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FORMULATION AND EVALUATION OF ANTI-AGING CREAM USING BANANA PEEL EXTRACT

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Keywords:

Banana peel; Anti-aging; Antioxidant; Cream; Cosmetics.

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ABSTRACT: Topical formulations may contribute to the reduction of oxidative stress in the skin. Banana peel is a fruit waste with antioxidant activity that is not yet included in a topical formulation. The aim of this study was to evaluate the antioxidant and anti-aging activity of a cream formulation containing a lyophilized extract of banana peel. The banana peel was extracted with ethanol, and a cream formulation containing 1% of the resulting extract was prepared. The total phenolic content (TPC), total flavonoid content (TFC), antioxidant and anti-aging activity of both extract and formulation were investigated. DPPH (2, 2-Diphenyl-1-picrylhydrazyl) free radical scavenging, ABTS (2, 2'-Azinobis (3-ethylbenzotrazole-6-sulfonate) cation radical scavenging, FRAP (Iron ion reduction) and CUPRAC (copper ion reduction) methods were used for antioxidant effect. For the anti-aging effect, elastase enzyme inhibitory activity was studied. The banana peel extract had a high antioxidant and anti-aging effect compared to the standards. Although the extract was added 1% in the cream, the cream showed antioxidant and anti-aging effects of about 80% of the extract. TPC and TFC findings also showed that this result due to phenolic and flavonoid compounds. It is possible to suggest that this formulation has the potential of antioxidant and anti-aging for topical use.

INTRODUCTION: Banana is a plant (fruit) that grows in tropical regions and is termed as soft, sweet, crusty, and sweet-chipped. It is rich in sugar and nutritious; it contains 70% water, significant amounts of carbohydrates, and a small amount of protein. The leaves are large and oval.

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The length is about 3 meters; the width is 60 cm. The original name of the banana is Musa, coming from the *Musaceae* family. Bananas are most commonly grown in Asian countries, especially Malaysia and South America, Central and North America, Africa, Oceania, and European countries follow this continent, respectively [1, 2].

All edible banana fruits are seedless and belong to two main species, *Musa acuminate Colla* and *Musa balbisiana Colla*. The hybrid of these two species, *Musa x paradisiaca* L., is also available today. Banana has now spread to almost 135 countries around the world. According to 2016 data, about

28% of the world's total banana production comes from India and China. Bananas are not only known to be rich in carbohydrates, dietary fiber, certain vitamins, and minerals, but are also rich in many health-promoting bioactive phytochemicals [3]. Banana peel is a waste that can be used in industry and in clinical trials. Bananas are one of the most popular fruits in 2013, with over 100 million tons produced worldwide. Banana peel, a byproduct that represents 40% of the banana's weight, is rich in bioactive components and has a high antioxidant capacity [4].

The banana peel has a higher antioxidant capacity than the pulp, with more than 40 individual compounds of phenolics [5]. Nagarajaiah and Prakash a have extracted the banana peel for determining chemical components, nutritional contents, and antioxidant activity [6]. Singh and Prakash obtained extracts of acetone, methanol: chloroform, and ethyl acetate from banana peels using Soxhlet and cold extraction methods. They applied the DPPH method for antioxidant activity determination, and the result is that the most active extract is the acetone extract obtained by the Soxhlet method [7]. It has also been reported that banana peel extract has antitumor, antifungal, and antimicrobial activity [8, 9].

In addition, banana blossoms also have an antioxidant effect [10]. Cosmetics are used to protect the skin against exogenous and endogenous harmful effects and also to enhance the beauty and attractiveness of the skin [11]. The use of cosmetics develops an attractive external appearance and achieves longevity of health by reducing skin disorders [12]. Plant parts used in cosmetic preparations should have various properties such as antioxidant, anti-inflammatory, antiseptic, softener, antiseboritic, anticerolytic, and antibacterial activity. It is desirable that the herbal products have fewer side effects than the products which generally contain synthetic materials [13]. In most cosmetic creams, active substances of plant are common ingredients responsible for several beneficial, antioxidant, antibacterial, antifungal, anti-inflammatory, or astringent activity [14, 15]. The formation of wrinkles mainly characterizes skin aging, uneven pigmentation, darkening, thinning, sagging, and roughening of the skin [16]. This can be caused by intrinsic or extrinsic mechanisms. Intrinsic skin aging is inevitable and occurs depending on the age of the person [17, 18]. The use of antioxidants in a topical formulation appears to be an interesting approach to protecting the skin against the oxidative stress caused by any extrinsic agent. To effect antioxidants against free radicals, the final formulation must be stabilized. Because antioxidants are very unstable, they can easily be oxidized and become inactive before reaching the area of action [19]. Often, antioxidant potential of a plant is evaluated with active compounds or purely isolated compounds, but there are very few reports on the antioxidant properties of the final formulations [20].

