Review

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Anti-Aging Properties of Ingredients Available in Zeitgain Cream

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Abstract

Skin aging is a multifactorial biological process influenced by intrinsic factors such as genetics and the natural chronological ageing process, as well as extrinsic environmental factors, including oxidative stress, UV radiation and pollution. Due to these, the structural and functional deterioration of skin occurs resulting in manifestations such as wrinkles, loss of elasticity and pigmentations. Anti-aging cosmeceuticals are widely recognised for their ability to mitigate these manifestations. However, synthetic formulations such as retinoid which are commonly used lead to adverse reactions and undesirable effects such as photosensitivity. With the increasing demand for safer and natural formulations, Zeitgain creams were developed in Sri Lanka, composed with natural bioactive ingredients such as virgin coconut oil, *Aloe vera*, pomegranate extract, cucumber seed oil, saffron, *Garcinia indica* (kokum), vitamin E, vitamin C, hyaluronic acid, niacinamide, and zinc PCA which have demonstrated significant antioxidant, anti-inflammatory and collagen preserving properties. These ingredients can scavenge reactive oxygen species, stimulate collagen and hyaluronic acid synthesis, inhibit matrix metalloproteinases and modulate inflammatory pathways, thereby improving skin hydration, barrier functions and elasticity. Zeitgain creams use functional excipients including glycerine, cetyl alcohol, stearic acid, glyceryl monostearate and carbopol, which contribute to skin hydration, emulsion stability and active ingredient delivery. Notably, safety considerations generally recognise these ingredients as safe. This review evaluates the scientific evidence related to bioactive compounds in Zeitgain creams, focusing on natural and synthetic components.

Keywords: skin aging; anti-aging creams; antioxidants; reactive oxygen species; bioactive compounds

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Introduction

Skin is considered the largest organ in the human body by weight as well as extent, and functions as a peripheral sensory organ as well as a protective barrier for the body (Venus et al., 2010). The skin acts as the barrier between the internal and external environments for the body, and it also incorporates all the major systems in the body, including the circulatory system, innervation and muscular systems, thereby aiding in homeostasis of skin (Tobin, 2005).

Skin aging is a complex process which involves a set of biological and biochemical changes and is affected by the changes in secondary structures of the skin, changes in underlying muscles, subcutaneous fat and bone structures (Shin et al., 2023). Skin aging can be separated into two main processes known as intrinsic aging and extrinsic aging (Kim et al., 2022). Extrinsic aging is the skin aging that is caused by environmental factors such as UV radiation, air pollution, smoking and lack of nutrients and intrinsic aging reflects to the genetic composition of the person (Puizina-Ivić N, 2008). Moreover, extrinsically aged skin can be identified by photo damage as wrinkles, pigmented lesions, hypopigmentation and actinic keratosis (He et al., 2023).

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Intrinsic Aging

Intrinsic aging, also known as chronological aging, is a natural biological process which is determined by genetics and it progresses through time. Intrinsic aging includes deterioration of skin structure and functions (Puizina-Ivić N, 2008 ; Hussein et al., 2024). Intrinsically aged skin can be seen with a smooth surface with fine wrinkles, dryness, loss of elasticity and the thinning of the dermis (Bielach-Bazyluk et al., 2021). These manifestations occur due to several factors such as decreased cellular proliferation, loss of extracellular matrix components (ECM) as collagen and elastin and reduced vascularization through aging (Kohl et al., 2011).

At the molecular level, oxidative stress plays a crucial role in skin aging (Webb et al., 2024). Oxidative stress, caused by reactive oxygen species (ROS) which are produced during aerobic metabolism of the cell (Rinnerthaler et al., 2015). These reactive oxygen species accumulate through time, thereby causing damage to DNA, proteins and lipids, causing DNA mutations (Du et al., 2013 ; Vina et al., 2013). Additionally, mitochondrial dysfunction, which occurs due to mutations in mitochondrial DNA and defective oxidative phosphorylation, contributes to overproduction of ROS, resulting in cellular damage (Barja, 2013 ; Ma et al., 2009 ; Menon et al., 2010). The shortening of telomeres contributes to skin aging as the shortening of telomeres occurs at each cell division (Zhu et al., 2018). Telomeres are the defensive caps at the ends of chromosomes. When the telomeres are critically shortened, they induce cellular senescence (cellular aging), particularly in highly proliferative cells such as keratinocytes and fibroblasts (Buckingham and Klingelhutz, 2011). Senescence cells are cells which are no longer dividing and will remain metabolically active. They contribute to tissue aging through senescence-associated secretory phenotype (SASP), which promotes inflammation and the degradation of ECM (Burton, 2009 ; Waaijer et al., 2012).

Extrinsic Aging

Extrinsic aging, also known as photo-aging, is mainly caused by external environmental stressors such as UV radiation, pollution, smoking, diet and exposure to different toxins (Krutmann et al., 2021). Compared to intrinsic aging, extrinsically aged skin appears more rough, leathery and deeply wrinkled, often with hyperpigmentation, telangiectasia and actinic keratosis (Puizina-Ivić N, 2008 ; Godic et al., 2014).

