Our Dermatology Online

Original Article

Fact-checking cosmetic trends: Systematic review of the use of topical astragalus derivatives to treat dermatologic conditions

Shangi Fu[1,2], Swathi Holla[1], Harrison Zhu[1], Sophia Fu[3], Kate Liu[3], Annie Vu[3], Zachrieh Alhaj[4], Danny Huynh[5], Ola Khaled Soliman[1], Ida Orengo[6]

[1]School of Medicine, Baylor College of Medicine, Houston, TX, USA, [2]Human Genome Sequencing Center, Baylor College of Medicine, Houston, TX, USA, [3]Glenda Dawson High School, Pearland, TX, USA, [4]John Sealy School of Medicine, University of Texas Medical Branch, Galveston, TX, USA, [5]Embedded Systems Engineering, Teal Systems, Houston, TX, USA, [6]Department of Dermatology, Baylor Collegeof Medicine, Houston, TX, USA

Corresponding author: Zachrieh Alhaj BS, BA, E-mail: ztalhaj@utmb.edu

ABSTRACT

Objectives: *Astragalus* plants and their derivatives have been used historically for the treatment of various conditions, and they have recently been used to treat dermatological diseases and as topical cosmetic enhancers. In this consolidated systematic review, we analyzed current peer-reviewed publications regarding the topical effects of *Astragalus* derivatives on the treatment of dermatological diseases and whether the current market claims of its benefits and harms are substantiated. **Methods:** A systematic review using PRISMA criteria was conducted, and two independent reviewers selected and collected data from 9 papers that met the inclusion criteria. **Results:** Findings from these papers demonstrated that topical *Astragalus* derivatives were effective in the treatment of alopecia, atopic dermatitis, wound healing, contact dermatitis, dermatophytosis, and psoriasis. The beneficial effects of *Astragalus* in these dermatological conditions were attributed to its immunomodulatory mechanisms. **Conclusion:** The wide availability of this product allows its easy use for treating common dermatological issues. However, these articles are limited by their assessment of use on non-human mammals, the short duration of trials, and unclear mechanisms of action that limit research development. Future research is needed to close these gaps before the development of *Astragalus*-based pharmaceuticals for dermatological conditions.

Key words: Astragalus, Cosmetic, Dermatology, Traditional medicine

INTRODUCTION

With over 2000 species identified Astragalus plants are part of the Leguminosae family, grow well in temperate environments, and are commonly used in Asian traditional medicine for a wide variety of ailments, including dermatological disorders [1–5].

While initially used for livestock and human consumption [6], Astragalus has been used in Chinese traditional medicine in treating diabetes, hypertension, and cancers, including leukemia and uterine cancer, as well as used for antiperspirant, antimicrobial, and tonic properties [4–7], Astragalus extracts are mainly made of saponins, terpenoids, flavonoids, and polysaccharides, which are believed to serve as active ingredients with antioxidant properties that can impart expedited healing [8]. Decreased aging is also found with astragaloside administration, a derivative of Astragalus extract, where the mice treated had brain function and blood serum composition more similar to younger mouse populations [9]. Traditional and modern uses of Astragalus include enhancing skin health and preventing and treating dermatological

How to cite this article: Fu S, Holla S, Zhu H, Fu S, Liu K, Vu A, Alhaj Z, Huynh D, Khaled Soliman O, Orengo I. Fact-checking cosmetic trends: Systematic review of the use of topical astragalus derivatives to treat dermatologic conditions. Our Dermatol Online. 2024;15(4):337-344.

Submission: 21.05.2024; **Acceptance:** 25.09.2024
DOI: 10.7241/ourd.20244.2

diseases. Traditional Chinese medicine uses astragalus as a *Qi* enhancer, known as life energy believed to travel through the human body, thus promoting the immune system, increasing vitality and energy, and preserving skin health [10–17]. Extract from *Astragalus gombiformis* has been shown to absorb UV radiation at an SPF of around 37.78, prevent inflammation at a percentage of 75.38%, and have a cytotoxic effect against *Artemia nauplii* but not against human erythrocytes [18]. This species of Astragalus has also been found to have at least 17 phenolic compounds that have strong antioxidant and anti-inflammatory properties [18]. *Astragalus membranaceus* was found to reduce DNA damage due to UVA exposure [18]. Topical astragalus, specifically Radix astragali, both fermented and non-fermented, have been shown to stimulate keratinocyte and fibroblast growth and hyaluronic production, and have low toxicity *in vitro* tests [19].

