

Skin Care Potential of Selected Medicinal Plants- A Review

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ABSTRACT

The wide popularity, acceptability and demand of herbal cosmetics has been increased in recent years due to awareness of harmful side effects and adverse reactions caused by synthetic cosmetics ingredients. Herbs, plant materials and plant products were used as cosmetics since ancient times. Various essential oils, juices, fixed oil, plant exudates, extracts, isolated compound obtained from natural sources have been used for their skin care potential in various herbal cosmetics. Herbal cosmetics getting more popularity and belief among the people due to safety, higher bio-compatibility, cost effectiveness, easy availability, lower side effects, environmental friendly nature and traditional experience of uses. Such reliability on herbal cosmetics encourage to screen more herbs, plant materials and natural ingredients for their cosmetic potential. Scientific review of available data and new researches on medicinal plants can provide basis to use more plants for their skin care potential. This review attempts to emphasize the use of some common medicinal plants for their skin care potential in herbal cosmetics.

KEY WORDS- Herbal cosmetics, Antioxidants, Polyphenol, Flavonoids, cosmetics

I. INTRODUCTION

The Uses of herbs and natural substance as cosmetics appeared in practice for various purpose since ancient times as the man has been developed.[1]The word cosmetic was derived from the Greek word “kosm tikos” meaning having the power to arrange, skill in decorating. Beauty is the desire of every human being on earth and appearance has always been a matter of prime importance.[2]Since ancient times humans have got special interest in taking care of the external appearance of the their body. In recent years due to awareness of harmful side effects and adverse reactions caused by synthetic cosmetics ingredients people want to use safe, natural, effective and healthy products, for this reason, cosmetics

containing natural ingredients have much more popular compare to synthetic cosmetics. [3]

As per as Drug and Cosmetic Act 1940 and Rules 1945, the cosmetics have been defined as “Any article intended to be rubbed, poured, sprinkled or sprayed on, or introduced into, or otherwise applied to, the human body or any part thereof for cleansing, beautifying, promoting attractiveness, or altering the appearance, and includes any article intended for use as a component of cosmetics.[4]

The term cosmeceuticals has been introduced by Raymond Reed founding member of US Society of cosmetics Chemist in 1961. He used the word for active and science based cosmetics. The term was further used by Dr. Albert Kligman in the year 1984 for the substances that have both cosmetic as well as therapeutic effects. Herbal cosmetics are basically the natural products obtained from plants or other natural sources and used to clean, beautify or provide attractiveness or to alter body appearance.[5]

Skin Care Potential of Common Medicinal Plants

Tamarindus indica

Tamarindus indica L., a valuable plant commonly known as Tamarind, The plant has well known for its fruits and used in the treatment of various ailments since ancient times by various traditional systems all over the world. Major active constituent present in fruits are polyphenolics compounds like apigenin, epicatechin catechin, procyanidin. Seed of the plant contains procyanidins as oligomeric tetramer, pentamer, hexamer and procyanidin B2, epicatechin.[6]The seed extract of the plant has found to be effective in skin scaliness, wrinkles, roughness, and antiaging on topically application.[7]

Centella asiatica

Centella asiatica Commonly known as Indian pennywort or mandukparni, belonging to family Apiaceae The herb has been used for its

medicinal value since ancient times, it was recommended for the treatment of various skin conditions such as leprosy, eczema, psoriasis lupus, varicose ulcers.[8] Kaempferol, quercetin, and rutin are the major compounds responsible for antioxidant effect of the plant. The plant extracts has found promising anti-skin-aging potential to use as cosmeceutical. [9]

Coffea arabica

Coffea arabica Linn. Popularly known as Coffee is widespread consumable drink all over the world belonging to family Rubiaceae The plant has been used for its pharmacological and cosmeticeutical effect since long time. Major active compounds responsible for biological activity of plants are phenolic compounds, alkaloids, terpenoids, carotenoids. Linolenic acid has found in greater extent in coffee seeds the compound has ability to blocks the harmful UV-rays and provide sunscreen effect.[10] The Linoleic acid and palmitic acid present in coffee oil may used in cosmetic preparations to improve skin appearance, and especially to overcome aging signs the oil also used to maintain skin humidity.[11]

