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Emulgel formulation of wild cherry leaves (*Antidesma bunius* L. Spreng) extract and its antioxidant activity

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ABSTRACT

Background: The ethanol extract of wild cherry (*Antidesma bunius* L. Spreng) leaves has been studied as a free anti-radical in an emulgel formulation. The purpose of this study is to determine the physical properties of an emulgel made from an ethanol extract of wild cherry leaves, as well as its anti-radical activity.

Methods: The maceration method was used to extract wild cherry leaves in 96% ethanol, which were then evaporated with a rotary evaporator. An emulgel was prepared to contain a 3.56% thick extract. The physical properties of the emulgel were evaluated consisting of the organoleptic test, pH test, homogeneity test, spreadability test, and adhesion test. The DPPH was used to test free anti-radical activity.

Results: The emulgel of the ethanol extract of wild cherry leaves had a yellowish-green, thick texture, a distinct aroma of the extract, was homogeneous, pH 6, spreadability ranged from 4.4-6.2 cm, and adhesion of 5.5 second. Emulgel had a very weak antioxidant activity with an IC_{50} of 6238 ppm.

Conclusion: Further optimization of the formulation and storage conditions may be required to enhance the antioxidant potential of the wild cherry leaf extract emulgel for topical applications.

Keywords: Antidesma bunius, emulgel, free radical, wild cherry

Introduction

Free radicals, consisting of atoms or molecules with one or more unpaired electrons, exhibit instability and high reactivity, making them a significant concern in the context of human health [1]. These radicals can cause oxidative stress, which accelerates premature aging [2]. However, the detrimental effects of free radicals can be mitigated with antioxidants, which are reducing compounds found in various plant [3].

Phytocosmetics have drawn attention to plant-derived antioxidants. One such plant source is the wild cherry leaf (*Antidesma bunius* L. Spreng, local name: buni), which ethanol leaves extract has been demonstrated to possess strong antioxidant activity with an IC_{50} of 61.8 ppm [4]. Given the increasing public interest in natural products with antioxidant properties, there is significant potential for the development of topical preparations utilizing plant extracts.

Emulgel, a combination of emulsion and gel preparations, offers numerous advantages as a topical preparation, including enhanced drug release, ease of application, non-greasy texture, simple cleanup, moisturizing properties, non-staining, prolonged shelf life, and environmental friendliness [5]. In this study, we aimed to develop an emulgel formulation containing wild cherry leaf extract to harness its antioxidant potential. The resulting formulation was evaluated for its physical properties, including organoleptic characteristics, homogeneity, pH, spreadability, and adhesion, as well as its free radical scavenging activity using the DPPH method.

Methods

Lead extraction

Fresh wild cherry leaves were collected, washed, dried, and ground into a fine powder. A total of 500

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Table 1. Formula of emulgel preparation of wild cherry leaf extract

Materials	Concentration (% w/w)	Function
Wild cherry leaf extract	3.56	Main active
Hydroxypropyl methylcellulose (HPMC)	1	Gelling agent
Span 20	1.25	Emulsifier
Tween 20	1.2	Emulsifier
Liquid paraffin	7.5	Emollient
Propylene glycol	15	Humectan
Triethanolamine (TEA)	1 gtt	pH regulator
Methylparaben	0.18	Preservative
Propylparaben	0.02	Preservative
Isopropyl myristate	5	Penetration enhancer
Cetyl alcohol	5	Emulsion thickeners and stabilizers
Stearic acid	5	Emulsion thickeners and stabilizers
Aquadest	*ad* 50 g	Solvent

Table 2. Appearance of emulgel

Parameters	Result
Color	Yellowish-green
Odor	Extract scent
Texture	Solid
Homogeneity	Homogen

grams of this powder was macerated in 3 liters of 96% ethanol within a container for 48 hours, and the process was repeated three times to obtain the macerate. The filtrate obtained was subsequently evaporated using a rotary evaporator at 60°C to yield a concentrated extract.

Emulgel formulation

The emulgel formulation was adapted from the methods previously described [6,7]. The ethanol extract of wild cherry leaves was incorporated into the emulgel, as detailed in Table 1. The gel base was prepared by dispersing hydroxypropyl methylcellulose (HPMC) in hot water (80°C) and adding one drop of triethanolamine (TEA).

The oil phase of the emulsion was made by dissolving stearic acid and cetyl alcohol. Span 20, isopropyl myristate, and liquid paraffin were then added. The mixture was stirred until homogeneous and heated to 70°C. Concurrently, the water phase was prepared by dissolving Tween 20 in distilled water and incorporating methylparaben and propylparaben, previously dissolved in propylene glycol. The mixture was then heated to 70°C. The oil phase was combined with the water phase and mixed at 2000 rpm for 10 minutes until a homogeneous and thick emulsion was achieved.