There are already products on the market that contain a large concentration of Astragalus derivatives. Listed on INCI Decoder, there are over 90 topical skin creams, toners, and essences with Astragalus currently on the market [20]. Some of the marketing claims advertising these products include "boosting energy," treating skin problems associated with "diabetes" and "night sweats," and resolving "acne," "psoriasis," "rosacea," "hyperpigmentation," and "dermatitis" [21–23]. Companies claim that it is useful in "deep moisture" due to "excellent absorption of the production" and it improves "skin elasticity," "inflammation," and "collagen production" [21–23].

Fortune Business Insights projects an economic increase in the skincare market, worth around 133.90 billion USD in 2018 to 200.25 billion USD by 2026, with a substantial percentage from the Asia Pacific. This sets the perfect environment for a large expansion of Asian skincare products that include Astragalus [24], thus potentially false marketing regarding the efficacy of this ingredient in dermatological diseases. Because of the long history of Astragalus use in medicine, including skincare, as well as the current integration of Astragalus in the cosmetic industry, consolidation of the available literature on the efficacy of topical Astragalus is vital in critically addressing current marketing claims and increasing consumer and manufacturer awareness of its uses.

As of this paper, no study has consolidated its benefits in all dermatological diseases through *in vivo* topical application. In this paper, we are performing a systematic review of the current publications regarding the topical effects of Astragalus derivatives on cosmetic properties of the skin, including the treatment of dermatologic diseases. We addressed its beneficial and harmful effects on skin health, determined the limitations of each study found, and consolidated this knowledge to disprove misleading marketing claims.

METHODS

Six possible search terms were created through the use of boolean operators, including the following: Astragalus topical skin*, Astragalus topical derm*, Astragalus topical cosmetic*, Astragalus topical hair*, Astragalus topical nail*, Astragalus topical beaut*. A C#.NET console application ran the search terms through PubMed to query the resulting links through an HTTP request. All subsequent literature was collected in February, 2022 and there were 27 publications gathered. Duplicates were removed and 18 publications were unique. Using our inclusion and exclusion criteria, the abstracts were initially reviewed to determine the papers' relevance, and irrelevant articles were removed. Our inclusion criteria included trials measuring the topical use of Astragalus derivatives on the skin in vivo in treating dermatological diseases, tested on animals and humans, and published at any point in time. Exclusion criteria include trials that do not have a vehicle or control; trials that focused on in vitro and ex vivo results; trials that only had histological parameters; reviews, commentaries, editorials, or any publications that did not present any original data; and articles not written in English. The resultant sum included 11 papers that fit the exclusion and inclusion criteria given (Fig. 1).

These publications were read entirely for their content, leading to a final 11 papers that fulfilled both the inclusion and exclusion criteria. Different data points were collected from each paper, and to reduce the risk of bias, different data points were collected by two reviewers, independently. The subsequent information was consolidated, and limitations and potential future research were assessed, discussed, and recorded. Data categories that were not included in each study were listed as "Not Available (N/A)" (Fig. 1).

RESULTS

Conglomerate Publications Information

The average sample size taken was 23.6. The average length of the studies was 12.5 days. Of the studies,