UV radiation was found to be the most common cause of extrinsic aging as it induces the production of ROS, resulting in oxidative damage to cellular DNA, lipid peroxidation and upregulation of matrix metalloproteinases (MMPs), which degrade collagen and elastin (Fraga et al., 1991 ; Randhawa et al., 2014). Further, UV radiation also activates the inflammatory pathways, resulting in impairment of immune surveillance in skin, accelerating skin aging (Bennet et al., 2008). External stressors such as tobacco and smoking (similarly contribute to skin aging), inducing oxidative stress and inflammation (Ali, 2020). In addition, they have the ability to activate receptors such as aryl hydrocarbon receptor (AhR), which causes the upregulation of MMPs and reduces the antioxidant capacity in skin resulting in visible signs of premature skin aging (Godic et al., 2014 ; Korkina et al., 2012). Subsequently, advanced glycation end products (AGEs), are formed through non-enzymatic reactions between sugar molecules and skin proteins. These will get accumulated in skin through time and environmental exposure, resulting in crosslinking of collagen and reduction of skin elasticity (Pageon, 2010). On the other hand, factors such as poor diet, high fat intake and hormonal changes influence the extrinsic aging by reduction of anti-oxidant protection, resulting in impairment of repair processes and promoting adipose infiltration to the dermis and altering facial contours (Nagase et al., 2013 ; Emmerson and Hardman, 2012).

Over the years, studies were conducted to mitigate the aging mechanism using various methods such as medications, medical treatments, changes in lifestyle and social programs (Yeh et al., 2022 ; Karimi, 2023). However, topically applied cosmeceuticals remain the common approach against aging (Griffiths et al., 2023). Among the treatment options, Retinoids are used due to their ability to induce the proliferation of keratinocytes, modulate gene expression and increase the synthesis of collagen (Mukherjee et al., 2006). Antioxidants also have shown an effect against aging as they reduce the oxidative stress due to the production of ROS and antioxidants such as vitamin C and E are commonly used to reduce the oxidative stress caused by ROS (Baumann, 2007).

Additionally, topical and oral administrations, treatments are done with advanced surgical procedures to counteract aging. Among which, chemical peels, dermabrasion, laser resurfacing and non-ablative fractional photo-thermolysis are used which will stimulate the dermal remodeling and collagen production (Li et al., 2022). In addition, injectable therapies such as botulinum toxins and dermal fillers are also used to reduce skin wrinkles (Tanaka et al., 2015).

The main objective of using anti-aging cosmeceuticals is to reducewrinkles and improve the appearance of the skin (Melo et al., 2024). The global market for anti-aging products was found to be 38.62 billion USD in 2018 and grows continuously as it is projected to reach 65.16 billion USD by 2032 exhibiting a growth rate of 3.71% annually (Fortunebusinessinsights.com, 2019). The increased global elderly population is the key driver for the anti-aging products (Juncan et al., 2023).

However, these chemical applications often have adverse effects (Juncan et al., 2023). Retinoids, the most common constituent in anti-aging cosmeceuticals, were found to cause skin irritations, erythema, scaling and increased photosensitivity and are also contraindicated during pregnancy (Mukjerjeet et al., 2006). Several chemical UV filters were also found to cause dermatitis and endocrine disruption effects (Ekstein and Hylwa, 2023 ; Heurung et al., 2014). Due to these adverse reactions, the necessity for novel treatment options and careful consideration of ingredients for anti-aging creams is needed (Berson et al., 2013).

Currently, there is a rising demand is present for topical applications made with natural components which are with less adverse effects, making it a safer alternative for anti-aging cosmeceuticals Berson et al., 2013). Natural extracts such as polyphenols from green tea (Auguste et al., 2023), curcumin (Silva et al., 2023), resveratrol (Markiewicz et al., 2022), ginseng (Kang et al., 2024) and *Aloe vera* (Siti Maimunah and Prayoga, 2023) were found to have antioxidant, anti-inflammatory and anti-collagenase activity which contributes to reducing skin aging (Li et al., 2023 ; Mukherjee et al., 2011). Additionally, the majority of these natural components can inhibit MMPs, scavenge ROS and modulate signalling pathways in ECM preservation (Draelos, 2001). In conclusion, it was concluded that the herbal extracts and natural products offer low-toxic and long-term tolerable treatment options for aging when compared with synthetic components (Mukherjee et al., 2011).

Novel anti-aging cosmeceutical known as Zeitgain was developed in Sri Lanka, containing common herbal products and nutraceuticals including, virgin coconut oil, Aloe vera gel, *Garcinia indica* extract, saffron, cucumber seed oil, water, perfume, vitamin E, glyceryl monostearate, glycerin, *Punica granatum* extract, cetyl alcohol, hyaluronic acid, phenoxyethanol, ascorbic acid, niacinamide, zinc PCA, carbapol, stearic acid and ethylene glycol monostearate as ingredients (Fadna Tea , 2025). This review is a comprehensive report of the evidence related to anti-aging properties in the ingredients available in Zeitgain cream®.

