Int. j. adv. multidisc. res. stud. 2023; 3(5):1008-1012

Received: 25-08-2023
Accepted: 05-10-2023

International Journal of Advanced Multidisciplinary Research and Studies

ISSN: 2583-049X

Formulation of Antioxidant Gel Biocosmetic Made of Cinnamon Bark Extract

[1] Sholichah Rohmani, [2] Tri Hastuti Fathimah, [3] Dian Eka Ermawati, [4] Heru Sasongko, [5] M Fiqri Zulpadly, [6] Diyah Tri Utami, [7] Nindita Clourisa Amaris S, [8] Annisa Diyan Meitasari, [9] Ulfa Afrinurfadhilah D, [10] Meta Kartika Untari

[1, 2, 3, 4, 5, 6, 7, 8, 9, 10] Departement of Pharmacy, Vocational School, Sebelas Maret University, Surakarta, Indonesia

Corresponding Author: **Sholichah Rohmani**

Abstract

Free radicals can damage collagen in the skin, which accelerates premature aging. Cosmetic preparations containing antioxidants are needed to slow down the premature aging process. Cinnamon bark is known to be able to fight free radicals due to the presence of cinnamaldehyde which is an antioxidant compound. Cinnamon bark extract is made into a gel preparation to make it easier to apply to the skin. This study aimed to determine the antioxidant activity of cinnamon bark extract in gel preparations. The extract was formulated in a gel with concentrations of 0.5%, 1%, and 2%. The gel's physical property evaluation included the tests of organoleptic, homogeneity, pH, spreadability, adhesion, viscosity, and antioxidant. The results indicated that adding different concentrations of the cinnamon bark extract did not show a significant difference in the evaluation of the gel's physical properties, which were the tests of organoleptic, pH, homogeneity, spreadability, adhesion, and viscosity. The cinnamon bark extract had a moderate antioxidant activity with an IC 50 value of 209.84±3.1. Each formula showed inactive antioxidant activity with IC 50 >500 ppm.

Keywords: Antioxidant, Gel, Cinnamon Bark

Introduction

The pharmaceutical industry has been developing herbal medicines derived from plants, including cosmetic preparations. Frequently, cosmetic preparations encountered are topical preparations containing extracts from plants. One is a preparation containing natural antioxidants that can protect the skin from free radicals. Free radicals are atoms or groups with one or more unpaired electrons.

Free radicals are also found in the environment, including cigarette smoke, environmental pollution, and ultraviolet rays [1]. Free radical compounds can trigger premature skin aging, such as reduced elasticity of skin collagen tissue, making the skin wrinkled, rough, and dry. The excess water evaporation can cause rough and dry skin, which causes skin dehydration. Therefore, skin protection is needed, such as skin moisturizing cosmetics containing antioxidants [2]. Cinnamon bark has potent antioxidant activity [3]. The cinnamaldehyde compound in cinnamon bark is an effective antioxidant against free radicals [4]. In addition, the content of chemical compounds such as phenols, terpenoids, and saponins is also a source of antioxidants [5]. Meanwhile, the content of tannins and flavonoids also acts as an antioxidant [6].

The strength of antioxidant activity can be seen in the IC 50 value of a compound. The antioxidant activity of cinnamon bark extract at a concentration of 1% has an IC 50 of 9.431 ppm [7]. It indicates that cinnamon bark extract has robust antioxidant activity since the IC 50 value is < 50 ppm [8]. Cinnamon bark extract is made into a topical preparation to increase ease of use.

The use of cinnamon bark extract requires a carrier, that is, a topical preparation that quickly penetrates the skin; one of which is a gel preparation. Cosmetics widely use gel preparations due to their rapid spread to the skin's surface, well-release active substances, high adhesion, cooling effect on the skin, and easily washed off with water [9].

Consequently, the researchers were concerned with making gel preparations from cinnamon bark extract, as well as seeing their antioxidant activity before and after the dosage forms were made based on the IC 50 value.

Materials and Methods

Instruments and Materials

The Instruments used in this study were analytical balance (Denver Instrument), glassware (Pyrex), rotary evaporator, oven (Oven Memmert), pH meter (Hanna HI-98107), spreadability tester, adhesiveness tester, microscope, viscometer (Rion Viscotester VT-04), micropipette (Socorex), UV-Vis spectrophotometer. The materials used in this study were Cinnamon bark, 96% ethanol, Aquadest, Carbopol, propylene glycol, nipagin, Triethanolamine, DPPH.

