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Original Article

PREPARATION AND CHARACTERIZATION OF *SONNERATIA ALBA* LEAF EXTRACT MICROCAPSULES BY SOLVENT EVAPORATION TECHNIQUE

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ABSTRACT

Objective: *Sonneratia alba* leaves were used by the community for traditional medicine to cure muscle pain, back pain, antioxidants, rheumatism, malaria, wounds, tuberculosis (TB) and as a spermicide. *S. alba* leaves extract was easy to damage because of the light exposure, change of pH, weather and a long period of storage time. The problem can be solved by coating the extract with a microencapsulation technique. The purpose of this research was to formulate the microcapsules of *S. alba* leaves extract with solvent evaporation technique using Ethocel 10 cP and Eudragit E100 as a matrix.

Methods: *S. alba* leaves were extracted using ethanol 96%. This extract was dried by a rotary evaporator. The microencapsulation process of *S. alba* leaves extract was done by solvent evaporation technique (O/W: oil in water). The formula of *S. alba* leaves extract microcapsules was designed into six formulas (Eudragit E100: EA_1, EA_2, EA_3 and Ethocel 10 cP: EB_1, EB_2, EB_3). Microcapsules of *S. alba* leaves extract were characterized for particle size in terms of surface morphology by scanning electron microscope (SEM) and encapsulation efficiency. Antioxidant activity of the formulation have been evaluated by DPPH method. Physical characterization on microparticles was performed by conducting entrapment efficiency and SEM picture.

Results: In this research, the microparticles containing *S. alba* extract has been developed by using ethyl cellulose (Ethocel 10 cP) and eudragit (Eudragit E100) as the polymer matrix. The results showed that a high concentration of polymer (Ethocel 10 cP and Eudragit E100) used in microencapsulation resulted in better *S. alba* leaves extract microcapsules in terms of physical characteristics. Particle size of microcapsules containing *S. alba* leaves extract were in the range of 0.701 to 1.163 µm. Encapsulation efficiency (% EE) was categorized as poor because the value were ≤ 80% to which 74.386% (EB_3) and 75.248% (EA_1). SEM picture of EA1 (Eudragit E100) revealed that the surface of microcapsule were rough and porous. When Ethocel 10 cP was used as a polymer, a smoother surface and less visible pores of microcapsule were obtained. The antioxidant ability of *S. alba* leaves extract microcapsule showed that IC_{50} values were 53.26 ppm.

Conclusion: It can be concluded that microcapsules of *S. alba* leaves extract can be prepared by solvent evaporation technique using Eudragit E100 and Ethocel 10 cP as polymer. *S. alba* leaves has potent antioxidant activity either as an extract or after being formulated into microcapsules.

Keywords: Microencapsulation, Solvent evaporation technique, *Sonneratia alba*, Antioxidant, Eudragit E100, Ethocel 10 cP

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INTRODUCTION

Herbal extracts have been widely accepted as potential medicines with less side effects as compared to synthetic drug molecules. In recent years, the focus has been directed towards the development of drug delivery system using biologically active compounds derived from natural sources [1, 2]. Herbal-based drug delivery systems have long been used in folk medicine, and herbal medicines of natural origin show good therapeutic activity with minimal side effects. The World Health Organization estimates that 80 % of the world's population currently uses herbal medicines for primary health care. Thus, researchers have begun to focus on herbal drugs and the use of materials of herbal origin. Herbal medicines have many advantages over traditional medicines, including a lower risk of side effects, lower cost, and widespread availability [3-6].

Medicinal plants are part of the history of human evolution. More than 50% of all drugs used in modern medicinal treatments are composed of natural products and derivatives thereof. The physicochemical stability is a determining factor in the quality of plant extracts and the transformation of these into dry-powdered form is the most desirable strategy, considering that this form improves its stability and facilitates the manipulation of the material [5]. Techniques for the incorporation of plant extracts within polymer matrices have indicated a good alternative for the improvement of the functionality of medicinal plant extracts. The spray-drying and solvent evaporation process that involves the dispersion of material inside a coated material is a technique that has been widely used in recent years for the incorporation of extracts into polymer matrices [7-15].

