A review of common European plants as active skincare ingredients

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1. Introduction

Consumer interest for naturally derived cosmetic ingredients and additives is growing. [1] Current consumer attitudes tend to favour green and natural seeming products, and they are growingly aware of the environmental impact cosmetics may have. Naturally derived ingredients are often perceived as more sustainable and environmentally friendly. [2] This article will not argue the possible merits or demerits of all naturally derived ingredients, but simply look at the possibilities of certain plant extracts.

Many consumers turn to naturally derived ingredients when making purchasing decisions about skincare. Plant extracts such as chamomile are well known to be skin calming, due to their polyphenolic composition. Polyphenols, such as flavonoids and tannins that are found in plants, often have beneficial properties when used in skincare. The anti-inflammatory action of these extracts can be explained by the presence of certain flavonoids, such as apigenin and luteolin. Therefore, plants that are known to contain these phytochemicals, are most likely to have anti-inflammatory properties.

The purpose of this review is to address different European plants that could possess potential to soothe the skin when used topically. This review will look at their historical use, pharmacognosy, and possible and current use in skincare. This review will also look at specific polyphenols that are prevalent in the plants discussed in this article.

The plants of interest that this review will focus on are *Achillea millefolium* (yarrow), *Epilobium angustifolium* (fireweed), *Equisetum arvense* (field horsetail), *Lythrum salicaria* (purple loosestrife), *Plantago major* (greater plantain) and *Silybum marianum* (milk thistle). They are all linked to anti-inflammation in ethnobotanical tradition, and all can be found in cosmetic products currently on the market.

2. Plants

The plants chosen for closer inspection in this article are all common plants that grow in abundance in Europe. None of them are endangered or rare. They are non-food competing crops, and due to their small size, they do not primarily function as carbon sinks.

It is good to note, that while these plants might have possible skin conditioning benefits, they could also have skin irritating and sensitising properties. Using botanical ingredients, such as plant extracts, requires a robust understanding of their constituents. The safety of using naturally derived skincare ingredients depends on a number of things, and understanding their toxicological properties is paramount.

2.1 *Achillea millefolium* (*yarrow*)

Prevalance
A. millefolium is a perennial plant that grows in Europe, Northern America, and Northern Asia.

Historical usage
A. millefolium has historically been used as tea and for flavouring foods. Topically it has been used for skin and mucous membrane infections, wound healing, treating burns, wounds, and acne. (Long list of books, to be added later.)

Constituents
A. millefolium contains flavonoids such as Apigenin and Luteolin, as well as Azulene, all of which are known to have skin conditioning properties.

Pharmacology
When applied topically, *A. millefolium* extract has anti-inflammatory properties. [3]
A. millefolium extracts have also been shown to inhibit tyrosinase, an enzyme that is responsible for pigmentation. The same extracts have also been shown to offer UV protection. [4]

Safety
As a member of the *Asteraceae* family, *A. millefolium* has the potential to be sensitising. [5]
Yarrow can contain linalool, thujone, quercetin, α-peroxyachifolid, and hydroquinone, all of which could potentially cause adverse reactions. However, these would be at extremely low quantities in a finished cosmetic product, and the CIR Panel has concluded that achillea millefolium flower/leaf/stem extract is safe in the present practices of use and concentration in cosmetics when formulated to be non-sensitising.
A. millefolium extract is considered safe for cosmetic use, with no special provisions in the Annexes to the EU Cosmetics Regulation.

2.2 *Epilobium angustifolium* (*fireweed*)

Prevalence
E. angustifolium is a perennial circumpolar plant that grows in open areas and pastures in the Northern hemisphere.

Historical use
Historically *E. angustifolium* has been used to brew tea and to help with stomach and urinary tract problems. Topically it has been used to treat scrapes, wounds, burns and skin infections. [6][7][8]

Constituents
E. angustifolium contains triterpenes - Oleanolic acid, Ursolic acid as well as various tannins and flavonoids. It also contains Oenothein B.

Pharmacology
E. angustifolium has shown antioxidant and antibacterial properties when used topically. [9]
Fireweed contains Oenothein B, a bioactive molecule that is known to have have sebum regulating (due to anti 5-alpha reductase inhibition) and anti-inflammatory properties.[10][11]
Fireweed extract is often used in products targeted at dandruff.