In this study, we would like to evaluate the effects of formulated cream on different parameters related to skin aging. For this purpose, we examined the antioxidant and anti-aging activities of the ethanol extract of the plant and the cream formulation containing this extract. We determined the TPC and TFC amounts of the samples. We used DPPH (2, 2-Diphenyl-1 -picrylhydrazyl) free radical scavenging, ABTS (2, 2'-Azinobis (3-ethylbenzotrazole-6-sulfonate) cation radical scavenging, FRAP (Iron ion reduction), and CUPRAC (copper ion reduction) methods for determining the antioxidant effect. Moreover, we have studied the elastase enzyme inhibitory assay for anti-aging potential.

MATERIALS AND METHODS: The bananas to be used in work were collected from Antalya-Alanya in August 2017. The bananas were peeled and dried, and kept at room temperature until work. β-Nicotinamide adenine dinucleotide, 2,2-diphenyl-1-picrylhydrazyl radical (DPPH), Phenazinemetho sulfate, nitro blue tetrazolium, butylated hydroxytoluene, butylated hydroxyanisole, α-tocopherol, iron (III) chloride, folin-ciocalteu reagent were purchased from Sigma Chemical Co. (St. Louis, MO). Stearic acid, spermaceti, cetyl alcohol, glycerin, triethanolamine, benzyl alcohol were from Laborteknik (Istanbul, Turkey). Identification of Banana: Bananas are one of the most important and oldest food crops of humankind, with evidence dating back to 4000 BC in New Guinea, including plantains [21]. Banana is a fruit belonging to the *Musaceae* family. Although the banana is basically a tropical fruit, it can also be grown in sub-tropical climate conditions in some

micro-climates. Musa species are geographically distributed over a wide area in tropical regions, from longitude 175 ºC East to 150 ºC West and latitudes 30 ºC North to 23 ºC south. The distribution is discrete. Because the species is cultivated on hundreds of islands of south and southeast Asia, the western tropical Pacific Ocean, Sri Lanka, India, Bangladesh, south and southeast China, Myanmar, Laos, Vietnam, Cambodia, Thailand, Malaysia, Indonesia, the Philippines and New Guinea [22]. The banana tree is 2-8 meters long. It has large leaves, large onion-like root stems. The leaf sheaths of the banana form a pseudostem around the inflorescences. False stems consist of tightly interlocking leaf sheaths.

The leaves emerge from the apical meristem or just below ground level on the rhizome. Successive leaves push themselves out through the middle of the pseudostem every 7 to 10 days, and with 25 to 40 leaves appearing before the inflorescence emerges terminally. During flowering, there are 10 to 15 leaves on a pseudostem [23]. Fruit maturation takes between 80 and 120 days, depending on the variety and season. During ripening, the fruits turn from green to yellow. Bananas are harvested approximately 15 days early for export, stored, and transported in cool cabinets. The mature fruit of the banana is 6 to 35 cm long, 2.5 to 5.0 cm thick. It is also green, yellow or red depending on the variety and maturity [24]. In Turkey, bananas are grown intensively in Anamur, Bozyazı, Alanya, Gazipaşa, and also in micro-climates protected by the Toros Mountains. Banana production in Turkey was first brought to Alanya from Egypt in 1935 and then to Anamur. In the study, the banana was identified according to the characteristics given in the literature [25].

Preparation of Extract: Banana peels were broken up by a laboratory blender and then extracted within ethanol for 1 week at room temperature. The solvent was changed three times in a week. The solvent was then removed using a rotary evaporator. The extracts were stored at 4 °C until study.

Preparation of Cream Formulation: Cream samples were prepared by slight modification of the formulation of Saad *et al.* [26]. Extracts from the banana peel were used in the formulation. The cream was prepared according to the amounts given in **Table 1.** In a beaker, the oil phase components were weighed and heated to 70 °C. In another beaker, the substances forming the water phase were completely dissolved and heated to the same temperature as the oil phase. The two phases were mixed in the same beaker at this temperature. The resulting emulsion was allowed to cool to 40 °C. At this temperature, preservative and essence were added to the formulation. The pH of the cream obtained was adjusted to 5.5-7 with citric acid.

TABLE 1: COMPOSITION AND AMOUNTS OF INGREDIENTS USED TO MAKE 50 G OF ANTI-AGING CREAM

	Ingredients	Amount (g)
Oil phase	Stearic acid	4
	Spermaceti	2.5
	Cetyl alcohol	3.5
	Glycerin	2.5
	Triethanolamine	1
Water phase	Benzyl alcohol	1
	Water	35
	Extract	0.5

Evaluation of Prepared Cream Formulations:

Physical Evaluation: The banana peel cream was tested for odour, appearance, and homogeneity through visual observation and touch.

Determination of Ph: The pH meter was calibrated using standard buffer solutions. About 0.5 g of the cream was weighed and dissolved in 50 ml of distilled water in a beaker, and its pH was measured.

