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Original Article

Spectrophotometric SPF Assessment and Phytochemical Screening of *Pleiogynium cerasiferum* Leaf Extracts

Bhawana Bhatt[1,*], Sudhakar Kaushik[2], Heena Mittal[3], Lata Sati[4]

[1]Department of Pharmacognosy, School of Pharmaceutical Sciences, Shri Guru Ram Rai University, Dehradun, Uttarakhand, INDIA.
[2]Department of Pharmacology, School of Pharmaceutical Sciences, Shri Guru Ram Rai University, Dehradun, Uttarakhand, INDIA.
[3]Department of Pharmaceutics, School of Pharmaceutical Sciences, Shri Guru Ram Rai University, Dehradun, Uttarakhand, INDIA.
[4]Department of Home Science, School of Humanities and Social Sciences, Shri Guru Ram Rai University, Dehradun, Uttarakhand, INDIA.

ABSTRACT

Background: Concerns over the environmental impact and potential health risks associated with synthetic Ultraviolet (UV) filters have intensified the search for natural, eco-friendly alternatives in sun protection formulations. In this study, we investigated the sun protection factor (SPF) of *Pleiogynium cerasiferum* leaves extracts using ethanol, aqueous and Petroleum ether as extraction solvents to assess their potential as natural UV-absorbing agents. **Materials and Methods:** *Pleiogynium cerasiferum* leaves extracts were analyzed using UV spectrophotometry via the Mansur equation, measuring absorbance across the UVB spectrum. Preliminary phytochemical analysis was conducted to identify major bioactive compounds. These analyses provided insights into the extracts potential bioactivity. **Results:** The preliminary phytochemical analysis of *Pleiogynium cerasiferum* extracts confirmed the presence of alkaloids, carbohydrates, flavonoids, glycosides, tannins, saponins, and phenols. Additionally, these extracts exhibited significant sun-protective properties. The ethanol extract demonstrated a Sun Protection Factor (SPF) value of 3.92, whereas the aqueous extract and petroleum ether extract showed SPF values of 1.10 and 0.36, respectively. **Conclusion:** The significant SPF values observed in *Pleiogynium cerasiferum* extracts highlight their potential as valuable additions to sunscreen formulations, enhancing sun protection while reducing dependence on synthetic UV filters. Furthermore, the incorporation of these natural extracts aligns with the growing demand for sustainable skincare solutions, offering benefits for both environmental safety and consumer health. These findings indicate that the extraction solvent plays a crucial role in isolating bioactive compounds responsible for UV absorption. The study highlights the potential of *Pleiogynium cerasiferum* as a natural source of photoprotective agents, warranting further investigation into its formulation for sunscreen applications.

Keywords: *Pleiogynium cerasiferum*, Ultraviolet (UV) radiation, Photo damage, Sunscreens, *In vitro activity*, Mansur equation.

Correspondence:
Dr. Bhawana Bhatt
Department of Pharmacognosy, School of Pharmaceutical Sciences, Shri Guru Ram Rai University, Dehradun-248001, Uttarakhand, INDIA.
Email: bhawanabhatt729@gmail.com

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INTRODUCTION

In recent years, sunscreens have become increasingly popular, not only for their aesthetic benefits but also for their essential role in shielding the skin from harmful Ultraviolet (UV) radiation.[1] The market offers a variety of sunscreen products, including standalone formulations as well as those incorporated into skincare, hair care, lip care, and eye care products. This research explores various aspects of sunscreens, focusing on their composition, effectiveness, safety considerations, and recent advancements in natural sun protection alternatives.[2] Synthetic sunscreen agents, while widely used, have been associated with adverse effects, including cell mutation, DNA damage, hormonal imbalances, and allergic reactions such as eczema.[3] Additionally, commercially available sunscreens often lack beneficial properties like wound healing, anti-inflammatory effects, cooling sensations, and anti-aging benefits. Moreover, skin damage caused by free radicals cannot be effectively mitigated unless photo-protective products incorporate free radical scavengers to counteract oxidative stress.[4]

