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Literature review: The utilization of tomatoes (*Solanum lycopersicum*) and lidah buaya (*Aloe vera*) in cosmetic applications

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ABSTRACT

The popularity of herbal cosmetics has been growing due to their effectiveness and ability to reduce the adverse effects associated with the use of synthetic goods. Plants contain phytochemicals like alkaloids, flavonoids, saponins, sterols, triterpenoids, and tannins, which give them many health benefits, such as antioxidant activity, anti-inflammatory effects, UV protection, skin regeneration, depigmentation, anti-dandruff properties, and more. Plants like tomatoes and *Aloe vera* contain phytochemicals that can be used in cosmetics. We want to give you all the information you need about how tomatoes and *Aloe vera* might be used in cosmetics. This includes what chemicals they contain, how they work biologically, and how to make cosmetics with them. This article review employs online literature studies as its methodology. The research data comprises articles sourced from reputable journal platforms, including Google Scholar, PubMed, Science Direct, and Research Gate. These articles were selected from publications spanning the period from 2013 to 2023. The research that has already been done supports the idea that both tomatoes and *Aloe vera* contain many chemicals that could be used in cosmetic treatments.

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INTRODUCTION

The term "cosmetics" originates from the Greek word "cosmeticos," which denotes the ability to arrange adornments and conveys a sense of strength. Cosmetics encompass a wide range of items, including serums, creams, perfumes, lotions, skin cleansing treatments, and ornamental cosmetics. In conjunction with advancements in cosmetic technology, the emergence of cosmeceuticals has facilitated a more precise targeting of specific cosmetic needs. Although classified and governed as cosmetics, cosmeceutical items have quantifiable efficacy on the skin similar to medicinal substances. People frequently use these products for diverse therapeutic purposes, including

mitigating wrinkles, achieving anti-aging effects, reducing hyperpigmentation, and managing hair breakage (Wathoni et al., 2018)

Cosmetic formulations frequently incorporate natural substances. Developers of herbal cosmetic products use a diverse range of cosmetic substances as the foundation for one or more herbal components, delivering the intended cosmetic advantages. The popularity of herbal cosmetics has been steadily rising due to their effectiveness in reducing the adverse effects associated with the use of synthetic goods (Wathoni et al., 2018).

It is expected that herbs possess a wide range of qualities, including antioxidant, anti-inflammatory, antiseptic, emollient, anti-seborrheic, anti-keratolytic, and antibacterial activities (Warade & Bhosale, 2023). Phytochemicals, such as alkaloids, flavonoids, saponins, sterols, triterpenoids, and tannins, are found in plants and help them do many good things, like protecting against UV rays, reducing inflammation, promoting skin regeneration, lightening skin, getting rid of dandruff, and more.

The fruit known as the tomato, scientifically referred to as Solanum lycopersicum, is recognized for its high nutritional content. Tomatoes are rich in lycopene, a naturally occurring antioxidant that possesses beneficial properties for skin health. The freshly harvested leaves of *Aloe vera* generate a gel substance. The utilization of *Aloe vera* gel is prevalent within the cosmetic and pharmaceutical sectors owing to its notable attributes in promoting wound healing. The widespread utilization of *Aloe vera* in cosmetic products, including soaps, moisturizing creams, shampoos, and cleansers, can be attributed to its inherent properties that promote softening and moisturization (Ijaz et al., 2022).

The objective of this review paper is to present an overview of the possible applications of tomatoes and *Aloe vera* in the field of cosmetics, focusing on their chemical composition, biological properties, and cosmetic formulations.