S. alba is a genus of the family Lythraceae which comprises of about several species. It is present in some parts of the world, which include Indonesia, some parts of Africa, Australia, South East Asia and the Pacific islands [16-22]. The *S. alba* includes mangroves whose ecosystems are very productive, both ecologically and economically, which are located between land and sea environments. *S. alba* mangrove plants are known to be in the form of shrubs or trees and grow in places with optimum sunlight, wind and high salinity. *S. alba* show several bioactivity, which include antioxidant, antimalaria, antimicrobes and anti-inflammatory [15-20].

Solvent evaporation method has been widely and extensively used to prepare polymeric microparticles containing different drugs and in the development of modified release systems [23-28]. It is a rapid process that does not involve severe heat treatment; therefore, it is a suitable method to preserve biological products, including temperature-sensitive products, without their degradation; it also allows for storage at room temperature [31-40]. It is an instantaneous process where spherical and uniform samples can be obtained, and the process can be easily scaled up [30-35, 40-45]. The effectiveness of the solvent evaporation method to produce microspheres depends on the successful entrapment of the active agent within the particles, and thus, this process is most successful with drugs which are either insoluble or poorly soluble in the aqueous medium, which comprises the continuous phase [32, 39, 46-50]. There are different methods to prepare microparticles by the solvent evaporation method. The O/W emulsion system consists of an organic phase comprised of a volatile solvent with dissolved polymer and the drug to be encapsulated and emulsified in an aqueous phase containing a dissolved surfactant. For

insoluble or poorly water-soluble drugs, the oil-in-water (O/W) method is frequently used. Another alternative to encapsulate hydrophilic drugs is to employ the water-in-oil-in-water (W/O/W) emulsion process. An aqueous solution of the drug is added to an organic phase consisting of the polymer and organic solvent with vigorous stirring to form the first W/O emulsion. The study included the development and characterization of the microparticles obtained *S. alba* leaves extract using the solvent evaporation method and the evaluation of the antioxidant potential of *S. alba* leaves extract from the encapsulated microparticles.

MATERIALS AND METHODS

Collection of plant materials

Fresh leaves of *S. alba* were collected in the month of July, 2022 from Muara Sabak (Jambi) and identified by a taxonomist from the Department of Biology, Faculty of Mathematics and Natural Sciences of Padjadjaran University.

Chemicals and reagents

Quercetin dehydrates, Ethocel 10 cp, Eudragit E 100, gallic acid, ethanol (C_2H_5OH), methanol, dichloromethane, hydrochloric acid, sodium hydroxide, PVA were bought from Merck Chemicals GmbH, Darmstadt, Germany. DPPH [1,1-Diphenyl, 2-picryl-hydrazyl] (Sigma-Aldrich, St. Louis, MO, USA), Naphthylethylenediamine dihydrochloride (PanReac AppliChem, Darmstadt, Germany), Thiobarbituric acid (TBA) and Trichloro acetic acid (Sigma-Aldrich, St. Louis, MO, USA). All other reagents used were of analytical grade and were purchased from Sigma-Aldrich (Saint Louis, MO, USA) and PanReac AppliChem (Darmstadt, Germany). UV spectra were recorded in Shimadzu 1601 UV-Visible spectrophotometer. The chemicals used were of good quantity and quality standard and do not require further purification.

Extraction

Dried *S. alba* leaves (5 kg) were grinded and extracted three times with 50 L of ethanol (24 h each) by maceration technique. The macerate was then concentrated, evaporated and dried in a vacuum at 60 °C using a rotary evaporator (buchi rotavapor R-205). The yield value was as much as 25.3% (w/w). The dry extract was stored in the refrigerator at 4 °C until when it will be used.

Phytochemical screening

Phytochemical screenings of the extract and isolate were perfomed to estimate the presence of its chemical constituents such as alkaloid, flavonoid, saponin, triterpenoid, tanins, glycosides, quinones and phenolic.