Viscosity: The measurement of viscosity of the prepared cream from banana peel was done with a Brookfield viscometer. The reading was taken at 100 rpm using spindle no. 6.

Spreadability: Emolliency, slipperiness, and amount of residue left after the application of the cream was checked.

Thermal Stability: Stability studies were carried out as per ICH guidelines for the formulated cream to access its stability parameters during its storage period. The cream-filled bottle was kept in a humidity chamber maintained 35 + 2 °C with 65+5% relative humidity (RH) for two months. At the end of the studies, samples were analyzed for their physical properties.

Microbiological Test: The formulated creams were tested for their sterility. A small quantity of the cream was inoculated into Muller Hilton agar media through the streak plate method and was at 37 °C for 24 h. After the incubation period, the plates were checked for any microbial growth by comparing with the control plate.

Determination of Total Phenolic Content: The amount of phenolic compounds found in the extract prepared from the banana peels and the cream prepared using this extract was determined by Folin Ciocalteu method [27, 28]. Gallic acid was used as the standard phenolic compound. A calibration graph of the gallic acid was plotted. 1000 ppm gallic acid solution was prepared. 0, 1, 2, 3, 4, 5, 6, 7 and 8 µL of this solution were added to the microplate wells and their volumes were completed to 184 µL with distilled water. Extract solutions were prepared at concentrations of 1-20 mg/mL, and cream solutions were also prepared at concentrations of 20-80 mg/mL. 4 µL of prepared samples were added to microplate wells, and these solutions were completed with 184 µL distilled water. 4 mL of Folin-Ciocalteu reagent and after 3 min, 12 mL of 2% Na_2CO_3 solution was added to the gallic acid solutions and samples. Distilled water was used instead of the sample for control. The solutions were incubated for 2 h, and the absorbances of them were read at 760 nm. Results were calculated as microgram in gallic acid equivalent (GAE).

Determination of Total Flavonoid Content: The amount of flavonoid compounds found in the extract prepared from the banana peels and the cream prepared using this extract was determined by aluminum nitrate method [29]. Quercetin was used as the standard flavonoid compound. A calibration graph of the quercetin was plotted. 1000 ppm quercetin solution was prepared. 0, 1, 2, 3, 4, 5, 6, 7, and 8 µL of this solution were added to the microplate wells, and their volumes were completed to 192 µL with 80% ethanol. 4 µL of potassium acetate, and after a minute, 4 µL of 10% aluminum nitrate was added to the microplate wells containing quersetin solution and samples. Distilled water was used instead of the sample for control. The solutions were incubated for 40 minutes, and the absorbances of them were read at 415 nm. Results were calculated as microgram in quercetin equivalent (QE).

Determination of Antioxidant Activity:

DPPH Free Radical Scavenging Activity: DPPH free radical scavenging activities of the extracts prepared from banana peels and the creams prepared from these extracts were applied according to the Blois method [30]. 0.1 mM solution of DPPH was used as free radical. 1-10 mg/mL stock solutions of extract and 20-80 mg/mL stock solutions of cream were prepared with ethanol. 2-20 µL of the stock solution was added to the wells and completed to 40 µL with ethanol. Then, 160 µL of DPPH solution was added to the mixtures in the wells. The final mixtures were incubated for 30 min. The absorbances of them at 517 nm were read. Ethanol was used as the control.

ABTS Cation Radical Scavenging Activity: ABTS cation radical scavenging activities of the extracts prepared from banana peels and the creams prepared from these extracts were applied according to Re *et al.* [31]. 1-10 mg/mL stock solutions of extract and 20-80 mg/mL stock solutions of cream were prepared with ethanol. 2-20 µL of the stock solutions were added to the wells and completed to 40 µL with ethanol. Then, 160 µL of ABTS solution was added to the mixtures in the wells. The final mixtures were incubated for 30 min. The absorbances of them at 734 nm were read. Ethanol was used as the control.

Cupric Ion Reducing Antioxidant Capacity (CUPRAC): Copper II ion reducing antioxidant capacity of the extracts prepared from banana peels and the creams prepared from these extracts were applied according to the Apak *et al.* [32].1-10 mg/mL stock solutions of extract and 20-80 mg/mL stock solutions of cream were prepared with ethanol. 2-20 µL of the stock solution was added to the wells and completed to 67 µL with ethanol. Then, 61 µL of 0.01 M $CuCl_2$ solution, 61 µL of 7.5×10^{-3} M neocuproine solution, and 61 µL of 1 M acetate buffer were added to the mixtures in the wells. The final mixtures were incubated for 30 min. The absorbances of them at 450 nm were read. Ethanol was used as the control.

