



The Effects of Passion Fruit (*Passiflora Edulis*) Seed Extract For Health Benefit

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Abstract: This study discusses the health benefits of the content of passion fruit (*Passiflora edulis*) seed extract. Google Scholar, Research Gate, and Mendeley were used as the search engine. The keywords were *Passiflora edulis*, passion fruit seed, antioxidant, and piceatannol. The benefits of passion fruit seed extract were analyzed from 21 articles. Twenty-one articles are used to demonstrate the health benefits of passion fruit (*Passiflora edulis*) seeds. The study's conclusions indicate that passion fruits may have anti-photoaging, anti-inflammatory, heart, liver, and kidney protective properties. They may also help treat skin conditions like striae distensae and acne vulgaris, as well as have anti-obesity, anti-hypertensive, anti-diabetic, anti-tumor, and anti-cancer properties. It is suggested where future research should go to improve the use of products made with passion fruits. It is hoped that more studies on the health benefits of passion fruit will be carried out using age-specific criteria, a larger sample size, and gender parity. Further prospective research is needed.

Keywords: Antioxidant; Passion fruit seed; *Passiflora edulis*; Piceatannol

Introduction

Many *Passiflora* species can be found in Southeast Asia, Australia, China, India, the Pacific Islands, and other nearby areas. Minerals and vitamins A, C, D, and E can be found in abundance in passion fruit. It is also the source of flavonoid, alkaloids, and carotenoids that is well known advantageous to human health. Essential fatty acids, which are useful in food and cosmetic industries, can be found in passion fruit seeds (55%–66% linoleic acid, 18%–20% oleic acid, and 10%–14% palmitic acid). Passion fruit are known to have compounds having sedative, analgesic, antihypertensive, and anxiolytic effects (Cerdeira-Silva et al., 2014). Passion fruit seeds are high in fats, carbohydrates, proteins, and minerals and store nutrients for the growth of the embryo. The edible seeds offer intriguing nutritional and biochemical characteristics with potential health and nutritional advantages. Numerous research have been done on the functionality of passion fruit seeds, which are regarded as a useful and nutritious resource

(Ramaiya et al., 2018). 88% of the total polyphenols in *P. edulis* were identified in the seeds, according to an analysis of the polyphenol concentrations in the peel, pulp, and seeds (Yuko Matsui et al., 2013). Stilbenes from *P. edulis* seeds have been isolated in numerous reports; of these, piceatannol (3,30,4,50-tetrahydroxy-trans-stilbene) is among the main elements believed to be present in *P. edulis* seeds (Kawakami et al., 2022).

Exposure to UV light can stimulate the production of matrix metalloproteinase enzymes (MMPs) that damage collagen and elastin, proteins that maintain skin elasticity (Jabłońska-Trypuć et al., 2016; Laronha & Caldeira, 2020). By containing vitamin C and E, passion fruit seeds can help inhibit the overproduction of MMPs and encourage collagen production, which in turn can help maintain skin elasticity and suppleness (Barić et al., 2020). Vitamin C in passion fruit seeds plays an important role in the synthesis of collagen. Sufficient collagen can help reduce fine lines and wrinkles on the skin, thereby providing a rejuvenating effect. Preliminary research shows the potential of passion fruit

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seeds in protecting the skin from damage caused by UV exposure and supporting the anti-aging process, further research is still needed to confirm these results in more depth. In developing skin care products containing passion fruit seed extract, aspects such as stability, proper formulation, and human clinical trials also need attention (Savoye et al., 2018).

The chemicals in passion fruit seeds have been demonstrated in numerous studies to have the ability to raise an individual's sensitivity to insulin. Increasing insulin sensitivity can lower the chance of developing diabetes as well as other diseases. Furthermore, the seeds of passion fruit are high in piceatannol, a kind of polyphenol that helps make overweight men more sensitive to insulin. When taken as a supplement, it lowers blood pressure and cholesterol and may help prevent type 2 diabetes. Passion fruit is rich in potassium and low in sodium which can be healthy for the heart. If consumed with its fiber-rich seeds, passion fruit can lower cholesterol in the body. In addition, consumption of passion fruit can lower blood pressure (Crosby et al., 2022; Uslu & Uslu, 2021).

This literature review describes the potential of passion fruit seeds as a natural ingredient that contains antioxidant and anti-inflammatory compounds for health benefit. Although further research is needed, the results present a positive view of the role of passion fruit seeds in holistic care.