Preparation of polymeric microparticles

The solvent evaporation method based on the formation of O/W emulsion was used to prepare microparticles. For the O/W method, ethyl cellulose (Ethocel 10 cP) (10%,15%, 20%) or Eudragit E100 (5%,10%, 20%) were dissolved in dichloromethane. 5 g of *S. alba* leaves extract were dissolved within this organic phase. The organic phase was then emulsified into 800 ml aqueous PVA solution (1.5% w/v) containing 0.5 M NaCl and NaOH at pH 12. The emulsion was stirred for 4 h at 500 rpm with a propeller stirrer (Heidolph Elektro GmbH and Co. KG, Kelheim, Germany) to allow microparticle hardening. After 4 h, the microparticles were separated from the external aqueous phase by wet sieving followed by washing with 200 ml deionized water, desiccator-drying for 24 h and storage in a desiccator.

Particle size analysis

Particle size mean and size distribution of the microparticles were measured by *Dynamic Light scattering* (DLS) (Cilas, 1064 L, France). The appropriate amount of dry microcapsules of each formulation is suspended in deionized water and sonicated for the appropriate time period before measurement. The average diameter of the volume, size distribution and polydispersity of the resulting homogeneous suspension were determined using the DLS technique. The microparticles suspension was dispersed in distilled water and then it was put into the sample chamber of the particle size analyzer and measurement of vesicular size was carried out.

Thin layer chromatography (TLC)

Qualitative analysis by thin layer chromatography (TLC) on ethanol extract of *S. alba* leaves and microcapsule with formula 20% Eudragit E100 polymer (EA3) and formula 20% ethocel 10 cP (EB3) were carried out several times using several eluents with different levels of polarity to obtain a solvent that was able to provide good separation. Spots on the TLC plate were monitored at wavelengths 254 nm and 366 nm. Determination of the class of compounds in the TLC test was done by spraying the TLC plate with several reagents using 10% H_2SO_4 in methanol p. a.

Scanning electron microscopy

The morphology of microparticles was analysed by scanning electron microscopy (SEM). For surface imaging, the microparticles were fixed on a sample holder with double-sided tape. To investigate the inner structure, the particles were spread on transparent tape and then cut with a razor blade. All samples were coated under argon atmosphere with gold to a thickness of 8 nm in a high-vacuum (SCD 040, Bal-Tec GmbH, Witten, Germany). Samples were then analysed on the scanning electron microscope (S-4000, Hitachi High-Technologies Europe GmbH, Krefeld, Germany).

Entrapment efficiency

Microparticles (10 mg) were extracted in 1 ml methanol, followed by agitation in a horizontal shaker (IKA HS 501 digital horizontal Shaker, Janke and Kunkel GmbH and Co. KG IKA Labortechnik, Staufen, Germany) for 2 h (n = 3). 0.1 ml of methanol extract was diluted in 10 ml of pH 7.4 phosphate buffer. The polymer was separated from the aqueous solution by filtration using filter paper (Whatman®, GE Healthcare UK Limited, Buckinghamshire, UK). Flavonoid (in *S. alba* leaves extract) concentration in the obtained aqueous solution was determined by UV-spectrophotometry at wavelengths of 435 nm, respectively (HP 8453 UV-Vis spectrophotometer, Agilent Technologies Deutschland GmbH, Waldbronn, Germany). The actual drug loading and encapsulation efficiency were calculated as follows:

Encapsulation efficiency (%) = (actual drug loading/theoretical drug loading) x 100 %

Antioxidant activity

Scavenging of DPPH radical

This assay is based on the measurement of the scavenging ability of antioxidant test extracts towards the stable radical. The free radical scavenging activity of the ethanol extracts of *S. alba*, was examined *in vitro* using DPPH [1,1-Diphenyl, 2-picryl-hydrazyl] radical. The test extracts were treated with different concentrations, from a minimum of 4 ppm to a maximum of 250 ppm. The reaction mixture consisted of 1 ml of 0.1 mmol DPPH in ethanol, 0.95 ml of 0.05 M Tris-HCl buffer (pH-7.4), 1 ml of ethanol and 0.05 ml of the herbal extract. The absorbance of the mixture was measured at 517 nm exactly 30 sec after adding extracts. The experiment was performed in triplicate and the percentage of scavenging activity was calculated using the following equation,

DPPH radical scavenging (%) = [(control absorbance-sample absorbance)/control absorbance] x 100

The blank was also carried out in a similar manner, using distilled water in the place of extracts. The activity was compared with ascorbic acid, which was used as a standard antioxidant.