Cinnamon Bark Extraction

The cinnamon bark was extracted by maceration method using 96% ethanol solvent with the simplicial: solvent ratio of 10:75 for three days. The 600-gram simplicial of cinnamon bark was moistened with 4.5 liters of 96% ethanol, and then stirred evenly to accelerate saturation. The macerate was filtered, and then concentrated using a rotary evaporator to obtain a thick extract.

Cinnamon Bark Extract Evaluation

Organoleptic test

The organoleptic test was carried out bylooking at the physical properties of the extract, including consistency, color and odor.

Rendement test

The resulting thick extract from the cinnamon bark was weighed entirely, and then the Rendement percentage (%) was calculated.

Formulation of Cinnamon Bark Extract Gel

Table 1: Formulation of cinnamon bark extract

Materials	F I	F II	F III
Cinnamon bark extract	0,5%	1%	2%
Carbopol	3%	3%	3%
Propylene-glycol	15%	15%	15%
Nipagin	0,03%	0,03%	0,03%
Triethanolamine	2%	2%	2%
Aquadest	ad 50 g	ad 50 g	ad 50 g

Information:
FI: Formulation I (0.5% extract concentration)
FII: Formulation II (1% extract concentration)
FIII: Formulation III (2% extract concentration)

Method:

(1): Carbopol was developed in a mortar with hot Aqua Dest in the amount of 10 times its weight for 30 minutes, then crushed until it was completely dispersed and a gel base was formed; (2): cinnamon bark extract, nipagin, propylene glycol, and TEA (triethanolamine) dissolved in a porcelain cup. Mix (2) with (1) in a mortar until a gel mass is formed. After the gel mass is formed, the remaining Aqua Dest is added to the mortar little by little. Mixing was carried out at room temperature.

Tests of Chemical-Physical Properties

Organoleptic test

This test was intended to determine the visual appearance related to shape, color, odor, and consistency.

pH Test

This test was carried out using a pH meter to determine the skins acceptance of the preparation.

Homogeneity Test

This test was to determine the level of homogeneity of the preparation. The cinnamon bark extract gel was smeared thinly on a slide, then covered with another slide, and observed under a microscope.

Spreadability Test

This test was to find out how much the gel spreads. About 0.5-gram cinnamon bark extract gel was placed in the middle of a petri dish attached to a millimeter block. Another petri dish was placed on top of the gel. Leave it for one minute, then measure the diameter of the spread. Add the 50 gram, 100-gram, and 150-gram weights; each one was left for one minute, and then the diameter of the spread was measured.

Adhesion Test

This test was to find out how long the gel could be attached to the skin surface. About 0.5-gram cinnamon bark extract gel was placed between two glass slides, and then the 1 kg weight was placed on it for 5 minutes. The object glass was placed on the test equipment, and then the 80-gram weight was released. The time when the two slides were released was recorded.

Viscosity Test

The viscosity measurement was done by placing the sample in the viscometer until the spindle was submerged. Set the spindle at 50 rpm [10].

Test of Antioxidant Activity

In the extract sample solution, a concentration series of 50, 100, 150, 200, and 250 ppm were made. A total of 4.0 mL of 0.1 mM DPPH solution was added to 20 µL, 40 µL, 60 µL, 80 µL, and 100 µL stock extract solution. In the sample formula solution, concentration series of 1000, 2000, 3000, 4000 and 5000 ppm were made. A total of 4.0 mL of 0.1 mM DPPH solution was added to 20 µL, 40 µL, 60 µL, 80 µL, and 100 µL of the formula solution. The solution was shaken for a minute and incubated. The absorbance of the sample solution was read using a UV-Vis spectrophotometer at maximum λ (518 nm).

Results and Discussion

Results of the Quality Control of the Cinnamon Bark Extract

Organoleptic Test

The extraction resulted in cinnamon bark extract with a thick mass consistency, dark brown color, and a distinctive smell of cinnamon.

Rendement Test

The rendement test aimed to determine the levels of the extract obtained from the extraction method used, the result was 20.04%.