Ferric Reducing Antioxidant Power (FRAP): Iron III ion reducing antioxidant power of the extracts prepared from banana peels and the creams prepared from these extracts were applied according to the Benzie and Strain [33]. 1-10 mg/mL

stock solutions of extract and 20-80 mg/mL stock solutions of cream were prepared with ethanol. FRAP reagent was freshly prepared before use. 10 mM 2, 4, 6-Tris (2-pyridyl) - s - triazine (TPTZ) is dissolved in 40 mMHCl. 20 mM $FeCl_3$ solution and 300 mM pH 3.6 acetate buffer were prepared with distilled water. The reagent was prepared by mixing TPTZ, $FeCl_3$, and acetate buffer in a ratio of 1:1:10. 2-20 µL of the stock solution was added to the wells and completed to 40 µL with ethanol. Then, 240 µL of FRAP reagent was added to the mixtures in the wells. The final mixtures were incubated for 30 min. The absorbances of them at 593 nm were read. Ethanol was used as the control.

Anti-aging Activity Assay:

Elastase Inhibitory Activity: Elastase enzyme inhibitory potential of the extracts prepared from banana peels and the creams prepared from these extracts were applied according to EnzChek® Elastase Assay Kit (E-12056) procedure [34]. 1-10 mg/mL stock solutions of extract and 20-80 mg/mL stock solutions of cream were prepared with DMSO. 2-20 µL of the stock solution was added to the wells and completed to 50 µL with DMSO. Then, 50 µLof 100 µg/mL Elastin and 50 µL of elastase enzyme were added to the mixtures in the wells. The final mixtures were incubated for 30 minutes. The absorbances of them at 593 nm were read. N-methoxysuccinyl-Ala - Ala - Pro - Val-chloromethyl ketone was used as the positive control, and reaction buffer was used as the negative control.

RESULTS AND DISCUSSION:

Total Phenolic and Flavonoid Content Results: Compounds of the ethanol extract prepared by banana peel and phenolic and flavonoid components of the cream prepared using the extract was given in **Table 1.** The sample which has the majority of the phenolic compounds is 20 mg/mL extract and 80 mg/mL cream. The sample which has the majority of the flavonoid is 10 mg/mL extract and 80 mg/mL cream. Both extract and the cream were found to contain an averagely 3 mg/mL phenolic compounds. The extract and cream were found to have 3 mg/mL substances in terms of flavonoid compounds.

TABLE 2: TOTAL PHENOLIC CONTENT (TPC) AND TOTAL FLAVONOID CONTENT (TFC) OF BANANA PEEL EXTRACT AND CREAM PREPARED FROM THIS EXTRACT

Samples	Concentrations (mg/mL)	TPC (µg GA/mg)	TFC (µg QE/mg)
Ethanol Extract	EtOH-1	3.054±0.006	4.685±0.005
	EtOH-2	2.919±0.002	4.103±0.013
	EtOH-5	3.121±0.011	1.808±0.003
	EtOH-10	3.926±0.009	4.822±0.011
	EtOH-20	7.215±0.003	3.760±0.002
Banana Peel Cream	BPC-20	3.188±0.008	3.726±0.003
	BPC-40	3.054±0.006	4.925±0.009
	BPC-80	4.195±0.001	6.979±0.004

Antioxidant Potential Results:

DPPH Free Radical and ABTS Cation Radical Scavenging Activity Results: Free radicals are dangerous substances which deactivate the molecules with which they react. If the atmosphere includes DPPH and ABTS radical, reactions cannot be experienced in the intended level. By these two methods, phenolic and flavonoid compounds included in the banana peel were expected to get into interaction with such radical and decrease, even remove their strength. How much both the banana peel ethanol extract and the cream formulation prepared from it deactivated such radical in different concentrations is shown in **Fig. 1.** Besides, radical scavenging activity comparison between BHA, BHT and a-Toc standards and the samples were included. The stocks which we prepared from ethanol extract in 1-20 mg/mL concentrations were found to remove DPPH radical in the values of similar to the standard concentrations within the increasing concentrations. Creams were detected to show activity in 40 mg/mL and 80 mg/mL concentrations.

It was observed that the ABTS cation radical scavenging activities increase in increasing concentration values. It was detected that the radical, sweeping impacts of extracts reached similar levels with the standards, and the cream solvent activities reached half of the standards. When DPPH and ABTS scavenging activity of the

extract was compared, it was observed that ABTS were removed in a higher level than DPPH was done; namely, the extract contained more cationic molecules.