RESULT AND DISCUSSION

The phytochemical screening of ethanolic extract of *S. alba* leaves revealed the presence of secondary metabolites such as saponins, tanins, phenolics, glycosides, alkaloids, flavonoids, quinones, and terpenoids, as shown in table 1. Specifically, phytochemical substances were used to recognize and detect therapeutic activity. These phytochemical compounds are known to be responsible for some medicinal activity which in this present study is antioxidant activity.

Table 1: Phytochemical screening of ethanolic leaf extract of *S. alba*

Secondary metabolites	Results
Alkaloids	+
Flavonoids	+
Tanins	+
Phenolic	+
Steroids	-
Terpenoids	+
Saponins	+
Glycosides	+
Quinones	+

+:Presence, -:Absence

Microparticle

Preparation of microparticles by solvent evaporation is widely used in the pharmaceutical industry. It can be applied for the encapsulation of a broad range of substances, from simple drugs to proteins and DNA [23-24]. There are several variation of the solvent evaporation technique that have been developed to get efficient drug encapsulation. For insoluble or poorly water-soluble drugs such as *S. alba* leaves extract, an O/W method is suitable used [34].

In case of the preparation of polymeric microparticles for sustained drug release by solvent evaporation technique, the solidification rate is a decisive factor for their release behaviour. A very slow hardening of the emulsion droplets leads to the diffusion of the drug substance out of the droplets and encapsulation efficiency becomes low. Solidification rate of polymeric microparticles during the solvent evaporation process was influenced solubility of polymers in organic solvents and the solubility of organic solvent in water, which in turn affects microparticle properties such as particle size, drug incorporation, matrix porosity, solvent residues and initial burst [30-35]. Dichloromethane is the most common solvent for encapsulation using the solvent evaporation technique because of its high volatility, low boiling point and high immiscibility with water [23, 24].

Microencapsulation techniques with film polymers can use several kinds of polymers, including Eudragit E100 and Ethocel 10 cP. Eudragit E100 is a cationic polymer based on dimethylaminoethyl methacrylate, butyl methacrylate, and methyl methacrylate. The glass transition temperature of Eudragit E100 is ~ 48 °C. If it is used as a polymer cover in microencapsulation, eudragit E100 forms a film that is easily soluble, permeable, and insoluble at pH 5 or higher but dissolves rapidly by forming salts at acidic pH, lower than 5.

Ethyl cellulose (EC) is a partly O-ethylated cellulose ether derivative. It is available in a variety of grades, which differ in viscosity, is usually hydrophobic in nature and is widely used in the biomedical and pharmaceutical industries. Ethyl cellulose is usually distinguished by viscosity, molecular weight and is referred to as "Ethyl Cellulose Polymer Premium", with the trade name Ethocel TM. Ethocel TM types are ethocel 4, 7, 10, 20, 45 and 100 cP. The one used in this research is ethocel 10 cP because it is most often used in the coating process in the pharmaceutical field.

Table 2: Data of microcapsules from ethanol extract of *S. alba* leaves with homogenizer speed of 2,700 rpm (5 min) followed by stirring by propeller stirrer 200 rpm (4 h)

Formula	Material	Product (g)	PSA (µm)	EE (%)
EA_1	Extract = 5 g Eugragit E100 = 5% PVA = 1.5%	4.007	0.950±0.01	75.248±3.32
EA_2	Extract = 5 g Eugragit E100 = 10% PVA = 1.5%	4.065	1.086±0.23	72.914±2.64
EA_3	Extract = 5 g Eugragit E100 = 20% PVA = 1.5%	4.487	1.163±0.27	73.860±2.01
EB_1	Extract = 5 g Ethocel 10 cP = 10% PVA = 1.5%	3.663	1.127±0.19	65.704±2.87
EB_2	Extract = 5 g Ethocel 10 cP = 15% PVA = 1.5%	4.317	0.701±0.03	74.111±3.15
EB_3	Extract = 5 g Ethocel 10 cP= 20% PVA = 1.5%	4.519	1.067±0.11	74.386±2.36