Evaluation Results of the Physical Properties of the Cinnamon Bark Extract

Organoleptic Test

The organoleptic test aimed to determine the preparation's consistency, color, and odor; the observation was adequate using the five senses. The results of organoleptic observations of cinnamon bark extract gel can be seen in Table 2.

Table 2: Organoleptic Observation Results of the Cinnamon Bark Extract Gel

Formulation	Color	Smell	Consistency
F I	Dark brown	distinctive cinnamon smell.	semi-solid consistency
F II	Dark brown	distinctive cinnamon smell.	semi-solid consistency
F III	Dark brown	distinctive cinnamon smell.	semi-solid consistency

Homogeneity Test

The homogeneity test aimed to determine the mixability of ingredients in gel preparations. Homogeneous gels could even affect the skin since the active ingredients were not spread evenly in the preparation. The homogeneity test results on formulas I, II, and III showed homogeneous results. However, in Formula III, the extract was less soluble in the gel base since the extract dried easily, so its solubility in a mixture of propylene glycol, TEA, and nipagin was reduced.

pH Test

The pH test needed to be done to determine the safety of topical preparations when applied to the skin. If it were too acidic, it would cause skin irritation. Conversely, if it were too alkaline, it would cause scaly skin. The pH observation results of the cinnamon bark extract gel can be seen in Table 3.

Table 3: pH Observation Results of the Cinnamon Bark Extract Gel

Formulation	pH (±SD)
F I	7,18±0,03
F II	7,18±0,02
F III	7,16±0,01

The pH test results in Formula I was 7.18±0.03, 7.18±0.02 in Formula II, and 7.16±0.01 in Formula III. These results indicated that the pH of all formulas in cinnamon bark extract gel preparations met the pH requirements that were safe for the skin, namely 5-10 [11]. However, this did not correspond to the conditions required for stable cinnamaldehyde (phenol); since phenol is stable in an acidic environment, it will affect its antioxidant activity. Furthermore, a statistical test using one-way ANOVA was carried out to determine the significance of the relationship between the addition of extract concentration and the pH of the gel preparation. The ANOVA test showed a significance value of 0.478 (>0.05), meaning there was no significant relationship between the addition of the extract concentration and the pH of the gel preparation.

Spreadability Test

The spreadability test in topical preparations was intended to determine the spreading ability of the gel. The spreading power of the gel is directly proportional to the speed with which the gel spreads; the greater the value of the diameter of the spreading power, the higher the speed of the gel spreading with only a little application; thus, the contact of the drug with the skin surface will increase [12]. The observation results of the spreadability of cinnamon bark extract gel can be seen in Table 4.

Table 4: Spreadability Observation Results of the Cinnamon Bark Extract Gel

Formulation	Spreadability ((±SD) cm)
F I	6,98±0,05
F II	5,10±0,51
F III	3,90±0,12

Based on these results, it can be seen that the more extracts added, the smaller the spread. This was because adding the extract increased the thickness of the gel preparation. Topical preparations have a diameter of 5-7 cm [12]. Therefore, only Formula I did not have good coverage because the higher the concentration of the extract, the less effective it was. The ANOVA test showed a significance value of 0.065 (>0.05), meaning that there was no significant difference in adding extract concentration to the spreadability of the gel preparation.

Adhesion Test

The adhesion test aimed to determine how long the topical preparation adhered to the skin surface. The thicker the consistency of the topical preparations, the longer the adhesion. The thicker the topical preparation, the longer the drug contact on the skin surface [13]. The adhesion observation results of cinnamon bark extract gel can be seen in Table 5.

Table 5: Adhesion Observation Results of the Cinnamon Bark Extract Gel

Formulation	Adhesion ((±SD) s)
F I	0,73±0,04
F II	1,48±0,08
F III	1,53±0,06

The adhesion test results showed the time needed for the two slides to detach. Based on these results, the addition of extract concentration to the preparation increased the adhesion of the cinnamon bark extract gel. This was because adding the extract could increase the viscosity of the gel so that the longer two slides were released. Good adhesion requires not less than 4 seconds [14]. All formula's adhesions were < 4 seconds, so they did not meet good gel adhesion. The ANOVA test showed a significance value of 0.467 (> 0.05), meaning that there was no significant difference in adding extract concentration to the adhesion of the gel preparation.

6. Viscosity Test

Viscosity is a statement of the resistance of a liquid to flow. The higher the viscosity, the greater the resistance [15].