Virgin Coconut Oil

Virgin coconut oil is commonly used as a moisturizer by tropical natives traditional remedy used by occupants in tropical regions as a moisturizer. Clinical studies have revealed that the use of virgin coconut oil (VCO) reduces the symptoms of dermatological disorders by its' moisturizing ability (Priwitaningrum et al., 2022). VCO was found to have anti-inflammatory activity and skin protective activity as VCO demonstrated in vitro inhibitory activity against certain inflammatory mediators such as TNF-α (by 62.34 %), IFN-γ (42.66 %), IL-6 (52.7 %) and IL-8 (53.98 %) (Nasution et al., 2025). VCO have the ability to improve the barrier function of the skin by upregulating aquaporin-3 (AQP-3), filagrin, and involucrin mRNA expression, thereby protecting against UVB radiation and reducing photo-aging (Pham et al., 2022). The physicochemical properties and biological activity analysis were conducted for VCO and it was found that it possesses anti-oxidant, anti-inflammatory, immunomodulatory, skin barrier protection, neuroprotective and systemic anti-aging activities (Mohammed et al., 2021 ; Rohman et al., 2019). Its anti-oxidant activity was found to be mediated through its phenolic compounds such as ferulic acid and p-coumaric acid thus reducing the oxidative stress from reactive oxygen species (ROS), a key driver for skin aging. Notably, it was concluded that VCO was found to be non-phototoxic and non-cytotoxic allowing it to be used long term for topical application in commercialized anti-aging creams (Varma et al., 2019). Different extracts of virgin coconut oil from different coconuts showed various physicochemical properties. Throughout the samples, it was found that *Ran Thambili* variant demonstrated potential anti-oxidant activity and sun protections with significantly higher UV absorbance compared to other variants. Moreover, the study further concluded that the variant can act as a sun protectant as well (Hewa Pathirana et al., 2021).

Aloe Vera

Aloe vera, a cactus-like plant from the Asphodelaceae family, is an herbal product used in traditional medical purposes throughout for wounds, burns, insect bites and skin inflammation (Surjushe et al., 2008). Importantly, Aloe vera gel was found to have anti-inflammatory, antiseptic, antimicrobial, anti-tumour, skin protective, anti-diabetic and antiviral activity (Dewi and Susanto, 2021). Notably, Aloe vera have the ability to induce collagen production and increase cell migration during wound healing (Garcia et al., 2019 ; Guenther et al., 2012 ; Komatsu et al., 2017). A study conducted by Mahadi et al (2019) further validated the antioxidant activity of Aloe vera rind and gel extracts. DPPH scavenging was done for both rind and gel extracts and the study concluded that the rind and gel extracts of *Aloe vera* have anti-tyrosinase activity which contribute to the reduction melanin pigments on skin as tyrosinase is the enzyme which aids tyrosine oxidation to form 3, 4-dihydroxy – L – phenylalanine (L-DOPA) which form melanin pigments (Mahadi et al., 2019 ; Lai et al., 2017. Ultimately, the study concluded that Aloe vera rind and gel extracts have potential antioxidant and anti-tyrosinase activity which aid in the reduction of skin aging (Mahadi et al., 2019), a similar study was conducted using Aloe vera rind and gel-derived nanoparticles that showed evidence that the nano-encapsulated extracts can reduce skin photo-aging by activating the Nrf2/ARE pathway. In the study, aloe-derived exosome-like nanoparticles (ADNPs) were prepared from both rind and gel extracts and have confirmed that the ADNPs have the ability to scavenge ROS generated during UVA and UVB exposure in HaCaT photo-damaged models and dermal fibroblast (DF) cell photo-aging models and have also demonstrated that they have the ability to protect DFs from DNA damage induced by UV radiation and reduce the formation of aging marker, ß-gal. The study further confirmed that the ADNPs can promote nuclear translocation of NrF2, thereby increasing the synthesis of antioxidant genes to combat dermal fibroblast cells' photo-aging (Sun et al., 2025 ; Schmidlin et al., 2019). Another study conducted to form an Aloe vera gel formulation as an anti-aging agent and concluded that the Aloe vera gel formulation showed anti-aging effects at 9% concentration, increasing the skin's moisture to 40.24%, smaller pores by 0.53% and reducing wrinkles by 0.33% (Maimunah and Prayoga, 2023). Apart from gel extracts, it was found that Aloe vera gel powder containing aloe sterols can prevent skin photo-aging in a mice model (Yao et al., 2016). UVB radiation often reduces a significant amount of skin hyaluronic acid levels and causes severe collagen damage. The study concluded that the Aloe vera gel powder protected against UVB-induced damage by enhancing the synthesis of hyaluronic acid and inhibiting ECM degradation (Yao et al., 2016 ; Saito et al., 2016). Antioxidant, anti-inflammatory, anti-apoptotic and skin regenerative properties of a novel formulation made with Aloe vera-based *Nerium oleander* extract formulation were compared against Aloe vera gel and concluded that the novel component demonstrated antioxidant properties against several cell models (DFs) higher than the Aloe vera gel extract alone (Benson et al., 2015).

Pomegranate

Pomegranate or *Punica granatum* is from the Lythraceae family and it was found that the fruit contains many compounds including anthocyanins, catechins and gallic acid which are good natural products with anti-oxidant activity (Chan et al., 2021). The pomegranate flower extract was found to promote skin tissue repair and is a scavenger for free radicals (Kaur et al., 2006). Additionally, pomegranate can ameliorate skin inflammations including herpetic stromal keratitis (Houston et al., 2017).