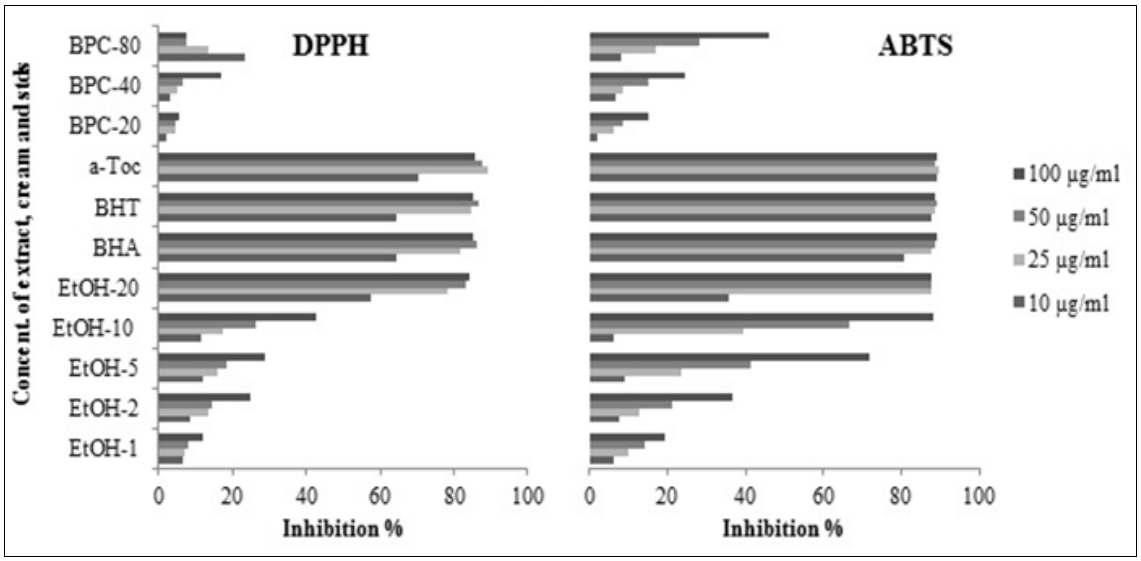

FIG. 1: DPPH FREE RADICAL AND ABTS CATION RADICAL SCAVENGING ACTIVITIES OF BANANA PEEL EXTRACT AND CREAM PREPARED FROM THIS EXTRACT. (ETOH: ETHANOL EXTRACT, BPC: BANANA PEEL CREAM)

Results of CUPRAC and FRAP: CUPRAC is a method used to measure the total antioxidant amount based on copper (II) reducing capacity. Another distinctive advantage of the CUPRAC method in the total antioxidant capacity (TAC) analysis compared to the other electron transfer methods are easy adjustment of the pH, easy usage and stable status of the reagents, being simple and bearing low costs and being able to be applied to the lipophilic antioxidants apart from hydrophilic antioxidants [35]. Copper (II) reducing capacities of antioxidants within the banana peel extract were shown in **Fig. 2.** Banana peel ethanol extract and solvents of its cream formulations in different concentrations were prepared. Copper ion reducing potentials of such solvents in 10-100 µg/mL concentrations were determined. BHA, BHT, and a-Toc were used as standards. 10 mg/mL extract showed copper ion reducing potential in a higher level compared to BHT and α-Toc in a similar level with BHA. The highest reducing activity was shown by 80 mg/mL solvent among the cream solvents. This solvent reduced copper ions up to half of the standards.

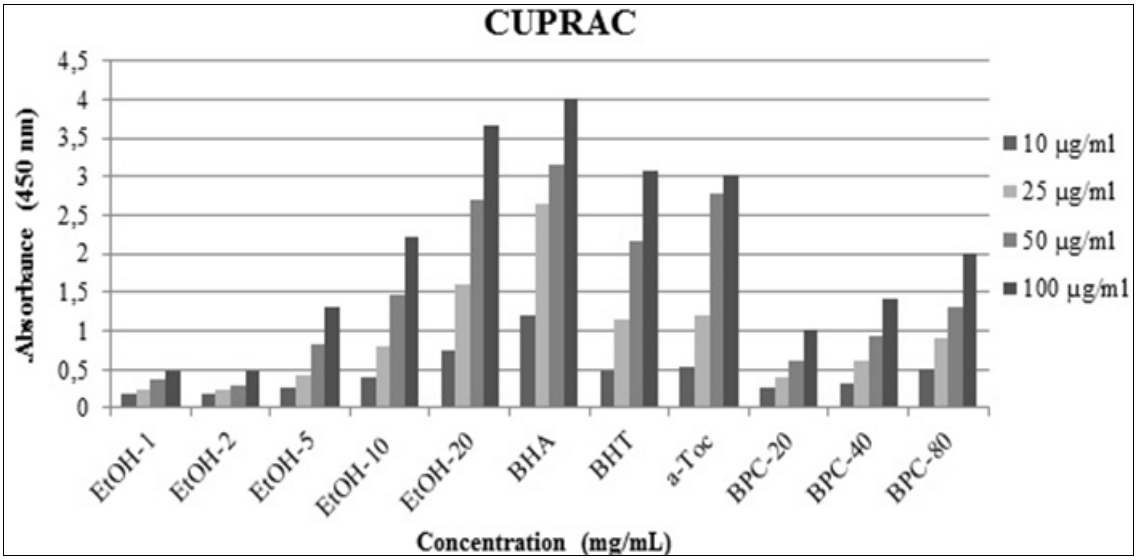

FIG. 2: CUPRIC ION REDUCING ANTIOXIDANT ACTIVITY OF BANANA PEEL EXTRACT AND CREAM PREPARED FROM THIS EXTRACT. (ETOH: ETHANOL EXTRACT, BP: BANANA PEEL)

