ASIAN JOURNAL OF PHARMACEUTICAL AND CLINICAL RESEARCH

INNOVARE ACADEMIC SCIENCES
Knowledge to Innovation

Vol 18, Issue 3, 2025

Online - 2455-3891
Print - 0974-2441

Research Article

COMBINATION OF FRANGIPANI (*PLUMERIA ALBA*) FLOWER ETHANOL EXTRACT AND SEAWEED (*ULVA LACTUCA*) EXTRACT AS A NATURAL SUNSCREEN CREAM

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Received: 01 January 2025, Revised and Accepted: 12 February 2025

ABSTRACT

Objective: This study evaluated the potential of frangipani (*Plumeria alba*) flower extract and seaweed (*Ulva lactuca*) extracts as natural sunscreen cream.

Methods: An experimental design with a randomized group approach was used, involving five sample groups. The sun protection factor (SPF) value was determined using an ultraviolet (UV)–visible spectrophotometer. Frangipani and seaweed were extracted using ethanol and formulated into a cream.

Results: The combination of 3% frangipani flower extract and 3% seaweed extract resulted in the highest SPF value of 17.6, demonstrating its effectiveness as a protector against UV radiation.

Conclusion: This study concludes that frangipani flower extract and seaweed extract are promising natural ingredients for use as safe, environmentally friendly sunscreens. These findings contribute to the utilization of local natural resources and the development of safer, ingredient-based cosmetic products.

Keywords: Frangipani flower, Photo-protective, Seaweed, Sun protection factor, Ultraviolet.

 DOI: http://dx.doi.org/10.22159/ajpcr.2025v18i3.53746. Journal homepage: https://innovareacademics.in/journals/index.php/ajpcr

INTRODUCTION

Ultraviolet (UV) radiation has been increasing in recent years. According to data from the Meteorology, Climatology, and Geophysics Agency (MCGA), the UV index in Bali ranges from 8 to 10. This UV index is classified as red, which indicates a very high risk of danger [1]. UV radiation can trigger the formation of reactive oxygen species (ROS), which can negatively impact the body. In the short term, UV exposure can damage the skin structure, triggering inflammation, sunburn, and abnormal pigmentation. Long-term exposure to UV radiation can increase the risk of skin cancer [2]. Under high UV index conditions, MCGA recommends using sunscreen with a minimum sun protection factor (SPF) of 15 when outdoors to protect the skin from harmful effects [1]. As a popular tourist destination, Bali offers a range of outdoor attractions, making sunscreen an important consideration for protecting the health of both visitors and local residents.

Today, sunscreens are available in various formulations and types. Based on their active ingredients, sunscreen formulations can be categorized into physical, chemical, natural, or organic types [3]. Sunscreens made from natural or organic ingredients are increasingly used because they are believed to be safer from side effects. However, they still require more thorough research. Studies have also highlighted the environmental impact of using organic-based sunscreens in several regions [4].

Several studies have shown the potential of natural ingredients as effective sun protectors [5-8]. Frangipani (*Plumeria alba*) and seaweed (*Ulva lactuca*) are natural ingredients that are still rarely used but are found in large quantities in the Bali region [9-11]. Previous research has shown that frangipani flowers contain active compounds beneficial for skin health, including antioxidants, antimicrobials, and anti-biofilm agents [12-15]. In addition, seaweed which contains bioactive compounds such as vitamin C, tocopherols, and polyphenols has potential to be a sun protector [9,11,16,17].

Based on the background, SPF testing in frangipani flower and seaweed cream is needed to support its function as a nature-based sunscreen. The use of these two natural materials can also be a potential for local natural resource management so that it can be utilized optimally. This study aimed to determine the SPF content of cream made from combination of frangipani flower extract and seaweed extract as a natural sunscreen.

METHOD

Sample collection and extraction

The samples in this study were frangipani (*P. alba*) flowers collected from Banjar Ekasila, Denpasar City, Bali, Indonesia, and seaweed (*U. lactuca*) collected from Sanur Beach, Denpasar, Bali, Indonesia. The flowers and seaweed were dried, made into powder, and then were extracted separately using an ethanol solution (70%).

Cream formulation

This study used an experimental method with a random group design consisting of 5 sample groups: One control group and four treatment groups. Control group (K) without extract content; treatment group 1 (P1) with 2% frangipani flower extract; treatment group 2 (P2) with 3% frangipani flower extract; treatment group 3 (P3) with 2% frangipani flower extract and 2% seaweed extract; treatment group 4

(P4) with 3% frangipani flower extract and 3% seaweed. The extracts were then formulated into a cream with a mixture of virgin coconut oil, maltodextrin, cocoa butter, tween 80, span 80, and glycerin.