Table 1. The Analysis of Passion Fruit potency on Health Benefit

Author & publication year	Research Methodology	Results
Wijoyo & Wahyuniari (2021)	Experimental study with post-test only control group design	Passion fruit seed extract cream inhibited increase of MMP-1 and decrease of collagen in Wistar rat skin that exposed to UV-B.
Aryunisari et al. (2021)	Pre-experimental clinical trial with pretest-posttest research design	6% purple passion fruit seed extract cream enhance the appearance of striae distensae, and user satisfaction is high with no negative side effect.
Dewi et al. (2020)	Open-label uncontrolled trial	When applied topically, extract from seeds of purple passion fruit reduces the number of lesions and UVRF, has few side effects, and has a high rate of satisfaction for acne vulgaris.
Fonseca et al. (2022)	Article Review	The fruit's various parts' varied potential is revealed through phytochemical characterization. In vitro effect of purple passion fruit that has been reported the most is its antioxidant activity (peel, pulp, and seeds); other reported effects include anti-inflammatory (pulp), antibacterial (peel and seeds), and antifungal (peel). Passion fruit peel and seed extract has exceptional anti-collagenase activity and may be developed into a skin nutraceutical with anti-aging properties.
Hartanto et al. (2019)	Experimental study	Chronic intake of passion fruit seed extract containing piceatannol prevents high-fat diet-induced cardiovascular disease in rats.
Ishihata et al (2016)	Experimental animal study with a post-test only control group design	Extract from passion fruit seeds had antibacterial effect against <i>P. acnes</i> , and the effect grew with concentration.
Jusuf et al (2020)	<i>In vitro</i>	The plant <i>Passiflora</i> 's culinary potential as well as the use of all parts as a source of components for health and wellbeing-promoting medications and cosmetics.
Zhang et al (2023)	Article Reviews	

Method

For this literature review, the search engines Mendeley, ResearchGate, and Google Scholar were utilized. Preliminary research articles and journals are used in the literature evaluation process. This literature review aims to investigate the health benefits of passion fruit (*Passiflora edulis*) seeds extract. The keywords were passion fruit seed, *Passiflora edulis*, antioxidant, and piceatannol. 21 trustworthy articles in either English or Indonesian that met the inclusion criteria for years 2013–2023 were found. 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 health benefit.

Result and Discussion

Twenty-one articles described the potency of passion fruit (*Passiflora edulis*) for health benefit. The study of passion fruit seeds used both experimental and literature research techniques. Samples ranged from bedside research to molecular analysis.

Author & publication year	Research Methodology	Results
Kandandapani et al (2015)	Experimental animal study with a post-test only control group design	Passion fruit extracts showed anti-diabetic and anti-oxidant potential against streptozotocin-induced diabetes rats.
Kitada et al (2017)	Randomized, placebo-controlled study	Piceatannol supplementation enhance metabolic health, increasing insulin sensitivity, lowering blood pressure in overweight men.
Krambeck et al (2019)	<i>In vitro</i>	The pharmaceutical and cosmetics industries can benefit from the use of Madeira Island's passion fruit oil due to its capacity to lower oxidative stress (ROS).
Krambeck et al (2020)	<i>In vitro</i>	Compared to other commercial oil, <i>P. edulis</i> extracts obtained using ultrasound method demonstrated notable levels of resveratrol and piceatannol. Because these compounds have been shown to have antioxidant and anti-aging properties, their presence suggests that this oil may find use in the pharmaceutical and cosmetic industries.
Lourith et al (2017)	Clinical trial study	Concealer mousse containing 0.1% passion fruit extract was found to be safe in human volunteers and did not cause skin irritation. Because it offers both UVA and UVB protection, this makeup sunscreen is safe to use every day.
Lourith et al (2013)	Experimental study	The antioxidant fraction that was recovered serves as a sunscreen and skin-lightening agent. Furthermore, cosmetics that lighten skin and contain extract from passion fruit seeds can be used to treat benign dark spots.
Maruki-Uchida et al (2013)	Experimental study	High concentrations of piceatannol found in passion fruit seed extract make it a promising ingredient for anti-photoaging cosmetics.
Matsui et al (2013)	Experimental study	It was discovered that the compounds derived from passion fruit seed extracts, specifically piceatannol, were in charge of suppressing melanogenesis and enhancing the production of collagen.
Mostefa et al (2023)	<i>in Vivo</i> and <i>in Silico</i> Studies	More research should be done on the stilbenes from <i>P. edulis</i> seeds, especially the stilbene dimers, as possible neuroprotective candidates.
Muslim et al (2023)	Experimental clinical trial study	Participants with aging facial skin showed a significant reduction in their DPAS score after 8 weeks using passion fruit seed extract cream.
Vera et al (2019)	Experimental study	<i>P. edulis</i> seed extract exhibited elastase inhibition activity.
Yamamoto et al (2018)	Randomized, double-blind, placebo-controlled parallel group, comparison study	Daily supplementation of piceatannol derived from passion fruit seed extract is effective for skin moisture.
Yepes et al (2021)	<i>In vitro</i>	<i>P. edulis</i> ethanol extract is a promising anti-aging treatment.

