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# Coffee and Skin: Consumption of Coffee Causes Skin Benefit

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# Abstract

Coffee contains more than 950 compounds have been identified after roasting. The main bioactive compounds in green coffee beans are polyphenols, trigonelline, Chlorogenic Acids (CGAs), cafestol and kahweol, and roasted coffee beans contain Caffeine (CAF), Caffeic Acid (CA), melanoidins. nicotinic acid (niacin or vitamin B3). Chlorogenic Acids (CGAs), cafestol and kahweol. Our focuses are beneficial compounds for the skin: 1: CAF; 2: Cafestol and kahweol; 3: CA; 4: Melanoidins; 5: Polyphenols. CAF inhibits skin carcinogenesis and protects against UV effects, thereby inhibiting aging induced by UV. In outdoor activities, consuming CAF might be benefit for sunburn and enhance performance. Cafestol and kahweol act as antiinflammatory and antiangiogenic agents and both compounds are potential agents for suppressing tumor growth by blocking or diminishing neoangiogenesis. CA has the potential to prevent skin cancer induced by UV exposure, and CA possesses antioxidant effects such as a photoprotective potential against DNA damage induced by free radicals. Melanoidins enhance the activities of phenolic compounds and might protect against skin cancer and infectious skin diseases. Polyphenols and flavonoids inhibit the formation of reactive oxygen species, protect the skin from oxidative stress, and suppress the effects of UV exposure. Polyphenols improve the skin barrier and the elasticity of the skin for anti-aging therapies. The consumption of coffee is beneficial for the skin, although the appropriate daily dose of coffee in order to obtain skin benefits remains unknown. We hope the development of coffee-based medicines for cosmetic are developed in the future.

Keywords: Skin; Coffee; Ultra violet; Caffeine; Polyphenol

### Introduction

An enormous amount of coffee is consumed every day worldwide, either in beverage form or in processed foods. Many people drink coffee to stay awake, as a luxury item, or because it is their favorite beverage. In daily life, coffee and tea are often consumed with a meal.

Coffee consumption affects human health, and the benefits of coffee for many organs, for the metabolism, and in helping to prevent many diseases are well recognized: advantage effects include decreasing in inflammatory markers [1], improving endothelial function [2] and decreasing the risk of Parkinson's disease [3] Alzheimer's disease type 2 diabetes mellitus [5-8] liver cancer [9] colorectal cancer [10] and brain tumors [4-11]. There are also disadvantages: Coffee is known to increase cardiovascular disease (anti-atherosclerotic) [12-20] and raising blood pressure [21-26], and increase plasma cholesterol and homocysteine levels [27-29]. Nevertheless, the effects of coffee on the skin have not yet been fully elucidated. Coffee has been reported to have an anti-proliferative effect against keratinocyte-induced apoptosis due to UV exposure [30,31], as well as to inhibit melanoma [32] and reduce the risk of Non-Melanoma Skin Cancers (NMSCs) such as Basal Cell Carcinoma (BCC) and Squamous Cell Carcinoma (SCC) [33-40].

Coffee contains many compounds, of which more than 950 have been identified after roasting [41]. These include Caffeine (CAF), theophylline, theobromine, polyphenols, Caffeic Acid (CA), pyrocatechol, diterpenes (cafestol and kahweol), anthocyanins, catechins, lactones, trigonelline, vitamin B3, potassium and magnesium [42-44]. Wierzejska [45] reports both beneficial compounds in coffee (CAF, polyphenols and trigonelline) and harmful ones (diterpenes and acrylamide). The main bioactive compounds in green coffee beans are polyphenols, trigonelline, Chlorogenic Acids (CGAs), cafestol and kahweol and roasted coffee beans contain CAF, CA, melanoidins, nicotinic acid (niacin or vitamin B3), Chlorogenic Acids (CGAs), cafestol and kahweol [46,47].

## **Literature Review**

These compounds play beneficial roles in the human body. For example, polyphenols are important in antioxidant activity, and CAF and trigonelline are important substances in improving cell activity [48]. We focus here on specific compounds that are beneficial for the skin: 1: CAF; 2: Cafestol and kahweol; 3: CA; 4: Melanoidins; 5: Polyphenols.