Data are expressed as mean±SD, n=3

ANNOTATION

EA_1 = Formula with eudragit E100 (5%)

EA_2 = Formula with eudragit E100 (10%)

EA_3 = Formula with eudragit E100 (20%)

EB_1 = Formula with ethocel 10 cP (10%)

EB_2 = Formula with ethocel 10 cP (15%)

EB_3 = Formula with ethocel 10 cP (20%)

PVA = Polivinyl Alkohol

PSA = *Particle Size Analyzer*

EE = *Encapculation efficiency*

Ethanol extract of *S. alba* leaves has low stability because it contains natural ingredients, so it is formulated in the form of microcapsules by utilizing a polymer that can protect the extract as an active ingredient. The polymer used is eudragit E100 and ethocel 10 cP with a concentration variation of 5, 10 and 20% and 10, 15 and 20%, respectively. PVA in microcapsule preparations is commonly used as a polymer stabilizing agent in the solvent evaporation method. However, the use of the polymer must be able to guarantee the stability of the extract, especially in terms of activity.

Based on observations of microcapsules from ethanol extract of *S. alba* leaves using polymer variations and different concentration variations above, we have obtained yields of each polymer with different concentrations, ie at 5% eudragit E100 produces 4.007 g, besides that 10% eudragit E100 produces 4.065 g while the eudragit 20% E100 produces 4.487 g. Likewise, with the ethocel 10 cP polymer with various concentrations, 10% ethocel 10 cP produces 3.363 g, in addition to the 15% ethocel 10 cP produces 4.317 g, while the 20% ethocel 10 cP produces 4.519 g (table 2). It can be concluded that the higher the concentration used in Eudragit E100 and ethocel 10 cP polymers, the higher the yield obtained.

Based on the results of the characterization of the microcapsule particle size of the *S. alba* leaf extract microcapsules in a formula using a 5% Eudragit E100 polymer resulting in particle size of 0.950 µm, when to formulas that use a 10% eudragit E100 polymer particle size of 1.086 µm, whereas in formulas with 20% Eudragit E100 polymer particle size of 1.163 µm. From the analysis data shows that the particle size is categorized into a micro size that is above 1 µm. Formula that uses 10% ethocel 10 cP polymer produced a particle size of 1.127 µm. The formula that uses 15% ethocel 10 cP polymer produces a particle size of 0.701 µm. Whereas the formula using 20% ethocel 10 cP produces a particle size of 1.067 µm. From 3 variations of the concentration of Eudragit E100 and ethocel 10 cP polymer, it can be seen that at a concentration of 20% shows the largest particle size compared to the other concentration (table 2). But these particle size is still categorized into a micro size that is above 1 µm.

Next is calculating the value of % encapsulation efficiency (% EE), which aims to find out how much % of the ethanol extract *S. alba* leaves used can be coated by polymer. In the formula using 5% eudragit E100 polymer, it is known that the % EE value is 75.248%. Using 10% eudragit E100 polymer is known that the % EE value is known as 72.914%, while the 20% eudragit E100 polymer is known to be the % EE value of 75.860%. It is categorized as poor because it has the % EE value of ≤ 80%. Whereas in formulas that use 10% ethocel 10 cP polymer, the% EE value is known to be 65.704%, the 15% ethocel 10 cP polymer give the % EE value is known to be 74.111%, while at a concentration of 20% ethocel 10 cP polymer give the % EE value is known to be 74.386%.

Zeta potential

The electrical potential at the bilayer boundary is known as the Zeta potential of the particle and has values that typically range from 100 mV to-100 mV. The magnitude of the zeta potential can predict colloidal stability. Microparticles with a Zeta Potential value greater than+25 mV or less than-25 mV usually have a high degree of stability. Dispersions with low zeta potential value will produce aggregates due to inter-particle Van Der Waals attractions [37-42]. Zeta Potential Analysis is a technique for determining the surface charge of particles in a solution (colloid). Microparticles have a surface charge that attracts a thin layer of charge ions that is opposite to the surface of the microparticles.