The emulgel was formed by blending the emulsion with the ethanol extract of wild cherry leaves, stirring until homogeneous, and gradually incorporating this mixture into the gel base while stirring continuously.

Emulgel evaluation

The physical properties of the emulgel preparation were evaluated to ensure that it met the requirements, including organoleptic, homogeneity, pH, adhesion, and spreadability tests. Organoleptic properties assessed included odor, color, and appearance. The homogeneity test was performed by applying the preparation onto a glass slide. The pH test was conducted by inserting a pH strip into the preparation, waiting for approximately one minute, and then

measuring the pH by comparing the color on the pH strip with a universal pH standard [8].

Adhesion testing involved weighing 250 mg of emulgel and placing it between two glass surfaces. A 1000 g weight was applied for 5 minutes, and the sample was then mounted onto an adhesion testing device. The time required for the two glass surfaces to separate was recorded [6].

The spreadability test was performed by placing 500 mg of emulgel at the center of a glass surface, covering it with another glass surface, and allowing it to sit for 1 minute. The diameter of the spread was then measured. Additional weights ranging from 50 to 250 grams were applied every minute, and the diameter of the emulgel spread was measured with each incremental load [6].

Free radical scavenging activity of emulgel containing wild cherry leaf extract

A 0.1 mM DPPH (2,2-diphenyl-1-picrylhydrazyl) solution was prepared for the free radical scavenging assay. A 1000 ppm vitamin C standard solution was created by dissolving 50 mg of vitamin C powder in analytical grade ethanol, yielding a final volume of 50 mL. This solution was further diluted to obtain six different concentrations (1, 2, 3, 4, 5, and 6 ppm) for the calibration curve.

For the sample solution, 1 gram of emulgel was dissolved in analytical grade ethanol in a 50 mL volumetric flask, resulting in a 20,000 ppm solution. This mixture was centrifuged for 10 minutes, and the resulting filtrate was collected. The filtrate was then diluted to produce nine concentrations (1000, 2000, 3000, 4000, 5000, 6000, 7000, 8000, and 9000 ppm).

Each standard or sample solution was mixed with the 0.1 mM DPPH solution in a 2:2 ratio. The mixtures were transferred to amber vials and vortexed. All solutions were incubated in a dark environment at room temperature for 30 minutes. Subsequently, the absorbance of each solution was measured using a UV-Vis spectrophotometer at a wavelength of 517 nm. The free radical scavenging activity was calculated using the following formula:

$$\% \text{ Free Radical Scavenging} = [(Ab - Aa) / Ab] \times 100\%$$

where Ab represents the absorbance of the DPPH solution, and Aa denotes the absorbance of the standard or emulgel sample.

The concentration of the emulgel or standard that exhibited 50% radical scavenging (IC_{50} value) was determined from the linear regression of concentration vs. percentage inhibition.

Results

Organoleptic and homogeneity test results

Organoleptic testing was conducted to evaluate the color, texture, and odor of the emulgel preparation containing the ethanol extract of wild cherry leaves. The results revealed that the emulgel exhibited a yellowish-green color, a thick texture, and a distinct aroma characteristic of the extract. Homogeneity testing was performed to ensure that the ingredients were uniformly mixed, as homogeneous preparations can provide a comfortable sensation when applied to the skin, without the presence of coarse particles [9]. In this study, the emulgel preparation demonstrated homogeneity, as evidenced by the absence of coarse particles in all three tests.

pH test results

The purpose of the pH test is to assess the acidity of the preparation, ensuring that it does not cause skin irritation. A pH value within the range of 4.5 to 6.5 is considered compatible with skin pH [10]. The pH of the emulgel preparation was determined to be 6, indicating that it falls within the acceptable pH range. A pH value below this range may lead to skin irritation, while a value above the range could cause the skin to become dry and scaly.

Adhesion test results

The objective of the adhesion test is to evaluate the ability of the preparation to adhere to the skin. Greater adhesion facilitates higher drug absorption through the skin. On the other hand, if the adhesion between the preparation and the skin is suboptimal, the drug may be easily removed from the skin. An adhesion time of 4 seconds or more is considered ideal for a preparation [11]. In this study, the adhesion time for the emulgel preparation was 5.5 seconds, indicating that the preparation meets the specified requirements.