Table 6: Viscosity Observation Results of the Cinnamon Bark Extract Gel

Formulation	Viscosity ((±SD) d.Pa.s)
F I	1.797,33±0,32
F II	2.108,00±0,31
F III	2.679,67±0,74

These data showed that adding the extract concentration increased the cinnamon bark extract gel's viscosity because the higher the addition of thick extract concentration, the higher the viscosity obtained. Carbopol has a viscosity of 400-600 d.Pa.s [16]. Each formula showed a viscosity of >600 d.Pa.s due to adding >2% Carbopol. The ANOVA test showed a significance value of 0.187 (>0.05), meaning that there was no significant difference in the addition of extract concentration to the viscosity of the gel preparation.

Test Results for Antioxidant Activity of Cinnamon Bark Extract Gel

Cinnamon bark has a high content of cinnamaldehyde. Cinnamaldehyde, a phenolic compound, has high antioxidant activity [17]. This test uses a UV-Vis spectrophotometer to obtain the DPPH absorbance value for each sample. Furthermore, based on the absorbance value, the percentage of inhibition can be calculated to find the amount of damping on DPPH. Then the IC 50 value can be calculated to determine the minimum concentration of cinnamon bark extract gel that can reduce DPPH (free radicals). IC 50 results can be seen in Table 7.

Table 7: IC 50 Results

Formulation	IC50 (±SD)
Vitamin C serum 10%	568,30±0,31
Cinnamon bark extract	209,84±0,10
F I	7839,17±0,91
F II	4450,01±0,09
F III	5238,10±0,36

Cinnamon bark extract is classified as a moderate antioxidant (IC50 101-250 ppm). This is different from the research by Mutiara *et al*. [7], which stated that the IC50 value of cinnamon bark extract was 9.431 ppm. This difference can be caused by several factors, such as where the cinnamon grows and different extraction treatments. In this study, during the maceration stage for 3 days no solvent replacement was carried out, causing compound withdrawal to be not optimal. Formulas I, II and III showed inactive antioxidant activity (IC50 > 500 ppm). The difference in the antioxidant activity of pure extracts and preparations containing extracts is because the extracts are incompatible with the excipients contained in the gel preparations. Each preparation showed a neutral pH (±7). This does not meet the atmosphere required for stable cinnamaldehyde. Cinnamaldehyde, a phenolic compound, can be stable at pH 5-6 [18].The ANOVA test showed a significance value of 0.000 (<0.05), which means that there was a significant difference in the increase in the concentration of the extract on the activity of the antioxidant gel.

Conclusion

Antioxidant activity of cinnamon bark extract gel belong to inactive antioxidants (IC50 >500 ppm). The higher the concentration of cinnamon bark extract, the lower IC50 value, so the higher the antioxidant activity of the gel.

The addition of the concentration of stem bark extract cinnamon did not show a significant difference to pH test results, test homogeneity, spreadability test, adhesion test and viscosity test.

Acknowledgement

We would like to thank Sebelas Maret University Surakarta for funding this research through a HGR grant in 2023.

