

## PHENOLIC CONTENT AND ANTIOXIDANT PROPERTIES OF SOME NATURAL COSMETIC CREAMS WITH PLANT-DERIVED INGREDIENTS AVAILABLE ON THE SERBIAN MARKET

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**Abstract:** The main goal of this study is to determine some properties of natural cosmetic creams that may have benefits for the skin. Five different cosmetic cream formulations with ingredients of botanical origin such as plant extracts, plant oil macerates, or essential oils were subjected to determine their phenolic content and antioxidant activity using the DPPH method. Total phenolic compounds were detected in all tested samples in the range of 1.7 to 0.2 mg GA/g but some samples did not contain flavonoids and did not possess antioxidant activity. The highest phenolic content and the strongest antioxidant activity were recorded for samples with the highest number of ingredients of plant origin.

**Keywords:** natural cosmetics, plant extracts, phenolic compounds, antioxidant activity

### Introduction

The global cosmetics market value is expected to reach \$716.6 billion by 2025. With such a considerable rise in the cosmetics market, many consumers seek products free or with minimal quantities of synthetic chemical compounds, considering such products as "greener" or "safer" for use and more beneficial for their healthy lifestyle. The development of greener and value-added cosmetics may emphasize the environmental, social, and economic positive impact of the cosmetic industry. These requirements have resulted in new approaches and innovations in the cosmetic industry, and, as a response, many new products are developed with ingredients of natural origin mainly derived from plants (Ferreira et al., 2022; Halla et al., 2018). One of the largest cosmetic product groups on the market is cream. The most common materials used in cosmetic cream preparation are water, oily materials (oils, fats), humectants, antioxidants, preservatives, pharmaceutical agents, and fragrances. Plant-derived ingredients in cosmetics are preferred instead of some synthetic

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compounds, mainly due to their better biocompatibility and biodegradability, low toxicity, and good protecting properties of the skin against UV irradiation, inflammation, infection, and hydration. According to the recent statistics natural cosmetics account for 3% of all cosmetic sales in Europe and their market share increased by 20% a year. The most common botanical cosmetic ingredients are vegetable oils, plant extracts, and essential oils (Dănilă et al., 2019). Many bioactive compounds presented in these plant-derived ingredients, namely, phenolic acids, flavonols, anthocyanins, carotenoids, and vitamins, when isolated or in combined extracts have beneficial effects on the skin such as antioxidant, anti-inflammatory, anticarcinogenic, and antibacterial properties (Alaya et al., 2021).

There are many cream formulations on the Serbian market with the addition of some ingredients from botanical origin or declared as natural cosmetics. Most of them are declared as creams with specific botanical ingredients for skin care but there is no data about some specific biological effect of that formulation, there is only information about the biological effects of the herbal ingredient itself. The main goal of this study is to determine some properties of natural cosmetic creams available on the Serbian market that may have benefits for the skin. Five different cosmetic cream formulations with ingredients of botanical origin such as plant extracts, plant oil macerates, or essential oils were subjected to determine their phenolic content and antioxidant activity using the DPPH method.



Figure 1. Photographs with main data of tested cream samples

### Materials and methods

#### Extraction

Five different cosmetic cream formulations were collected in retail stores in Kragujevac (Serbia) during January 2024. The appearance, main data, and list of ingredients of analyzed samples are shown in Figure 1 and Table 1. For the determination of the total phenolic and flavonoid content of collected samples, as well as their antioxidant properties, creams were extracted with 96% ethanol. For this purpose, 5 g of cream sample was mixed with 50 mL of ethanol and heated with constant stirring in a water bath until completely melted. Then, the extraction was continued on an ultrasound bath (40°C) for 20 min. After cooling to room temperature, samples were left overnight in the refrigerator and then centrifuged for 15 min at 4000 rpm. The obtained ethanolic extract was decanted and used for further analyses.

