Orginal Article

Shallot essential oil emulgel formulation and stability test using HPMC variations as an analgesic

Heru Nurcahyo[1]*, Sari Prabandari[1], Joko Santoso[1], Kusnadi[1]

[1]Department of Pharmacy, Polytechnic of Harapan Bersama, Tegal, Indonesia.

Correspondence: Heru Nurcahyo, Department of Pharmacy, Polytechnic of Harapan Bersama, Tegal, Indonesia. heru.nurcahyo@poltektegal.ac.id

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ABSTRACT

More than 70 percent of workers have musculoskeletal disorders (MSDs) and joint pain, which are characterized by abnormalities in the blood circulation system, muscles, tendons, joints, ligaments, bones, and nerves. More than 30 percent of workers choose to use herbal therapy as a complementary therapy to reduce the symptoms of MSDs. Shallot oil is one of the herbs that may be used as an analgesic, antipyretic, antioxidant, anti-inflammatory, and immunomodulator. The application of topical formulation in the form of emulgel is an interesting strategy and makes it easy to use. In this experimental method, shallots are dried and steam-distilled, S-allyl cysteine (SAC) is qualitatively tested using High-Performance Liquid Chromatography (HPLC), an emulgel is formulated using different forms of Hydroxy Propyl Methyl Cellulose (HPMC) and physical tests and cycling stability tests are conducted. The results of qualitative tests using HPLC on the SAC standard obtained a chromatogram with a retention time of 3.330 min and shallot essential oil at 3.223 min, where the chromatogram was in the same peak. The HPLC formulation produced stable organoleptic test results at concentrations of 2, 2.5, and 3%. However, formulation 2 yielded the best emulgel formulation based on the stability test using the cycling test method, where the results of the pH, spreadability, and viscosity tests remained stable until the sixth cycle test.

Keywords: Emulgel, Shallot, S-allyl cysteine, Hydroxy Propyl Methyl Cellulose

Introduction

More than 70 percent of workers have musculoskeletal disorders (MSDs) and joint pain [1]. They are characterized by abnormalities in the blood circulation system, muscles, tendons, joints, ligaments, bones, and nerves [2]. An investigation was carried out into the prevalence of MSDs caused by several things, like body mass index, namely overweight and obesity [3], significant imbalances of muscle and bone capacity [4], excessive workload [5, 6], accumulation of injuries [7], and poor posture at work [8].

More than 30 percent of workers choose to use herbal therapy as a complementary therapy to reduce the symptoms of MSDs [9]; doing a massage and providing topical traditional oils are options used to relieve pain and inflammation [10]; apart from that, it provides benefits in overcoming health problems [11], relieves symptoms [12], improves overall health [13], and has a cheaper perspective [14]. This is interesting to research and requires traditional products downstream to reduce the interference of these MSDs.

Research on Indonesian medicinal plants and herbal medicine has succeeded in identifying more than 4000 species [15], which are grouped as promotive and preventive measures, one of which is the shallot plant [15]. It can be used for muscle relaxation after activities. Based on in vivo research, shallot also has potential as an analgesic [16-18], antipyretic [19, 20], antioxidant [16, 21], and anti-inflammatory [16, 18, 21, 22].

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Materials and Methods

Tools and materials

The tools used are HPLC (Thermo Scientific Ultimate 3000); analytical balance (Sojikyo); oven type FCD-2000 (Memmert); refrigerator (Sharp); homogenizer (IKA); emulsifying equipment commonly used in laboratories; glass tool (Pyrex); pH meter (Ohous); spreadability test; and viscometer (Brookfield LV).

The materials used are shallot essential oil (PT. Syailendra Bumi Investama), magnesium chloride (Pharma Lab), HPMC (PT Bratachem), methylparaben (PT Bratachem), propylparaben (PT Bratachem), oleum MP (PT Bratachem), and aquadest (PT Bratachem).

Method of research

Preparation of essential oils

Shallots (Allium ascalonikum L.) 20 kg were washed under running water, chopped, and dried in the oven at 40 °C for 72 hours. When dry, they were ground using a blender and distilled by steam [23, 24].