References

1. Chen J, Liu Y, Zhao Z, Qiu J. Oxidative stress in the skin: Impact and related protection. International Journal of Cosmetic Science. 2021; 43(5):495-509. Doi: doi:org/10.1111/ics.12728
2. Hoang HT, Moon JY, Lee YC. Natural Antioxidants from Plant Extracts in Skincare Cosmetics: Recent Applications, Challenges and Perspectives. Cosmetics. 2021; 8(4):p106. Doi: doi:org/10.3390/cosmetics8040106
3. Sirait TS, Arianto A, Dalimunthe A. Phytochemical Screening of Cinnamon Bark (Cinnamomum burmanii) (C. Ness & T. Ness) C. Ness ex Blume Ethanol Extract and Antioxidant Activity Test with DPPH (2,2-diphenyl-1-picrylhydrazyl) Method. International Journal of Science, Technology & Management. 2023; 4(1):254-259. Doi: doi:org/10.46729/ijstm.v4i1.739
4. Tafzi F. Bioactivity of Cinnamon (Cinamomum sp). Indonesian Food Science and Technology Journal. 2019; 3(1):18-22. Doi: doi:org/10.22437/ifstj.v3i1.10191
5. Djarot P, Yulianita, Utami NF, Putra AM, Putri YIM, Muhardianty SM, *et al*. Syaepulrohman, A. Bioactivities and Chemical Compositions of Cinnamomum burmannii Bark Extracts (Lauraceae). Sustainability. 2023; 15(1696):1-15. Doi: doi:org/10.3390/su15021696
6. Harborne JB. Metode Fitokimia Penuntun Cara Modern Menganalisis Tumbuhan. Bandung: ITB Press, 2006.
7. Mutiara R, Priani SE, Mulyanti D. Uji Aktivitas Antioksidan Ekstrak Kulit Batang Kayu Manis (Cinnamomum burmanni (Nees & T. Nees) Bl.) dan Formulasinya dalam Bentuk Sediaan Masker Gel Peel Off. Prosiding Penelitian SPeSIA Unisba. 2015; 2(1):602-606. Doi: http://dx.doi.org/10.29313/.v0i0.2132
8. Priani SE, Mutiara R, Mulyanti D. The development of antioxidant peel-off facial masks from cinnamon bark extract (Cinnamomum burmannii). Pharmaciana. 2020; 10:69-76. Doi: 10.12928/pharmaciana.v10i1.14193.
9. Zagórska DM, Sobczak M. Hydrogel-Based Active Substance Release Systems for Cosmetology and Dermatology Application: A Review. Pharmaceutics. 2020; 12(5):p396. Doi: 10.3390/pharmaceutics12050396
10. Hosny KM, Rizg WY, Khallaf RA. Preparation and Optimization of In Situ Gel Loaded with Rosuvastatin-Ellagic Acid Nanotransfersomes to Enhance the Anti-Proliferative Activity. Pharmaceutics. 2020; 12(3):p263. Doi: doi.org/10.3390/pharmaceutics12030263
11. Nurul PS, Rini DS, Rifka AA. Effectiveness of Jatropha Curcas (Jatropha Curcas) As a Burn Healing Gel Preparation. Journal of Health, Technology and Science. 2023; 3(3):58-67. Doi: doi:org/10.47918/jhts.v3i3.846
12. Bakhrushina E, Anurova N, Zavalniy S, Demina B, Bardakov I, Krasnyuk I. Dermatologic Gels Spreadability Measuring Methods Comparative Study. International Journal of Applied Pharmaceutics. 2022; 14(1):164-168. Doi: 10.22159/ijap.2022v14i1.41267

13. Ariyanthini K, Angelina E, Permana K, Thelmalina F, Prasetia I. Antibacterial Activity Testing of Hand Sanitizer Gel Extract of Coriander (Coriandrum Sativum L.) Seeds against Staphylococcus Aureus. Journal Pharmaceutical Science and Application. 2021; 3(2):98-107. Doi: 10.24843/JPSA.2021.v03.i02.p06
14. Ermawati DE, Ramadhani CI. Formulation of Anti-Acne Gel of Moringa oleifera, L. Ethanolic Extract and Antibacterial Test on Staphylococcus epidermidis. Majalah Farmaseutik. 2020; 16(2):154-162. Doi: doi:org/10.22146/farmaseutik.v16i2.50319
15. Nurman S, Yulia R, Irmayanti, Noor E, Candra Sunarti T. The Optimization of Gel Preparations Using the Active Compounds of Arabica Coffee Ground Nanoparticles. Scientia Pharmaceutica. 2019; 87(4):p32. Doi: doi.org/10.3390/scipharm87040032
16. Ismail SH, Hamdy A, Ismail TA, Mahboub HH, Mahmoud WH, Daoush WM. Synthesis and Characterization of Antibacterial Carbopol/ZnO Hybrid Nanoparticles Gel. Crystals. 2021; 11(9):p1092. Doi: doi.org/10.3390/cryst11091092
17. Christiany C, Sudrajat SE, Rahayu I. The Potency of Cinnamomum Zeylanicum to Prevent Diseases: A Review. Eureka Herba Indonesia. 2021; 2(1):49-58. Doi: org/10.37275/ehi.v2i1.11
18. Clark, Jim. The Acidity of Phenol 2023 [Internet]. Cornwall: Clark, Jim. The Acidity of Phenol [updated 2023; cited 2023 March 13], 2023. Available from: https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Supplemental_Modules_(Organic_Chemistry)/Phenols/Properties_of_Phenols/Acidity_of_Phenols