Simmondsia chinensis

Simmondsia chinensis commonly known as jojoba belonging to family Simmondsiaceae. The seed and oil of the plant has been used medicinally since long time for the treatment of many skin and scalp problems. The oil of jojoba has composed of the free fatty acids, wax esters, alcohols, hydrocarbons and sterols, vitamins. The oil of the jojoba has been widely used in cosmetics to restore the ordinary health of skin as well as hair.[12] The plant has proved to beneficial against various skin infections, anti-acne and antipsoriasis, wound healing and skin aging. Moreover The plant has emollient action and also enhance the absorption of topical drugs.[13,14]

Matricaria recutita

Matricaria recutita commonly known as German chamomile or English chamomile belonging to family Asteraceae. The plant has long history to use as herbal medicine for various skin disorders.[15] The active constituents present in the plant includes, flavonoids, rutin, quercetin apigenin, luteolin, terpenoids chamazulene, matricine, bisoprolol, levomenol, hydroxycoumarins and mucilages. chamazulene and levomenol has found to responsible for various beneficial effect like anti-inflammatory, wound

healing. natural moisturizing agent, improvement in skin texture and elasticity, sunlight protection and antipruritus agent.[16]

Glycyrrhiza glabra

Glycyrrhiza glabra L. known by various common names as licorice, glycyrrhiza or sweet wood belonging to family Fabaceae The plant has very long history of use in various traditional system of medicine for gastrointestinal problems, cough, bronchitis, and arthritis.[17] The major active compound responsible for biological activity of plant are glycyrrhizin, chalcone, isoflavonoid glabridin, isoliquiritigenin. The liquorice root extract has proved to effective against oxidative stress injuries in skin.[18,19] In addition glabridin found in extract of the plant has responsible for antioxidant, skin-whitening agent and skin depigmentation effect. [20,21]

Vitis vinifera

Vitis vinifera, commonly known as grapes, belonging to family Vitaceae, The plant has been widely consumed all around the world and traditionally used for its wound healer and anti-inflammatory properties. The major active compounds present in plants are organic acids, oils melatonin and polyphenols. The fruit of the plant has rich in polyphenol like flavonoids, resveratrol proanthocyanidins and stilbenes. The seed and fruit extracts of the plant has found to effective as ultraviolet radiation protection, antioxidant, antiaging, depigmentation, anti-inflammatory, wound healing, skin irritation and antimicrobial.[22,23] in addition it has been also proved to beneficial as anti-caries, antidandruff, antifungal, flavouring and sunscreen agent.[24]

Glycine max

Glycine max L. commonly known as soybean, belongs to the family Fabaceae pea family. The plant is native to southeastern Asia. The plant has long history to use as food and drugs for various ailments in various traditional systems. The major constituent present in plant are phospholipids and essential fatty acids other biologically active compound found in plant are saponins, isoflavones, phytosterols, essential amino acids, phytoestrogens like genistein and daidzein.[25] Soybean oil has been used to improve moisturizing and lubrication properties of skincare formulation. Soybean extracts has found to effective as skin photoprotective, increasing skin elastin and

collagen synthesis, reducing the effect of photoaging and hyperpigmentation disorders. [26]

Mangifera indica

Mangifera indica L, commonly known as mango belonging to family Anacardiaceae, The plant has been cultivated throughout the tropical and subtropical areas and considered as one of the main tropical fruits in the world originated from Asia.[27] The plant has been well known for its pharmaceutical, nutraceutical and cosmetic effects in various traditional system. The major compounds present in Mango fruits are antioxidants like polyphenols, carotenoids and ascorbic acid. Polyphenolic compounds mangiferin Chlorogenic acid, gallic acid quercetin, kaempferol present in mango fruits are majorly responsible for skin care potential of the plant.[28] The unripe fruit extracts of the plant has been used for promoting skin-whitening, anti-aging of skin and fibroblast regeneration.[29]

Phyllanthus emblica

Phyllanthus emblica L. commonly known as Amla or Indian gooseberry, belonging to Family Phyllanthaceae. The plant has been used in ayurvedic and other traditional systems of medicine for various health benefits since ancient time.[30] The major active constituent present in plants are phenolics, flavonoids, tannins, and vitamins.[30,31] The plant are well known for its antioxidant, anti-diabetes, anti-inflammation, anticancer properties. In addition to that active constituent found to be effective in skin protection from UV irradiation, reducing skin inflammation, anti-skin aging.[32,33]