Discussion

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. An antioxidant can neutralize free radicals, preventing them from endangering 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)

One thing that has attracted attention is passion fruit seeds (*Passiflora edulis*) because of their nutritional content which is rich in antioxidant and anti-inflammatory compounds. Several studies have

identified that passion fruit seeds contain bioactive compounds such as flavonoids, ascorbic acid (vitamin C), and beta-carotene which have strong antioxidant properties. By shielding the skin from the damaging effects of free radicals generated by UV radiation exposure, antioxidants help to lower oxidative stress and inflammation in the skin (Gupta et al., 2022). Vitamin C in passion fruit seeds plays an important role in the synthesis of collagen. Sufficient collagen can help reduce the appearance of fine lines and wrinkles on the skin, thereby providing a rejuvenating effect (Cao et al., 2022).

Numerous polyphenols have been identified in passion fruit seeds, with piceatannol (4, 4', 3', 5'-tetrahydroxy-transstilbene) being the most significant. Piceatannol is widely known to have numerous positive effects on the skin, such as boosting collagen synthesis, lowering melanin synthesis, raising glutathione's antioxidant activity, and preventing the generation of reactive oxygen species (ROS). According to Matsui et

al., *Passiflora edulis* promotes the synthesis of collagen and inhibits melanogenesis. The tyrosinase activity of *Passiflora edulis* seed extract can be inhibited due to its high polyphenol content. This will help to keep aging and skin damage at bay (Matsui et al., 2010; Muslim et al., 2023).

Passion fruit peel and seeds' ethanol extract can protect liver, heart, and kidneys against oxidative stress in a rat model of streptozotocin-induced oxidative stress by increasing superoxide dismutase levels and lowering 2-thiobarbituric acid reactive substance levels. (Kandapani et al., 2015).

Piceatannol's in vitro antioxidant activity in human fibroblast cells was studied. Piceatannol has been shown to have some cytoprotective properties and strong antioxidant activity even at low concentrations. Because piceatannol has an extra hydroxyl group at the 3' position, it is more active than resveratrol. Compared to resveratrol, piceatannol is more reactive and has a higher antioxidant capacity due to the additional hydroxyl group present in it (Krambeck et al., 2023).

Strong antioxidants found in passion fruit (*Passiflora edulis*) include piceatannol and scirpusin B, a dimer of piceatannol, as previously discovered by Hiroko Maruki Uchida et al. Reactive oxygen species (ROS) produced by UVB in the keratinocytes can be inhibited by piceatannol. Furthermore, matrix-metalloproteinase (MMP)-1 activity was increased upon medium transfer from UVB-irradiated keratinocytes to non-irradiated fibroblasts. This MMP-1 induction was decreased upon pretreatment of the keratinocytes with piceatannol. These findings imply that piceatannol inhibits MMP-1's UVB-induced activity and lowers the production of ROS in keratinocytes (Maruki-Uchida et al., 2013).

In studies conducted on humans, the majority of participants reported a notable improvement in their acne vulgaris after using 10% passion fruit seed extract cream for eight weeks. The antibacterial effect of passion fruit seed extract against *Propionibacterium acnes* has been observed, and this activity may have played a role in the improvement of acne vulgaris observed in human studies. Furthermore, a human study showed that striae distensile, a common form of skin scarring, could be treated with a cream that contained 6% *P. edulis* seed extract. It appears that applying *P. edulis* seed extract topically can help improve skin conditions like striae distensile and acne vulgaris (Aryunisari et al., 2021; Dewi et al., 2020; Jusuf et al., 2020).

Studies have also looked at *P. edulis* seed extract's impact on fat metabolism. In vivo studies revealed that high-fat diet-fed rats displayed aberrant serum profiles and signs of cardiovascular disease, while high-fat diets supplemented with *P. edulis* seed ethanol extracts improved cardiac function, blood triglyceride,

cholesterol, and liver enlargement (Ishihata et al., 2016). Additionally, ovariectomized mice given high-fat diet experienced noticeable increases in body weight and visceral fat. Nevertheless, these effects were dramatically attenuated when the mice were given a high-fat diet supplemented with 0.05% piceatannol from passion fruit seeds. Piceatannol is major polyphenol in passion fruit seed extract that has anti-obesity effects. In mice fed a high-fat diet, the weights of the liver, spleen, perigonadal, and retroperitoneal fat were reduced when the mice consumed diets containing piceatannol (Tung et al., 2016).