A study conducted has further validated the anti-aging effects of pomegranate by conducting a clinical trial for the antioxidant and whitening ability of fermented pomegranate extracts. The study concluded that the fermented pomegranate extracts can improve skin conditions, including acting as a moisturizer, skin brightening, elasticity and collagen (Chan et al., 2021). It was further confirmed that a topical cream made with anthocyanins extracted from pomegranate showed significantly increased anti-aging activity ex vivo as well as in vivo without adverse reactions. Also, the cream was found to have anti-wrinkling, improving elasticity and reduction of scars along with whitening abilities in volunteers (Abdellatif et al., 2020). Study conducted to analyse the beneficial dermatological effects of commercially available pomegranate extract, Pomanox® in an in-vivo model. Hs68 cells were used (human foreskin fibroblast cell line) and it was concluded that the extract is capable of enhance collagen synthesis, retention of hyaluronic acid in the extracellular matrix, inhibit MMP-1 thereby reduce the degradation of collagen, reduction of reactive oxygen species (ROS) in UV damaged cells and inhibit tyrosinase as well (Mariné-Casadó et al., 2022). In contrast, pomegranate seeds were found to have anti-ageing effects; evidence was found which states that the pomegranate seed oil extracts are with the ability to reduce the effects of phenobarbital and formaldehyde induced neurological oxidative stress and inflammation in skin as the pomegranate seed oil extracts have necessary metals such as potassium, sodium, calcium, iron and zinc thus, indicating a positive treatment option for skin conditions (Hamouda and Felemban, 2023).

Cucumber Seed Oil (*Cucumis sativus*)

Cucumber seed oil is a lipid-rich extract obtained from cucumber seeds. This extract contains linoleic acid, an unsaturated fatty acid which comprises over 40% of total fatty acids in cucumber seed oil (Oragwu Ifeoma et al., 2021). A study was conducted and it concluded that cucumber seed oil was found to be rich in vitamin E, along with phytosterols such as ß-sitosterol and spinesterol and these bioactive components aid in various bioactivities such as allowing UV absorbance and ß-sitosterol provides antioxidant activity against ROS made through UVB radiation and protection through lipid peroxidation (Wang et al., 2022) It was further found that the bioactive components in cucumber seed oil contribute to reduce skin aging through their antioxidant and anti-inflammatory activity. Tocopherol and phenolic components in the oil can scavenge ROS from UV radiation or environmental stress, thereby protecting cellular components and DNA from oxidative stress (Wang et al., 2022 ; Godic et al., 2014).

Garcinia indica (Kokum)

Garcinia indica has unique bioactive compounds, particularly benzophenones such as garcinol, which exhibit strong UV-protective, antioxidant, and anti-proliferative properties (Jayakar et al., 2020). These bioactive compounds gained the attention of the cosmetic industry (Deodhar and Dhawal, 2022). According to the study done by Deodhar and Dhawal (2022), ethyl acetate extracts (EAE) and their water-treated variant (TEAE) show high SPF (sun protection factor) potential and antioxidant activity when combined with 3% Octyl methoxycinnamate (OMC) (Deodhar and Dhawal, 2022).

Kokum butter, which is derived from the same plant, provides cell proliferation and migration support and can act as a cell-proliferative agent. Kokum butter is better than cocoa butter in rejuvenating skin cells. And also it was found that, when combined with TEAE, kokum butter reduced the cytotoxic effects induced by garcinol-rich extracts and OMC (Dhawal and Deodhar, 2023). As evidenced by Mohammed et al (2017) its synergistic effects with TEAE significantly improved cell regeneration and wound healing. This makes it a potent natural component for cosmetic formulations aimed at skin repair and anti-aging (Mohammed et al., 2017).

These findings suggest that kokum extracts and butter are highly promising in natural cosmetic formulations for UV protection ,skin healing, rejuvenation, and anti-aging industry (Deodhar and Dhawal, 2023 ; Deodhar and Dhawal, 2022 ; Mohammed et al., 2017 ; Ramachandran et al., 2021 ; Deodhar et al., 2020).

Hyaluronic Acid

The natural levels of hyaluronic acid (HA) in the dermis decrease with age. This leads to reduced skin hydration and elasticity (Papakonstantinou et al., 2012). Therefore, as topical application of HA helps to maintain skin moisture, reduce the appearance of fine lines, and improve skin texture and firmness, it is widely incorporated into anti-ageing creams (Mondon et al., 2015 ; Fallacara et al., 2018). The effectiveness of HA depends significantly on its molecular weight. Enhanced skin penetration and biological activity can be achieved by HA with low molecular weight and microencapsulated sodium hyaluronate (NaHA) (Essendoubi et al., 2016 ; Juncan et al., 2021). These forms play a major role in anti-aging formulation by providing superior anti-wrinkle effects and in commercial cosmetics, HA is often combined with other actives like peptides, amino acids, and plant extracts to further boost its efficacy (Juncan et al., 2021).