Safety
E. angustifolium extract is considered safe for cosmetic use, with no special provisions in the Annexes to the EU Cosmetics Regulation.

2.3 *Lythrum salicaria (purple loosestrife)*

Prevalance
Lythrum salicaria is a perennial herb that grows in Europe, Asia and Northern Africa.

Historical Use
L. salicaria has been used as a medicinal plant since ancient times. Some reported uses have been treatment of hemorrhages, infected wounds and dysentery. In the 1960's *L. salicaria* was often used for diarrhoea. [12]

Constituents
L. salicaria contains polyphenols, such as ellagitannins, tannin related compounds, flavonoids (such as Luteolin, Orientin, Isoorientin, Apigenin, and Vitexin), phenolic acids and antocyanins. (same end note as before)

Pharmacology
The diseases that have been historically treated with *L. salicaria*, have been associated with excessive inflammatory response. Therefore, the anti-inflammation properties of *L. salicaria* have been studied. Data has been collected on the gastrointestinal tract, skin and mucosa diseases possessing inflammatory background, but recent tests on skin inflammation have not been conducted. (same end note as before)

Safety
L. salicaria extract is considered safe for cosmetic use, with no special provisions in the Annexes to the EU Cosmetics Regulation.

2.4 *Plantago major (greater plantain)*

Prevalance
Plantago major is a small perennial plant that grows in most parts of the world.

Historical use
P. major can be eaten raw or made into juices and tinctures. *P. major* has commonly been used for numerous skin issues, from wounds, to itching as well as blisters and infections. *P. major* has been used for treating wounds since the ancient Greeks. *P. major* leaf's healing properties are even mentioned in Shakespeare's Romeo and Juliet (Act I, Scene II)

Constituents
The greater plantain contains alkaloids, tannins, organic acids and iron.
P. major contains caffeic acid and its derivatives, flavonoids (such as Apigenin and Luteolin) as well as plantamajoside and ursolic acid. [13] These compounds and others likely found in *P. major* poses anti-inflammatory and antioxidant properties.

Pharmacology
P. major leave extracts, ethanol- and water-based as well as freeze-dried, have all been shown to have a wound healing effect when used in an ex vivo porcine wound-healing model.[14]

Safety
P. major extract is considered safe for cosmetic use, with no special provisions in the Annexes to the EU Cosmetics Regulation.

2.5 *Silybum marianum (milk thistle)*

Prevalance
S. marianum is an annual or biennial plant that inhabits most of Europe.

Historical Use
S. marianum has sometimes been cultivated due to its edible leaves. Historically it has been used for uterine issues. Topically it has been used as a skin conditioning agent. [15]

Constituents
The main constituent of *S. marianum* is a phenolic compound called Silymarin.

Pharmacology
Silymarin, a constituent of *S. marianum*, is flavonolignan, that has been studied for its burn and wound healing properties. It also has strong free radical scavenging and antioxidant properties. [16] [17]

Safety
S. marianum in extract form is considered safe for cosmetic use, with no special provisions in the Annexes to the EU Cosmetics Regulation.

Table 1. Plants and their commercial extracts with examples of finished products

Botanical name	**Common name**	**Pharmacological Use**	**Cosmetic raw materials**	**Finished products**
Achillea millefolium	Yarrow	Skin and mucous membrane infections, wound healing [6] Treating burns, wounds, acne and skin infections [7][8]	Yarrow Extract H. HL., Provital Phytelene EG 472 Yarrow, Greentech	Aurelia Probiotic Skincare – Brigthening Anti-Pollution Mask De Mamiel – Atmospheriques Pure Calm Cleansing Dew
Epilobium angustifolium	Fireweed	Scrapes, wounds, acne, psoriasis, burns and skin infections [7]	Defenscalp PF, Lucas Meyer Cosmetics Epilobium Oleoactif, Hallstar	Natura Siberica – Flora Siberica Kamchatka Rosebay Willowherb Shampoo
Lythrum salicaria	Purple loosestrife	Treatment of eczema [12]	Sveltine ST, BASF	Oyuna - Natural Balance Prebiotic Face Cream
Plantago major	Greater Plantain or Arctic Plantain	Itchy skin, insect bites, sunburns, skin infections and wounds [7] [8]	Plantain Leaf Extract, Phytobasic, Bio-Botanica Inc Plantago Major, In vitro Planttech	Madara – Cleansing Milk Neal's Yard Remedies – Lavander & Aloe Vera Cooling Cream
Silybum marianum	Milk Thistle	Anti-oxidant, skin conditioning [15]	Actiphyte Milk Thistle, Lipotec SAU Silymarin Phytosome, Indena SpA	January Labs - Revitalizing Day Cream De Mamiel – Rise SkinCeuticals- Silymarin CF