Researchers have conducted numerous studies on the application of Solanum lycopersicum (tomato) and Aloe vera (Lidah Buaya) in the field of cosmetics. An important part of the study is looking into how these natural substances could be used in cosmetics because they are good for skin health and protection. Antioxidants found in tomatoes, such as lycopene, flavonoids, and vitamin C, can protect the skin from damage caused by UV radiation and free radicals. Aloe vera possesses bioactive constituents, including polysaccharides, amino acids, vitamins, and minerals, which exhibit moisturizing, soothing, and anti-inflammatory properties when applied topically to the skin. The existing body of literature indicates that the utilization of tomato and aloe vera extracts in cosmetic compositions such as sunscreen, lotion, cream, and serum may offer advantageous properties for skin protection and anti-aging effects. Nevertheless, it is imperative to acknowledge the existing constraints and identify potential avenues for further investigation in order to enhance the composition, uniformity, and effectiveness of cosmetic formulations incorporating tomato and aloe vera extracts.

RESEARCH METHOD

To generate a critique of this work, we conducted an online literature review. The research data include articles sourced from reputable journal platforms, including Google Scholar, PubMed, Science Direct, and Research Gate. These articles encompass publications spanning the period from 2013 to 2023.

The purpose of this literature review is to assess the paper's merits and demerits, pinpoint and elucidate the study designs that enable the production of peer-reviewed journal articles, appraise the theories employed, and offer succinct suggestions for future investigators.

RESULTS AND DISCUSSIONS

Tomatoes (*Solanum lycopersicum*)

The taxonomic family Solanaceae classifies tomatoes. People widely consume tomatoes and use them in a broad range of culinary applications. It is not recommended to consume tomato plant leaves due to the presence of harmful alkaloids, although the fruits of the plant are safe for consumption. Tomatoes possess notable nutritional value due to their high vitamin content, particularly vitamin C, as well as their mineral composition, which includes calcium, phosphorus, and iron. Although scientifically classified as a short-lived perennial, the tomato plant, known as *Solanum lycopersicum*, is commonly cultivated as an annual crop. Tomato plants often exhibit a vertical growth pattern, reaching a height ranging from 1 to 3 meters. These plants possess stems that are characterized by a relatively low degree of lignification, rendering them weakly woody in nature. Furthermore, tomato plants commonly exhibit scrambling behavior, often intertwining with neighboring vegetation. Tomatoes exhibit a variety of shapes, including round, flattened oblong at the top and bottom, and pear-shaped. The fruit can be classified as an edible berry, exhibiting vibrant colors, typically red, because of the presence of lycopene pigment. In its natural state, the fruit measures approximately 1-2 cm in diameter, but cultivated varieties tend to be significantly bigger. From a botanical perspective, tomatoes are classified as berries, but they are commonly regarded as vegetables in terms of their nutritional characteristics(Shukla et al., 2013).

Pharmacological activity (uses): In order to address numerous human diseases, including but not limited to cancer kinds such as lung, prostate, stomach, cervix, breast, mouth, colon, esophagus, and pancreas, as well as conditions like high blood pressure, edema, kidney and liver difficulties, and the need for antioxidant catharsis, therapeutic interventions are employed. Tomatoes have been found to provide beneficial properties for maintaining liver health. Tomatoes possess detoxifying properties within the human body. The potential cause of the observed phenomenon in tomatoes could be attributed to the presence of chlorine and sulfur. The presence of sulfur compounds in tomatoes has been found to have hepatoprotective properties, hence potentially safeguarding the liver against the development of cirrhosis. In recent times, a range of chemicals exhibiting antimutagenic qualities have been identified in vegetables and herbs. Substantial data is now being amassed, suggesting that the consumption of these compounds by dietary means can potentially mitigate the risk of cancer and other malignant ailments in human beings. (Shukla et al., 2013) Tomato plants have various properties that have been studied in the field of academia. These include killing parasites, reducing inflammation, stopping cancer, protecting against oxidative stress and free radicals, stopping platelets from sticking together, killing fungi, biological activity and gene isolation, passing kinase activity, enzymatic activity, high invertase activity, and chromosomal abnormalities.