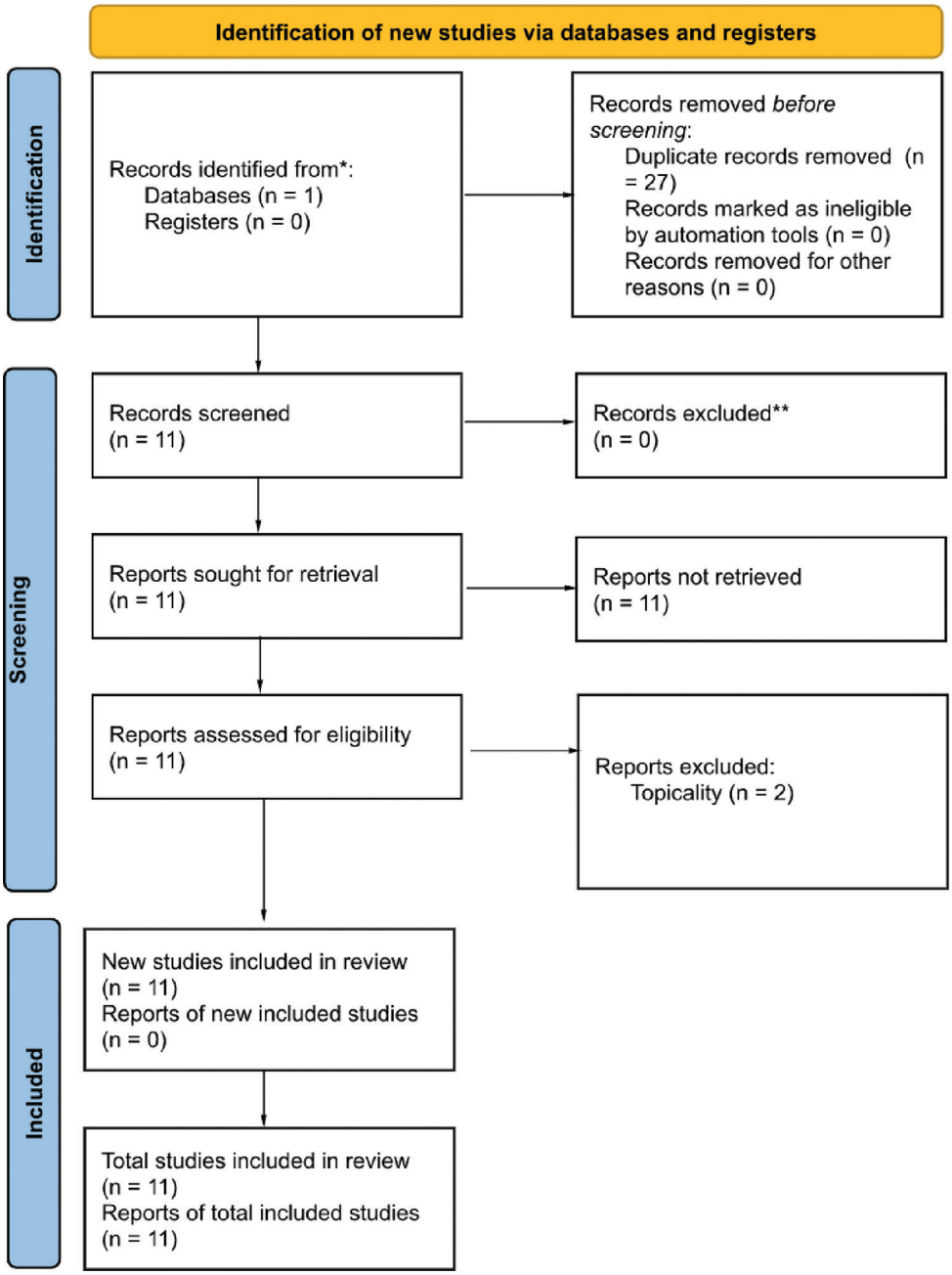

Figure 1: PRISMA Model of the performed methods, updated as of Feb 2022.

mouse test subjects were most frequently utilized (77.8%), followed by rats (11.1%), and guinea pigs (11.1%) (Table 1).

Alopecia

The Astragaloside IV component of *Astragalus membranaceus* was shown to lead to recovery of hair shaft length and broken hair follicles in depilated mouse skin, likely through inhibition of apoptotic pathways in 7-week old female mice with natural hair loss in the telogen phase, whereas controls remained depilated (Table 1). Astragaloside IV markedly decreased caspase, NF-kB, Bax and p53, Fas/Fas-L signaling, and upregulation of anti-apoptotic Bcl-2 [25,26]. These apoptotic pathways have been associated with a transition from the anagen (growth) phase to the catagen (regression) phase of the hair growth cycle [27,28], thus leading to hair loss.

