

The Biorevitalization Effect of Serum Containing Rose Apple Leaf Extract on the Parameters of Premature Skin Aging

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ABSTRACT

Rose apple (*Syzygium jambos*) is known for its antioxidants and could potentially be used as an anti-aging cosmetic. This study reported the potential of rose apple leaf extract as a skin serum for the biorevitalization- with improvement based on pigmentation, wrinkles, pore, and sensitivity parameters in the skin of women aged 30 to 40. The skin serum was formulated with various concentrations of 5%, 10%, and 15% of rose apple leaf extract. The Pretest-Posttest with Control Group Design were conducted by measuring skin condition with the API-100 Aram Huvis Innovation Skin Analysis System. Data analyses using the Kruskal-Wallis's test and Mann-Whitney's test. The phytochemical contents of rose apple leaf extracts showed alkaloids, flavonoids, saponins, phenol as gallic acid, and tannic acid, which function as antioxidants that is comparable to vitamin C with IC₅₀ of up to 7.29%. Experimental data showed that rose apple leaf extract affects skin biorevitalization based on reduction in pore size, skin pigmentation, and sensitivity parameters. This study strongly suggests the potential of rose apple leaf extract as an anti-aging ingredient to prevent premature skin aging.

Keywords: syzygium jambos, premature aging, pore, melanin, sensitivity

INTRODUCTION

The development of skin revitalization methods, i.e., recovery after any damage (including aging) has increased in recent years [1]. Sunray exposure is often considered a major cause of skin damage by initiating reactive oxygen species (ROS) [2]. It can interfere with protein; fatty acids and saccharides causing oxidative damage [3] leading to a degeneration of skin collagen and ultimately signs of premature aging in the skin. Aging is related to morphological changes, which include loss of skin elasticity, increased wrinkling, uneven pigmentation, dryness, and

roughness [4][5]. Topical formulations have recently attracted a lot of attention and interest as a method of medication delivery to the human skin. The current approach in skin protection to reduce the rate of skin aging is the topical use of plant extract containing phenolics and antioxidants [6].

Rose apple (*Syzygium jambos*) has been used as a traditional medicinal plant as a diuretic agent, for rheumatism, toothache, gastrointestinal disease, and fever as well as its antibacterial and anti-inflammatory effects [7]. A report showed the presence of flavonoid compounds, anacardic acid, myricetin, gallic acid squalene, and ursolic acid from *S. jambos* extract [8]. Other researchers studied the chemical profile of *S. jambos* and discovered 17 substances such as flavonol glycosides and flavones, as well as ellagitannins and phenolic acids. Anacardic acid has also been linked to antibacterial, antioxidant, anti-inflammatory, and anticancer properties. Furthermore, ethanol extract and three components, myricetin, myricitrin, and gallic acid, shown strong antioxidant activity with IC₅₀ values ranging from 0.8-1.9 g/ml, equivalent to vitamin C, the reference antioxidant agent. Furthermore, *S. jambos* leaf extract containing ursolic acid and myricitrin components effectively reduced the production of inflammatory cytokines IL-8 and TNF- by up to 99%. Rose apple leaf extract has also shown promising antioxidant activity in different experimental models [9]. Quantitative tannin content was also shown in rose apple bark extract with water and acetone as solvents of 77% and 83% [10]. Another study stated that the tannin content was also found to be very high in rose apple bark at 2.5 mg/ml, in seeds at 1.9 mg/ml while in leaves 1.4 mg/ml in acetone solvent [11]. The tannin concentration of the tropical plant's lower stems is relatively high, approximately 16%. Extracts of *S. jambos*' bark, leaves, and seeds have a strong inhibitory impact on the development of *S. aureus* and *E. coli* [12]. Squalene, ursolic acid, gallic acid, myricetin, myricitrin, and anacardic acid have all been extracted from the ethanolic extract of *S. jambos* leaves [7]. Another study discovered that *S. jambos* ethanolic stem bark extract and extracted triterpenoids such as friedelin, -amyirin acetate, betulinic acid, and lupeol [13]. The seeds are used to treat diarrhea and even diarrhea accompanied by fever, dysentery, sore throat, diabetes, and infectious diseases. A decoction of the bark is given to relieve asthma and bronchitis [14].

Cosmetic products with natural ingredients have been widely developed in Indonesia and are more attractive to the market. There is a higher demand for cosmetic products that can prevent or inhibit the premature aging process. Studies have shown that anti-aging cosmetics are becoming a trend for consumers over the age of 25 to prevent premature aging [15][16]. Several benefits of anti-aging products are supplying antioxidants to skin tissue, stimulating the regeneration process of skin cells, maintaining skin moisture and elasticity, stimulating the production of collagen and glycosaminoglycans, and protecting the skin from ultraviolet damage. The benefits of anti-aging skincare include preventing degenerative damage that causes the skin to look dull and wrinkled and making the skin look healthy and bright [17].