Chemical Content: The compounds examined in this study include lycopene, β-carotene, carotenoids, lutein, total phenols, polyphenols, α-tocopherol, potassium, folate, flavonoids, ascorbic acid, dehydroascorbic acid, the total content of vitamin C and vitamin E, fatty acids, carbohydrates, and hydrophilic and lipophilic antioxidant activity. Tomatoes possess a diverse array of nutritional components, including vitamin C, lycopene, moisture, carbohydrates, proteins, fats, fiber, vitamin A, thiamine, riboflavin, niacin, ascorbic acid, magnesium, oxalic acid, phosphorus, sodium, potassium, copper, sulfur, chlorine, iron, calcium, flavonoids, rubberonoids, and steroidal saponins (Shukla et al., 2013)

Lidah Buaya (*Aloe vera)*

The genus Aloe is characterized by its perennial nature and succulent xerophytic adaptation, enabling its growth in temperate and sub-tropical climates across the globe. The plant originates from the continent of Africa. *Aloe vera* is a member of the Asphodeloideae family, which has a vast array of over 360 documented species. The genus Aloe encompasses multiple species, such as *Aloe vera*, Aloe barbadensis, Aloe ferox, Aloe chinensis, Aloe indica, and Aloe peyrii. The

botanical specimen under consideration has characteristics reminiscent of a cactus, featuring elongated, dagger-shaped foliage of a vibrant green hue. The leaves are succulent, tapering towards their tips and displaying irregular, serrated edges adorned with sharp, pointed thorns. Furthermore, the leaves contain a transparent, gelatinous substance (Sharma et al., 2014).

The freshly harvested leaves of the *Aloe vera* plant yield a transparent and viscous gel known as *Aloe vera* gel. The foliage exhibits succulent characteristics, with thorny appendages and containing gelatinous substances devoid of pigmentation. The length of the object ranges from 30 to 60 centimeters, while its thickness at the base measures 10 centimeters. *Aloe vera* contains a variety of chemicals that exhibit distinct structural characteristics. The composition of leaves consists of three distinct components, namely gel, latex, and bark. Aloe leaves synthesize the gel within their cellular structures (Venkata Sunnetha et al., 2019). The fruit flesh of *Aloe vera* is composed of around 98.5% water. The transparent, gel-like substance present in parenchyma cells is called mucus and is primarily composed of 99.5% water. The solid components that make up the remaining 0.5 to 1% of the substance consist of minerals, fat-soluble and water-soluble vitamins, polysaccharides, organic acids, enzymes, and phenolic compounds (A. Kaur et al., 2011). Additionally, it contains amino acids, vitamins, sterols, and lipids. The composition of latex includes yellow sap, glycosides, and anthraquinones. The skin serves as a protective barrier for the gel matrix, acting as the external layer. The skin is responsible for the synthesis of proteins and carbohydrates (Maan et al., 2018).

Aloe vera, a botanical species commonly used in the pharmaceutical industry, is particularly employed in cosmetic applications. Multiple research studies have demonstrated that *Aloe vera* synthesizes a diverse array of biologically active chemicals that possess notable pharmacological advantages. The active constituents encompass aloe, emodin, gum, essential oils, and various other substrates (Hendrawati et al., 2020).

Anthraquinones, lignins, tannins, saponins, sterols, and flavonoids are just some of the secondary metabolite chemicals that *Aloe vera* is known to have. This particular plant exhibits therapeutic promise when applied topically, namely in terms of its anti-inflammatory, antioxidant, anti-antibiotic, and antibacterial properties. In addition, it aids in healing burns and wounds, promotes skin hydration, and protects against UV rays and radiation (Aryantini et al., 2020).

Pharmacological Activities (uses): Assessing the levels of vitamins, A, B-carotene, C, and E present within a substance achieves the determination of its antioxidant activity. These entities possess antioxidant characteristics. The substance contains calcium, magnesium, potassium, sodium, and the mineral zinc, which plays a significant part in the enzymatic activity that serves as antioxidants.

Wound healing: There is a growing body of information that substantiates the efficacy of *Aloe vera* in the treatment of first- to second-degree burns. The therapeutic effects of Aloevera gel in wound healing have been attributed to the presence of mannose-6 phosphate. The Brady kinase enzyme has been found to possess anti-inflammatory properties, which can effectively mitigate excessive inflammation when administered topically to the skin.