Pleiogynium cerasiferum (F. Muell.) R. Parker is an evergreen tree which comprises approximately 70 genera and 700 species worldwide. This species has synonyms, including *Pleiogynium timorense* and *Pleiogynium solandari*. In Australia, the family is represented by nine genera and 13 species, with eight species occurring in tropical Queensland.[5] Phytochemical analysis of the genus *Pleiogynium* has identified four phenolic compounds: catechin, quercetin, quercitrin, and rutin. Furthermore,

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Pleiogynium species exhibit potent antioxidant, hepatoprotective, renoprotective, analgesic, and anti-inflammatory effects.[6,7]

This research focuses on the spectrophotometric assessment of the Sun Protection Factor (SPF) of *Pleiogynium cerasiferum* leaf extracts. With growing concerns about the environmental and health risks of synthetic sunscreens, plant-derived photoprotective agents are gaining attention. The study involves a phytochemical screening to identify key bioactive compounds, including flavonoids, phenolics, and tannins, which are known for their UV-absorbing and antioxidant properties. The SPF values of different extracts will be determined using UV-vis spectrophotometry, and a correlation between phytochemical composition and UV absorption will be analyzed. The study aims to assess the feasibility of *P. cerasiferum* extracts for cosmeceutical applications, particularly in natural sunscreen formulations. The findings could contribute to the development of eco-friendly, plant-based sun protection products with additional skin benefits, offering a sustainable alternative to chemical sunscreens. This research supports the growing demand for safer and more natural skincare solutions in the cosmetic industry.

MATERIALS AND METHODS

Source of Plant Material

The plant was authenticated from Botanical Survey of India, Dehradun, Uttarakhand. The plant was accessioned at herbarium of this office with the NO.: Tech/Herb (Ident.) 2018-19/ with Acc. No. 118588

Preparation of *Pleiogynium cerasiferum* leaves extracts

Fresh *Pleiogynium cerasiferum* leaves were collected, thoroughly washed with water twice, and chopped into small pieces to achieve a stable mass. The dried material (100 g) was subjected to cold maceration for 72 hr using 1000 mL of individual solvents, namely ethanol, aqueous & petroleum ether After maceration, the extracts were filtered using Whatman filter paper and concentrated in a water bath until completely dry. The resulting dark residue was stored in a sealed container at 4ºC in a refrigerator for further analysis.[8,9]

Screening of preliminary phytochemicals of *Pleiogynium cerasiferum* extracts

A preliminary phytochemical screening of the crude drug extracts in various solvents was conducted to identify plant constituents. Standard procedures were used to detect alkaloids, carbohydrates, glycosides, tannins, saponins, phenols, and flavonoids. The detection of these bioactive compounds suggests the potential therapeutic and pharmacological significance of the extracts, supporting their possible application in natural product research and pharmaceutical development.[10-13]

Assessment of the SPF value of *Pleiogynium cerasiferum* extracts

The Sun Protection Factor (SPF) of *Pleiogynium cerasiferum* extracts was assessed using Mansur's method. A 100 mL volumetric flask was filled with 0.2 g of extract (ethanol, aqueous & petroleum ether) and diluted to volume with ethanol. A 25 mL aliquot was transferred to a 50 mL volumetric flask, further diluted with ethanol to achieve the desired concentration. Another 25 mL aliquot was then transferred to a separate 50 mL volumetric flask, adjusted to the final concentration with ethanol, and analyzed using a UV spectrophotometer. Absorbance was measured at 5 nm intervals between 290 and 320 nm, and the SPF was calculated using Mansur's formula:[14-16]

$$SPF_{spectrophootometric} = CF \times \sum_{290}^{320} EE(\lambda) \times I(\lambda) \times Abs(\lambda)$$

Where:

CF= Correction Factor (10),

EE (λ)=Erythmogenic impact of wavelength radiation, λ,

Abs (λ)=Values of Spectrophotometric absorbance at wavelength λ,

EE stands for erythemal effect spectrum, and I is for solar intensity spectrum,

Statistical analysis: Results of the experiments are reported as means.