Spreadability test results

The spreadability test is designed to assess the ease with which a preparation can be spread when applied to the skin. A preparation with good spreadability ranges from 5 to 7 cm. Greater spreadability indicates that the active substance can disperse more extensively and

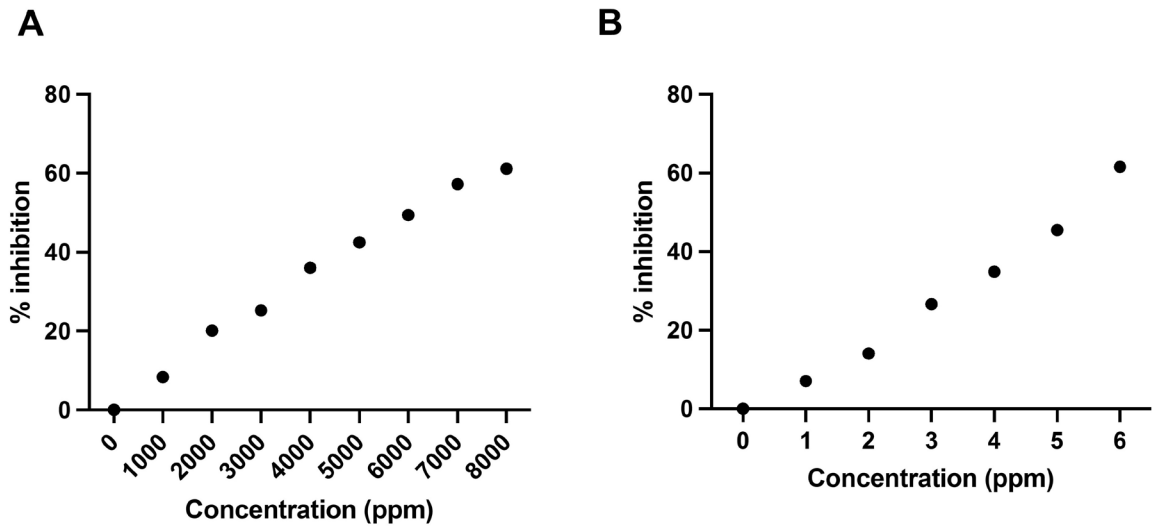

Figure 1. Free radical scavenging activity. (A) Emulgel of wild cherry leaf extract, (B) vitamin C

come into contact with a larger area of the skin [10]. In this study, the emulgel preparation demonstrated a spreadability ranging from 4.44 to 6.25 cm.

Free radical scavenging activity of emulgel

The maximum wavelength measurement for DPPH was 517 nm, with an absorbance of 0.5603. This finding aligns with Molyneux's (2004) report, which stated that the maximum wavelength for DPPH is 517 nm [12]. The determination of the optimal operating time aims to identify the ideal incubation period for the sample and the DPPH solution to react completely. Stable absorbance at a specific time characterizes the operating time. In this study, the operating time was determined to be 30 minutes.

As the concentration of the test compound increases, the intensity of the DPPH color decreases, indicating the presence of antioxidant activity. For the wild cherry leaf extract emulgel, the regression equation $y = 0.0073x + 4.4596$ was obtained with an R^2 value of 0.9884, resulting in an IC_{50} value of 6238.41 ppm (Figure 1).

Discussion

Wild cherry leaves have been extracted and formulated into emulgel preparations for use as free radical scavengers. The emulgel preparation has been characterized by its physical properties, including organoleptic, homogeneity, pH, adhesion, and spreadability. A good semi-solid preparation for topical use can have a spreadability range of 3-5 cm [13]. The emulgel preparation created in this study meets these requirements.

Vitamin C is used as a comparator because it exhibits strong free radical scavenging activity, and is relatively safe, non-toxic, and readily available. The IC_{50} measurement result of vitamin C is 5.22 ppm, classified as a powerful antioxidant [14]. In contrast, the IC_{50} value of the emulgel preparations containing wild cherry leaf extract is 6238 ppm. IC_{50} values above 200 ppm still exhibit free radical scavenging activity, but the activity is classified as very weak [13]. Compared to vitamin C, the free radical scavenging activity of the emulgel preparations containing wild cherry leaf extract is very weak.

This discrepancy may be attributed to several factors, such as excessive heating during the extract thickening process and the length of time between storing the extract and emulgel samples and testing their antioxidant activity. This study spanned approximately three months, from maceration to antioxidant testing. The maximum storage life of samples is between 1-2 months; beyond this time, an increase in sample concentration is necessary to achieve the maximum percentage of inhibition [15].

As the sample storage time increases, the percentage of sample inhibition decreases. The impact of storage on the preparation, in addition to being influenced by storage duration, can also be affected by environmental factors such as light exposure, which can cause oxidation processes that reduce antioxidant activity, and inadequate packaging methods that allow the preparation to be in greater contact with

the environment, thus diminishing its antioxidant activity [16].

Conclusion

The emulgel formulated with wild cherry leaf ethanol extract exhibits yellowish-green physical properties, a distinctive extract aroma, a thick consistency, a pH of 6, homogeneity, an adhesion time of 5.46 seconds, a spreadability range of 4.44-6.25 cm, and very weak antioxidant activity. Further optimization of the formulation and storage conditions may be required to enhance the antioxidant potential of the wild cherry leaf extract emulgel for topical applications.

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None.

Author contributions

WAS contributed to design the research concept, collect the data; YA contributed to analyze the data, and write the manuscript; DAPK contributed to collect the data and write the manuscript; WAS, YA approve the the final version of the manuscript.

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