One of the cosmetic dosage forms that have recently gained exponential development and have high popularity in the realm of skincare is serum. The serum has low viscosity and is categorized as an emulsion preparation [18]. The serum itself can be processed using two bases, namely water, and oil bases. The serum has the advantage that it has a high concentration of active ingredients so that the effect is more quickly absorbed by the skin, can provide a more comfortable skin feel and better spread on the surface of the skin. Serums contain a higher

percentage of natural active substances that are good for the skin compared to other products such as face creams. Serum can also be used by people of various ages, parents, and young people/teenagers. Nowadays cosmetic serum is just a commercial term in the cosmetic world, known for its low viscosity with a high concentration because it contains more bioactive ingredients with lesser solvent [19].

So far, there are no anti-aging cosmetic products, especially serum, which is made of the natural ingredient, the rose apple extract. This research aims to determine the potential of rose apple ethanol leaf extract on the effect of skin biorevitalization- namely improvement of skin parameters in terms of pigmentation, wrinkles, pore, and sensitivity on the skin of women aged 30-40 with signs of premature aging. For this reason, it is necessary to apply bioactive antioxidants that are applied topically to prevent premature skin aging [20].

MATERIALS AND METHODS

The research method used *Pretest-Post test Control Group Design* involves sampling and sample processing, making simplicia, extract making, quantitative phytochemical screening, antioxidant activity test, formulating anti-aging serum and anti-aging activity test by measuring skin condition with the API-100 Aram Huvis Innovation Skin Analysis System and data analysis with the Kruskal-Wallis's test and Mann-Whitney's test. The independent variable is the ethanol extract of rose apple in serum formulations, the dependent variable is the biorevitalizing effect of the ethanol extract of rose apple on the improvement of skin conditions in terms of pigmentation, wrinkle, pore, and sensitivity to the skin. 24 volunteers in this study are women aged 30-40 with signs of premature aging on their skin.

The tools used in this research include glassware, juicer, incubator, autoclave, analytical balance, filter paper No.1, pH meter, centrifuge, rotary evaporator, Brookfield viscometer, glass serum container, stirring rod, and Ultraviolet-spectrophotometer visible (Shimadzu 1800), analytical balance (Precisa), rotary vaporizer (IKA®), sonicator (Branson 1800), test tube (Iwaki), separating funnel (Iwaki), Erlenmeyer (Iwaki), porcelain crucible, vaporizer, ultraviolet lamp (Camag), measuring flask (Iwaki), beaker glass (Iwaki), pipette (Iwaki), oven (Mettler), Whatman filter paper No. 42, pH paper and API-100 Aram Huvis Innovation Skin Analysis instrument.

The testing material used was rose apple ethanol extract. The chemicals used in this study were aqua dest, 70% ethanol, xanthan gum, glycerin, sodium benzoate, and potassium sorbate, 96% ethanol, 30% ethanol, n-hexane p.a, acetone, distilled water, silica gel 60 F254 20 x 20 cm, quercetin, gallic acid, catechins, and all reagents purchased from Merck: aluminum chloride (AlCl_3), chloroform (CHCl_3), methanol (CH_3OH), ethyl acetate ($\text{C}_4\text{H}_8\text{O}_2$), hydrochloric acid (HCl), glacial acetic acid solution, ninhydrin, -naphthol, nitric acid (HNO_3), sulfuric acid (H_2SO_4), rhodamine B, zinc powder (Zn), magnesium (Mg) powder, boric acid (H_3BO_3) powder, oxalic acid ($\text{C}_2\text{H}_2\text{O}_4$) powder, vanillin sulfuric acid, vanillin hydrochloric acid, iron (III) chloride (FeCl_3) salt, gelatin, ether (C_2H_5)₂O, iodine, potassium iodide (KI), potassium permanganate (KMnO_4), mercury (II) chloride (HgCl_2), bismuth nitrate ($\text{Bi}(\text{NO}_3)_3$), picric acid ($\text{C}_6\text{H}_3\text{N}_3\text{O}_7$), ammonium molybdate ($(\text{NH}_4)_6\text{Mo}_7\text{O}_{24}$), acetic acid anhydride, Baljet's solution, sodium hydroxide (NaOH), n-butanol ($\text{C}_4\text{H}_{10}\text{O}$), diethyl ether, and petroleum ether.

The sampling method of rose apple was carried out purposively without comparing it with the same plant from other areas. About 6 kg of rose apple leaves were sorted by wet sorting to be separated from the impurities. The leaves are washed, drained, then cut into smaller pieces. Then dried by drying in the lab oven at 50°C for 7 days, later then blended and sieved with a 40-mesh sieve to obtain a dry powder.