Atopic Dermatitis

Astragalus membranaceus has demonstrated various anti-inflammatory effects that have alleviated atopic

Table 1: Summary of Publication Data

Article	Astragalus species	N =	Duration	Species Tested	Aim of Study	Application	Additional ingredients	Controls	Effects on Skin	Possible Mechanisms
Kim et al. - 2014	Astragalus membranaceus (specifically Astragaloside IV component)	28	15 days	Mouse	Treat Alopecia	1 and 100 uM topical application on depilated skin	N/A	Negative control - 100 uL of vehicle (100% methanol)	Recovery of tapering hair shaft length and broken hair follicles	Inhibition of p53 and bax transcription overall inhibiting the Fas/FasL mediated apoptotic pathway through caspase-dependent signalling
Nam et al.	Astragalus membranaceus	20	20 days	Mouse	Treat Atopic Dermatitis	Topical application onto dorsal skin treated with DCMB (AD-inducing)	Combined with Schizonepeta tenuifolia, Cryptotympana pustulata, Angelica sinensis, and Arctium lappa (20g each)	Negative control - vehicle Positive control - dexamethasone	Reduction of dermatitis scores, reducing itching, mast cell infiltration, erythema, and lichenification.	Decrease of IL-22. Restoration of DSC1, a cohesion mediator leading to restoration of skin barrier integrity protecting against lichenification.
Kim et al. - 2013	Astragalus membranaceus	15	17 days	Mouse	Treat Atopic Dermatitis	Topical application onto dorsal skin treated with DCMB (AD-inducing)	N/A	Control - Vehicle; Negative Control - DCNB	Treated mice dispalyed reduced skin thickening and reduced hyperplasia of both the epidermis and dermis than DNCB-induced mice.	Restored expression of NF-□B, suppression of IgE, Th2 response cytokines, and TNF-a.
Fayazzadeh et al.	Astragalus gummifer	N/A	10 days	Mouse	Wound healing	250 uL topical application	N/A	Control - Deionized sterile water	Greater wound closure, contraction as early as day 3. On day 10, there was greater epithelium repair and wound healing index with no infiltration of inflammatory cells.	Acceleration of transition from inflammation and granulation phases and enhancement of scar formation and extracellular matrix remodelling.
Jo et al.	Astragalus membranaceus Fisch ex bunge	30	11 days	Mouse	Contact dermatitis	30 mg/mL of AM	N/A	Negative control - vehicle Positive control - dexamethasone	Decrease of dermatitis, skin severity score, hyperplasia, mast cell infiltration, and scratching behavior	Inhibition of NGF-TrkA signalling pathways and profinflammatory chemokines likely via Th2 mediated pathways
Han et al.	Astragalus membranaceus	N/A	11 days	Rats	Wound Healing	Topical application of hydrophilic wound dressing dipped in *Astragalus Radix* preparation	N/A	Positive Control - Epidermal Growth Factor (EGF)	Induction of early basal cell proliferation, angiogenesis, and suppression of inflammation leading to rapid significant improvement of wounds.	Unclear
Luo et al.	Astragalus Membranaceus (specifically Astragaloside IV component)	N/A	10 days	Mouse	Wound healing (diabetic)	None.	N/A	Negative control - vehicle	Greater wound closer, accelerated reepithelization and upregulated total collagen production. Increased vascularization and markers of angiogenesis	Upregulation of CD31 (marker of angiogenesis), VEGF, and vWF. Upregulation of alternatively activated macrophages also likely played a role.