Punica granatum

Punica granatum L commonly known as pomegranate belonging to the family Punicaceae, The well known plant that has been extensively used in traditional medicine for various ailment. [34] The fruit, juice, bark and seed oil has been used for its anti-inflammatory, antibacterial, dysentery, diarrhea and for prevention of skin and breast cancer. Fruits are rich in phenolic compounds with strong antioxidant activity.[35] Major polyphenolic compound responsible for biological activity are catechin, quercetin, kaempferol, and equol. The plant has proved to have significant role in UV-induced skin damage, photoprotective, Anti aging and antioxidant effect.[36]

Moringa oleifera

Moringa oleifera commonly known as moringa or drumstick tree belonging to family Moringaceae. The plant is indigenous to South Asia and used in various traditional systems since long time. The leaf, seed and fruits extract of the plant has shown wide range of therapeutic and medicinal activity including analgesic, anti-ulcer, anti-inflammatory, antipyretic, hepatoprotective anticancer, anti-allergic antioxidant, gastroprotective, cardiovascular, wound healing anti-obesity, antiepileptic, antiasthmatic, antidiabetic, diuretic, local anesthetic, anthelmintic, antidiarrheal antimicrobial and immunomodulatory properties. The major active constituent present in plants are phenolic acids carotenoids, polyunsaturated fatty acids, tocopherols, flavonoids and various minerals.[37] The seed oil of the plant has been used to maintain the natural skin pigmentation, mild sun protective and anti-fungal activity.[38] The leaf extract has been proved to effective in revitalizing of skin and reducing signs of skin aging.[39]

Helianthus annuus

Helianthus annuus commonly known as Sunflower, Family: Asteraceae. A well-known plant used worldwide for its nutritional and medicinal value. Traditionally the plant has been used in treatment of variety of ailments like bronchial, laryngeal infections, coughs and colds, fever, cuts and wounds heart disease, kidney related problems. The plants contains numerous biologically active compounds includes terpenoids, carbohydrates, flavanoids, phenolic compounds, tannins, alkaloids, steroids, fixed oil, saponins, and proteins.[40] Topically the oil of sunflower has been found to effective in treatment of dry and scaly skin condition, dermatitis, fungal infection, in addition to that oil has been effectively used as lubricant, anti-wrinkle and anti-ageing effect in cosmetics.^[41]

Betula pendula

Betula pendula Roth commonly known as a birch tree belonging to family Betulaceae. White or silver birch, traditionally plant parts have been utilized for various medicinal purposes, it has been used to treat various skin conditions like eczema, inflammations, urinary disorders, rheumatism. The leaf bud oil used as antiseptic in various cosmetic products. The extract of the plant has been reported for many polyphenolic constituents such as quercetin, kaempferol catechin, myricetin, p-

coumaric acid.[42] The leaf extract of the plant used for skin-whitening and antioxidant effects in cosmetics. [43]

II. DISCUSSION AND CONCLUSION

The medicinal plants used in skin care cosmetics has not only the potential to enhance beauty but they also have medicinal properties due to presence of multiple chemical constituent. These chemical constituents may give additional benefit to treat various skin related problems, so using medicinal plants for cosmetics may give some desired medicinal benefit for skin and body apart from their cosmetic effect. As the demand is rising for skin care herbal cosmetics over synthetic cosmetics, more plants needed to screen scientifically for their cosmetic potential. Group of compound found to responsible for cosmetic effect of medicinal plants are Flavonoids, carotenoids, polyphenols, terpenoids, antioxidants, vitamins and fixed oil found to be responsible for cosmetic effects of selected medicinal plants. Selective research approach needed to prove clear relation between chemical constituent and skin care cosmetic effect of selected medicinal plants, which may further provide the bases to use of selected chemical compound in cosmetic products in future.