Extracts were made by maceration using 96% ethanol and 98% hexane as solvent. A total of 5 kg of rose apple powder was put into a vessel and poured with 10 parts of 96% ethanol, and one part of powder. It was then concentrated using a rotary evaporator at 45°C and then placed on a water bath at 70-80°C until a thick extract was achieved.

The phytochemical contents measured in this research activity were alkaloids; flavonoids; saponins; and phenol. The flavonoid group was identified as quercetin, while the phenol group was identified as gallic acid and tannic acid. The qualitative and quantitative determination of rose guava leaf extraction consisted of several steps: (1) The process of drying rose apple leaves at a temperature of 50°C to a moisture content of 5%; (2) Reducing the size of dried rose apple leaves to 1000 microns; (3) Extraction using hexane and ethanol as solvents; (4) Vacuum filtering of the extraction results; (5) Drying using a rotary evaporator; (6) Qualitative test using indicators (reagents); and (7) Quantitative test using the gravimetric method and UV-VIS spectrophotometer.

A quantitative test of rose apple leaf extract was done using a spectrophotometer and gravimetry. The phenol group (as gallic acid and tannic acid) was measured using the spectrophotometer method at a wavelength of 760 nm. The flavonoid group used a spectrophotometer method as quercetin with a wavelength of 431 nm. The gravimetric method was used to measure saponins and alkaloids.

The antioxidant activity test used a free radical scavenging power model, namely 1,1-diphenyl-2-picrihidazil (DPPH). Based on the reduction of the colored DPPH free radical methanol solution by free radical inhibition, this approach operates by scavenging DPPH free radicals. When a purple DPPH solution comes into contact with an electron donor, the DPPH is reduced, and the purple color fades and is replaced with yellow color of the picryl group. DPPH absorbance values ranged from 515-520 nm. A compound is classified as a very strong antioxidant if the $IC_{50} < 50$, strong (50 to 100), moderate (100 to 150), and weak (151 to 200). The smaller the IC_{50} value means the higher the antioxidant activity. The data evaluation technique for the antioxidant activity of the extract was carried out by comparing the concentration (ppm) of the extracted extract with the % value of the antioxidant extracted plotted in a regression graph.

The study was conducted for four weeks, and observations were made every week. This procedure was performed for each formula and base as a control. Participants were randomized into four groups: the control group (N=6) and the experimental group (N=18). Members of the control group, F0 (N=6) used a skin serum product that mainly consisted of a basic formula without ethanolic extract of rose apple leaves. There were six women in the control group ranging in age from thirty to forty years. There were eighteen women between the ages of thirty to forty in the experimental group.

Members of the experimental group used serum products with rose apple leaf ethanol extract with concentrations of 5%, 10%, and 15% respectively. The experimental group was further divided into three groups, F1 (N=6) with 5% ethanolic serum extract, F2 (N=6) with 10% ethanolic serum extract, and F3 (N=6) with 15% ethanol extract serum. All participants were given serum product in a 30ml dropper glass bottle and given instructions for daily use of the serum in the upper arm area 2 cm from the elbow joint, applying 1 ml of formulated serum to the skin of the upper arm in the designated area after washing in the morning and evening separately, instructed to then gently massage serum until fully absorbed. The observation was conducted for four weeks [21]. The ethical clearance of this research has been approved by Health Research Ethics Commission - Universitas Prima Indonesia No. 023/KEPK/UNPRI/IV/2021.

All volunteers enrolled in this study will have their forearm skin analyzed in a predetermined area with the API-100 Aram Huvis Innovation Skin Analysis System at weeks 0, 1, 2, 3, and 4 to evaluate skin conditions in terms of pigmentation, wrinkle, pore, sensitivity [22]. Measurement of the effectiveness of anti-aging begins by measuring the initial condition of the skin that has been predetermined in the volunteers. The volunteers will have cleansed their forearm area before each test. Then, with the API-100 Aram Huvis Innovation Skin Analysis System tool, measurements will be targeted at a predetermined upper arm area of the volunteer at weeks 1, 2, 3, and 4. All results are then collected and analyzed to evaluate the results. The parameters measured are wrinkle, pore, pigment, and sensitivity.

RESULTS AND DISCUSSION

Phytochemical content

A qualitative test of the phytochemical content of rose apple leaf extract was carried out using various reagents. The results of the qualitative analysis of the phytochemical content of rose apple leaves are shown in table 1. Furthermore, the extraction results obtained showed in table 2 that the phytochemical contents are alkaloids 77.94%; flavonoids 48.63%; saponins 84346.04 ppm; phenol as gallic acid 33075.64 ppm, and phenol as tannic acid 14266.84 ppm respectively.