FRAP is based on the total quantity assignment of antioxidants by iron (III) reduction capacity. The results are referred as Trolox equivalent and shown in **Fig. 3.** The method is only based on iron ions and not suitable for mechanic and physiologic antioxidant activities. However, it is simpler, faster and cheaper than the other methods [36]. Solvents in different concentrations to search for iron reducing capacities of banana peel ethanol extract and cream solvents were prepared. BHA, BHT, and Trolox were used as standards. The extract and 40 mg/mL cream solvent showed the highest level of iron-reducing activity in 20 mg/mL.

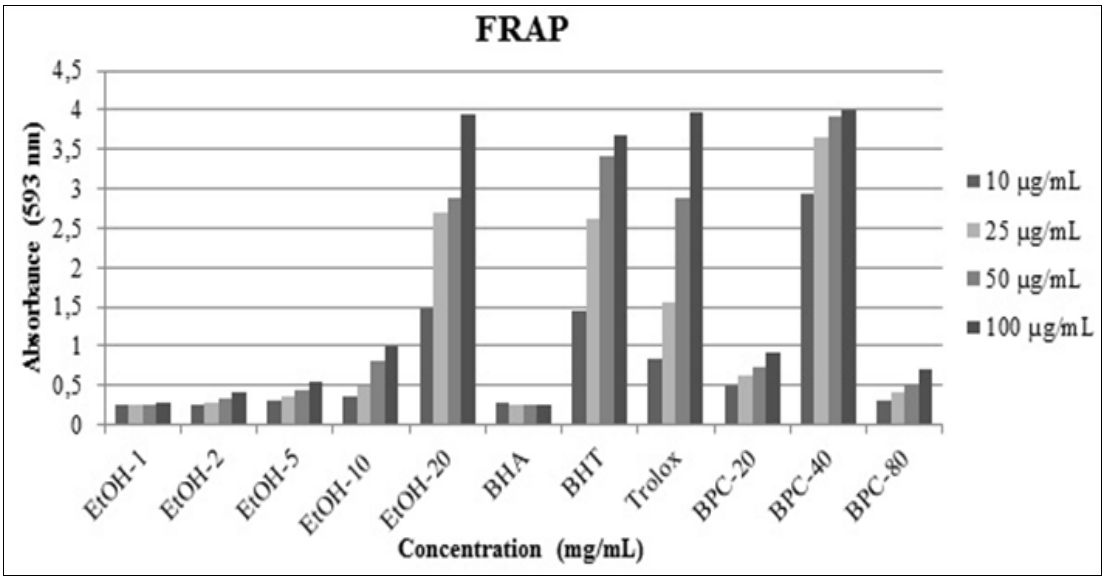

FIG. 3: FERRIC REDUCING ANTIOXIDANT POWER OF BANANA PEEL EXTRACT AND CREAM PREPARED FROM THIS EXTRACT. (ETOH: ETHANOL EXTRACT, BPC: BANANA PEEL CREAM)

Anti-aging Potential Results: The elastase enzyme separates elastase protein which gives flexibility to ligaments. The most effective concentrations among antioxidant activity results were determined to be 20 mg/mL extract and 80 mg/mL cream formulations **Fig. 4.** It was detected that these two have 64.97% and 52.94% elastase enzyme inhibition, respectively. Ethanol extract inhibited elastase enzyme up to almost half of the standards, and cream formulation showed anti-aging activity by approximately 80% of extract and 65% of standards.