REFERENCES

- [1]. Bijauliya RK, Alok S, Kumar M, Chanchal DK and Yadav S: A comprehensive review on herbal cosmetics. *Int J Pharm Sci Res* 2017; 8(12): 4930-49. doi: 10.13040/IJPSR.0975-8232.8(12).4930-49.
- [2]. Khole PL, Jadhav HR, Thakurdesai P and Nagappa AN: Cosmetics Potential of Herbal Extracts. *Natural Product Radiance* 2005; 4(4): 315-321.
- [3]. Francisco José González-Miner, Luis Bravo-Díaz and Antonio Ayala-Gómez *Rosmarinus officinalis L. (Rosemary): An Ancient Plant with Uses in Personal Healthcare and Cosmetics*, *Cosmetics* 2020, 7, 77; doi:10.3390/cosmetics7040077.
- [4]. Tripathy Dhull, K, Tripathy Swagat and Dureja Harish, *Cosmetics: Regulatory Scenario in USA, EU and India* *Journal of Pharmaceutical Technology, Research and Management* November 2015 vol 3 pp. 127-13.
- [5]. Saha R: Cosmeceuticals and herbal drugs: practical uses. *International Journal of Pharmaceutical Research and Sciences*, 2012; 3: 59-65.
- [6]. Bhadoriya SS, Ganeshpurkar A, Narwaria J, Rai G, Jain AP. *Tamarindus indica: Extent of explored potential*. *Pharmacogn Rev.* 2011;5(9):73-81. doi:10.4103/0973-7847.79102
- [7]. Waqas MK, Khan BA, Akhtar N, et al. *Fabrication of Tamarindus indica seeds extract loaded-cream for photo-aged skin: Visioscan® studies*. *Postepy Dermatol Alergol.* 2017;34(4):339-345. doi:10.5114/ada.2017.69314
- [8]. Gohil KJ, Patel JA, Gajjar AK. *Pharmacological Review on Centella asiatica: A Potential Herbal Cure-all*. *Indian J Pharm Sci.* 2010;72(5):546-556. doi:10.4103/0250-474X.78519
- [9]. Buranasudja, V., Rani, D., Malla, A. et al. *Insights into antioxidant activities and anti-skin-aging potential of callus extract from Centella asiatica (L.)*. *Sci Rep* 11, 13459 (2021). <https://doi.org/10.1038/s41598-021-92958-7>
- [10]. Patay Eva Brigitta, Papp Tímea Bencsik, N'ora, *Phytochemical overview and medicinal importance of Coffea species from the past until now*: *Asian Pacific Journal of Tropical Medicine* 2016; 9(12): 1127-1135, <http://dx.doi.org/10.1016/j.apjtm.2016.11.008>.
- [11]. Diamantino Monik Ellen dos Santos, Chaves Anny Carolinny Tigre Almeida Silva, Daniel de Melo, Lemos Gisele da Silveira, Queiroz Raphael Ferreira: *Formulation of an Antioxidant Cosmetic Cream Containing Coffea arabica Fractions*, *International Journal of Advanced Engineering Research and Science (IJAERS)* Vol-6, Issue-6, June- 2019 DOI 10.22161/ijaers.6.6.85
- [12]. Gad Heba A, Roberts Autumn, Samirah H Hamzi, Gad Haidy A. 4, Touiss Ilham 5, Altyar Ahmed E. et al *Jojoba Oil: An Updated Comprehensive Review on Chemistry, Pharmaceutical Uses, and Toxicity* *Polymers* 2021, 13, 1711. <https://doi.org/10.3390/polym13111711>
- [13]. Pazyar N, Yaghoobi R, Ghassemi MR, Kazerouni A, Rafeie E, Jamshyidian N. *Jojoba in dermatology: a succinct review*. *G Ital Dermatol Venereol.* 2013 Dec;148(6):687-91. PMID: 24442052.
- [14]. Gupta, V., P. Mittal, P. Bansal, S. L. Khokra, and D. Kaushik.