(Disclaimer. While the commercially available extracts are listed next to the finished cosmetic products, there is no known customer relationship between the two, they are only examples.)

3 Constituents with skin benefiting properties

The finished plant extracts as well as the finished commercial products that are on the market claim a variety of different skincare benefits. It is of interest to look even deeper into these extracts and the constituents, to see which of them could be responsible for the effect seen in skincare. Here are some of the constituents and their effects listed.

3.1 Apigenin

Apigenin, 4',5,7-trihydroxyflavone, is a flavone with anti-inflammatory, antioxidant and anti-carcinogenic properties. It has also demonstrated anti-ageing properties.[18]
Apigenin is found in *A. millefolium, L. salicaria* and *P. major.*

3.2 Luteolin

Luteolin, 3′,4′,5,7-tetrahydroxyflavone, is a flavonoid that exists in many types of plants. It is a strong antioxidant, and has the potential to supress proinflammatory mediators in the skin. Luteolin therefore has the potential to help with wound healing, alleviate inflammatory skin conditions and combat photoaging. [19]
Luteolin is found in *A. millefolium, L. salicaria* and *P. major*.

3.3 Ursolic Acid

Ursolic acid is pentacyclic triterpenoid, a triterpene compound found in many types of plants. It has anti-inflammatory, antioxidant, and anti-carcinogenic properties. [20]
Ursolic acid can be found in *E. angustifolium* and *P. major*.

3.4 Silymarin

Silymarin is a flavonoid found in *S. marianum*. Silymarin has antioxidant properties and is well known for its UVB-photoprotective properties. Silymarin can therefore be said to combat photoageing. [15]

Plant constituent	**Function**	**Found in**
Apigenin	Anti-inflammatory Antioxidant Anti-carsinogenic Anti-ageing [18]	*A. millefolium* *L. salicaria* *P. major*
Luteolin	Anti-inflammatory Antioxidant [19]	*A. millefolium* *L. salicaria* *P. major*
Ursolic Acid	Anti-inflammatory Antioxidant Anti-carsinogenic [20]	*E. angustifolium* *P. major*.
Silymarin	Antioxidant Anti-photoageing [15]	*S. marianum*

Discussion

Using plant extracts in skincare is nothing new. Marketing claims are often based around exotic botanical ingredients. With a bigger emphasis on sustainability, the exoticism of far-fetched raw materials seems to be trend that may soon pass. It would be great to see some of these less exotic and glamourous plants used instead for skin soothing actives. They clearly contain many of the same constituents that are beneficial to skin, and grow in abundance in Europe. They do not compete with food crops, and they do not need irrigation of cultivation to grow. Therefore they can make the ideal skincare ingredients, however, their efficacy needs to be proven.

When using plants as the starting material for cosmetic ingredients, factors such as impurities, differences between soil quality, weather conditions, pollutants and contaminants must be closely monitored. These will all have an impact, and therefore strict quality control measures must be in place to ensure consumer safety and unchanged quality.

While all phenolic compounds have antioxidant properties, it is important to differentiate the most beneficial components of the plants studied, and possibly refine them for use in cosmetics. This refinement will require further investigation into extraction techniques to optimise the yield value for each constituent.

Conclusion

The plants covered in this review are what one might consider weeds, and their cultivation has not been abundant. As hardy plants that do not compete with food crops for cultivated land, their potential for development into more refined cosmetic ingredients remains largely untapped. Further investigation on the impact on biodiversity and the local ecosystems should be done prior to any harvesting to ensure sustainable sourcing.