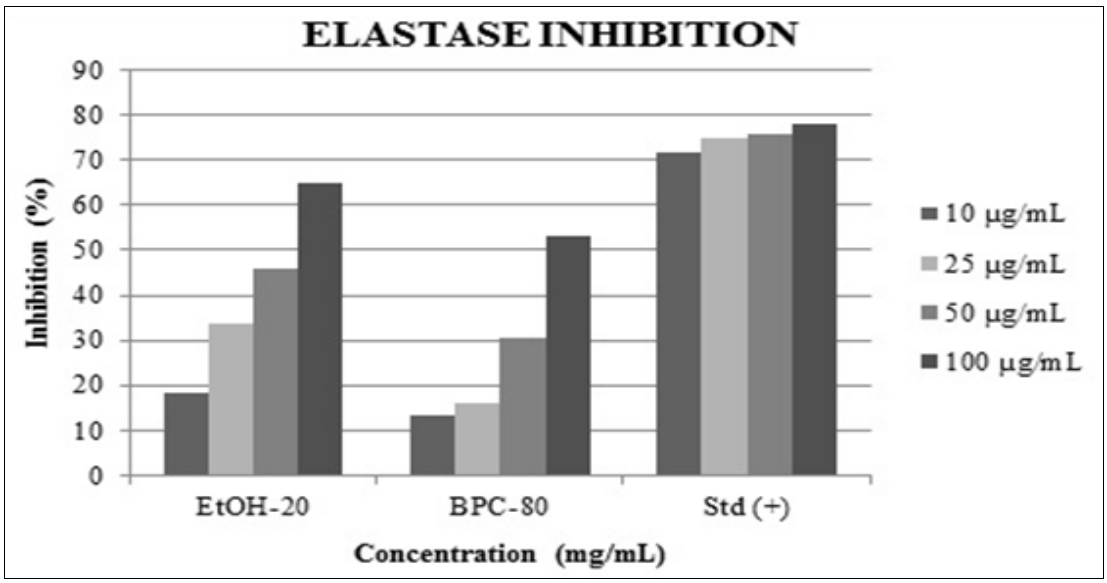

FIG. 4: ELASTASE INHIBITORY ACTIVITY OF BANANA PEEL EXTRACT AND CREAM PREPARED FROM THIS EXTRACT. (ETOH: ETHANOL EXTRACT, BPC: BANANA PEEL CREAM, STD: N-METHOXYSUCCINYL-ALA-ALA-PRO-VAL-CHLOROMETHYL KETONE)

Evaluation of Cream Formulation: While preparing, the cream was evaluated according to various parameters. The results are seen in **Table 3.** pH of the cream was detected to between 6.8 and 7.1. The cream was seen to have an odour similar to the banana aroma in an acceptable level and color like banana yellow. When applied, the cream was determined to have a moisturizing and slippery, nice feeling on the skin. It was found that the cream protected its physical parameters, namely, kept its stability during the study, and any microbial organism wasn't created in the cream.

TABLE 3: EVALUATION PARAMETER OF CREAM PREPARED USING BANANA PEEL EXTRACT

Parameter	Observation
Odour	Acceptable
Appearance	Banana yellow
Homogenity	Homogenous
pH	6.8-7.1
Viscosity	4600 cp
Spreadability	Good
After feel	Emollients and slipperiness
Stability	Stable until the entire period of study
Microbial test	No growth of colonies

DISCUSSION: Minimum 5000 phenolic substances have been prepared up until today, and more than 2000 of those are out of natural flavonoids. It might be found as glycosides in alive textures of the plants such as leaf, flower or fruits; as aglycones in xylems; and as in both forms in the cores [37]. They are herbal phenolics, one of the first compounds used by humans consciously and called as "tanen" in the past. A common property of them is to create a complex with proteins and causes sediments [38].

Flavonoids and cinnamic acids are known to be the most significant antioxidants and free radical scavenger and chain brokers [37]. Butylated hydroxyoluen (BHT), propilgallat, and tert-butylhydroquinone (TBHQ) are used against oxidative rancidity in food substances [39]. However, the consumers mostly prefer to use natural antioxidants instead of synthetic substances in recent years [39, 40, 41]. Siddique *et al.* determined that the amount of phenolic substance in the 80% ethanolic extract of banana peel, maximum phenolic, and flavonoid extraction was performed in the presence of a combination of aqueous and organic solvents, and these results were similar to the previous study results [42]. Azizuddin *et al.* found that flavonoid contents in Musa sapientum peels were higher than Musa acuminate banana peel extract [43]. Using antioxidants in topical formulations might be seen as an appealing approach to protect the skin against oxidative stress caused by external factors. To explain the activity of the antioxidants against free radicals, since they are not very stable and can be oxidized easily, they are of significance to stabilize the final formulation. Banana peel extract is considered to be a natural antioxidant. Natural antioxidants are known to be beneficial for skin aging, protection of the skin against the sun, and against skin cancer [19].

Phenolic compounds are widely found in plants and have many biological effects, including antibacterial and antioxidant activity [44]. A previous study stated that phenolic and flavonoid contents were related to their antioxidant activities [45]. Consumption of antioxidants can prevent oxidative stress, which can cause many diseases. Plants such as guava, tea, coffee, banana, papaya contain phenolic, and flavonoid compounds [46]. We calculated the phenolic compound of ethanol extract, which we prepared from banana peel as equal to the gallic acid and the flavonoid compound as equal to the quercetin. Someya *et al.* found the phenolic compound amount of banana peel as 907 mg/100 gr dry sample in their studies [47].