SPF and antioxidant testing

The cream was tested for SPF levels using *a* UV-visible spectrophotometer [18]. The SPF level test was carried out 3 times, and the mean value for each group was calculated at the end of the measurements. The antioxidant capacity of the cream was also tested by spectrophotometry using 2,2 difenil-1-picrylhydrazyl (DPPH) method and gallic acid as standard [19,20]. The DPPH assay was appropriate method for this study due to DPPH as stable free radical, and its behavior closely mimics that of ROS in living organisms. Data analysis was a descriptive analysis that showed an overview of SPF and antioxidant capacity in each treatment group. One-way analysis of variance (ANOVA) analytical analysis was carried out to see the significance of the difference in treatment between groups.

RESULTS AND DISCUSSION

Research results

The results of the SPF test in all treatment groups and the significance value of the one-way ANOVA test are presented in Table 1.

Table 1 shows the results of the SPF value test in each treatment and the significance value of the one-way ANOVA test. Based on the significance test, it was found that the treatments had a significant effect (p=0.001). Of the 5 sample groups, the highest SPF value was obtained in treatment 4 with 3% frangipani and 3% seaweed extract, which was 17.6. However, treatment 3 (frangipani flower extract+2% seaweed) and treatment 4 did not show statistically significant differences.

Table 2 below shows the antioxidant activity results in each treatment group, which is tested using the spectrophotometry method with the gallic acid standard.

Based on the results in Table 2, the one-way ANOVA test results showed that the treatments had a significant effect with a value of p=0.001. The strongest antioxidant capacity of the 5 treatment groups was in treatment 4 (P4) with a capacity of 352. 474. Fig. 1 shows a picture of the cream of frangipani flower extract and seaweed extract.

Table 1: SPF results on all treatments and significance between treatments

Treatment	SPF value	p-value
P0 (control)	7.739^{c}	0.001
P1 (2% frangipani flower extract)	8.867^{b}	
P2 (3% frangipani flower extract)	9.114^{b}	
P3 (2% frangipani flower extract+2% seaweed)	16.856^{a}	
P4 (3% frangipani flower extract+3% seaweed)	17.606^{a}	

P: Treatment of samples, SPF value: SPF test result using the UV-Vis spectrophotometer method, p-value: Significance value in 5 treatments (one-way ANOVA), SPF: Sun protection factor. Different letters behind the numbers in the same column indicate significantly different values

Table 2: Antioxidant capacity value for each treatment group

Treatment	Antioxidant capacity	p-value
P0 (control)	254.257^{c}	0.001
P1 (2% frangipani flower extract)	258.048^{c}	
P2 (3% frangipani flower extract)	269.074^{bc}	
P3 (2% frangipani flower extract+2% seaweed)	288.756^{b}	
P4 (3% frangipani flower extract+3% seaweed)	352.474a	

P: Treatment of samples, p-value: Significance value in 5 treatments (one-way ANOVA). Different letters behind the numbers in the same column indicate significantly different values

DISCUSSION

Based on the results of the study, treatment 4 had the highest SPF value at 17.6, which was classified as medium category. This shows the potential of using natural ingredients such as frangipani flower and seaweed as sunscreen. These results are in accordance with the research by He *et al*. (2021) that mentions the potential of marine algae antioxidants as a radiation protective agent for the skin. Natural materials from the sea can act as natural photoprotective agents because they contain bioactive compounds such as mycosporine-like amino acids, sulfate polysaccharides, carotenoids, and polyphenols [3,5,21]. Marine algae-derived compounds exhibit various biological activities, including UV absorption, antioxidant, anti-aging, and immunomodulatory effects [11,21-24].

Compared to the antioxidant capacity of the control (254,257), the addition of 2% frangipani flower extract resulted in an increase to 258.048. This suggests that even a small amount of frangipani extract can positively influence antioxidant capacity. Antioxidant capacity refers to the ability of a substance to neutralize the harmful effects of free radicals in the body. Free radicals are unstable molecules that can damage cells and contribute to aging and various diseases [2,9].

A higher concentration of frangipani extract continues to improve the antioxidant capacity. At 3% frangipani flower extract, the antioxidant capacity increases to 269.074. The combination of frangipani extract and seaweed at this concentration shows a notable increase in antioxidant capacity, reaching 288.756. This suggests that seaweed may have a synergistic effect with the frangipani flower extract, enhancing its antioxidant activity. The highest antioxidant capacity (352.474) was 3% frangipani flower extract+3% seaweed. This suggests that seaweed may have a synergistic effect with the frangipani flower extract, enhancing its antioxidant capacity.