Table 1: Phytochemical investigations of petroleum ether, ethanol, and water extracts of leaves of *Pleiogynium cerasiferum*.

Phytochemical screening of *Pleiogynium cerasiferum* leaves extracts			
Chemical constituents	**Petroleum ether extract**	**Ethanol extract**	**Aqueous extract**
Alkaloids	+	+	-
Carbohydrates	+	+	+
Glycosides	-	+	-
Tannins	+	+	+
Saponin	-	+	+
Flavonoids	+	+	+
Phenols	+	-	+

RESULTS

Phytochemical screening

A variety of metabolites were identified in *P. cerasiferum* extracts (Table 1). Alkaloids were present in petroleum ether and ethanol extracts, known for their effects on the nervous system, appetite suppression, and diuretic properties.[17,18] Glycosides, traditionally used in the treatment of cardiac disorders, were specifically present in the ethanol extract.[19,20] Tannins were present in all the extracts and are known for their potent antioxidant properties, offering diverse health benefits. They are known for their cardioprotective, anti-inflammatory, anti-carcinogenic, and anti-mutagenic properties, among others.[21-23] Flavonoids, known for their protective effects against allergies, carcinogens, and other harmful agents, were detected in all extracts. Research indicates that flavonoid compounds exhibit various bioactive properties, including antioxidative activity, free radical scavenging potential, and cardioprotective, antidiabetic, anti-inflammatory, and anti-allergic effects. Additionally, certain flavonoids have shown promising antiviral activities.[24,25] Carbohydrates were present in all extracts, playing a crucial role in energy metabolism and various physiological functions.[26] Phenols were detected in aqueous and petroleum ether extracts, known for their strong antioxidant properties and potential health benefits, including anti-inflammatory and antimicrobial effects.[27] Saponins were present in ethanol and aqueous extract, they are recognized for their bioactive properties, such as immune-boosting, cholesterol-lowering, and antifungal activities.[28]

Table 2: SPF value of Ethanolic extract of Leaves of *Pleiogynium cerasiferum*.

Sl. No.	Wavelength (λ nm)	$EE_{(\lambda)} \times I_{(\lambda)}$	Absorbance Value ($abs_{(\lambda)}$)	$EE_{(\lambda)} * I_{(\lambda)} * abs_{(\lambda)}$
	290	0.015	0.5042	0.0075
	295	0.0817	0.4581	0.0374
	300	0.2874	0.4264	0.1225
	305	0.3278	0.385	0.1262
	310	0.1864	0.3523	0.0656
	315	0.0839	0.3310	0.0277
	320	0.018	0.3179	0.0057
SPF				3.92

Table 3: SPF value of Pet. ether extract of Leaves of *Pleiogynium cerasiferum*.

Sl. No.	Wavelength (λ nm)	$EE_{(\lambda)} \times I_{(\lambda)}$	Absorbance Value ($abs_{(\lambda)}$)	$EE_{(\lambda)} * I_{(\lambda)} * abs_{(\lambda)}$
	290	0.015	0.0441	0.0006
	295	0.0817	0.0416	0.0034
	300	0.2874	0.0388	0.0111
	305	0.3278	0.0359	0.0117
	310	0.1864	0.0328	0.0061
	315	0.0839	0.0315	0.0026
	320	0.018	0.0303	0.0005
SPF				0.36

Table 4: SPF value of aqueous extract of Leaves of *Pleiogynium cerasiferum*.