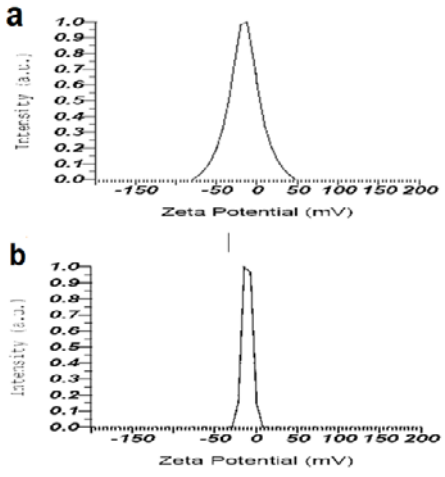

Fig. 1: Zeta potential profile of *S. alba* leaves ethanol extract microcapsule, (a) EA_3 = Eudragit E100 Formula (20%); (b) EB_3 = Ethocel Formula 10 cP (20%)

Zeta potential value of *S. alba* leaves ethanol extract microcapsule (EA_3 = Eudragit E100 Formula (20%)) that values-18.2 mV, while Zeta potential value of *S. alba* leaves ethanol extract microcapsule (EB_3 = Ethocel Formula 10 cP (20%)) that values-11.7 mV (fig. 1). This shows that the two polymers used in the preparation of these microcapsules produce dispersions with low zeta potential values that will produce aggregates due to inter-particle Van Der Waals attractions.

Thin layer chromatography

The use of the TLC method is intended as an initial qualitative analysis of the stability of the active ingredients used. Components of chemical compounds move up to follow the mobile phase because the adsorbent absorption of chemical components is not the same so chemical components can move at different distances based on the level of polarity. This is what causes the separation of components of chemical compounds in the extract.

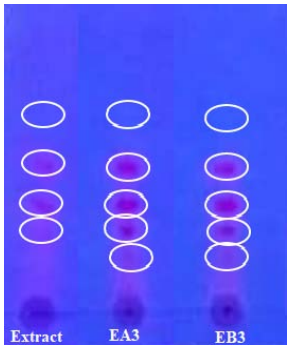

Fig. 2: TLC profile of *S. alba* leaves ethanol extract; EA3 = Eudragit E100 Formula (20%); EB3 = Ethocel Formula 10 cP (20%) under UV light 366 nm

The results obtained from the ethanol extract of *S. alba* leaves seen under UV light 366 nm showed the presence of four and five stains with varying Rf values (fig. 2 and table 3).

Table 3: Rf value calculation results in thin layer chromatography profiles

Rf value	Extract	EA3	EB3
1	0.60	0.50	0.49
2	0.48	0.40	0.50
3	0.34	0.32	0.32
4	0.24	0.24	0.22
5	-	0.16	0.14

It can be seen from the results of TLC above (fig. 2) shows that the presence of polymers with certain concentrations does not affect the compounds contained in the ethanol extract of *S. alba* leaves. So it can be concluded that each formula with 20% E100 Eudragit polymer (EA_3) and 20% ethocel 10 cP (EB_3) produce a stable formula. This is shown by the results of the spots on the TLC, which are evident when compared to the extract but also are considered based on the results of the particle size and the value of % EE that is better than other formulas.

Scanning electron microscope

Two of the best formulas have been obtained from the 6 formulas, namely, the formula using 20% eudragit E100 polymer (EA_3) and the formula using 20% ethocel 10 cP polymer (EB_3). The determination of the two best formulas is based on observations of particle size and % EE previously obtained. Microcapsules refer to particles with a diameter of 1-1000 µm. Microcapsules are usually assumed that the formulations described as microcapsules consist of active substances and polymer mixtures.