Table 1. Qualitative test results of phytochemical screening

No.	Secondary Metabolite	Reagent	Results	
			Ethanol	N-Hexane
1	Alkaloid	Dragendorff's	+	-
		Bouchard	+	-
		Meyer	+	-
2	Flavonoid	Mg + Amil		
		Alcohol + HCl Powder	+	+
3	Saponin	Hot water	+	-
4	Phenol	FeCl ₃	+	-

Table 2. Quantitative test results from rose apple extract

N o	Parameters	Methods	Results	Unit
1	Alkaloid Ethanol Extract	Gravimetry	77.94	%
2	Saponin Ethanol Extract	Gravimetry	48.63	%
3	Flavonoid as Quercetin Ethanol Extract	Spectropho metry UV-VIS	84346.04	ppm
	Hexane Extract		152703.16	ppm
4	Phenol as Gallic Acid	Spectropho metry UV-VIS	33075.64	ppm
	Phenol as Tannic Acid		14266.84	ppm

Several studies have been carried out on plants of the genus *Syzygium* to explain their chemical and pharmacological properties. The results are found in various formulations including juices, jellies, and jams, and the genome in the DNA and RNA chains of the genus *Syzygium* contains protein compounds that can be used as medicinal plants [23]. This study supports the findings of a previous study [24] on the extraction of rose apple leaves, which found that a 70% acetone solvent could extract phytochemical components such as alkaloids, saponins, and phenols, flavonoids, and steroids found in rose apple leaves. In another study, phytochemical screening revealed that 50% of rose apple ethanol extract was positive for flavonoids, tannins, saponins, and steroids/terpenoids, and 70% of ethanol was positive for flavonoids, tannins, saponins, and steroids/terpenoids, and 90% ethanol was positive for flavonoids, tannins, and steroids/terpenoids. [25]. Other investigations have revealed polyphenols, flavonoids, tannins, and sterols from various portions of the *S. jambos* species that exhibit antibacterial activity to anti-inflammatory activity via analgesic, antiviral, antidermatophytic, anticancer, and hepatoprotective activities [9]. Furthermore, a decoction of this fruit has been reported to help with dyspepsia, wounds, syphilis, leprosy, and toothache [26]. *Syzygium jambos* is a widely distributed medicinal plant that has long been used as a pain reliever and painkiller [27]. Another reported the hexane and methanol compounds extracted from the leaves of *Syzygium jambos* (L.) Alston (Myrtaceae) which proved to be effective against the herpes virus and was shown to have high inhibitory activity against the herpes virus [28].

Antioxidant Activity

The result of IC₅₀ is 7.2935 ppm. The IC₅₀ value of all samples of the extraction time variation test shows an IC₅₀ value of less than 50. These results indicate that the extract of rose apple leaves is a very strong antioxidant with a very low IC₅₀ value of 7.29.

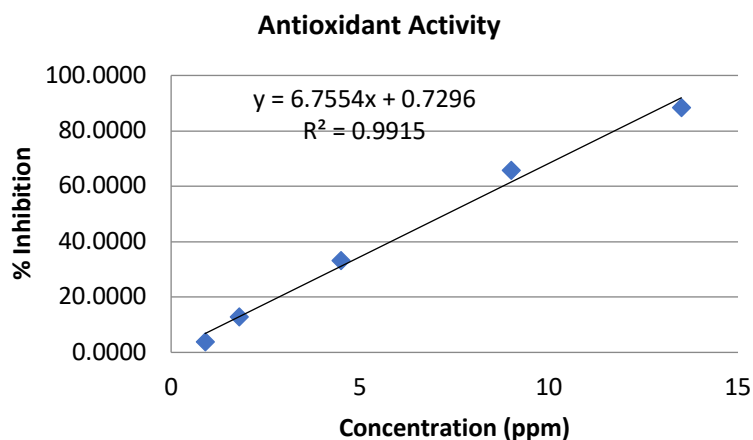


Figure 1. DPPH radical scavenging activity

A recent study on two isolated glycosylated flavonoids showed that the flavonoid content in rose apple lowers TNF- production, with IC₅₀ values of 1.68 and 1.11 M in the RAW cell line 264.7, respectively. Furthermore, at a dosage of 5 mg/kg, flavonoids reduced TNF-, C-reactive protein, and fibrinogen levels [29]. The inflammatory process in the human body is an indicator of a disease process. According to research [30], in vitro and in vivo models may be used to test the anti-inflammatory efficacy of crude extracts and purified components from *S. jambos*. This plant extract reduced the production of inflammatory cytokines IL-8 and TNF- by 74-99 percent, demonstrating an anti-acne effect on the skin [7].