Qualitative test of S-allyl cysteine (SAC) by HPLC

The columns used are a C-18 column, UV detector, and pump. After the HPLC tool is turned on, the pump is started using the mobile phase acetonitrile: aquabidest (50:50 v/v) flowing for ± 20 minutes with a flow rate of 1 ml/minute at an emulsifying wavelength of 195 nm until a baseline is obtained, which indicates that the system is stable.

Emulgel formulation and manufacturing method

Emulgel formulations were divided into Formulation 1 (F1), Formulation 2 (F2), and Formulation 3 (F3), which can be seen in **(Table 1)**.

Table 1. Emulgel formulation

Emulgel material	Formulation 1 (%)	Formulation 2 (%)	Formulation 3 (%)	Function
Onion Oil	5	5	5	Active substance
Magnesium Klorida	5	5	5	Active substance
HPMC	2	2,5	3	Emulgelling
Tween	1	1	1	Humektan, permeation enhancer
Methylparaben	0,18	0,18	0,18	Preservative
Propylparaben	0,02	0,02	0,02	Preservative
Ol MP	2	2	2	Aromatic
Aquadest ad	Ad100	Ad100	Ad100	Solvent

The formulation is made by weighing all the materials based on the calculation for the amount of emulgel formulation of 100 grams. Put the HPMC into the stirrer by heating at a temperature of 70 °C and a speed of 900 rpm until it is homogeneous to form mucilage; add magnesium chloride, which has been dissolved in water; add onion oil; add MP oleum, which has been mixed with nipagin and nipasol; and add tween 80. Stir until homogeneous to form an emulgel mass.

Emulgel stability test (Cycling test)

The cycling test is carried out starting on cycles 0-6. The emulgel formulation that will be tested was stored at a cold temperature of ± 4ºC for 12 hours in the refrigerator, removed, and stored at a temperature of ± 40ºC for 12 hours in the oven; this was calculated as 1 cycle [25].

Organoleptic test

The emulgel formulation that had been made was physically observed; including its color, odor, and texture.

Homogeneity test

Applying the emulgel formulation to a glass object performs homogeneity testing. This test aims to determine whether the emulgel formulation is homogeneous or not. This will be indicated by the absence of granules in the emulgel formulation.

Spreadability test

Test the spreadability by weighing 0.5 grams of the emulgel formulation in the middle of a round glass. The top round glass is weighed with a total weight of 250 grams for 1 minute. Then the diameter of the resulting emulgel was calculated.

pH Test

This test uses a pH meter that has been previously calibrated. The test is done by dipping the electrode in the emulgel formulation, where previously 0.5 grams of the emulgel formulation had been dissolved using 10 mL of distilled water.

Viscosity test

The viscosity test of the emulgel formulation is done using a tool in the form of a Brookfield LV Viscometer. Prepare spindle number 4, set the speed to 60 rpm, weigh 0.5 grams of emulgel dissolved in 10 mL of distilled water, and put the emulgel into the rotating spindle until the viscometer shows a constant number.

Data analysis

The analysis is done using Origin Pro 2017 with the double Y method and a histogram. The histogram was used to get an idea of the effect of increasing HPMC concentration on the stability test by observing the results of the viscosity.

Results and Discussion

The qualitative method for determining SAC using HPLC uses the acetonitrile mobile phase: aquabidest (50:50 v/v) with a flow rate of 1.0 ml/minute, and the stationary phase used is ODS, or Okta Desil Silica (C-18) [26]. This high-performance liquid chromatography condition was used to analyze the standard SAC solution and the levels of shallot essential oil samples. The results of the SAC standard at an injection concentration of 200 ppm obtained a chromatogram with a retention time of 3.330, as shown in **(Figure 1)**. The sample's test results showed a retention time that was nearly identical to the SAC standard. Retention time is the time interval required by the solute from injection until it leaves the column and the signal is captured by the detector [27]. In measuring the retention time of shallot essential oil samples obtained with a concentration of 200 ppm, namely 3.223 in **(Figure 2)**, this means that the samples used in the research contained SAC.