(*Contd...*)

Table 1: (*Continued*)

Article	Astragalus species	N =	Duration	Species Tested	Aim of Study	Application	Additional ingredients	Controls	Effects on Skin	Possible Mechanisms
Mikaeili et al.	Astragalus verus olivier	25	13 days	Guinea pigs	Dermatophytosis	Topical application	N/A	Negative Control - Solvents of Extracts; Positive Control - Griseofulvin	20 and 40% formulations demonstrated increased hair growth with no signs of infection, decreased lesions scores, and greater clinical efficacy compared to negative controls. However, griseofulvin had the greatest efficacy.	Immunological boosting and antimicrobial properties.
Cheng et al.	Astragalus mongholicus Bunge	N/A	6 days	Mouse	Psoriasis	50 uL topical application	N/A	Negative control - Vehicle (40% ethanol, 60% ddH2O)	Alleviation of skin inflammation, psoriasis area and severity index score, erythema, and scaling. Reduction of epidermal thickness and inhibition of neutrophil infiltration	Reduction of epidermal proliferation marker Ki67. Reduction of superoxide generation and neutrophil activation, reducing CD11b.

dermatitis symptoms in mice [29,30] (Table 1). Treatment with *Astragalus membranaceus* in mice with chemically-induced atopic dermatitis resulted in a reduction of skin thickening and hyperplasia in both the epidermis and dermis when compared to negative controls. These findings may be due to decreased inflammation resulting from *Astragalus membranaceus* restoring NF-κB expression and suppressing Th2-mediated pathways and TNF-a [29]. Similarly, a paper investigating the effects of an herb mixture including *Astragalus membranaceus* on mice with chemically induced atopic dermatitis found that treatment resulted in reduced skin thickness, itching behavior, lichenification, and mast cell infiltration. In this study, *Astragalus membranaceus* was combined with 4 other herbs in equal parts, so it is difficult to attribute these effects solely to Astragalus [30].

Contact Dermatitis

Astragalus membranaceus fisch ex bunge (AM) alleviated the severity and symptomatology of contact dermatitis in male mice (n=30). In terms of scratching behavior, epidermal and dermal thickness, AM demonstrated a similar, significant reduction compared to dexamethasone. AM also significantly reduced mast cell infiltration and Th2-mediated cytokines were also reduced significantly, but dexamethasone was more effective [31].

Wound Healing

Astragalus membranaceus induced basal cell proliferation, angiogenesis, and suppression of inflammation, leading to rapid significant improvement of wounds in comparison to epidermal growth factor (EGF) [32] (Table 1). Another study found that the Astragaloside IV component of *Astragalus membranaceus* led to improved wound closure and re-epithelialization in mice with diabetic ulcers induced by streptozotocin significantly greater than in control mice [33]. Extracellular matrix (ECM) components, such as collagen or fibronectin, were also significantly increased in the mice treated with astragaloside IV. Significant upregulation of angiogenic markers, such as CD31, VEGF, and vWF, likely mediates these regenerative mechanisms [33]. Similarly, in non-diabetic mice, a study by Fayazzadeh and colleagues found that the application of *Astragalus gummifer* (Tragacanth) as a wound dressing resulted in greater wound closure, contraction, epithelium repair, and wound healing index with no inflammatory cells

compared to equal amounts of control intervention (sterilized water) [34].

Dermatophytosis

Astragalus verus olivier topical application of greater than 20% concentration was able to demonstrate greater clinical efficacy against *Trichophyton verrucosum* infection in guinea pigs compared to negative controls [35]. Clinical outcomes of negative controls demonstrated patches of hair loss, ulcerated or scaly skin, and severity of lesions [35]. While the 10% *Astragalus verus olivier* was able to induce some antimicrobial effects, these results were not as significant as the >20% concentrations. However, the application of griseofulvin demonstrated the greatest effect [35].

DISCUSSION

Topical application of *Astragalus* in animal studies has shown alleviation of various skin conditions, but none have investigated its effects in humans.

Most studies suggest that the beneficial effects of *Astragalus* are due to immunomodulation [29,30,33,36,37]. One study investigated antimicrobial properties but was unable to identify a mechanism for the antifungal action of *Astragalus verus olivier* [35]. Few studies investigate side effects or efficacy compared to accepted pharmacologic treatment. One study comparing *Astragalus* to other treatments found that the overall efficacy of *Astragalus* extracts was lower than standard-of-care treatments [35]. However, a different study by Han and colleagues found that the effects of Astragalus were superior to those of EGF in wound healing [32]. Future studies comparing *Astragalus* to approved, standard-of-care medications could be relevant to clinical practice, if tested on humans. As an example, comparing astragaloside IV to FDA approved drugs for hair loss, such as finasteride and minoxidil, may demonstrate interesting results.