Anti-ulcer activity: Several glycoproteins found in the gel of *Aloe vera* exhibit properties that inhibit tumor growth and alleviate ulceration.

Anti-bacterial and antiviral activity: 12 anthraquinones make up *Aloe vera* gel, and these phenolic chemicals have historically been recognized for their laxative properties. Aloin and emodin exhibit analgesic, antibacterial, and antiviral properties.

Anti-septic and analgesic properties: *Aloe vera* gel contains several fatty acids, including cholesterol, campesterol, B-sitosterol, and lupesol. Each of these substances exhibits anti-inflammatory effects, with lupesol further possessing antibacterial and analgesic qualities.

Other medicinal uses: Historically, *Aloe vera* gel has been employed in both topical applications, such as the management of wounds, burns, and skin irritations, as well as internal usage for the treatment of constipation, ulcers, diabetes, migraines, arthritis, and immune system

inadequacies. Polysaccharides in *Aloe vera* enhance insulin levels and demonstrate hypoglycemic effects.

Cosmetic and skin protection applications: Aloin and its gel commonly treat acne topically, serving as a skin tonic. *Aloe vera* is employed for its skin-soothing properties and its ability to maintain skin hydration, thus aiding in the prevention of scalp dryness and the development of scaly skin, particularly in harsh and arid climates. *Aloe vera*'s laxative effect is due to the presence of anthraquinones. *Aloe vera* possesses hydrating and anti-aging properties, in addition to exhibiting anti-septic and anti-diabetic actions (Sanghi, 2015).

Chemical content: According to (Sanghi, 2015) this particular plant possesses a significant abundance of natural compounds that have the potential to enhance overall well-being.:

Polysaccharides: The content of *Aloe vera* gel is primarily water, accounting for around 99% of its composition. It possesses a pH level of 4.5, rendering it somewhat acidic. Frequently, several commercially available topical ointments designed for skin application incorporate this gel as an active component. The gel contains glucomannan, which is a type of emollient polysaccharide. Glucomannan, a type of emollient polysaccharide, exhibits favorable moisturizing properties and finds common use in many cosmetic formulations. We extracted additional polysaccharides, including arabinan, arabinorhamnogalactan, galactan, galactogalacturan, glucogalactomanan, and glucuronic acid-containing polysaccharides, from the inner gel component of *Aloe vera* leaves.

Anthraquinones: *Aloe vera* contains several bioactive compounds, including emodin, aloetic acid, antranol, aloin A and B, and isobarbaloin, an emodin ester of cinnamic acid.

Vitamin / Mineral: Provides vitamins C, A, E, B, β-Carroten, Zinc, Calcium, Copper, Magnesium, Manganese, and phosphate.

Enzymes: The composition of the substance includes several enzymes, namely alliase, alkaline phosphatase, amylase, catalase, lipase, peroxidase, and carboxypeptidase.

Amino acids: Provides 20 of the 22 amino acids humans need and 7 of the 8 essential amino acids.

Plant Sterols: There are four plant steroids that are commonly known as campestrol, cholesterol, β-sitosterol, and lupeol.

Cosmetic Preparation

Extensive research has been undertaken on the development of cosmetic products derived from tomatoes and *Aloe vera*. Tables 1 and 2 summarize the study.

Table 1. Cosmetic preparations of tomatoes (*Solanum lycopersicum*)

