega-3 which could be extracted from the purslane leaves was 220.8 mg for each 100 g simplicia of dried purslane leaves. 100 g dried simplicia was obtained from the 1.3 kg wet purslane leaves. It means that the content of omega-3 in wet purslane leaves was 0.017%. This result demonstrated the high concentration of omega - 3 in the purslane leaves. Hence, purslane plant has high potential to become new sources of ALA food supplements or functional food ingredients.

The Results of the Encapsulation

The extracts obtained were then encapsulated using the plate drying method. It was performed by changing the shape of the core material in the form of omega-3 oil from purslane plant extract to form solid particles or in the form of aggregates (crystals). The extract was then inserted into gelatin capsules as its coating. The encapsulation process was conducted to protect the core material from the influence of the external environment.

CONCLUSION

The maceration extraction method by using the mixture of 48% alcohol and 52% distilled water as solvent resulted in the increasing quantity of omega – 3 oil directly proportional to the total of the solvent used. The highest amount of extract which was 36.856 grams was obtained on 30 days maceration using 3 liters of solvent. The best quality of omega – 3 oil extract was obtained on the maceration at 20 days and 1 L of solvent with the amount of omega -3 oil of 220.8 mg and the extract amount to 19.894 grams. The extract of omega – 3 oil was then encapsulated using the plate drying method to maintain the quality of the core material by changing the phase of omega – 3 oil into crystals during the process to avoid damage from the influence of environment.

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PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6