In wound healing, upregulation of angiogenic factors may be one mechanism for Astragaloside IV. *Astragalus gummifer*'s wound-healing abilities may be related to structural similarity to chitosan, another arabinogalactan-containing polysaccharide biopolymer that has been demonstrated to accelerate wound closure [38,39]. There are current materials on the market, such as HyaloFill, based on the extracellular matrix and polysaccharide structures intended as skin substitutes [40]. In the setting of MOHS microscopic surgery, these materials have been shown to clinically augment wound healing [41]. However, no human trials on *Astragalus* and wound healing have been conducted and animal trials are potentially confounded by variations in animal behavior that may diminish wound healing activity. Applying separate wounds to the same animal may also reduce this limitation [34]. While this data shows some promise in the topical use of *Astragalus* as a dermatologically effective ingredient for treatment, a major limitation is that none of the current literature measures its effects on human subjects.

Another limitation of many of the reviewed studies is that human skin conditions were studied using animal models with chemically or other artificially induced skin conditions, rather than on animals that had naturally developed these skin conditions [29,30]. Due to this limitation, the effects of *Astragalus* on humans with organically developed skin conditions may differ from what was observed in the above studies

Even with these limitations, further publications support that *Astragalus* derivatives are a promising ingredient to incorporate as an adjunct to currently established treatments for dermatological diseases. It is appropriate to use commercially as a cosmetically beneficial ingredient and may be implemented in the future for clinical use. While there are major limitations to some of the studies that were discussed, preliminary data *in vitro* and *in vivo* supports the proposed mechanism in skin diseases, and show that it does not induce skin irritation, decrease dermatological symptoms, promote wound healing, and may treat alopecia.

CONCLUSIONS

With its long history in medical use throughout Asia, *Astragalus* is a species of plant that has become more widely used in modern medicine and cosmetics. Its growing popularity in commercial use begs the question of its efficacy on dermatological conditions with topical application. We found that *Astragalus* has preliminary animal research supporting its treatment of dermatitis, alopecia, dermatophytes, and wound healing, and has the potential to be more effective than established treatments. Additional experimentation is still needed to measure its effects long-term, against current treatments, and in human trials, however, its

current use in cosmetics, skincare, and clinics can be beneficial to consumers to enhance skin health and treat skin diseases.

Statement of Human and Animal Rights

All the procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the 2008 revision of the Declaration of Helsinki of 1975.

