JPPIPA 9(11) (2023)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

The Potency of Passion Fruit (*Passiflora Edulis*) Prevents Uv-Induced Skin Aging

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Received: September 27, 2023
Revised: October 9, 2023
Accepted: November 25, 2023
Published: November 30, 2023

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DOI: 10.29303/jppipa.v9i11.5483

Abstract: The importance of skin health and appearance has led to increased awareness of the negative effects of skin aging induce by UV light. This research aims to examine the effect of passion fruit (*Passiflora edulis*) in preventing photoaging. Google Scholar, Research Gate, and Mendeley were used as the search engine. The keywords were passion fruit and photoaging. The effect of passion fruit to prevent photoaging were analyzed from 15 articles. The antioxidant contained in passion fruit has been reported and showed can suppress Reactive Oxygen Species (ROS), anti-inflammation activity, inhibit melanin synthesis and tyrosinase activity. This will contribute to prevention skin aging and skin damage by UV exposure.

Keywords: Antioxidant; *Passiflora edulis*; Passion fruit; Photoaging

Introduction

Skin aging is a natural and gradual process characterized by various changes in the skin's appearance, texture, and function over time. It is influenced by both intrinsic (internal) and extrinsic (external) factors. Intrinsic aging, often referred to as chronological aging, is determined by genetic factors and the natural aging process. It typically begins in the late 20s or early 30s and includes the following changes: Thinning of the skin, reduced cell turnover, decreased hydration, and loss of fat. Extrinsic aging is primarily driven by external factors, with UV (ultraviolet) radiation from the sun being one of the most significant contributors (Zhang et al., 2018) Skin aging due to UV exposure is often referred to as "photoaging." UV radiation, primarily from the sun, is one of the most significant external factors that accelerate the aging process of the skin. Photoaging leads to specific changes in the skin's appearance and structure, distinct from the natural aging process. UV damage contributes to skin aging such as collagen breakdown, elastin degradation, formation of wrinkles, age spot, hyperpigmentation and thinning skin, weakened skin immunity (Maretalinia et al., 2023; Rittié et al., 2015).

UV exposure can cause skin aging through several mechanisms, primarily involving damage to the skin's structure and function. The mechanisms such as free radical formation, DNA damage, telomere shortening, skin inflammation, activation of cellular pathways and collagen elastin degradation. UV exposure generates Reactive Oxygen Species (ROS) and free radicals within the skin. These highly reactive molecules can damage cellular structures, including proteins, lipids, and DNA. Free radical damage contributes to oxidative stress and accelerates skin aging. When DNA is harmed, it can lead to mutations and errors in the DNA replication process. This can result in the formation of abnormal cells and contribute to skin cancer development over time. UV radiation can accelerate telomere shortening, telomeres are protective caps on the ends of chromosomes that shorten as cells divide, leading to cellular aging and reduced skin regeneration capacity. In addition, UV radiation triggers an inflammatory response in the skin.

How to Cite:
Wijoyo, S., & Wahyuniari, I. A. I. (2023). The Potency of Passion Fruit (Passiflora Edulis) Prevents Uv-Induced Skin Aging. *Jurnal Penelitian Pendidikan IPA*, *9*(11), 1142–1147. https://doi.org/10.29303/jppipa.v9i11.5483

This inflammatory process can lead to redness, swelling, and skin irritation. Chronic inflammation caused by repeated UV exposure contributes to premature aging. UV radiation can activate cellular pathways that promote skin aging, including the production of enzymes that degrade collagen and the release of inflammatory mediators. UV exposure can stimulate the production of enzymes called matrix metalloproteinases (MMPs), which break down collagen and elastin fibers. This leads to a breakdown of the skin's support structure and contributes to the formation of wrinkles and sagging skin. Thus we need antioxidants to fight negative effect of UV exposure that connected to free radicals (Fisher, 2002; de Jager et al., 2017; Wang et al., 2018).