Research by Parikh *et al*. [22] showed that brown algae contain large quantities of polyphenols, which support its function as an antioxidant and skin health (photoprotector). This is in line with Widyasari Wijaya *et al*. [16] and Sami *et al*. [25], who show the presence of polyphenols, vitamin C, vitamin E, carotenoids, and polysaccharides in seaweed. Seaweed has the potential to be an antioxidant, anti-inflammatory, and skin health, especially with its UV-absorbing properties.

This natural material from the sea shows stability and adequate UV protection as a sunscreen formulation. In addition, sunscreens made from marine natural materials can be an environmentally friendly alternative to conventional chemical sunscreens that can negatively affect health and the environment [26,27].

Frangipani (*P. alba*) flower was found to have biological activities that include antioxidant, antibacterial, antiarthritic, antitumor, and anti-diabetic properties [13,28,29]. The bioactive compounds found in frangipani flowers include alkaloids, terpenoids, phenolic compounds, flavonoids, steroids, and glycosides [12-15]. The content of these compounds, apart from being antioxidants, also acts as photoprotective

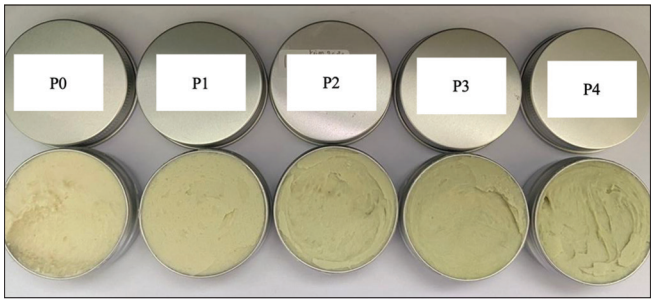

Fig. 1: Cream of frangipani flower and seaweed extract according to treatment from left to right: Control, Treatment 1, Treatment 2, Treatment 3, and Treatment 4

ingredients that have the potential to be sunscreens that can replace synthetic chemicals in the future [30].

Several previous studies have shown the role of bioactive compounds *Plumeria* spp. For health, the specific role of a sun protector has not been explored more specifically. This study obtained SPF in cream with frangipani flower extract alone at P1 and P2, namely 8.8 and 9.1. Meanwhile, the SPF in the combination of frangipani flower extract and seaweed was higher at 17.6 in the P4 group. These results show that the combination of bioactive compounds in the two natural materials provides a synergistic effect on photoprotective function. It is known that natural materials have a survival defense mechanism that protects against the adverse effects of UV radiation, namely with their a specialized plant metabolites (SPMs) as photoprotectors [31].

Frangipani flowers and seaweed contain antioxidants that neutralize free radicals (ROS). UV radiation triggers the production of ROS in the skin and body, making the antioxidant properties of these two natural ingredients beneficial in supporting the skin's protective function [5,32,33].

This combination of frangipani flower extract and seaweed SPF has high potential as a natural sunscreen. In addition to being made from natural materials to maintain local wisdom so that it does not pollute the environment or threaten the extinction of a species, these two natural materials also have a biological function from the content of their bioactive compounds, such as antioxidants and vitamins that are beneficial for health. The limitation of this study is that it has not conducted dermatology testing on experimental animals to determine the undesirable effects on the skin.

CONCLUSION

This study shows that the combination of frangipani flower extract and seaweed has significant potential as a natural sunscreen with good SPF effectiveness. The results showed that the frangipani flower and seaweed extracts were safe to use and provide protection against UV radiation, making them a good alternative to chemical-based sunscreens. By utilizing local natural resources, this research contributes to skin health and supports environmental sustainability. Further research is needed to explore the mechanism of action of bioactive compounds in these two materials as photoprotectors.

ACKNOWLEDGMENTS

We would like to express our sincere gratitude to the individuals and institutions that contributed to the success of this research. Special thanks to the Faculty of Medicine and Health Science, Warmadewa University for providing the necessary facilities and support. Our appreciation extends to the funding bodies that supported this research, enabling us to explore the potential of natural ingredients in sunscreen formulations. Finally, we would like to thank our families and colleagues for their encouragement and assistance during the research process.

CONFLICT OF INTEREST

There are no conflicts of interest in this text.

AUTHORS CONTRIBUTIONS

All authors have accepted responsibility for the entire content of this manuscript. PAWW and MP developed performed the experiments and wrote the manuscript. NWSE, LGE, and NWDE analyzed the data and wrote the manuscript. PAWW contributed to the final version of the manuscript and supervised the project.

FUNDING

This research was funded by Internal Grant from Faculty of Medicine and Health Science, Warmadewa University, Bali, Indonesia.

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