Conflict of Interest Statement

NONE

References

1. Green Consumer Behavior in the Cosmetics Market, N. Amberg, (2019)
2. An Exploratory Study of Consumer Attitudes Toward Green Cosmetics in the UK Market, Y. Lin, (2018)
3. The estimation of the traditionally used yarrow (*Achillea millefolium* L. Asteraceae) oil extracts with anti-inflamatory potential in topical application, Journal of Ethnopharmacology, (March 2017)
4. Achillea millefolium L. and Achillea biebersteinii Afan. Hydroglycolic Extracts–Bioactive Ingredients for Cosmetic Use, (2020) Molcules
5. Safety Assessment of *Achillea millefolium* as Used in Cosmetics , International Journal of Toxicology, (2016)
6. Hoida luonnollisesti itseäsi, luontaishoito-opin perusteet, Rauli Mäkeilä, WSOY, (1997)
7. Suomen luonnon lääkekasvit, Sinikka Piippo, Tammi, (2018)
8. Frantsila luonnon kotiapteekki, Virpi Raipala-Cormier, WSOY, (2019)
9. In Vitro Human Skin Penetration, Antioxidant and Antimicrobial Activity of Ethanol-Water Extract of Fireweed (Epilobium angustifolium L.), Molecules, (2021)
10. Inhition of 5 alpha-reductase and aromatase by the ellagitannins oenothein A and oenothein B from Epilobium species., Ducrey B ; Marston A ; Göhring S ; Hartmann RW ; Hostettmann K ;
    Germany, George Thiem, Planta medica, Planta Med, (1997)
11. Oenothein B's contribution to the anti-inflammatory and antioxidant activity of Epilobium sp.Kiss AK ; Bazylko A; Filipek A ; Granica S ; Jaszewska E ; Kiarszys U ; Kośmider A ; Piwowarski J,Germany, Urban & Fischer Verlag, Phytomedicine : international journal of phytotherapy and phytopharmacology, Phytomedicine, 2011
12. L ythrum salicaria L.-Underestimated medicinal plant from European traditional medicine. A review. Piwowarski JP ; Granica S ; Kiss AK ; Ireland, Elsevier Sequoia,Journal of ethnopharmacology, J Ethnopharmacol, (2015)
13. The traditional uses, chemical constituents and biological activities of *Plantago major* L. A review
14. Promotion of wound healing by *Plantago major* L. leaf extracts – *ex-vivo* experiments confirm experiences from traditional medicine. Muhammad Zubair, Hilde Nybom, Christina Lindholm, Johanna M. Brandner & Kimmo Rumpunen
15. Skin Protective Activity of Silymarin and its Flavonolignans, Jitka Vostolova et al (2019)
16. Silymarin, the antioxidant component of *Silybum marianum*, protects against burn-induced oxidative skin injury, Hale Z.Toklu[a]TubaTunalı-Akbay[b]GözdeErkanlı[c]MeralYüksel[d]FerihaErcan[c]GökselŞener
17. The effect of silymarin (*Silybum marianum*) on human skin fibroblasts in an *in vitro* wound healing model Roya Sharifi, Parvin Pasalar, Mohammad Kamalinejad
18. Apigenin inhibits UVA-induced cytotoxicity *in vitro* and prevents signs of skin aging *in vivo*, Choi, Sungjin; Youn, Jeungyeun; Kim, Karam; Joo, Da Hye; Shin, Shanghun; et al. **International Journal of Molecular Medicine; Athens** Vol. 38, Iss. 2, (2016)
19. Luteolin as a modulator of skin aging and inflammation, Fabian Gendrisch, Philipp R. Esser, Christoph M. Schempp, Ute Wölfle, (25 December 2020)
20. Ursolic acid in health and disease, Dae Yun Seo,[1] Sung Ryul Lee,[1,2] Jun-Won Heo,[3] Mi-Hyun No,[3] Byoung Doo Rhee,[1] Kyung Soo Ko,[1] Hyo-Bum Kwak,[3] and Jin Han (2018)