Wavelength (λ nm)	$EE_{(\lambda)} \times I_{(\lambda)}$	Absorbance Value ($abs_{(\lambda)}$)	$EE_{(\lambda)} * I_{(\lambda)} * abs_{(\lambda)}$
290	0.015	0.1250	0.0018
295	0.0817	0.1280	0.0104
300	0.2874	0.1258	0.0361
305	0.3278	0.1182	0.0387
310	0.1864	0.0936	0.0174
315	0.0839	0.0641	0.0053
320	0.018	0.0375	0.0006
SPF			1.10

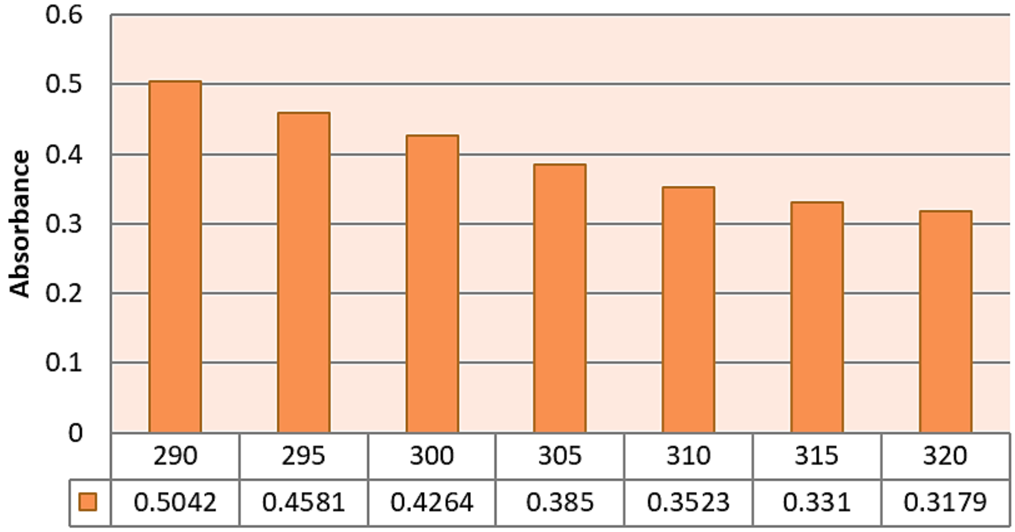

Figure 1: SPF values of the Ethanolic extract of Leaves of *Pleiogynium cerasiferum*.

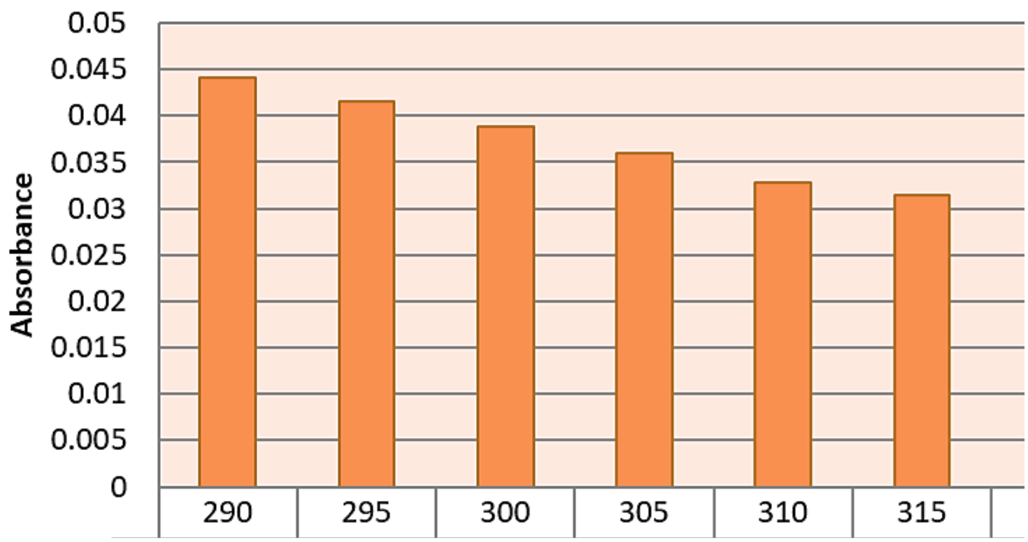

Figure 2: SPF values of the Pet. ether extract of Leaves of *Pleiogynium cerasiferum*.