Table 1. Ingredient list of tested cream samples

| Sample | Ingredients (INCI)  |
|--------|---|
| 1      | Olea Europaea Fruit Oil, Calendula Officinalis Flower Oil, Aqua, Beeswax, Cocos Nucifera Oil, Hypericum Perforatum Oil, Lavandula Angustifolia Essential Oil, Calendula Officinalis Flower Extract, Tocopheryl Acetate, Propolis, Mentha Piperita Essential Oil, Hypericum Perforatum Flower Extract, Benzyl Alcohol, Dehydroacetic Acid  |
| 2      | Olea Europaea Fruit Oil, Helichrysum Arenarium Flower Oil, Matricaria Chamomilla Flower Oil, Calendula Officinalis Flower Oil, Butyrospermum Parkii Butter, Beeswax, Aqua, Prunus Dulcis Oil, Macadamia Ternifolia Oil, Corylus Avellana Oil, Persea Gratissima Oil, Rosmarinus Officinalis Essential Oil, Tocopheryl Acetate, Melaleuca Leaf Essential Oil, Benzyl Alcohol, Dehydroacetic Acid   |
| 3      | Aqua, Helichrysum Angustifolium Flower Water, Sorbitan olivate (and) Cetearyl olivate, Glycerin, Niacinamid, Simmondsia Chinensis Oil, Butyrospermum Parkii Butter, Cannabis Sativa Seed Oil, Olea Europaea Fruit Oil, Calendula Officinalis Flower Oil, Squalane, Aloe Barbadensis Leaf Extract, Tocopheryl Acetate, Cananga Odorata Flower Essential Oil, Benzyl Alcohol, Hyaluronic Acid, Cucumis Sativus Fruit Extract, Calendula Officinalis Flower Extract, Rubus Idaeus Seed Extract, Sodium gluconate, Dehydroacetic Acid |
| 4      | Petrolatum, Paraffinum Liquidum, Helianthus Annuus Seed Oil, Glycine Soja Oil, Parfum, Calendula Officinalis Flower Extract, Tocopherol, Daucus Carota Sativa Root Extract, Beta-Carotene, Benzyl Alcohol   |
| 5      | Aqua, Stearic Acid, Calendula Officinalis Flower Extract, Octyldodecanol, Cetyl alcohol, Glycerin, Caprylic/Capric Triglyceride, Triethanolamine, Phenoxyethanol, Ethylhexylglycerin, Tocopheryl Acetate, Perfume, Tetrasodium EDTA, Rosmarinus Officinalis Leaf Extract  |

### Determination of total phenolic and flavonoid content

Total phenolic content in cosmetic creams was determined in their ethanolic extracts using Folin-Ciocalte reagent and the result is expressed in gallic acid equivalents (mg GA/g of cream). The total amount of flavonoids was determined using AlCl<sub>3</sub> as reagent by spectrophotometric method and expressed in quercetin equivalents (mg Qv/g cream). The detailed procedures are described in a previously published paper by Srećković et al. (2020).

### Determination of antioxidant activity using the DPPH method

The same volumes of ethanolic extract of cream samples and DPPH solution (80 µg/mL) prepared in ethanol were mixed to determine their potential to neutralize DPPH radicals. The samples were incubated for 30 min at room temperature in a dark place and the absorbance of the samples was recorded at 517 nm (Kumarasamy et al., 2007). The antioxidant activity of cream samples was expressed in Trolox equivalents per gram of cream (mg Trolox/g of cream).

## Results and discussion

Table 2. Organoleptic characteristics of cream samples

| Sample | Appearance           | Color       | Consistency | Shine          |
|--------|----------------------|-------------|-------------|----------------|
| 1      | homogeneous ointment | orange      | semi-solid  | slightly shiny |
| 2      | homogeneous ointment | dark yellow | semi-solid  | slightly shiny |
| 3      | homogeneous emulsion | cream white | semi-solid  | pearlescent    |
| 4      | homogeneous ointment | orange      | semi-solid  | shiny          |
| 5      | homogeneous emulsion | white       | semi-solid  | pearlescent    |