After scanning an electron microscope can see the difference between microcapsules using eudragit E100 and ethocel 10 cP polymers, namely microcapsules using Eudragit E100 polymers have a rough and porous surface (fig. 3. a1 and a2) while ethocel 10 cP has a smoother surface and less visible pores (fig. 3. b1 and b2). Microcapsules using Eudragit E100 have a particle size of 1.163 µm while those using Ethocel 10 cP have a particle size of 1.067 µm; this indicates that the resulting particle size has met the size requirements of the microcapsules.

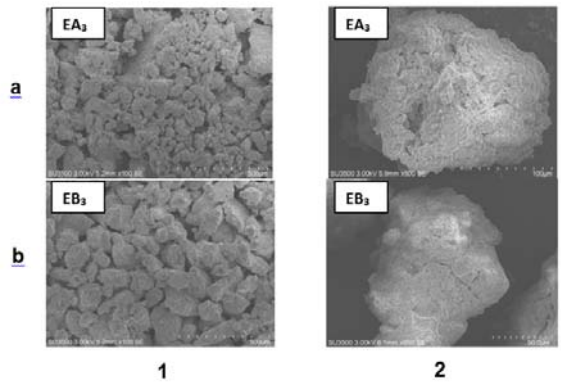

Fig. 3: SEM (Scanning electron microscope) Eudragit E100 and Ethocel 10 cP polymer microparticles at magnifications of 100x and 650x. a). Eudragit E100 (20%, EA_3) and b). Ethocel 10 cP (20%, EB_3), 1) magnifications of 100x and 2) magnifications of 650x

Antioxidant activity

The antioxidant reacts with stable free radical, DPPH and converts it to 1,1-Diphenyl-2-Picryl Hydrazine. The ability to scavenge the free radical, DPPH was measured at an absorbance of 517 nm. So the DPPH–RSA and its %inhibition of ethanol extracts of *S. alba* leaves that IC_{50} values 53.26 ppm and microcapsule showed that IC_{50} values 54.18 ppm (table 4). Ascorbic acid (Vitamin C) has taken as reference which showed 6.20 ppm (table 4). The Results showed that ethanol extracts of *S. alba* leaves and microcapsule contain ethanol extracts of *S. alba* leaves has potent antioxidant activity.

Table 4: Antioxidant activity of microcapsules from ethanol extract of *S. alba* leaves

Sample	IC_{50} (ppm)
Ascorbit acid	6.20±1.75
Ethanol extracts of *S. alba* leaves	53.26±1.24
Microcapsule (contain ethanol extracts of *S. alba* leaves)	54.18±1.24

Data are expressed as mean±SD, n=3, DPPH radical scavenging activity of *S. alba* leave ethanol extracts and microcapsule (contain ethanol extracts of *S. alba* leaves), each value is expressed as mean±SD (n = 3), means within each sample are significantly different, $p<0.05$.

According to Molyneux (2004), parameters for antioxidant testing based on the ability to inhibit free radicals 50% are categorized if<50 (Very Strong), 50-100 (Strong), 101-150 (Medium),>150 (Weak). The ability of vitamin C can inhibit free radical activity and is classified as very strong (IC_{50}<50 ppm), due to vitamin C having more hydroxyl groups in its structure so as to stabilize free radicals. While the antioxidant ability of ethanol extracts of *S. alba* leaves that IC_{50} values 53.26 ppm and microcapsule showed that IC_{50} values 54.18 ppm, this is because the extract contains fewer classes of compounds that are possible as a source of free radical stabilizing hydroxyl groups. Antioxidant activity is influenced by the number of hydroxyl groups that are able to donate hydrogen atoms to neutralize free radicals.

CONCLUSION

Based on the result, it concluded that microcapsules of *S. alba* leaves extract can be prepared by solvent evaporation technique (O/W: oil in water) using Eudragit E100 and Ethocel 10 cP as polymer. Characterization of the microcapsules revealed that the parameter process used on this method is applicable to produce microcapsules which stable in physical properties and also in pharmacological activity as antioxidant. The results of this study indicated that *S. alba* leaves extract microcapsule has potent antioxidant.

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CONFLICTS OF INTERESTS

No conflicts of interest is associated with this work.

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