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# Discussion

#### Caffeine (CAF)

CAF (1,3,7-trimethylxanthine) is a plant purine alkaloid and an antagonist against adenosine receptor [49]. CAF is a natural alkaloid that is present in the leaves, seeds, and fruits of various botanical species [50]. CAF is derived from xanthine and the amount of CAF obtained depends on the species and origin of the plant [51]. The CAF content of coffee varies; for example, that of *Coffea arabica* ranges from 0.8 to 1.4% (w/w), while that of Coffea robusta ranges from 1.7 to 4.0%.

It is well known that CAF counters sleepiness and increases alertness because it stimulates the central nervous system and the heart, resulting in increased brain activity [52]. CAF can be used to treat mild respiratory depression caused by narcotics, circulatory failure [53], and headache, when used with aspirin [54].

CAF is responsible for the bitter taste of brewed coffee [55-58] and it remains chemically stable during coffee roasting [59]. It is a major bioactive component of both coffee and tea [57,58]. Regarding its effects on human health, CAF promotes wound healing [60], increases endothelium-dependent vasodilatation [61-63], increases arterial stiffness (resulting in elevated blood pressure) [64,65], compensates antioxidant capacity [66,67], decreases glucose disposal [68], affects pain modulation [69] and protects against malignant melanoma [70,71]. It also possesses both anti-inflammatory and pro-inflammatory activities [72]. These effects are beneficial for autoimmune diseases such as multiple sclerosis. Regarding the skin, CAF inhibits skin carcinogenesis and protects against UV effects, thereby inhibiting aging induced by UV [73,74]. Consuming coffee might also provide certain advantages for preventing dermatoses. Consuming coffee without CAF or with reduced CAF eliminates or reduces toxicities due to CAF, but might lessen the advantages for the skin. For those involved in outdoor activities, consuming CAF might be benefit for sunburn and enhance performance.

### Cafestol (coffee lipid) and kahweol

Coffee contains cholesterol-raising diterpenes such as cafestol and kahweol. These compounds are affected by brewing using filter paper, and the concentrations of cafestol and kahweol in unfiltered boiled coffee are higher than those in filtered coffee [75]. Cafestol and kahweol are found about 4 mg lower in the coffee oil of unfiltered coffee [76]. Cafestol (coffee lipid) and kahweol are both found in coffee oil, and are sensitive to heat, light and acid. Serum lipid levels of these compounds increase with the consumption of unfiltered coffee [77,78]. Kahweol and cafestol are structurally similar; however, their effects on the lipid metabolism have been shown to be different: Cafestol is more effective as a cholesterol-raising factor, while kahweol is more effective as an adipogenesis inhibitor [79]. Previous studies have confirmed that cafestol and kahweol act as antiinflammatory and antiangiogenic agents and that both compounds are potential agents for suppressing tumor growth by blocking or diminishing neoangiogenesis [80-84].

Cafestol is found at levels of 0.25-0.3 mg/100 mL in regular coffee and up to 4 mg/100 mL in unfiltered coffee [85]. High cafestol intake has been found to affect blood cholesterol levels; in one study, the daily consumption of 60 mg cafestol for 28 days increased total cholesterol levels by approximately 30 mg/dl [86]. Cafestol has shown beneficial biological effects such as anticancer, anti-inflammatory, anti-diabetes and anti-obesity properties [87-91]. Coffee consumption is not recommended for patients with dyslipidemia.

Kahweol is an unstable substance in its purified form, and possesses activities such as the suppression of macrophagemediated inflammation and the enhancement of anti-oxidative and anti-angiogenic properties [92,93]. It has also been found to increase the output of *HAS1*, *HAS2*, occludin and *TGM-1*, which are responsible for preventing water loss from the skin [94,95]. Kahweol may reduce pro-inflammatory pigmentation, anti-aging due to oxidative stress and prevent skin tumorigenesis.

#### Caffeic Acid (CA)

The phenolic compound CA (3,4-dihydroxycinnamic acid) is found in plant materials and has anti-allergic properties that inhibit itching [96-101]. CA appears as hydroxycinnamate or phenylpropanoid metabolites in many plants such as coffee, blueberries, apples [102], mint herbs, plums and black chokeberries [103]. It is found at levels of 35-175 mg/200 ml coffee [104] or 9-87 mg/100 g coffee [103,105], and there are 250-500 mg of CA in a typical daily amount of coffee [106]. A total of 33% of CA is absorbed in the intact form intestinally [107] and 67% of chlorogenic acid is metabolized to CA in the colon after consumption. In the skin, CA inhibits melanin production in melanocytes [108-111] and Lee [112] reports that CA and coumaric acid-conjugated peptides affect anti-Melanocortin Receptor 1 (MC1R) antagonist in the melanin synthesis of melanocytes. The chemical structure of CA is very similar to that of L-tyrosine, which also inhibits melanin production [110-113] and is a skin-whitening agent [112,113]. A previous report found that CA suppresses interleukin-10 and Mitogen-Activated Protein Kinase (MAPK) activation, and protects against UVB-induced skin damage in mouse skin [114]. Thus, with the consumption of coffee, CA has the potential to prevent skin cancer induced by UV exposure [33,104,115-117].