Determination of sun protection factor of *Pleiogynium cerasiferum* extracts

The photoprotective activity (SPF) of *P. cerasiferum* extracts was determined using an *in vitro* technique, with SPF values calculated based on the Mansur equation method. Tables 2-4 present the absorbance and wavelength data of the different extracts, while Figures 1-3 illustrate their absorption profiles. In this study, UV-B radiation was selected for SPF testing as it is most prevalent during daylight hours, leading to prolonged skin exposure. Among the extracts, the ethanol extract exhibited the highest SPF value of 3.92, followed by the aqueous extract 1.10 and the petroleum ether extract 0.36. These results suggest that the ethanol extract of *P. cerasiferum* offers the most significant sun-protective potential.

DISCUSSION

An analysis of the SPF value of *Pleiogynium cerasiferum* extracts was performed using a UV spectrophotometer. Phytochemical investigations were done for petroleum ether, ethanol, and aqueous extracts of leaves of *Pleiogynium cerasiferum* and it was found that carbohydrates, flavonoids, tannins compounds are present in all the samples. Few tests are positive for alkaloids, glycosides saponin, and phenols. With an SPF value of 3.92, the ethanol extract demonstrated the highest sun-protective activity, followed by the aqueous extract 1.10 and the petroleum ether extract 0.36 respectively. These findings indicate that *Pleiogynium cerasiferum leaves* extracts can enhance the sun-protection capabilities of existing sunscreen formulations. Incorporating these natural extracts into sunscreen products may improve overall SPF ratings, thereby offering an effective alternative to synthetic UV filters while promoting more sustainable skincare

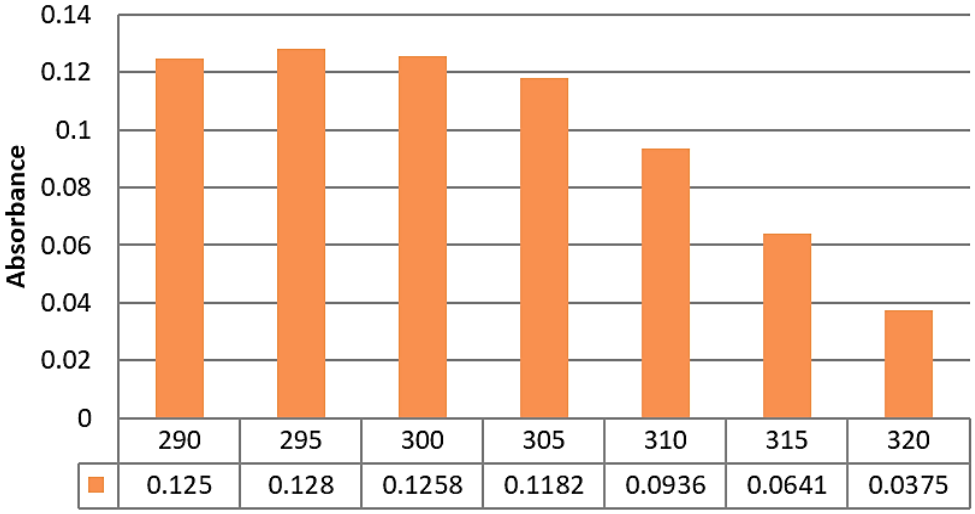

Figure 3: SPF values of the Aqueous extract of Leaves of *Pleiogynium cerasiferum*.

solutions. Further research and formulation studies will optimize performance.

CONCLUSION

The study highlights the potential of *Pleiogynium cerasiferum* leaf extracts in sun protection, with the ethanol extract demonstrating the highest SPF value. The presence of flavonoids and tannins suggests their role in UV absorption. While the SPF values are lower than commercial sunscreens, incorporating these natural extracts into formulations could enhance photoprotection and sustainability. Their antioxidant properties may offer additional skincare benefits while reducing dependence on synthetic UV filters. Future studies should focus on optimizing these extracts for practical sunscreen applications and broader dermatological use.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

UV: Ultraviolet; **SPF:** Sun Protection Factor; **CF:** Correction factor (10); **EE (λ):** Erythmogenic impact of wavelength radiation, λ; **Abs (λ):** Values of Spectrophotometric absorbance at wavelength λ; ***P. cerasiferum* extract:** *Pleiogynium cerasiferum* Extract.