- “PHARMACOLOGICAL POTENTIAL OF MATRICARIA RECUTITA-A REVIEW”. International Journal of Pharmaceutical Sciences and Drug Research, Vol. 2, no. 1, Jan. 2010, pp. 12-16, <http://ijpsdr.com/index.php/ijpsdr/article/view/68>.
- [15]. Stallings AF, Lupo MP. Practical uses of botanicals in skin care. *J Clin Aesthet Dermatol.* 2009;2(1):36-40.
- [16]. Pastorino G, Cornara L, Soares S, Rodrigues F, Oliveira MBPP. Liquorice (*Glycyrrhiza glabra*): A phytochemical and pharmacological review. *Phytother Res.* 2018;32(12):2323-2339. doi:10.1002/ptr.6178
- [17]. Castangia I, Caddeo C, Manca ML, Casu L, Latorre AC, Díez-Sales O et al Delivery of liquorice extract by liposomes and hyalurosomes to protect the skin against oxidative stress injuries. *Polym.* 2015 Dec 10; 134():657-63.
- [18]. Mostafa DM, Ammar NM, Abd El-Alim SH, El-ansary AA. Transdermal microemulsions of *Glycyrrhiza glabra* L.: characterization, stability and evaluation of antioxidant potential. *Drug Deliv.* 2014 Mar; 21(2):130-9.
- [19]. Simmler C, Pauli GF, Chen SN. Phytochemistry and biological properties of glabridin. *Fitoterapia.* 2013 Oct; 90():160-84.
- [20]. Pastorino G, Cornara L, Soares S, Rodrigues F, Oliveira MBPP. Liquorice (*Glycyrrhiza glabra*): A phytochemical and pharmacological review. Pastorino G, Cornara L, Soares S, Rodrigues F, Oliveira MBPP. *Phytother Res.* 2018 Dec; 32(12):2323-2339.
- [21]. Ciganović P, Jakimiuk K, Tomczyk M, Zovko Končić M. Glycerolic Licorice Extracts as Active Cosmeceutical Ingredients: Extraction Optimization, Chemical Characterization, and Biological Activity. *Antioxidants* (Basel). 2019;8(10):445. Published 2019 Oct 1. doi:10.3390/antiox8100445
- [22]. Soto María Luisa, Falqué Elena, Domínguez Herminia, Relevance of Natural Phenolics from Grape and Derivative Products in the Formulation of Cosmetics, *Cosmetics* 2015, 2, 259-276; doi:10.3390/cosmetics2030259.
- [23]. Ferreira MS, Magalhães MC, Oliveira R, Sousa-Lobo JM, Almeida IF. Trends in the Use of Botanicals in Anti-Aging Cosmetics. *Molecules.* 2021 Jun 11;26(12):3584. doi: 10.3390/molecules26123584. PMID: 34208257; PMCID: PMC8230945.
- [24]. Ribeiro AS, Estanqueiro M, Oliveira MB, Sousa Lobo JM. Main Benefits and Applicability of Plant Extracts in Skin Care Products. *Cosmetics.* 2015; 2(2):48-65. <https://doi.org/10.3390/cosmetics2020048>
- [25]. Ferreira MS, Magalhães MC, Oliveira R, Sousa-Lobo JM, Almeida IF. Trends in the Use of Botanicals in Anti-Aging Cosmetics. *Molecules.* 2021 Jun 11;26(12):3584. doi: 10.3390/molecules26123584. PMID: 34208257; PMCID: PMC8230945.
- [26]. Stallings AF, Lupo MP. Practical uses of botanicals in skin care. *J Clin Aesthet Dermatol.* 2009;2(1):36-40.
- [27]. Meran Keshawa Ediriweera, Kamani Hemamala Tennekoon, and Sameera Ranganath Samarakoon A Review on Ethnopharmacological Applications, Pharmacological Activities, and Bioactive Compounds of *Mangifera indica* (Mango) Hindawi Evidence-Based Complementary and Alternative Medicine Volume 2017, Article ID 6949835, 24 pages <https://doi.org/10.1155/2017/6949835>
- [28]. Lauricella, M., Emanuele, S., Calvaruso, G., Giuliano, M. and D'Anneo, A. (2017) Multifaceted Health Benefits of *Mangifera indica* L. (Mango): The Inestimable Value of Orchards Recently Planted in Sicilian Rural Areas. *Nutrients*, 9, 525. <https://doi.org/10.3390/nu9050525>
- [29]. Yu, C. , Lin, Y. , Su, H. , Kan, K. , Liu, F. , Lin, S. , Chung, Y. , Hsu, H. and Lin, Y. (2019) Unripe Fruit Extracts of *Mangifera indica* L. Protect against AGEs Formation, Melanogenesis and UVA-Induced Cell Damage. *Food and Nutrition Sciences*, 10, 188-197. doi: 10.4236/fns.2019.102014.
- [30]. Gantait S., Mahanta M., Bera S., Verma S.K. Advances in biotechnology of *Embllica officinalis* Gaertn. syn. *Phyllanthus emblica* L.: A nutraceuticals-rich fruit tree with multifaceted ethnomedicinal uses. *3 Biotech.* 2021;11:62. doi: 10.1007/s13205-020-02615-5.
- [31]. Variya B.C., Bakrania A.K., Patel S.S. *Embllica officinalis* (Amla): A review for its phytochemistry, ethnomedicinal uses