Flavonoids are one type of compound that functions as an excellent free radical scavenger [31]. It is proven that the plant extract *S. jambos* contains flavonoid compounds and has shown considerable anti-inflammatory activity against several models. Some of these compounds such as epirobidanol and 4'-dehydroxyrobidanol have been identified and exhibit tyrosinase inhibitory activity which is required as an active ingredient in gels in skin beauty [31]. Several studies on *S. jambos* also found that there was high antioxidant activity. The content of saponins, phenols, flavonoids, and steroids in the form of sterols contained in it has the highest antioxidant activity based on the percentage of free radical inhibition [14]. The facts found can support the claims of traditional medicine uses *S. jambos* bark extract to treat infectious diseases [10].

The antioxidant and anti-inflammatory properties of *S. jambos* extract and components were shown to be closely linked. Another significant aspect to explore is the primary ingredients of *S. jambos* extract, namely flavonoids and ellagitannins, the majority of which will be glycosylated and subsequently discovered in great levels in the blood due to their water solubility. This parameter is critical in medication development since it improves the medicine's therapeutic effect. As a result, *S. jambos* is a promising plant for the creation of strong traditional remedies against inflammatory illnesses [30].

Biorevitalizing effects

This study evaluated the biorevitalizing effect of the ethanolic extract of rose apple leaves *S. jambos* on improving skin conditions in terms of pigmentation, wrinkle, pore, and sensitivity

on the skin of women aged 30-40 with visible signs of premature aging within 4 weeks. The results of changes in skin conditions according to the formula given 0%, 5%, 10%, and 15% in 4 weeks of observation, can be seen in Figure 2.

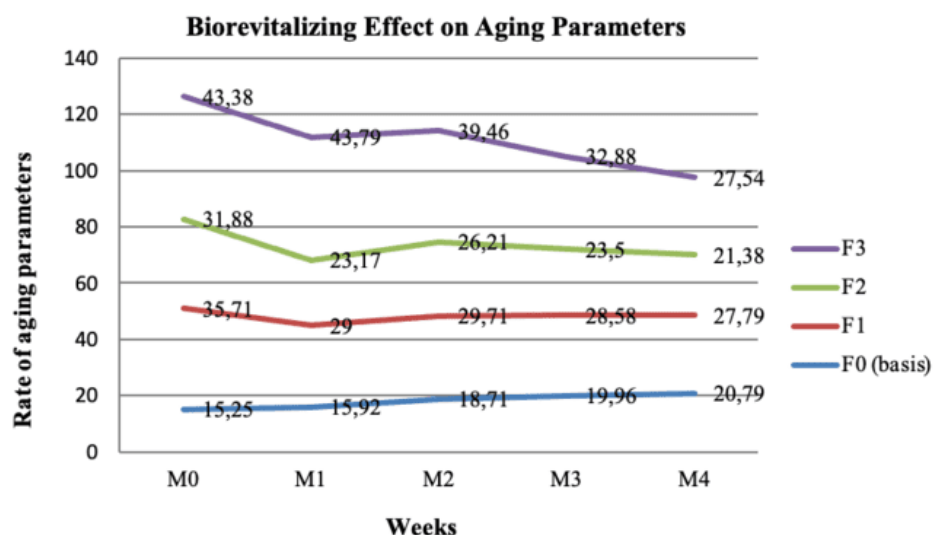


Figure 2. The average of the skin parameters within 4 weeks between the four formulas

From the data in Figure 2, it can be concluded that in the group given the 0% formula or base serum, the average skin conditions parameters of premature aging tend to increase in 4 weeks. In addition, it can be seen that the group that was given the 15% formula saw a significant decrease in the average skin condition parameters of premature aging.

This study was conducted to determine the effect of skin biorevitalization of the ethanolic extract of rose apple leaves on improving skin conditions in terms of pigmentation, wrinkle, pore, and sensitivity, on the skin of women aged 30-40 with visible signs of premature aging within 4 weeks. The results of this study showed that in the group given the 0% formula or basis, the average skin condition parameters on premature aging tend to increase in 4 weeks. In addition, it can be seen that the group that was given the 15% formula saw an average decrease in skin condition parameters with a significant decrease in value.

According to one study, providing an ethanol extract of *S. jambos* can prevent the production of edema produced by carrageenan and histamine. This study also describes the plant extract's considerable acute anti-inflammatory efficacy. The presence of bioactive polyphenolic substances such as catechin hydrate, rutin hydrate, ellagic acid, and quercetin may explain *S. jambos* as anti-inflammatory and antioxidant action. This plant also contains polyphenolic chemicals and hydrated catechins [32]. In addition, a study was carried out to explore the fungal growth inhibitory action of the plant extract *S. jambos* L. (Alston) and promising as a guide for the development of anti-dermatophytes and anti-inflammatory therapies in the skin [33]. *S. jambos* extract's significant anti-inflammatory and antioxidant activity has been shown to decrease and renew the skin. Antioxidant products applied to the skin can intervene at different times of the skin pigmentation process by activating intrinsic photoprotective mechanisms and improving the rate and quality of skin pigmentation [34]. The skin naturally depends on

antioxidants to protect it from ROS generated by sun exposure and physiological metabolic processes. Our bodies defend against ROS phenomena through endogenous antioxidants but when endogenous antioxidants are insufficient or unbalanced in defense against oxidants, exogenous antioxidants can help restore balance. For this reason, it is also necessary to apply antioxidants that are applied topically to increase the antioxidant reserves of the skin [2].