Vitamin E

Skin aging has many manifestations such as wrinkling, changes in skin tone and dryness of the skin and both intrinsic and extrinsic factors contribute to these manifestations (Hajibabaei, 2016). Human skin requires water and lipid-soluble components with antioxidant activity to reduce the skin aging. Among which, vitamins C and E are components which have high antioxidant activity but cannot be produced naturally in the body and need to be taken as supplements (Hajibabaei, 2016 ; Keen and Hassan, 2016 ; Ahmed et al., 2020). Vitamin E have eight known naturally occurring substances known as α, ß, γ and δ tocopherols and α, ß, γ and δ tocotrienols (M. Voljč et al., 2011). Among the eight forms, α-tocopherol is the most biologically active and most widely distributed form of vitamin E (Halliwell and Gutteridge, 2015). Notably, there's also a synthetic vitamin E form which is synthetic DL-α-tocopherol acetate, consisting of eight stereoisomers and is the commonly used vitamin E supplementation. But it was concluded through a scientific study that D-α-tocopherol, a natural vitamin E form, has superior bioavailability in comparison with the synthetic component (Lauridsen et al., 2002). It was further concluded that Vitamin E and Vitamin C have significant antioxidant activity and have the ability to improve skin color, elasticity and radiance. Also, the vitamins had the ability to improve smoothness, reduce scaling and reduce wrinkles (Rattanawiwatpong et al., 2020 ; Qaragholi et al., 2022 ; Hahn et al., 2016). It should be further noted that Zeitgain cream, produced in Sri Lanka, utilizes the natural form of Vitamin E which results in higher bioavailability of the vitamin (Fadna tea, 2025).

Ascorbic Acid

Ascorbic acid (vitamin C) is well known for its antioxidant and anti-aging properties. Its derivatives are widely used in cosmetic products (Liping et al., 2020). It has the potential to improve skin elasticity and reduce the appearance of wrinkles by stimulating collagen synthesis (Jeong et al., 2017). The Oral supplementation of vitamin C can be combined with marine collagen peptides to be effective against skin aging markers. It was able to increase skin hydration, dermal ultrasound density, appearance and radiance during a 180-day clinical trial by increasing collagen and elastic fiber of skin (Costa et al., 2015).

A study conducted by Kim et al (2012) showed that vitamin C exhibited a significant anti-aging effect through improving mitochondrial membrane potential, improving the beating frequency of aged cells and enhancing telomerase-related genes such as hTERT, hTR and TRF2. This study was done using a hESC-derived cell model and concluded that vitamin C has the potential to maintain the telomere and cellular longevity (Kim et al., 2012).

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As it helps to suppress pigmentation and decompose melanin, it can also be used as a skin whitening agent. Ascorbic palmitate is a common lipophilic form of vitamin C used in the cosmetic industry. It has been shown to intensify UVB-induced skin damage, suggesting a potential pro-oxidant effect under UV exposure (Gosenca et al., 2010). Additionally, it can provide photoprotective benefits by reducing UV-induced oxidative damage to skin cells (PubChem, 2025). Ascorbyl palmitate also exhibits anti-mutagenic activity, further supporting its role in protecting skin from environmental stressors (Meves et al., 2002).

Niacinamide (Vitamin B3) and Zinc PCA

Niacinamide (Vitamin B3) and Zinc PCA gained popularity for their multifunctional properties in skin care (Leite and Campos, 2022 ; Lee et al., 2024). It can be used to treat acne-prone and inflamed skin. Niacinamide exhibits antimicrobial, anti-inflammatory, and sebostatic effects and improves the skin's barrier function and even tone by contributing to ceramide synthesis, and inhibits melanosome transfer (Wohlrab and Kreft, 2014). Zinc PCA provides antibacterial and anti-inflammatory properties and reduces sebum production (Gupta et al., 2014 ; Seo et al., 2009). The combination of Vitamin B6 derivatives it can maintain skin homeostasis and enhance production of the natural moisturising factor (NMF) (Melo et al., 2014). In the study done by Andrade et al (2018), participants were advised to apply a dermocosmetic cream gel combining 4% Niacinamide, 1% Zinc PCA, and 3% Vitamin B6 derivative to the entire face for six weeks. According to the study results, inflammatory acne lesions and porphyrin content were reduced significantly (Andrade et al., 2018).

Walocko et al (2017) demonstrated that topical Niacinamide significantly reduces acne and performs comparably to standard treatments, while the study done by Calixto and Maia (2015) detected sebum-reducing effects (Walocko et al., 2017 ; Calixto and Maia, 2015). The Vitamin B6 derivative further supports filaggrin synthesis and enhances skin hydration (Seo et al., 2009 ; Palmer and Kitchin, 2010). As evidenced by the above studies, it's clear that this formulation is beneficial for maintaining youthful skin by reducing inflammation, controlling oil production, and preserving skin barrier integrity.

Saffron

Saffron is a pivotal component as it has crocin and safranal which are potent antioxidants and anti-inflammatory agents thereby having the ability to reduce oxidative stress through UV damage (Iliass Lahmass et al., 2017). These components, particularly tepals, are essential for skin suppleness and wrinkle reduction, further aid in collagen formation (Samarghandian et al., 2020). Saffron in anti-aging creams have the ability to neutralize free radicals, thereby minimizing skin damage and preserve youthful appearance (Fekrat, 2004; Mohajeri et al., 2020). In-vitro studies have further proven that saffron can enhance collagen and hyaluronic acid synthesis, promote fibroblast migration and antioxidant activity, thus confirming its protection against oxidative stress on cells by ROS (Xiong et al., 2023). As mentioned by Iliass Lahmass et al, (2017), saffronel, a volatile oil derived from saffron was found to have inhibitory activity against extracellular matrix degrading enzymes such as collagenases, hyaluronidase and elastase, also providing photo-protective effect as well (Madan and Nanda, 2018). Animal studies further confirmed that oral and topical application of saffron reduces UV-induced wrinkle formation, preserves collagen content and modulates aging-related signalling pathways such as ERK1/2 and MMP-2 (Li et al., 2021).