Passion fruit (*Passiflora edulis*) contain various that components, including nutrients, fiber, and antioxidants. The antioxidants such as flavonoids, carotenoids, polyphenols and vitamin C. Its antioxidant and nutrient content play a role in preventing skin aging due to UV exposure. By limiting free radical damage, antioxidants may help slow the aging process and minimize the development of wrinkles and fine lines due to UV exposure. Previous studies showed that flavonoids and polyphenols can against free radical and reduce inflammation. Carotenoid can protect the skin from oxidative stress caused by UV exposure. Vitamin C plays a crucial role in collagen production. Collagen is essential for maintaining skin's elasticity and preventing sagging skin. Vitamin C can also help repair damaged skin cells and reduce the appearance of age spots due to UV radiation. In addition, passion fruit seeds contain water, so if included in the diet, they will contribute to overall hydration. Well-hydrated skin tends to be more resilient and able to handle UV exposure (Muslim et al., 2023; Yepes et al., 2021; Pullar et al., 2017; Sies, 2015).

Research on passion fruit (*Passiflora edulis*) has revealed several potential health benefits, and its various components have been investigated for their medicinal properties. There are some overviews of some areas of research on the effects of passion fruit in medicine, along with references for further reading. Some studies have investigated the potential cardiovascular benefits of passion fruit. Its fiber content and antioxidants may contribute to improved heart health by reducing cholesterol levels and lowering blood pressure. Some studies have explored the potential anti-cancer properties of passion fruit compounds, such as polyphenols. These compounds may have protective effects against certain types of cancer. Passion fruit extracts and oils also have been studied for their potential in skincare products. Their antioxidant and anti-inflammatory properties may help protect the skin from UV damage and promote a healthier complexion for aging skin (Serban et al., 2016; Grigalius et al., 2017; Cordova et al., 2013).

Method

Google Scholar, ResearchGate, and Mendeley were used as search engines for this literature review. The literature review method uses journals and preliminary research publications. This literature review research method aims to investigate the potency of passion fruit (*Passiflora edulis*) prevents UV-induced skin aging. The keywords were passion fruit seeds and UV-induced skin aging. There were 15 reliable articles with inclusion criteria of published years 2015-2023, using Indonesian or English, and non-full-text literature was excluded. This research will be conducted by collecting and evaluating various relevant literature sources to identify previous studies that have been conducted on this topic. By summarizing and synthesizing the findings from the existing literature, the main objective is to gain a comprehensive understanding of the potency of passion fruit seeds content on sun protection and its impact on the skin aging process.

Result and Discussion

Fifteen articles described the potency of passion fruit (Passiflora edulis) prevents UV-induced skin aging. Passion fruit seeds were studied by experimental and literature review methods. Samples varied from molecular to bedside investigation.

Table 1. The Analysis of Passion Fruit potency on UV-Induced Skin Aging

Author & Publication Year	Research Methodology	Results
Muslim et al (2023)	Experimental clinical trial study	There was significant decrease in DPAS score in participants with facial skin aging after 8 weeks of using passion fruit purple variant seed extract cream
Yepes et al (2021)	*In vitro*	Findings from this study suggest that ethanol extract of *P. edulis* has a great potential as an anti-aging agent.
Maruki-Uchida et al (2013)	Experimental study	Piceatannol in passion fruit seed extract containing high amounts of piceatannol are potential anti-photoageing cosmetic ingredients.