Antioxidants can be obtained synthetically. The use of natural antioxidants has recently increased because it has several advantages such as being easier to obtain, at a more affordable price, with no intermediate reactions that occur, and also containing several different types of antioxidants [34]. As one of the plants with a high content of antioxidants, *S. jambos* has been investigated for its effect on the activity of protein disulfide isomerase (PDI). *S. jambos* extract showed dose-dependent anti-PDI activity with an IC_{50} of 14.40 g/mL. Next, we examined the effect of *S. jambos* on endothelin-1 (ET-1)-stimulated PDI activity in human endothelial cells. *S. jambos* extract reduced ET-1-stimulated ROS to a basic level ($p < 0.05$, $n=3$) so it was effective in preventing premature aging of the skin due to free radicals [35].

The effectiveness of skin biorevitalization

The difference in the concentration of ethanolic extract of rose apple leaves in concentrations of 5%, 10%, and 15% in skin serum formulations with biorevitalization effectiveness on the skin of women aged 30-40 can be seen by analyzing the data. The data were first analyzed to determine the normality of data distribution using the Shapiro-Wilk test, where the data obtained were not normally distributed where a $p < 0.05$. Furthermore, because the data were not normally distributed, to determine the effect of the given formula on the parameters of premature aging of women's skin, the data were analyzed using the non-parametric Kruskal-Wallis's test to determine the effect and biorevitalization activity on the skin in the different formula preparations. Furthermore, analysis was done on the effect of the formula on skin conditions for four weeks of treatment using the Mann-Whitney Test.

Table 3. Result of the non-parametric Kruskal-Wallis Test

	Mean	Median	SD	Min	Max	p-value
Pore	28.95	28	12.384	6	62	0.001
Melanin	34.35	32	25.380	1	90	0.000
Wrinkle	27.10	26.5	12.056	3	76	0.316
Sensitivity	20.52	8.5	27.244	1	96	0.002

$\alpha = 0.05$

Table 3 showed the results of the skin analysis test with 4 groups of formulas F0%, F5%, F10%, and F15% on improving skin conditions of women aged 30-40 with signs of premature aging, after 4 weeks. The p -value obtained for the pore parameter (P) is 0.001 where $\alpha < 0.05$, so the given formula has a significant effect on reducing pores. The p -value for the pigmentation/melanin (M) parameter is 0.000 where $\alpha < 0.05$, so the formula given has a significant effect on skin pigmentation. The p -value for the wrinkle parameter (W) is 0.316 where $\alpha > 0.05$, so the formula given does not have a significant effect on reducing wrinkles. Finally, the p -value for the sensitivity parameter (S) is 0.002 where $\alpha < 0.05$, so the formula given has a significant effect on skin sensitivity.

Furthermore, the Mann-Whitney test was performed to see the effect of each formula group (F5%, F10%, and F15%) on the control group (F0). These results are used to determine which formula has the most effect on skin improvement and prevention of premature aging with four parameters tested. The results of the Mann-Whitney statistical test can be seen in Table 4.

Table 4. Result of the Mann-Whitney test			
Variabel	Formula Base (F0%)	Formula 5% (F5%)	p-value
	Mean Rank		
Pore	24.97	36.03	0.014*
Melanin	22.85	38.15	0.001*
Wrinkle	28.13	32.87	0.029*
Sensitivity	24.68	36.32	0.007*
	Formula Base (F0%)	Formula 10% (F10%)	p-value
	Mean Rank		
Pore	24.68	36.32	0.100
Melanin	29.48	31.52	0.652
Wrinkle	27.80	33.20	0.231
Sensitivity	29.45	31.55	0.599
	Formula Base (F0%)	Formula 15% (F15%)	p-value
	Mean Rank		
Pore	22.52	38.48	0.000*
Melanin	21.03	39.97	0.000*
Wrinkle	26.05	34.95	0.048*
Sensitivity	23.22	37.78	0.001*

***Indicated a significant difference at $\alpha = 0.05$**

Table 4 showed there is a significant effect on the 5% and 15% formulas on changes in skin aging parameters in terms of pigmentation, wrinkle, pore, and sensitivity while the 10% formula has no significant difference and no effect on the parameters studied. For the 5% formula, the p-value of each parameter is obtained, namely pore = 0.014, melanin = 0.001, wrinkle = 0.029 and sensitivity = 0.007 were all ≤ 0.05 . While the 10% formula obtained p-value for each parameter, namely pore = 0.100, melanin = 0.652, wrinkle = 0.231 and sensitivity = 0.599 where all > 0.05 , so there is no effect on the 10% formula on the parameters of premature skin aging studied. Furthermore, the 15% formula obtained the p-value of each parameter, namely pore = 0.000, melanin = 0.000, wrinkle = 0.048 and sensitivity = 0.001 where all ≤ 0.05 , so there is a significant effect on the 15% formula on the parameters of premature skin aging studied.