Water

Water is commonly used in many anti-aging creams and plays a pivotal role in formulating anti-aging creams (Yang et al., 2021). Water provides skin hydration, aids in skin barrier repair and enhances the bioavailability of the active ingredients (Wolf et al., 2010). A Study conducted using an in-vitro model mimicking skin's natural hydration components demonstrated that a formula which is rich in water aided in increasing the water content in the stratum corneum and aided to maintained

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the hydration for a long period (Jacques et al., 2022 ; Saraf et al., 2010). In addition, clinical trials were conducted to evaluate an oil-in-water emulsion incorporated with botanical extracts and ferulic acid and the trial confirmed that significant improvement of skin density and skin elasticity was observed, stating the importance of incorporating water as a delivery system for anti-aging formulations (Moldovan et al., 2016).

Perfume

The general use of perfume is to provide fragrance (Ziegler, 1932). However, recent studies have found that certain perfumes have anti-aging activity and have contributed for the anti-aging effect of the cream. A study was conducted to assess the anti-aging activity of Chinese perfume (*Aglaia odorata*) using a yeast model. The study concluded that the Chinese perfume has anti-oxidant activity and the components n-hexadecanoic acid, ß-tumerone, 2-propenoic acid and 3-phenyl-methyl ester are the components which are responsible for the antioxidant activity (Perdani et al., 2024). Similarly, a study was conducted to assess the anti-aging activity of *Rosa centifolia*, a plant whose extract is used as a perfume in many sectors, including cosmetics. The study concluded that the plant extract has potential anti-hyaluronidase activity and antioxidant activity, which aid in reducing photo-aging of skin and degradation of hyaluronic acid due to UVB radiation. Isoquercitrin, quercitrin and euscaphic acid were isolated as bioactive compounds which give out the anti-aging activity by *Rosa centifolia* (Dubois et al., 2022). To further validate, Indian sandalwood oil was found to have antioxidant and anti-aging potential. It was concluded that Indian sandalwood oil had superior antioxidant activity in comparison with vitamin E as well. Furthermore, the study also concluded that the extract can inhibit the pollutant level of MMP-1, stating its efficacy to reduce skin photo aging (Francois-Newton et al., 2021).

Glycerin

Also known as glycerol is used as a humectant in anti-aging cream formulations (M Lodén and Wessman, 2001). It is with the ability to attract and retain moisture in the stratum corneum thereby increasing the skin moisture and aiding in skin barrier functions. Nevertheless, it was concluded that up to 20% concentration of glycerin was known to have skin hydration activity without disrupting the skin barrier functions or causing skin irritations (Lodén and Wessman, 2001). Glycerin is also with the ability to enhance corneocyte cohesion and stabilizes the lipid matrix thereby aiding in maintaining the skin elasticity and aid to reduce skin wrinkles (Chen et al., 2022). In vivo studies have further proved that glycerin can increase the recovery rate of damaged skin barrier functions by enhancing stratum corneum hydration (Fluhr, 1999).

Glyceryl Monostearate

This component does not have any bioactive components which aid in preventing skin aging. However, it is widely used in anti-aging cream development, especially in oil-in-water creams as a co-emulsifier (Kabara, 2018). Additionally, it was found to be used as a consistency regulator, thereby contributing to emulsion stability, viscosity and sensory appeal (O'laughlin, 1989). It was proved that glyceryl monostearate has the ability to produce a mixed crystal bilayer network which enhances the physical stability and the viscosity of the formulation and due to this ability, it provides support to skin barrier hydration thereby aiding in preventing drying of skin and formation of wrinkles. As glyceryl monostearate is a lipid-compatible monoacylglycerol, it can easily be incorporated with skin lipids and gets metabolized upon absorption, thereby preventing irritations (Ballmann and B.W. Müeller, 2008).

Carbopol

Commonly, anti-ageing cosmeceuticals use natural extracts and novel delivery methods to increase the efficacy of the treatment. Among which, carbopol, a polymer known for its viscosifying and stabilizing properties, is used in the majority of the commercialized anti-aging lotions and creams (Yadav et al., 2021). Carbopol is an essential component to provide a gel-like consistency to creams, ensuring the consistency and stability (Sadok et al., 2013). Its abilities depend on certain factors such as formulation concentration and manufacturing procedures which affect the consistency of the cream (Liu et al., 2024 ; Sadok et al., 2013). Carbopol stabilizes emulsions by preventing the separation of oil and water phases, which is an essential component in product efficacy (Didriksen, 2002). Moreover, carbopol increases the adhesion of the cream to the skin, thereby increasing the duration of residence and aiding in boosting active ingredient distribution (Hamdi et al., 2023). Similarly, Carbopol 940®, a synthetic polymer of carbopol, is used as a thickening agent and an emulsifier in the cosmeceutical industry. It has the ability to further stabilize the creams' texture and increase the spreadability on the skin (Tiwari et al., 2024). To further illustrate, several carbomers of carbopol known as carbopol1342® and carbopol 1382® were found in various commercial anti-aging creams as well (Didriksen, 2002). It was stated that the use of carbopol can lead to prolonged drug release and enhanced permeation, which is beneficial for the sustainable action of anti-aging creams (Hamdi et al., 2023).