The five different cosmetic creams (Figure 1) that contained ingredients from plant origin were collected in local stores in Kragujevac to determine their antioxidant potential and phenolic content. These properties of cosmetic formulations mainly originate from their botanical ingredients, which are significant for the biological activity of cosmetic formulation and their beneficial effects on the skin. All analyzed samples were semi-solid consistency, homogeneous ointments, or emulsions, and yellow, orange, or white color (Table 2). All samples contained a minimum of two ingredients from plants and calendula flower extract (*Calendula officinalis* L.) (Table 1). According to the ingredients listed on the cream packaging presented in Table 1, samples 1, 2, and 3 are mainly composed of plant oily macerates, plant oils, extracts and essential oils, while the main ingredients of samples 4 and 5 were synthetic

components such as perfumes and hydrocarbon derivatives of petroleum origin.

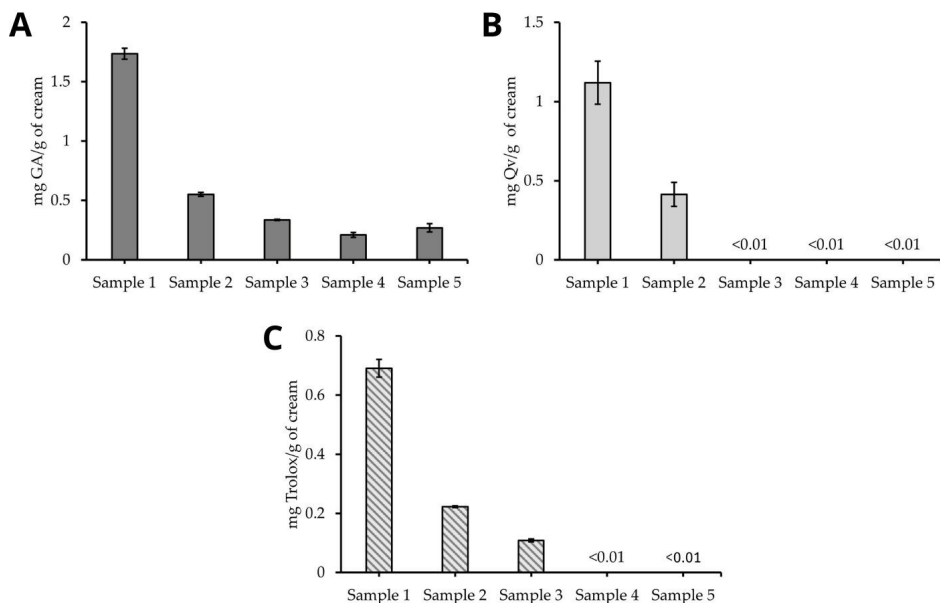


Figure 2. Total phenolic content (A), total flavonoid content (B), and antioxidant activity (C) of analyzed cosmetic creams

The total phenolics were quantified in all cream samples, while detectable amounts of flavonoids were found only in samples 1 and 2 (Figures 2A and 2B). Also, both samples 1 and 2, followed by sample 3 contained the highest total phenolic content and displayed antioxidant activity determined using the DPPH method. These results indicate a correlation between total phenolic and flavonoid content in creams with their antioxidant activity. The significantly higher total phenolic and flavonoid content, as well as antioxidant activity in comparison with other samples showed sample 1. This sample, according to its ingredients list, contains all natural ingredients (apart from low quantities of benzyl alcohol and dehydroacetic acid as preservatives) with high content of *C. officinalis* macerate in olive oil, as well as *C. officinalis*, *H. perforatum*, and propolis extracts. Significant phenolic and flavonoid contents and antioxidant activity were recorded for sample 2 rich in plant oils and different plant oily macerates.

## Conclusion

These results indicate that cosmetic formulations that contain plant-derived ingredients do not always exert beneficial effects (such as antioxidant activity) on users, just because they contain some bioactive plant ingredients. It is obvious that there must be a sufficient amount of selected plant-derived ingredients in any formulation in order to exert some biological activity.

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