REFERENCES

1. Podlech D. The genus Astragalus L. (Fabaceae) in Europe with exclusion of the former Soviet Union. Feddes Repert. 2008;119:310–87.
2. Benchadi W, Haba H, Lavaud C, Harakat D, Benkhaled M. Secondary metabolites of astragalus cruciatus link. and their chemotaxonomic significance. Rec Nat Prod. [Internet] 2013;7:105-13.
3. Xu L, Podlech DF. Astragalus Linnaeus, Sp. Pl. 2: 755. 1753. Flora China. 2010;10:329–33.
4. Choudhary MI, Jan S, Abbaskhan A, Musharraf SG, Samreen null, Sattar SA, et al. Cycloartane triterpenoids from Astragalus bicuspis. J Nat Prod. 2008;71:1557–60.
5. Avunduk S, Mitaine-Offer AC, Alankuş-Calişkan O, Miyamoto T, Senol SG, Lacaille-Dubois MA. Triterpene glycosides from the roots of Astragalus flavescens. J Nat Prod. 2008;71:141–5.
6. Li X, Qu L, Dong Y, Han L, Liu E, Fang S, et al. A review of recent research progress on the astragalus genus. Mol Basel Switz. 2014;19:18850–80.
7. Fathiazad F, Khosropanah MK, Movafeghi A. Cycloartane-type glycosides from the roots of Astragalus caspicus. Bieb Nat Prod Res. 2010;24:1069–78.
8. Ibrahim LF, Marzouk MM, Hussein SR, Kawashty SA, Mahmoud K, Saleh NAM. Flavonoid constituents and biological screening of Astragalus bombycinus. Boiss Nat Prod Res. 2013;27:386–93.
9. Lei H, Wang B, Li WP, Yang Y, Zhou AW, Chen MZ. Anti-aging effect of astragalosides and its mechanism of action. Acta Pharmacol Sin. 2003;24:230–4.
10. Yen K. The illustrated chinese materia medica (p. 84). Taipei Taiwan SMC Publ. Inc 1992;
11. Chen KT, Su CH, Hsin LH, Su YC, Su YP, Lin JG. Reducing fatigue of athletes following oral administration of huangqi jianzhong tang. Acta Pharmacol Sin. 2002;23:757–61.
12. Lee KY, Jeon YJ. Macrophage activation by polysaccharide isolated from Astragalus membranaceus. Int Immunopharmacol. 2005;5:1225–33.
13. Wang KH, Lin RD, Hsu FL, Huang YH, Chang HC, Huang CY, et al. Cosmetic applications of selected traditional Chinese herbal medicines. J Ethnopharmacol. 2006;106:353–9.
14. Cho WCS, Leung KN. In vitro and in vivo immunomodulating and immunorestorative effects of Astragalus membranaceus. J Ethnopharmacol. 2007;113:132–41.
15. Zhu X, Zhu B. Mechanisms by which Astragalus membranaceus injection regulates hematopoiesis in myelosuppressed mice. Phytother. Res. Int. J. Devoted Pharmacol. Toxicol. Eval Nat Prod Deriv. 2007;21:663–7.
16. Kim JH, Kim MR, Lee ES, Lee CH. Inhibitory effects of calycosin isolated from the root of Astragalus membranaceus on melanin biosynthesis. Biol Pharm Bull. 2009;32:264–8.
17. Kuo YH, Tsai WJ, Loke SH, Wu TS, Chiou WF. Astragalus membranaceus flavonoids (AMF) ameliorate chronic fatigue syndrome induced by food intake restriction plus forced swimming. J Ethnopharmacol. 2009;122:28–34.
18. Lekmine S, Boussekine S, Akkal S, Martín-García AI, Boumegoura A, Kadi K, et al. Investigation of photoprotective, anti-inflammatory, antioxidant capacities and LC-ESI-MS Phenolic profile of astragalus gombiformis pomel. Foods Basel Switz. 2021;10:1937.
19. Hsu MF, Chiang BH. Stimulating effects of Bacillus subtilis natto-fermented Radix astragali on hyaluronic acid production in human skin cells. J. Ethnopharmacol. [Internet] 2009;125:474–81.
20. Astragalus Membranaceus Root Extract (Explained + Products) [Internet]. INCI Decod. [cited 2022 Jun 26];Available from: https://incidecoder.com/ingredients/astragalus-membranaceus-root-extract?uoffset=1
21. Astragalus and Geranium Toner (Skin Prep) - Mei Zen | Acurea USA [Internet]. Acurea USA [cited 2022 Jun 26];Available from: https://acureausa.com/astragalus-and-geranium-toner
22. Astragalus [Internet]. Elma Skin Care [cited 2022 Jun 26];Available from: https://elmaskincare.com/herbs/herbs_astragalus.htm