In this study, it was found that *S. jambos* ethanol extract given to the skin of women, can affect decreasing premature aging parameters and improve skin conditions in terms of pigmentation, wrinkle, pore, and sensitivity seen in 4 weeks. Meanwhile, the parameter of skin condition, namely the assessment of wrinkles, this serum has not seen the effect of significant changes. The p-value for the pore parameter (P) is 0.001 where < 0.05 , pigmentation/melanin (M) is 0.000 where < 0.05 , wrinkles (W) is 0.316 where > 0.05 , and sensitivity (S) is 0.002 where < 0.05 , so it can be said that the given formula has a significant effect on improving the skin conditions studied, namely the condition of pores, pigmentation and skin sensitivity. Meanwhile, for the wrinkle parameter, it is showed to not to have a significant effect in this study.

The effectiveness of this serum preparation proved to have an effect on the 5% and 15% formulas. For the 5% formula, the p-value of each parameter is obtained, namely pore = 0.014, melanin = 0.001, wrinkle = 0.029 and sensitivity = 0.007 where all ≤ 0.05 . Furthermore, the 15% formula obtained the p-value of each parameter, namely pore = 0.000, melanin = 0.000, wrinkle = 0.048 and sensitivity = 0.001 where all ≤ 0.05 , so there is a significant effect on the 15% formula on the parameters of premature skin aging researched.

Skin aging manifests itself in a variety of ways, including the existence of wrinkles, uneven skin tone, large pores, and skin dryness. Earlier research attempted to test the impact of an encapsulated serum containing vitamin C (20% w/w), vitamin E, and European raspberry leaf (*Rubus idaeus*) cell culture extract, which has high amounts of anti-oxidants, on the face skin of women aged 30 to 65 years. The result was a significantly improved skin tone, elasticity, and overall brightness of the facial skin [36]. The plant *S. jambos* has a high antioxidant capacity. When compared to normal ascorbic acid (vitamin C) per gram of extraction, the total antioxidant capacity of the ethanol extract was determined to be 628.5 mg ascorbic acid/g extract [32]. The ethanolic extract of *S. jambos* possesses antioxidants that are substantially greater than vitamin C and has a considerable effect on premature aging markers in women's skin.

Another parameter as a marker of premature aging of the skin is the process of melanin production in the skin. The skin has the same number of melanocytes per unit surface, but there are differences in their structure. The process of skin pigment production or melanogenesis is mainly regulated by solar radiation, hormones, and other endogenous and exogenous factors. Tannic acid can also reduce the rate of pigment degradation through the copigmentation process. Tannic acid is known from the results of the quantitative test in this study, and was contained in the ethanol extract of rose apple leaves. A study stated that there is an effect of copigmentation with tannic acid and an increase in melanocyte activity and an increase in melanin transfer to keratinocytes [36].

Furthermore, in addition to pigmentation or melanin parameters in the skin, one of the other premature aging parameters is the condition of the pores on the skin. One of the active substances that prevent acne is an antioxidant and anti-inflammatory contained in several types of plants that can be a source of natural antioxidants [7]. Flavonoids have been found in significant concentrations in *S. jambos* and examined for their ability as antioxidants, where flavonoids may transform or diminish free radicals as well as act as anti-free radicals. A study formulated the ethanolic extract of jackfruit leaves containing flavonoids in the form of a cream, with a concentration of 2, 4, 6, and 8% as an anti-aging preparation. After 4 weeks of therapy, the ethanol extract of jackfruit leaf cream showed its efficacy as a good anti-aging agent. About 8 % formula cream boosted 9.3 % moisture and 8 % evenness, shrunk 15 % pores, and eradicated 18.7 % blemishes, according to the findings. Cream from 8% jackfruit leaf ethanol extract has the best anti-aging effectiveness [37].