Stearic Acid

Also, another common ingredient in commercialized anti-aging creams and lotions is due to its ability to hydrate skin, resulting in preserving the skin's elasticity and suppleness (Susu, 2015). Stearic acid functions as an emulsifier and thickening agent, particularly when combined with other agents such as squalene, olive oil and glycerin monostearate, which aid in the maintenance of the texture of the cream and aid in moisture retention, thereby enhancing the overall hydrating ability of the cream (Susu, 2015 ; Wu, 2012). Moreover, stearic acid can aid skin barrier functions as it contributes to the skin's lipid matrix (Pereira-Leite et al., 2023). Notably, it improves skin hydration by promoting the elongation of fatty acids and ceramides, which are essential components in skin hydration (Yarova et al., 2022). Stearic acid is used significantly in anti-aging creams as some formulations consist of 15 – 19% stearic acid, highlighting the importance of product composition (Susu, 2015). It was stated that stearic acid is a key ingredient in creams that aim to mimic the natural sebum membrane of the skin, thus enhancing moisture retention and skin flexibility (Wu, 2012).

Ethylene Glycol Monostearate (EGMS)

EGMS is widely used along with other emulsifying agents such as mono or di stearate of polyethene glycol, which aids in the formation of a stable emulsion and improves the absorption by skin as well (Fiume et al., 2020). The use of EGMS was found to enhance the cream's self-emulsifying ability, assuring equal dispersion of active ingredients and increasing the total effectiveness of the product (Fontanelli, 1999). It was found that a combination of EGMS with other fatty alcohols and oils produces a non-greasy, smooth texture required for consumer approval (Qing and Lianghao, 2018). It was observed that formulations developed by Guibiao Wu and Liu Qingfang contain glyceryl monostearate, a related ingredient that operates similarly to EGMS in emulsifying and hydrating, improving the cream's ability to retain skin moisture (Qingfang, 2015; Wu, 2012).

Cetyl Alcohol

Cetyl alcohol can be defined as a synthetic, solid, fatty alcohol and a nonionic surfactant (Fukushima et al., 1976). Even though it has an alcoholic nature, it doesn't act as short-chain drying alcohols like ethyl or denatured alcohol, which are considered irritants. They are recognized as emollients and thickeners that benefit dry skin and are commonly used as an emulsifying agent in pharmaceutical and cosmetic preparations (Lynde,2 001 ; PubChem, 2025 ; Rieger and Rhein, 2017 ; Ash, 2004).

Phenoxyethanol

Phenoxyethanol is a well-known preservative in anti-aging cream development (B. Dréno et al., 2019). It functions as an antimicrobial agent as it prevents microbial contaminations in the formulation, being active against both gram-positive and gram-negative microorganisms and yeast (Puschmann et al., 2018). Therefore, it is an important component to increase the shelf-life and integrity of the product (Varvaresou and Papageorgiou, 2016). Morever, it has the ability to be stable across a wide pH range and is compatible with other formulation ingredients. Phenoxyethanol is one of the safest preservatives when used in less than 1% w/w concentration as well. However, even at <1% concentration, few cases were reported to have irritations or allergic reactions against phenoxyethanol (Lilienblum and Panderi, 2016). Phenoxyethanol is further used in anti-aging creams as it can stabilize the emulsions, preserve fragrance and prevent degradation of ingredients thereby, aiding to maintain the consistency, efficacy and sensory appeal of the formulations (Doctor's Desk, 2023). Even though phenoxyethanol does not have any direct anti-aging properties, it is a crucial component to ensure the safety and longevity of the formulations and their active ingredients.

Safety and Regulatory Considerations

Safety and regulatory considerations of anti-aging creams is essential as they are composed of bioactive ingredients (Ulbricht et al., 2008). Even though the majority of the ingredients used in commercialized anti-aging topical formulations, such as *Aloe vera*, pomegranate and virgin coconut oil are Generally Recognized As Safe (GRAS), adverse effects can occur. For instance, *Aloe vera*, known and used for its soothing antioxidant properties was found with rare cases of allergic contact dermatitis and in oral forms, it was found to have hepatotoxicity and gastrointestinal toxicity (Ulbricht et al., 2008 ; Steenkamp and Stewart, 2007). Pomegranate extract is considered dermatologically safe and less toxic (Patel et al., 2008). Similarly, virgin coconut oil demonstrated non-toxic effects in vitro (Pham et al., 2022). However, it may cause acneiform eruptions or contact sensitivity in susceptible individuals (Ibrahim et al., 2016).