Author & Publication Year	Research Methodology	Results
Kawakami et al (2022)	Article Reviews	P. edulis seed extracts have been reported to exhibit various physiological functions, such as antioxidant effects, improvement of skin condition, fat-burning promotion effects, and hypoglycemic effects.
Lourith et al (2017)	Clinical trial study	The safety of 0.1% passion fruit extract concealer mousse was assessed. It did not cause skin irritation when assessed in human volunteers. This sunscreen makeup product provides UVA and UVB protection and is therefore suitable for daily application.
Agung et al (2019)	Experimental animal study with a post-test only control group design	The passion fruit seed extract cream inhibited the increase of level of MMP-1 and the decrease of total collagen level in Wistar rat skin was exposed to UV-B.
Krambeck et al (2023)	Article Review	The piceatannol found in passion fruits can be used in a wound-healing, or as anti- ageing, antioxidant, anti- acne and skin whitening, among other effects.
Dewi et al (2020)	Open-label uncontrolled trial	Topical use of passion fruit purple variant seeds extract improves acne vulgaris with reduction in lesion counts and UVRF, minimal adverse events, and good satisfaction rate.
Mostefa et al (2023)	in Vivo and in Silico Studies	These findings suggest that the stilbenes from *P. edulis* seeds, particularly the stilbene dimers, warrant further investigation as potential neuroprotective candidates.
Huang et al (2022)	In vitro and pre-post intervention clinical trials	The results indicated that PeLOX4 may be a candidate gene involved in fruit ripeness and the formation of volatile aroma compounds, with the increase in fruit ripening, the expression level of PeLOX4 increased and theLOX enzyme activity increased accordingly, thereby promoting the synthesis of volatile esters in fruit pulp. Our discovery lays the foundation for the functional study of LOX in passion fruit.
Krambeck et al (2019)	*In vitro*	The passion fruit oil from Madeira Island can be used by the pharmaceutical and cosmetics industry because of its potential to reduce oxidative stress (ROS).
Krambeck et al (2020)	*In vitro*	The *P.edulis* extracts that were obtained by the ultrasound method showed significant amounts of piceatannol and resveratrol when compared with the commercial oil. The presence of these compounds indicates that this oil could have potential applications in the cosmetic and pharmaceutical industries, due to their proven antioxidant and anti-aging properties.
Cao et al (2022)	*In vivo* experimental studies	While defective mitophagy-induced accumulation of damaged mitochondria contributes to AD progression, *P. edulis* pericarp improvesmitochondrial quality and homeostasis through BNIP3/DCT1-dependentmitophagy and SOD-3-dependent mitochondrial resilience, both via increased nuclear translocation of the upstream transcriptional regulator FOXO3 /DAF-16.
J. Zhang et al (2023)	Article Reviews	the potential of *Passiflora* for food applications and the use of all parts as a source of ingredients for medicines and cosmetics that promote health and well-being.
Urrego et al (2021)	*In vivo*	This is the first unequivocal report of the presence of these compounds in P. edulis f. edulis leaves. The most favorable results of anti-inflammatory activity were obtained for the flavonoid-rich fraction. All the fractions and isolated compounds evaluated, presented high percentages of inhibition of nitric oxide synthase activity.

Discussion

Photoaging of skin is caused by overexposure to UV radiations, which increases the production of Reactive Oxygen Species (ROS) causing lipid peroxidation, DNA damage, and proteins alterations. Moreover, ROS can also contribute to skin aging by direct activation of enzymes responsible for the cleavage of extracellular matrix (ECM) components, as well as accelerate skin pigmentation by its action on keratinocytes, adjacent to melanocytes, to induce melanogenesis by increasing the amounts of the melanogenic factors tyrosinase and tyrosinase-related protein 1 (TRP 1). Free radicals, inhibits the oxidation process, absorbs UV rays, and suppresses enzymatic activity. This mechanism occurs because of the alleged presence of phenolic compounds in it (Muslim et al., 2023; Yepes et al., 2021).

Antioxidants play a crucial role in combating free radicals by neutralizing their harmful effects. Free radicals are unstable molecules with unpaired electrons, which can lead to oxidative stress and damage to cells and tissues. Antioxidants donate electrons to free radicals, stabilizing them and preventing further damage. Antioxidants also effectively break the chain reaction of oxidative stress. Once a free radical is neutralized by an antioxidant, it no longer poses a threat to other molecules in the body. Some antioxidants, such as flavonoids, carotenoids, polyphenols and vitamin C, have the ability to regenerate after donating an electron to a free radical. This means they can continue to neutralize multiple free radicals (Sies, 2015).