Forms and Nutrition	Dosage Concentration	Chemical Content	Refference
Cream (As a moisturizer and antioxidant)	Tomatoes 0,8 g	Polisakarida, mineral, gula, lipid, protein, senyawa fenolik, likopen dan berbagai vitamin.	(Ijaz et al., 2022)
Lotion (Sunscreen)	Tomatoes 1,5%	Polifenol, flavonoid, monoterpenoid dan seskuiterpen, serta saponin. Mengandung likopen sebagai turunan dari senyawa terpenoid.	(Sopyan et al., 2017)
Lotion (Antioxidant)	Tomatoes 50%	Antioksidan, vitamin C, vitamin E, likopen, flavonoid dan asam fenolik.	(Ariyanti et al., 2022)
Cream (Anti-aging)	Tomatoes 0,75%	Karotenoid, likopen, ÿ-karoten, vitamin C dan E.	(Lakshmi et al., 2017)
Face wash Gel (Moisturizes and nourishes the skin)	Tomatoes 0,3 g	Anti alergi, aktivitas antidermal, antioksidan, anti-inflamasi, antijamur.	(Mendhekar & Badhe, 2018)
Masker (Antioxidant)	Tomatoes 10%	Likopen	(Syamsidi et al., 2021)
Cream (Sunscreen)	Tomatoes 3,14%	Likopen	(Sjahjadi et al., 2022)
Cream (Sunscreen)	Tomatoes 9%	Likopen	(Pratiwi et al., 2023)

The plant species *Solanum lycopersicum*, often known as tomatoes, possesses lycopene components that have considerable antioxidant properties. Tomatoes possess antioxidants such as lycopene, flavonoids, and vitamin C. Antioxidants have the ability to safeguard the skin against detrimental effects stemming from ultraviolet (UV) radiation and free radicals while also exhibiting potential in averting the onset of diverse chronic ailments (Sjahjadi et al., 2022)(Pratiwi et al., 2023). Therefore, tomatoes can be used as cosmetic ingredients, particularly in the formulation of sunscreens, creams, and lotions (Aryantini et al., 2020)(Lakshmi et al., 2017). Studies have found that tomato extract-infused cosmetic formulations possess beneficial antioxidant and protective properties for the skin. Tomatoes may have chemicals that could be used to make cosmetics because they are antioxidants. Antioxidants protect the skin from damage and early aging caused by UV radiation and free radicals.

Table 2. Cosmetic preparations Lidah buaya (*Aloe vera*)

Forms and Nutrition	Concentration	Chemical Content	Refference
Facial wash Gel (Naturaal Surfactant)	*Aloe vera* 0,50%	Flavonoids, tannins, polyphenols and triterpenoids.	(Wulandini et al., 2019)
Lotion (Sunscreen)	*Aloe vera* 20%	Amino acids, aloin, emodin, resins, lignin, saponins, anthraquinones, vitamins and minerals.	(Hendrawati et al., 2020)
Cream (As an anti-aging and moisturizing)	*Aloe vera* 0,75%	Antioxidant	(Borah et al., 2022)
Hair tonic	*Aloe vera* 7,50%	Lignin, folic acid, vitamin A, and 20 types of amino acids	(Indriaty et al., 2018)
Toner (Refining and soothing the skin)	*Aloe vera* 1 gram	Vitamins, enzymes, minerals, sugars, lignin, saponins, salicylic acid and amino acids.	(Agaldare et al., 2013)
Gel (Soothes the skin)	*Aloe vera* 47,5%	Antraquinon, lignin, alkaloid, saponin, sterol, flavonoid dan	(Aryantini et al., 2020)
Ointment (Moisturizes and treats various skin conditions)	*Aloe vera* 7,2 gram	Antioxidant, anti-inflammatory, antimicrobe	(Venkata Sunnetha et al., 2019)
Cream (Antimicrobial)	*Aloe vera* 10%	Saponin, tanin, flavonoid, from terpenoid, anthraquinon	(Azubuike et al., 2015)
Lotion (Moisturizes and provides a cooling effect on the skin)	*Aloe vera* 12%	Sterols, proteins, lignin, polysaccharides, vitamins, minerals, enzymes, amino acids, anthraquinones, saponins and minerals such as calcium, magnesium, zinc, vitamins such as A, B12, C, E as well as essential fatty acids.	(Satheeshan et al., 2020)