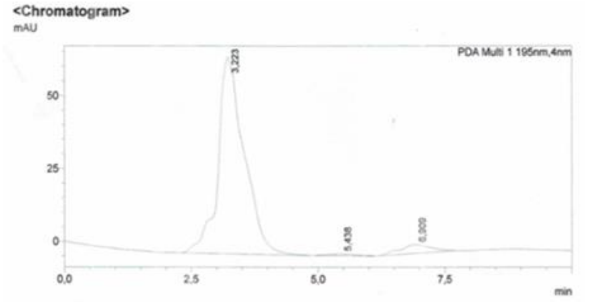

Figure 1. Chromatogram of the S-allyl cysteine (SAC) compound.

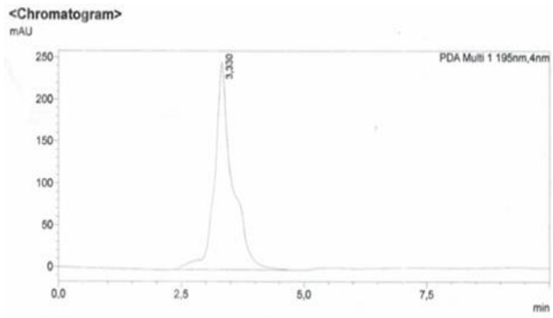

Figure 2. Chromatogram of shallot essential oil.

The cycling test method stability test was done by observing the physical stability parameters of the emulgel. The organoleptic test results show that the organoleptic observations from cycles 0 to 6 of the formulation did not change; the emulgel was stable whereas formulations 1, 2, and 3 showed a white, homogeneous, and aromatic smell. To show that the formulation must have a homogenous composition and that there are no discernible coarse grains, homogeneity emulgel's physical properties are tested [28]. There is no difference in texture; formulations 2 and 3 are slightly thicker than formulation 1, which is soft. This depends on HPMC; the thicker the emulgel, the higher its concentration [29-31] in **(Table 2)**.

Table 2. The Results of the Organoleptic Test

Cycle	Color			Homogeneity			Smell		
	F1	F2	F3	F1	F2	F3	F1	F2	F3
0	white	white	white	Homogeneous	Homogeneous	Homogeneous	aromatic	aromatic	aromatic
1	white	white	white	Homogeneous	Homogeneous	Homogeneous	aromatic	aromatic	aromatic
2	white	white	white	Homogeneous	Homogeneous	Homogeneous	aromatic	aromatic	aromatic
3	white	white	white	Homogeneous	Homogeneous	Homogeneous	aromatic	aromatic	aromatic
4	white	white	white	Homogeneous	Homogeneous	Homogeneous	aromatic	aromatic	aromatic
5	white	white	white	Homogeneous	Homogeneous	Homogeneous	aromatic	aromatic	aromatic
6	white	white	white	Homogeneous	Homogeneous	Homogeneous	aromatic	aromatic	aromatic

Table 3. The Results of the Spreadability, pH Test, and Viscosity

Cycle	Spreadability Test (cm) Daya Sebar (Cm)			pH			Viscosity (Cps)		
	F1	F2	F3	F1	F2	F3	F1	F2	F3
0	5,40 ±0,7	5,68 ±0,8	6,08 ±0,1	5,84 ±0,8	5,60 ±0,6	5,98 ±0,9	19516±30	19791±60	13206±60
1	5,25 ±0,6	5,70 ±0,8	4,83 ± 0,8	6,14 ±0,1	6,15 ±0,1	6,12 ±0,1	12718±60	12455±10	12908±30