- and medicinal potentials with respect to molecular mechanisms. *Pharmacol. Res.* 2016;111:180–200. doi: 10.1016/j.phrs.2016.06.013.
- [32]. Kunchana K, Jarisarapurin W, Chularojmontri L, Wattanapitayakul SK. Potential Use of Amla (*Phyllanthus emblica* L.) Fruit Extract to Protect Skin Keratinocytes from Inflammation and Apoptosis after UVB Irradiation. *Antioxidants* (Basel). 2021;10(5):703. Published 2021 Apr 29. doi:10.3390/antiox10050703
- [33]. Chaikul, M. Kanlayavattanakul, J. Somkummerdet al., *Phyllanthus emblica* L. (amla) branch: A safe and effective ingredient against skin aging, *Journal of Traditional and Complementary Medicine*, <https://doi.org/10.1016/j.jtcme.2021.02.004>
- [34]. Shaygannia Erfaneh, Bahmani Mahmoud, Zamanzad Behnam, and Kopaei Mahmoud Rafieian- A Review Study on *Punica granatum* L., *Journal of Evidence-Based Complementary & Alternative Medicine* 2016, Vol. 21(3) 221-227
- [35]. Park Hye Min, Moon Eunjung, Kim Ae-Jung, Kim Mi Hyun, Lee Sanghee, Lee Jung Bok, Extract of *Punica granatum* inhibits skin photoaging induced by UVB irradiation *Volume 49, Issue 3, March 2010 Pages 276-282* 2010 <https://doi.org/10.1111/j.1365-4632.2009.04269.x>
- [36]. Lisbeth A. Pacheco-Palencia, Giuliana Noratto, Lal Hingorani, Stephen T. Talcott, and Susanne U. Mertens-Talcott Protective Effects of Standardized Pomegranate (*Punica granatum* L.) Polyphenolic Extract in Ultraviolet-Irradiated Human Skin Fibroblasts *Journal of Agricultural and Food Chemistry* 2008 56 (18), 8434-8441 DOI: 10.1021/jf8005307
- [37]. Bhattacharya A, Tiwari P, Sahu PK, Kumar S. A Review of the Phytochemical and Pharmacological Characteristics of *Moringa oleifera*. *J Pharm Bioallied Sci.* 2018;10(4):181191. doi:10.4103/JPBS.JPBS_126_18
- [38]. Athikomkulchai, S.; Tunit, P.; Tadtong, S.; Jantrawut, P.; Sommano, S.R.; Chittasupho, C. *Moringa oleifera* Seed Oil Formulation Physical Stability and Chemical Constituents for Enhancing Skin Hydration and Antioxidant Activity. *Cosmetics* 2021, 8, 2. <https://doi.org/10.3390/cosmetics8010002>
- [39]. Ali Atif, Akhtar Naveed, Chowdhary Farzana Enhancement of human skin facial revitalization by moringa leaf extract cream, *Postep Derm Alergol* 2014; XXXI, 2: 71–76, DOI: 10.5114/pdia.2014.40945
- [40]. Tasneem Bashir, Zia-Ur-Rehman Mashwani, Kulsoom Zahara, Shakeela Haider, Shaista Tabassum and Mudrikah. Chemistry, Pharmacology and Ethnomedicinal Uses of *Helianthus annuus* (Sunflower): A Review. *Pure and Applied Biology*. Vol. 4, Issue 2, 2015, pp 226-235
- [41]. Stoia M, Oancea S. 2015. Selected Evidence-Based Health Benefits of Topically Applied Sunflower Oil. *Applied Science Reports*, 10(1), 45-49. DOI:10.15192/PSCP.ASR.2015.10.1.4549
- [42]. Nurul Aini Mohd Azman, Monika Skowrya, Kwestan Muhammad, María Gabriela Gallego & María Pilar Almajano Evaluation of the antioxidant activity of *Betula pendula* leaves extract and its effects on model foods, *Pharmaceutical Biology*, Volume 55, 2017 - Issue 1 published online 2 Feb 2017.
- [43]. Germanò MP, Cacciola F, Donato P, Dugo P, Certo G, D'Angelo V, Mondello L, Rapisarda A. *Betula pendula* leaves: polyphenolic characterization and potential innovative use in skin whitening products. *Fitoterapia*. 2012 Jul;83(5):877-82. doi: 10.1016/j.fitote.2012.03.021. Epub 2012 Mar 28. PMID: 22480759.