Ointment (For skin benefits)	*Aloe vera* 4 mL	Vitamins, enzymes, minerals, sugars, lignin, saponins, salicylic acid and amino acids. Vitamins: Contains vitamins A (beta-carotene), C and E which are antioxidants. It also contains vitamin B12, folic acid, and choline.	(Borah et al., 2022)
Gel (Antiaging)	*Aloe vera* 1 mL	Cytokinins, phenol compounds, as well as Vitamins E and C.	(B. Kaur & Kalsi, 2019)
Cream (Whitening, anti-wrinkle, anti-aging, and sunscreen effect on skin)	*Aloe vera* 0,35 gram	Proteins, carbohydrates (including mucopolysaccharides), vitamins (including B1, B2, B3, B6, C, and folic acid) and minerals.	(Dusi & Saminathan, 2020)
Gel (Moisturizes the skin)	*Aloe vera* 10%	Saponin, flavonoid dan lignin.	(Aryantini et al., 2020)
Moisturizer (Moisturizes the skin)	*Aloe vera* 10%	Bradikinase, lignin, and vitamins namely vitamins A, C, E, B12.	(Harianti & Harismah, 2020)

The bioactive parts of *Aloe vera* include polysaccharides, amino acids, vitamins, minerals, and enzymes. These parts show promise for use in cosmetic formulations.(Borah et al., 2022)(Dusi & Saminathan, 2020). These substances possess the potential to have advantageous effects on the skin, including but not limited to moisturization, calming, and inflammation reduction (Satheeshan et al., 2020). *Aloe vera* expedites the process of wound healing and mitigates the formation of scars. *Aloe vera* could be used as an active ingredient in sunscreens because it can protect the skin from the damage that ultraviolet (UV) radiation can cause (Dusi & Saminathan, 2020). Various cosmetic products, including lotions, creams, soaps, and serums, incorporate *Aloe vera* as one of their key ingredients (Azubuike et al., 2015). So, *Aloe vera*'s chemical makeup could be used in cosmetics because it has good effects on the skin, like keeping it moist, easing irritation, and protecting it from the harmful effects of UV light.

CONCLUSION

The conducted research infers that the chemical composition of tomatoes, including lycopene, vitamin C, potassium, vitamin K, and folate, exhibits promising prospects for utilization in cosmetic formulations, particularly as constituents with antioxidant properties and sun protection capabilities. The successful formulation of tomato ethanol extract into a cream preparation has demonstrated its promise as an effective sunscreen. Furthermore, it is worth noting that the lycopene present in tomatoes exhibits promising potential for use in cosmetic formulations, including but not limited to lotions, creams, and sunscreens. The chemical composition of tomatoes exhibits a significant association with the prospective advancement of cosmetic formulations, particularly in relation to safeguarding the skin against the harmful effects of ultraviolet radiation and the advantageous properties of antioxidants.

The scientific investigation of tomato (Solanum lycopersicum) and aloe vera (Aloe vera) in cosmetic applications enhances our understanding of the potential advantages of these natural components for skincare. Examining the medicinal attributes of tomato and aloe vera, demonstrating their promise in the field of skincare.

According to research in the literature, using Solanum lycopersicum (tomato) and Aloe vera in cosmetics has shown a lot of promise. Nevertheless, certain constraints exist in the realm of cosmetic formulation optimization, stability, efficacy, and safety. Additionally, the standardization of extraction procedures and the implementation of quality control measures are necessary in order to acquire active compounds. Further comprehensive clinical research is required in order to substantiate the effectiveness and safety of cosmetic goods.

The existing body of literature can help identify potential areas for future research. One such area is the investigation of the bioavailability of active chemicals in cosmetic formulations, with the aim of comprehending their features related to skin absorption and penetration. This study aims to investigate the potential synergistic effects of combining tomato and aloe vera extracts with both natural and synthetic cosmetic ingredients. The focus is on understanding how these combinations may impact skin aging, pigmentation, and overall skin health. Additionally, the study seeks to explore consumer perception and acceptance of cosmetic products that incorporate tomato and aloe vera extracts. The findings will inform the formulation of these products to align with market demand and preferences.

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