Though the bioactive components are considered safe, adverse reactions could occur in certain individuals. To mitigate these risks, there are safety and regulatory frameworks which vary globally but, they have a common emphasis on product safety. Anti-aging products are primarily regulated as cosmetics under the jurisdiction of the United States and the European Union (Rosholt, 2009). This is only valid for cosmesuticals which provide drug-like effects, resulting in further investigations of their efficacy and safety claims (Schroeder, 2009). Regulatory frameworks such as the European Union's EC regulation 1223/2009 require all cosmetic products to undergo safety assessment, proper labelling and post-marketing surveillance to assess adverse reactions. Furthermore, information made on packaging should be clear, not misleading and based on evidence aligned with EU regulation No. 655/2013 (Foodresearchlab.com, 2025). Regulations need to be strictly followed with well-defined maximum concentrations and toxicity warning labels ingredients such as retinol or arbutin (Cosmeticscare.eu, 2025). Considerably, according to the guidelines, products should come with a cosmetic product safety report which is registered in the cosmetic product notification portal (CPNP) and display international nomenclature of cosmetic ingredients (INCI) according to the EU guidelines (Cosmeticscare.eu, 2025).

Similarly, when developing anti-aging creams, safety assessments are also an important component, particularly in those which involve bioactive compounds. They must undergo rigorous safety and efficacy testing, including allergenicity and toxicity tests. In addition to alignment with the safety panels, good manufacturing procedures should also be followed to assure constant product safety and quality (Schroeder, 2009).

Conclusion

Skin aging is considered a multifactorial biological process caused by intrinsic and extrinsic factors such as genetic composition, telomere shortening, UV exposure, pollution and oxidative stress. With prolonged exposure or through time, these processes result in deterioration of structural and functional properties of the skin, thereby manifesting as wrinkles, loss of elasticity and irregular pigmentations. To reduce these effects, certain therapeutic options have been developed and among which, anti-aging creams are the most commonly used component.

This review scientifically evaluates the evidence supporting anti-aging properties of common ingredients available in commercialized Zeitgain cream. The analysis uncovered that several natural and synthetic components such as virgin coconut oil, *Aloe vera*, pomegranate extract, vitamin E, C, saffron and cucumber seed oil, demonstrated significant antioxidant, anti-inflammatory and regenerative effects. Many ingredients function by scavenging ROS, enhancing collagen synthesis and hyaluronic acid synthesis and inhibiting the enzymes which degrade the extracellular matrix. Even though the ingredients such as cetyl alcohol, glyceryl monostearate, and glycerin used as emulsifiers or bases for the formula, these ingredients were found to help mitigate aging through skin hydration or as antioxidants as well. In addition, these ingredients, including carbopol and stearic acid play a pivotal role in enhancing the product stability and skin penetration as well.

Importantly, formulating anti-aging creams using natural ingredients or herbal extracts offers a more promising, safe and sustainable alternative to anti-aging creams composed of synthetic components such as retinoids, which can cause severe adverse reactions and photosensitivity.

Finally, even though the evidence provides an encouraging outlook, the majority of it was derived from animal studies or in vitro cell models, which limits validation for human consumption through clinical trials. Additionally, the synergistic ability of the herbal components when in a formulation remains unexplored. Therefore, even if the evidence is supportive, long-term clinical trials should be conducted to assess the stability and sustainability of the products.

Zeitgain cream made with bioactive herbal and nutraceutical components, offers a significantly supportive method to reduce the signs of skin aging. With increased demand for safer and tolerable alternatives, further studies and innovation using bioactive natural compounds should be conducted to develop more potent and safe anti-aging creams.

Limitations

Even though the anti-aging properties of the ingredients available in commercialized anti-aging creams are present with a significant amount of evidence, certain limitations were observed through the critical analysis of the literature. The majority of the literature found was only relying on in vitro analysis of animal studies to determine the anti-aging effects. Only a few studies were conducted using clinical trials to evaluate the properties. Randomized human trials should be conducted to ingredients to obtain a better view of the properties and the outcome of the ingredients when used by humans (Mukhjeet et al., 2006 ; Abdellatif et al., 2020 ; Pham et al., 2022). Additionally, in herbal components such as pomegranate, virgin coconut oil or *Aloe vera*, due to the presence of differences due to plant variant, extraction techniques and formulations, it poses challenges in reproducing and standardizing (Mahadi et al., 2020 ; Varma et al., 2019 ; Chen et al., 2021). Even though creams with formulations consisting of many ingredients, like Zeitgain creams, are popular, the majority of the studies conducted have evaluated the effects of individual components without addressing the synergistic activity of the components in the formulations (Juncan et al., 2023). Finally, the majority of the conducted studies presented the short-term effects of the ingredients rather than long-term sustainable effects (Rattanawiwatpong et al., 2020 ; Hahn et al., 2016).

Future Directions

Future studies should be conducted using randomized clinical trials with complete formulations to assess the efficacy and the safety of the creams in the populations (Mukhjeet et al., 2006 ; Abdellatif et al., 2020). Conducting mechanistic studies, which investigate how the ingredients modulate oxidative stress pathways, telomere attrition, collagen synthesis or MMPs can offer more insight into the biological basis of the anti-aging properties (Burton, 2008 ; Barja, 2013). Even though only a few studies were conducted, using nano-encapsulated delivery systems which prove to have better bioavailability and safety provides a method to increase the efficacy of the creams (Sun et al., 2025 ; Liu et al., 2024). Moreover, long-term clinical studies need to be conducted to assess the cumulative safety, potential toxicity and immunological effects due to prolonged exposure to the formulations (Saito et al., 2016 ; Pham et al., 2022). Finally, emerging topics such as personalized skincare based on genomics and metabolomics should be explored to develop targeted anti-aging creams to individual skin biology (Li et al., 2021 ; Xiong et al., 2023).

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