2	5,27 ±0,6	6,17 ±0,1	6,60 ±0,6	6,08 ±0,8	6,13 ±0,1	6,14 ±0,1	19256±30	20405±10	20183±30
3	6,12 ±0,1	7,25 ±0,6	6,93 ±0,9	6,15 ±0,2	6,26 ±0,2	6,33 ±0,3	18953±30	19450±10	19213±30
4	5,73 ±0,8	7,25 ±0,6	6,83 ±0,8	6,34 ±0,3	6,45 ±0,4	6,49 ±0,4	18368±30	18345±10	18545±10
5	7,00 ±0,5	6,77 ±0,4	6,70 ±0,7	5,95 ±0,9	6,09 ±0,1	5,96 ±0,9	18248±30	23756±10	29091±60
6	6,77 ±0,3	6,77 ±0,4	6,57 ±0,6	6,25 ±0,2	6,36 ±0,3	6,32 ±0,3	19858±30	22610±10	23295±10

The pH test results on emulgel formulations 1, 2, and 3 fulfill the requirements; the data can be seen in **(Table 3)**. The emulgel formulation of shallot essential oil is safe for the skin [32]. The pH requirements for a good emulgel formulation range from 4.5 to 6.5 [25, 33]. pH measurements are carried out to determine the potential level of product irritation on the skin (Latifah), where good products have a pH that is similar to the skin's pH. Skin irritation or dryness can result from products that are too acidic or alkaline [34, 35]. A pH that is too alkaline can cause scaly skin, especially when scrub formulations have physical properties that erode the surface of dead skin [36]. Therefore, the pH of cosmetic formulations should be tried to be the same or as close as possible to the physiological pH of the skin, namely 4.5–6.5 [37, 38].

Based on the emulgel viscosity test using a Brookfield Viscometer RVT equipped with spindle no. 4 with a speed of 60 RPM (rounds per minute), it shows that the viscosity of shallot emulgel formulation for all formulations fulfills the requirements with a good viscosity value, which is based on SNI for a range 6000–40,000 cps (SNI 16-4399-1996) [25, 39]. The viscosity test results can be seen in **(Table 3)**.

Emulgel viscosity is an important property that determines the flow resistance of the emulgel formulation so that the emulgel can spread well on the skin surface [40]. The longer the emulgel's retention time in the workplace, the higher its viscosity [41]. Based on analysis using Origin Pro 2017 using the double Y method, the histogram in **Figure 3** is obtained.

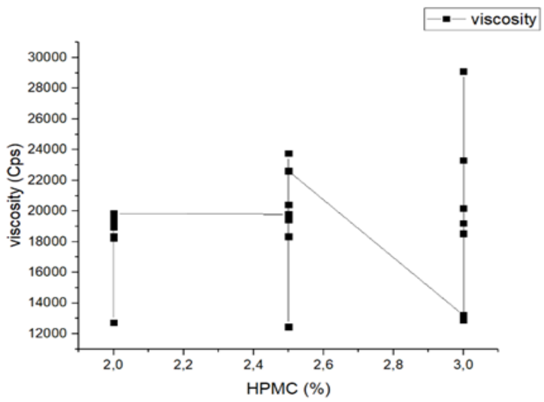

Figure 3. Histogram of the relationship between viscosity and HPMC concentration

The histogram shows that increasing the HMPC content will increase the viscosity value [42]. High concentrations of HPMC will increase the viscosity of the emulgel [43] and reduce the quality of the emulgel by reducing the spread of the emulgel on the skin [44]. In other studies, it was shown that increasing the HPMC content caused the emulgel to become darker and thicker in the form [45], increased viscosity [46], increased adhesive power [47], and decreased spreadability [48], but did not affect the homogeneity or pH of the emulgel [49, 50].

Conclusion

A chromatogram with a retention time of 3.330 minutes and a shallot essential oil retention time of 3.223 minutes, where the chromatogram was in the same peak, was obtained by qualitative tests using HPLC on SAC standards. The HPLC formulation resulted in stable organoleptic test results at concentrations of 2, 2.5, and 3%. Meanwhile, the cycling test method stability test showed that formulation 2 had the best emulgel formulation, with results from the pH, spreadability, and viscosity tests being stable until the sixth cycle of testing.

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Conflict of interest: None

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Ethics statement: None

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