CA possesses antioxidant effects such as a photoprotective potential against DNA damage induced by free radicals, and could protect skin from aging and from developing malignant melanoma [118-121] due to its radical scavenging activity and inhibition of lipid peroxidation [122,123]. Utsunomiya [124] showed that CA (6 mM) inhibited the growth of both DNA and RNA viruses, provided that it was added at the beginning of the infection, with an inhibitive affect that lasts up to three hours after infection and then decreases [124]. Previous reports have also found that CA (1.0 mg/mL) inhibited the growth of Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa and Listeria monocytogenes [125,126]. It is possible that consuming coffee might improve atopic dermatitis with bacterial infection. In the future, CA might lead to the development of medicine for whitening skin and controlling infection.

**Melanoidins** 

Melanoidins are antioxidant compounds found in coffee, beer, bread, and grilled meats. An average coffee consumer (4 cups/ day) can obtain 1.5 g of melanoidins [127].

Melanoidins are extracted during the coffee brewing process [128,129], and arise as the result of a non-enzymatic browning reaction, the Maillard Reaction (MR), that occurs during high-temperature processing (temperature range: From 90°C to 200°C). During this reaction, melanoidins become antioxidant "Maillardized dietary fibers" [130-132]. Melanoidins have been found to have more powerful antioxidant activity in coffee than in other processed foods [128]. They have antimicrobial and anti-cancer activities [133] in addition to their antioxidant activity, which may be linked to their phenolic compounds [130,134-138]. Melanoidins not only enhance the activities of phenolic compounds but also might protect against skin cancer and infectious skin diseases.

#### **Polyphenols (flavonoids)**

Non-enzymatic antioxidant compounds include polyphenol, vitamin C, vitamin E, melatonin, zinc, copper, ubiquinone, melatonin, and uric acid [139-142]. Polyphenolic compounds include flavonoids, stilbenes, phenolic acid, tannins and diferuloylmethane. There are more 10,000 flavonoids, classified into the following subclasses: Flavones, isoflavones, flavanones, anthocyanidins, flavanols, flavanonols, anthoxanthins, and chalcones [143-150].

Polyphenols are present in fruits, vegetables and beverages [151] and it is known that there are approximately 300 mg of polyphenols in typical daily consumption of coffee, though the specific concentration of polyphenols in coffee depends on brewing. Polyphenols, especially flavonoids, possess antiinflammation, anti-cancer, anti-allergic and anti-bacterial effects, promote the immune system, and act as anticoagulants. Furthermore, polyphenols smooth, soften, hydrate and soothe the skin and have an astringent effect by inhibiting the activity of elastase and collagenase in the skin [146-149,152-154]. Most polyphenols can prevent the penetration of UV radiation (UVB, UVC and UVA) into the skin, and may act as a sunscreen. They can reduce inflammation due to oxidative stress and DNA damage by UV radiation in the skin [155]. Coffee polyphenols also improve vascular function and decrease hyperpigmentation [156-160]. Because polyphenols improve the skin barrier and the elasticity of the skin [158,161], they are used in anti-aging therapies. Polyphenols and flavonoids inhibit the formation of reactive oxygen species, protect the skin from oxidative stress, and suppress the effects of UV exposure [45,147,154]. Thus, consuming coffee could prevent oxidative damage or damage due to UV exposure. These polyphenol activities may improve acne, atopic dermatitis, sunburn or suntan, and protect against the development of actinic keratosis or squamous cell carcinoma. Further research is needed on the effect of polyphenols in the skin in order to optimize their consumption and clarify precise doses and frequencies.

# Conclusion

The consumption of coffee is beneficial for the skin, although daily skin care is also needed. The appropriate daily dose of coffee in order to obtain skin benefits remains unknown, and the specific amount further depends on the kind of coffee and on how it is brewed. Coffee-based medicines for cosmetic use show promise for future development.

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