23. Essence Toner - Pyunkang Yul US Official [Internet]. Pyunkang Yul [cited 2022 Jun 26];Available from: https://pyunkangyul.us/products/essence-toner
24. ASEAN Cosmeceuticals Market Size & Growth | Report [2028] [Internet]. Fortune Bus. Insights [cited 2022 Jun 27];Available from: https://www.fortunebusinessinsights.com/asean-cosmeceuticals-market-106253
25. Kim SH, Shin TY. Anti-inflammatory effect of leaves of Eriobotrya japonica correlating with attenuation of p38 MAPK, ERK, and NF-kappaB activation in mast cells. Toxicol Vitro Int J Publ Assoc BIBRA. 2009;23:1215–9.
26. Kim MH, Kim SH, Yang WM. Beneficial effects of Astragaloside IV for hair loss via inhibition of Fas/Fas L-mediated apoptotic signaling. PloS One. 2014;9:e92984.
27. Lindner G, Botchkarev VA, Botchkareva NV, Ling G, van der Veen C, Paus R. Analysis of apoptosis during hair follicle regression (catagen). Am J Pathol. 1997;151:1601–17.
28. Stenn KS, Combates NJ, Eilertsen KJ, Gordon JS, Pardinas JR, Parimoo S, et al. Hair follicle growth controls. Dermatol Clin. 1996;14:543–58.
29. Kim JH, Kim MH, Yang G, Huh Y, Kim SH, Yang WM. Effects of topical application of Astragalus membranaceus on allergic dermatitis. Immunopharmacol Immunotoxicol. 2013;35:151–6.
30. Nam YK, Kim MH, Ha IJ, Yang WM. Derma-Hc, a New Developed Herbal Formula, Ameliorates Cutaneous Lichenification in Atopic Dermatitis. Int J Mol Sci. 2021;22:2359.
31. Jo SY, Kim MH, Lee H, Lee SH, Yang WM. Ameliorative and synergic effects of derma-h, a new herbal formula, on allergic contact dermatitis. Front Pharmacol. 2020;11:1019.
32. Han DO, Lee HJ, Hahm DH. Wound-healing activity of Astragali Radix in rats. Methods Find Exp Clin Pharmacol. 2009;31:95–100.
33. Luo X, Huang P, Yuan B, Liu T, Lan F, Lu X, et al. Astragaloside IV enhances diabetic wound healing involving upregulation of alternatively activated macrophages. Int Immunopharmacol. 2016;35:22–8.
34. Fayazzadeh E, Rahimpour S, Ahmadi SM, Farzampour S, Sotoudeh Anvari M, Boroumand MA, et al. Acceleration of skin wound healing with tragacanth (Astragalus) preparation: an experimental pilot study in rats. Acta Med Iran. 2014;52:3–8.
35. Mikaeili A, Modaresi M, Karimi I, Ghavimi H, Fathi M, Jalilian N. Antifungal activities of Astragalus verus Olivier. against Trichophyton verrucosum on in vitro and in vivo guinea pig model of dermatophytosis. Mycoses. 2012;55:318–25.
36. Kim MH, Kim SH, Yang WM. Beneficial effects of Astragaloside IV for hair loss via inhibition of Fas/Fas L-mediated apoptotic signaling. PloS One. 2014;9:e92984.
37. Cheng WJ, Chiang CC, Lin CY, Chen YL, Leu YL, Sie JY, et al. Astragalus mongholicus Bunge Water Extract Exhibits Anti-inflammatory Effects in Human Neutrophils and Alleviates Imiquimod-Induced Psoriasis-Like Skin Inflammation in Mice.

Front Pharmacol. 2021;12:762829.
38. Ishihara M, Nakanishi K, Ono K, Sato M, Kikuchi M, Saito Y, et al. Photocrosslinkable chitosan as a dressing for wound occlusion and accelerator in healing process. Biomaterials. 2002;23:833–40.
39. Ishihara M, Ono K, Sato M, Nakanishi K, Saito Y, Yura H, et al. Acceleration of wound contraction and healing with a photocrosslinkable chitosan hydrogel. Wound Repair Regen Off Publ Wound Heal Soc Eur Tissue Repair Soc. 2001;9:513–21.
40. Lu KW, Khachemoune A. Skin substitutes for the management of mohs micrographic surgery wounds: a systematic review. Arch Dermatol Res. 2023;315:17-31.
41. Dika E, Fanti PA, Patrizi A, Misciali C, Vaccari S, Piraccini BM. Mohs Surgery for squamous cell carcinoma of the nail unit: 10 years of experience. Dermatol Surg Off Publ Am Soc Dermatol Surg Al. 2015;41:1015–9.

Source of Support: This article has no funding source.

Conflict of Interest: The authors have no conflict of interest to declare.