A double-blind, placebo-controlled crossover study on humans with fat metabolism revealed that consuming 10 mg piceatannol from passion fruit seed extract for one week can decreased the respiratory quotient both at rest and during very light exercise (Adrianus et al., 2020). Compared to the placebo, there was significant improvement in fat burning and a decrease in the respiratory quotient with oral administration of 10 mg piceatannol from passion fruit seed extract for two weeks, even during moderate-intensity exercise, according to another study. These findings demonstrate that piceatannol-containing passion fruit seed extract can enhance fat burning during exercise and at rest (Matsui et al., 2021).

Studies have looked into the potential anti-diabetic benefits of passion fruit seeds. Oral administration of passion fruit peel and seed extract for longer than seven days lower blood glucose levels in rats exposed to oxidative stress caused by streptozotocin (Kandapani et al., 2015). Single dose of passion fruit seed extract containing piceatannol, significantly lowered blood glucose levels in experiments conducted on a genetically engineered diabetic mouse model (Uchida-Maruki et al., 2015). A study looked at the effect of piceatannol from passion fruit seeds in lowering blood glucose level using freely moving healthy rats in order to understand the mechanism of blood glucose regulation (Oritani et al., 2016). The results of this study indicate that piceatannol from passion fruit seeds elevate glucose tolerance by encouraging secretion of insulin. Intravascular administration of piceatannol lowering blood glucose levels during glucose tolerance test and fasting test, and increased the insulin secretion index during the glucose tolerance test. When given 10 mg piceatannol/kg body weight/day for four weeks, C57BL/6J mice fed a high-fat diet showed a reduction in the area under the blood glucose curve in oral glucose tolerance test. In this investigation, piceatannol boosted the levels of AMP-activated protein kinase, insulin receptors, Sirt1, Sirt3, Sirt6, and two downstream targets of SIRTs, forkhead box O1 and peroxisome proliferator-activated receptor gamma coactivator 1-alpha (Lee et al., 2019).

The impact of seed extract on glucose metabolism have been inspected with human trials. Overweight men who consumed 20 mg/day of piceatannol from passion fruit seeds for eight weeks saw reductions in blood pressure, heart rate, insulin resistance, and serum insulin levels. It is anticipated that *P. edulis* seeds will effectively increase insulin sensitivity (Kitada et al., 2017).

P. edulis seed antihypertensive potential was assessed *in vivo* and showed that ethanolic extracts of passion fruit seeds protected rats against hypertension brought on by nitric oxide deficiency. Passion fruit seed extracts have been shown to have an antihypertensive effect through the synthesis of nitric oxide and the inhibition or antagonistic action of angiotensin-II (Rodríguez et al., 2021). Research has also been done on *P. edulis* seeds' potential to fight cancer. According to reports, passion fruit seed extract slows down the growth of cancer cells via human glyoxalase I (Takayuki Yamamoto et al., 2019). The activation of apoptosis through mitochondrial pathway is proposed as the mechanism of passion fruit seed extract antitumor activity in MCF-7 cells (Mota et al., 2018). An *in vivo* investigation showed that aqueous extract of passion fruit seeds, given for ten weeks, changed the levels of p21, cyclin D1, and cyclin-dependent kinase 4; it also slowed the progression of the disease in the transgenic mouse prostate model of adenocarcinoma and reduced the incidence of preneoplastic lesions (Kido et al., 2020). Numerous preclinical investigations have demonstrated that piceatannol can stop cancer from spreading to different organs (Banik et al., 2020). Taken together, these data suggest that extracts from *P. edulis* seeds may have anti-cancer properties.

Conclusion

Twenty-one articles are used to demonstrate the health benefits of passion fruit (*Passiflora edulis*) seeds. The study's conclusions indicate that passion fruits may have anti-photoaging, anti-inflammatory, heart, liver, and kidney protective properties. They may also help treat skin conditions like striae distensile and acne vulgaris, as well as have anti-obesity, anti-hypertensive, anti-diabetic, anti-tumor, and anti-cancer properties. It is suggested where future research should go to improve the use of products made with passion fruits. It is hoped that more studies on the health benefits of passion fruit will be carried out using age-specific criteria, a larger sample size, and gender parity. Further prospective research is needed.

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Author Contributions

Investigation, D.K and S.P; formal analysis, D.K and S.P; investigation, D.K and S.P; resources, D.K and S.P; data curation D.K and S.P; writing—original draft preparation, D.K and S.P; writing—review and editing, D.K and S.P; visualization, D.K and S.P; supervision, D.K and S.P; project administration, D.K and S.P; funding acquisition, D.K and S.P. All authors have read and agreed to the published version of the manuscript.

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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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