Passion fruit seeds are known to be rich in antioxidants, particularly vitamin C, carotenoids, flavonoids, and polyphenols. Antioxidants play a crucial role in neutralizing free radicals generated by UV radiation. Polyphenols are chemical compounds found in a variety of plants. Passion fruit seeds have been found to contain a lot of polyphenols, the most important of which is piceatannol (4, 4, 3′, 5′-tetrahydroxy-transstilbene). It is well known that piceatannol has many benefits for the skin, including increasing the production of collagen, decreasing the production of melanin, increasing the antioxidant activity of glutathione, and eliminating the formation of Reactive Oxygen Species (ROS). Matsui *et al.* reported that *Passiflora edulis* has an inhibited melanogenesis and stimulates collagen synthesis. The high level of polyphenol in *Passiflora edulis* seed extract can inhibit tyrosinase activity. This will contribute to the prevention of skin damage and aging (Matsui, 2010; Muslim et al., 2023).

In vitro antioxidant activity of piceatannol in human fibroblast cells was investigated. It was demonstrated that piceatannol has strong antioxidant activity even at low concentrations and has a certain cytoprotective capacity. Piceatannol is more active than resveratrol due to the presence of an additional hydroxyl group at 3′ position. The presence of an extra hydroxyl group in piceatannol makes it re-active and a more potent antioxidant when compared to resveratrol (Krambeck et al., 2023).

Hiroko Maruki Uchida et al. have previously identified piceatannol and scirpusin B, which is a dimer of piceatannol, as strong antioxidants that are present in passion fruit (Passiflora edulis). The piceatannol can suppressed the UVB-induced generation of Reactive Oxygen Species (ROS) in the keratinocytes. In addition, the transfer of the medium from the UVB-irradiated keratinocytes to non-irradiated fibroblasts enhanced matrix-metalloproteinase (MMP)-1 activity, and this MMP-1 induction was reduced when the keratinocytes were pretreated with piceatannol. These results suggest that piceatannol attenuates the UVB-induced activity of MMP-1 along with a reduction of ROS generation in keratinocytes (Maruki-Uchida et al., 2013).

Andres Yepes et al. assess the anti-aging potential of the ethanol extract of *Passiflora edulis Sims* seeds, through *in vitro* determination of antioxidant activity and inhibition assays of some enzymes related to skin aging. They found *Passiflora edulis* has a great potential as an anti-aging agent (Yepes et al., 2021).

Norman Urrego et al. reported the effect of *Passiflora edulis* leaves extract as an anti-inflammatory which was evaluated by measuring myeloperoxidase and nitric oxide levels. The result is three minor flavonoids were detected; and three known saponins, cyclopassiflosides IX, XI and III were isolated and identified. This is the first unequivocal report of the presence of these compounds in *P. edulis f. edulis* leaves. The most favorable results of anti-inflammatory activity were obtained for the flavonoid-rich fraction. All the fractions and isolated compounds evaluated, presented high percentages of inhibition of nitric oxide synthase activity (Urrego et al., 2021).

Conclusion

The potential of Passion fruits (*Passiflora edulis*) to prevent UV-induced skin aging as shown in 15 articles used. According to the findings of this study, the passion fruits are potential become anti-photoaging cosmetic ingredients and has effect anti-inflammation. Future research directions are proposed on how to better utilize and develop products anti-aging with containing passion fruits. It is hoped that future research on anti-aging passion fruit will be conducted with a larger sample size, gender balance, and age-specific criteria. Additional prospective studies are required.

Acknowledgments
The authors would like to thanks to Universitas Udayana for give occasion for this research.

Author Contributions
Investigation, S.W and I.A.I.W; formal analysis, S.W and I.A.I.W; investigation, S.W and I.A.I.W; resources, S.W and I.A.I.W; data curation, S.W and I.A.I.W; writing—original draft preparation, S.W and I.A.I.W; writing—review and editing, M.F.S and I.G.N.D: visualization, , S.W and I.A.I.W; supervision, S.W and I.A.I.W; project administration, S.W and I.A.I.W; funding acquisition, S.W and I.A.I.W. All authors have read and agreed to the published version of the manuscript.

Funding
This research was independently funded by researchers.

Conflicts of Interest
We certify that there is no conflict of interest with any financial, personal and other relationships with other peoples or organization related to the material discussed in the manuscript.

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