The next parameter to be investigated as a form of skin change in dealing with premature aging is skin wrinkle. Previous research was conducted to see the effect of Robusta coffee which has a higher antioxidant content such as *chlorogenic acid (CGA)* and caffeine on photoaging due to UVB radiation in mice. The results showed a significant reduction in wrinkle scores within 10 weeks of applying the cream and UVB radiation [38]. In addition, another study stated that

there was an anti-aging and skin lightening effect from the 0.4% formulation of natural *pterostilbene*. from *Pterocarpus marsupium* extract containing flavonoids on the skin of the arm of the participants for 8 weeks. The result is that natural *pterostilbene* is effective in reducing wrinkles and fine lines, increasing skin hydration elasticity, and showing no side effects within 8 weeks of use [39]. Meanwhile, in this study, evaluations were made within 4 weeks of using *S. jambos* ethanol extract, in comparison to the longer duration of studies above, so the effectiveness of this serum has yet to show a significant reduction in skin wrinkles.

Photographic data obtained by API-100 Aram Huvis Innovation Skin are shown in Figure 3.

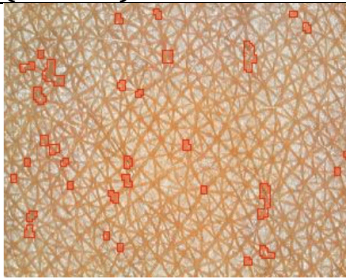
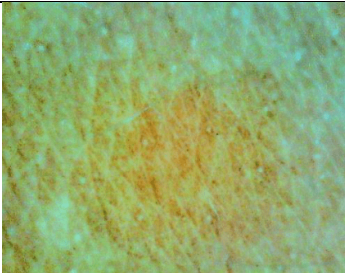
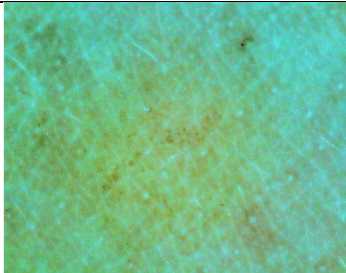
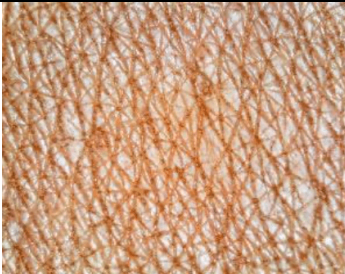
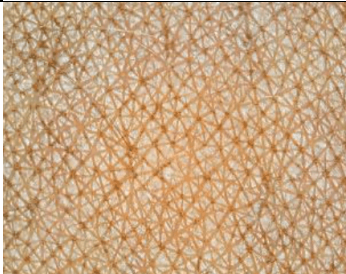
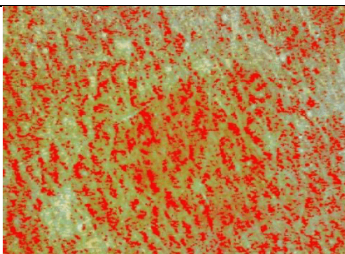
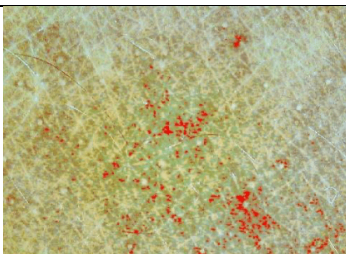
Parameters	Before (Week-0)	After revitalization (Week-4)
Pore		
Melanin		
Wrinkle		
Sensitivity		

Figure 3. Photographic images of parameters before and after revitalization with skin serum of rose apple extract using the 15% formula

Sunlight causes an increase in the generation of reactive oxygen species (ROS), which causes skin aging and hyperpigmentation issues. An ethanolic fraction of three plant extracts, *Annona squamosa* L., *Ardisia elliptica* Thunb., and *Senna alata* (L.) Roxb., was shown to have high

antioxidant content and activity, as well as considerable inhibition of tyrosinase and collagenase [39]. In one study, it was investigated that flavonoids are responsible for the anti-inflammatory activity of arnica montana extract, and aloin, anthrone-C-glucosyls with antibacterial activity. The flavonoid active substance has been shown to reduce the release and permeation of aloin, with limited activity on the surface to which it is applied. As a result, human skin fibroblasts can metabolize absorbed aloin into structurally related compounds that increase skin sensitivity to ultraviolet light [40]. A study states that the flavonoid compounds in cocoa pod extract contribute to functional cosmetic properties. This compound helps reduce wrinkles on the skin and reduce pores after 3 weeks of use [41].

CONCLUSION

The phytochemical compounds obtained from the ethanolic extract of rose apple leaves are alkaloids, flavonoids, saponins, and phenol as gallic acid, and phenol as tannic acid which functions as an antioxidant that is comparable to vitamin C. The formulated serum made from rose apple leaf extract affects skin revitalization, counteracts free radicals, and provides an anti-aging effect with a reduction in pore parameters, pigmentation, and skin sensitivity whereas a 15% formula has the most significant effect. These research results showed the good potential of rose apple leaf extract as a natural alternative in anti-aging ingredient in skin care formulations.

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