SUMMARY

Growing concerns over the environmental and health risks associated with synthetic UV filters have spurred interest in natural alternatives for sun protection. This study evaluated the sun protection potential of *Pleiogynium cerasiferum* leaf extracts using ethanol, aqueous, and petroleum ether as solvents. UV spectrophotometric analysis via the Mansur equation revealed that the ethanol extract exhibited the highest SPF value (3.92), followed by aqueous (1.10) and petroleum ether (0.36) extracts. Preliminary phytochemical screening confirmed the presence of alkaloids, flavonoids, tannins, phenols, and other bioactive compounds. These findings suggest that Pleiogynium cerasiferum holds promise as a sustainable and effective source of natural UV-absorbing agents for sunscreen formulations.

REFERENCES

1. Mancuso JB, Maruthi R, Wang SQ, Lim HW. Sunscreens: an update. Am J Clin Dermatol. 2017; 18(5): 643-50. doi: 10.1007/s40257-017-0290-0, PMID 28510141.
2. Manikrao Donglikar M, Laxman Deore S. Sunscreens: a review. Phcogj. 2016; 8(3): 171-9. doi: 10.5530/pj.2016.3.1.
3. Gupta A, Sahu S, Gond SP, Singh B, Rajendiran A, Singh A. Pharmacological review of chemical agents used in sunscreen preparations. J Pharm Neg Results. 2022: 2692-702. doi: 10.47750/pnr.2022.13.S05.415.
4. Donglikar MM, Deore SL. Development and evaluation of herbal sunscreen. Pharmacogn J. 2016; 9(1): 83-97. doi: 10.5530/pj.2017.1.15.
5. Jessup LW. Pleiogynium. Flora Aust. 1985; 25.
6. Said A, Abuotabl EA, Raoof GF, Huefner A, Nada SA. Phenolic contents and bioactivities of pericarp and seeds of *Pleiogynium solandri* (Benth.) Engl. (*Anacardiaceae*). Iran J Basic Med Sci. 2015; 18(2): 164-71. PMID 25810891.
7. Al Sayed EA, Martiskainen O, Sinkkonen J, Pihiaja K, Ayoub N, Singab AE, *et al.* Chemical composition and bioactivity of *Pleiogynium timorense* (*Anacardiaceae*). Nat Prod Commun. 2010; 5(4): 545-50. doi: 10.1177/1934578X100050, PMID 20433069.
8. Ahmad F. A, A Shehta H. Assessment of the effects of different extraction methods on the phytochemicals, antimicrobial and anticancer activities of *Eruca sativa* extracts. Novel Research in Microbiology [journal]. 2020; 4(3): 825-44.
9. Ali Z, Kaushik S, Singh R, Bhatt B. Exploration of phytochemical and sun protection efficacy of *Anthocephalus chinensis* Leaves extracts. Trop J Nat Prod Res. 2023; 7(4).
10. Joshi A, Bhobe M, Sattarkar A. Phytochemical investigation of the roots of *Grewia microcos* Linn. J Chem Pharm Res. 2013; 5(7): 80-7.
11. Goyal PK, Jain R, Jain S, Sharma A. A Review on biological and phytochemical investigation of plant genus Callistimon. Asian Pac J Trop Biomed. 2012; 2(3): S1906-9. doi: 10.1016/S2221-1691(12)60519-X.
12. Altemimi A, Lakhssassi N, Baharlouei A, Watson DG, Lightfoot DA. Phytochemicals: extraction, isolation, and identification of bioactive compounds from plant extracts. Plants (Basel). 2017; 6(4): 42. doi: 10.3390/plants6040042, PMID 28937585.
13. Ghisalberti EL. Detection and isolation of bioactive natural products. In: Molyneux R, Colegate S, editors. In bioactive natural products. CRC Press; 2007: 11-76. doi: 10.12 01/9781420006889.ch2.
14. Imam S, Azhar I, Mahmood ZA. *In vitro* evaluation of sun protection factor of a cream formulation prepared from extracts of *Musa accuminata* (L.), *Psidium gujava* (L.) and *Pyrus communis* (L.). *In vitro*. 2015; 8(3).
15. Mazumder MU, Das K, Choudhury AD, Khazeo P. Determination of sun protection factor (spf) number of some hydroalcoholic vegetable extracts. PharmaciaTutor. 2018; 6(12): 41-5. doi: 10.29161/PT.v6.i12.2018.41.
16. Malsawmtluangi C, Nath DK, Jamatia I, Zarzoliana E, Pachuau L. Determination of sun protection factor (SPF) number of some aqueous herbal extracts. J App Pharm Sci. 2013; 3(9): 150-1. doi: 10.7324/JAPS.2013.3925.