Nagarajaiah and Prakash 6 detected 430 mg/100 gr dry sample in their studies We found 721.5 mg/100 gr dry sample in our study. While Nagarajaiah and Prakash 6 found the total flavonoid amount as 222.91 mg/ 100 gr dry sample, we detected 376 mg/100 gr dry sample. According to the results, it is seen that the phenolic and flavonoid compounds of the banana peel ethanol extract which we obtained are in the level to have an antioxidant impact. We determined the antioxidant activity according to the DPPH and ABTS radical scavenging capacity of the banana peel extract and cream prepared and CUPRAC and FRAP reduction capacity. We observed that ABTS cation radicals were tried to be removed at a high level in the concentration of which samples were increasing. Accordingly, we came to the conclusion that the anionic and flavonoid compounds were intense in the extract. Singh and Prakash applied acetone, methanol-chloroform and ethyl acetate, and hot and cold extraction methods to the banana peel in their

study. By only using DPPH method, they determined the antioxidant activities of extracts. By applying acetone extract and Sokslet method and hot extraction, they obtained the highest activity as 72.83% inhibition [7]. Nagarajaiah and Prakash applied DPPH method and obtained 49% inhibition with banana ethanol extract [6]. Palanisamy and friends found the lowest IC_{50} value for ethanol fruit extract of banana according to DPPH method as 0.9 mg/mL and detected IC_{50} value of ethanol fruit extract for ABTS method as 1 mg/mL [48]. Dahham and Agha found IC_{50} value of banana pulp against DPPH radical as 44.07 µg/mL in their study [49]. Laeliocattleya *et al.* studied the bioactive components and antioxidant activity of ethanol and ethyl acetate extracts of candibanana (*Musa paradisiaca*).

They found that the antioxidant activity of the ethanol extract is higher than the ethyl acetate extract and also that ethanol is a better solvent than ethyl acetate to dissolve bioactive compounds in candi banana [50]. Fidrianny *et al.* categorized all of the banana and nangka banana peel extracts (except the ethanolic peel extract of the nangka banana) as very potent antioxidants using the DPPH test. They determined that phenolic compounds in tanduk banana and nangka banana peel extracts made the greatest contribution to their antioxidant activities by DPPH and CUPRAC assays. They found that Nangka banana peel extracts gave linear results in the DPPH and CUPRAC assays [51]. We found IC_{50} value of banana peel ethanol extract as 5.73 µg/mL for DPPH method and as 46.07 µg/mL for ABTS method in our study. Banana peel ethanol extract was found to have an intense impact against the radical molecules.

The metal reducing capacity of banana peel was determined by CUPRAC and FRAP methods. According to these methods, antioxidant impact in a similar level to the standards in 20 mg/mL concentrations was obtained. It was seen that reducing capacity potential in a level higher than 50% of the standards was reached for cream formulations prepared in different concentrations. Since elastase causes wrinkles and aging in the skin by breaking the elastin, evaluating the anti-elastase activity of a plant extract might be a beneficial indicator of its potential application in cosmetic agents. The extract prepared showed potential anti-elastase activity in 20 mg/mL concentration (EtOH-20) and the cream formulation showed potential anti-elastase activity in 80 mg/mL concentration (BPC-80). Sundaram and friends observed the antioxidant and anti-aging activities of leaves of Nycranthes arbor-tristis, fruit pulps of Aegle marmelos and terminal meristem of flower Musa paradisiacal which were mature and immature [52]. They found the IC_{50} values of fruit pulps of immature Aegle marmelos and terminal meristem of *Musa paradisiaca* flower as 127.385 µg/mL and 138.724 µg/mL, respectively. They found the herbal formulation which they prepared by using them as 172.1 µg/mL. We detected the IC_{50} value of EtOH-20 as 65.31 µg/mL and IC_{50} value of BPC-80, the cream formulation which we prepared by using the extract as 93.85 µg/mL. It is seen that our formulation realized much more successful elastase inhibition compared to the former.

The physicochemical properties of the cream formulation are seen on **Table 3.** Determining the pH value is of importance to determine cosmeceutical and pharmaceutical stability. A change in pH of the product shows a potential interaction providing an opinion on the final product quality and that a chemical reaction is experienced [53]. pH of human skin is normally 4.5-6. Frequent washing and soap usage cause the acidity of the skin to be lost. Therefore, moisturizing has an acidity range to keep the skin in the normal pH level. This pH range is [5, 8]. The cream formulation has an acceptable and non-irritating property with 6.8 pH value. Spreadability is the term referring to the scope of the area where the topical application spread to the affected areas of the skin. The therapeutic activity of the formulation depends on the spreadability value. Therefore, the determination of the spreadability is a significant parameter to evaluate the topical application. The structure of the cream formulation is homogeneous, and it can be spread homogeneously, and it softens.

CONCLUSION: Banana, a tropical fruit, is consumed as a nutritious fruit for a long year. Its peel is tried to be proved that might have various biological impacts. Banana peel extract and cream formulation prepared from it showed a high level of antioxidant and elastase inhibition activity. It was detected that the cream which was formulated

according to the findings might have anti-aging potential and can be used on the skin. It was found that adding banana peel extract into the cream at the rate of 1% in 20 mg/mL concentration can be used as anti-aging, according to the results. Using banana peel in cosmetics products was researched in the study, and other researches for skin will be conducted in further studies.

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