17. Yadav M, Chatterji S, Gupta SK, Watal G. Preliminary phytochemical screening of six medicinal plants used in traditional medicine. Int J Pharm Pharm Sci. 2014; 6(5): 539-42.
18. Varela C, Silva F, Costa G, Cabral C. Alkaloids: their relevance in cancer treatment. In: In New insights into glioblastoma. Academic Press; 2023: 361-401. doi: 10.1016/B978-0-323-99873-4.00006-2.
19. Cohen PA, Ernst E. Safety of herbal supplements: a guide for cardiologists. Cardiovasc Ther. 2010; 28(4): 246-53. doi: 10.1111/j.1755-5922.2010.00193.x, PMID 20633025.
20. Botelho AF, Pierezan F, Soto-Blanco B, Melo MM. A review of cardiac glycosides: structure, toxicokinetics, clinical signs, diagnosis and antineoplastic potential. Toxicon. 2019; 158: 63-8. doi: 10.1016/j.toxicon.2018.11.429, PMID 30529380.
21. Kumari M, Tannins JS. An antinutrient with positive effect to manage diabetes. Res J Recent Sci ISSN. 2012; 2277: 2502.
22. Oluwole O, Fernando WB, Lumanlan J, Ademuyiwa O, Jayasena V. Role of phenolic acid, tannins, stilbenes, lignans and flavonoids in human health-a review. Int J Food Sci Technol. 2022; 57(10): 6326-35. doi: 10.1111/ijfs.15936.
23. Li P, Yin YL, Li D, Kim SW, Wu G. Amino acids and immune function. Br J Nutr. 2007; 98(2): 237-52. doi: 10.1017/S000711450769936X, PMID 17403271.
24. Karak P. Biological activities of flavonoids: an overview. Int J Pharm Sci Res. 2019; 10(4): 1567-74. doi: 10.13040/IJPSR.0975-8232.10(4).1567-74.
25. Rakha A, Umar N, Rabail R, Butt MS, Kieliszek M, Hassoun A, *et al.* Anti-inflammatory and anti-allergic potential of dietary flavonoids: a review. Biomed Pharmacother. 2022; 156: 113945. doi: 10.1016/j.biopha.2022.113945, PMID 36411631.
26. Hanhineva K, Törrönen R, Bondia-Pons I, Pekkinen J, Kolehmainen M, Mykkänen H, *et al.* Impact of dietary polyphenols on carbohydrate metabolism. Int J Mol Sci. 2010; 11(4): 1365-402. doi: 10.3390/ijms11041365, PMID 20480025.
27. Laganà P, Anastasi G, Marano F, Piccione S, Singla RK, Dubey AK, *et al.* Phenolic substances in foods: health effects as anti-inflammatory and antimicrobial agents. J AOAC Int. 2019; 102(5): 1378-87. doi: 10.5740/jaoacint.19-0131, PMID 31200787.
28. Jolly A, Hour Y, Lee YC. An outlook on the versatility of plant saponins: a review. Fitoterapia. 2024; 174: 105858. doi: 10.1016/j.fitote.2024.105858, PMID 38365071.

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