



Review Article

Composition and Health Properties of Coffee Bean

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Abstract: Coffee is one of the most consumed beverages in the world. It is a main dietary source of polyphenol and phenolic acid. These constituents of the coffee are correlated well with the high antioxidant property, weight loss, mood enhancing and increase alertness, effectiveness against hypertension and anticancer property. Therefore, this review highlighted the health properties of the coffee bean.

Keywords: Coffee Beans, Composition, Health / Benefit

1. Introduction

Coffee is one of the most consumed beverages in the world. This is due to its distinctive aroma and flavor which readily attract although some are intrigued for its caffeine content [1]. According to International Coffee Organization, coffee used to be traded as key export and cash crop in many countries. The global coffee production is estimated to be 143.25 million of 60kg bags of coffee produced in 2014/2015 alone. The data showed 2.4% increase of average annual growth rate in global coffee consumption since 2011 which display increment over the years.

World coffee commercial production depends heavily on two species, *Coffea arabica* L. and *Coffea canephora* Pierre, also known as robusta. *C. arabica* has become the most important species by representing 65% of the world coffee production. *C. liberica* (or liberica coffee) is another species numbered at third and has a share of less than one percent of world coffee production [2]. Green coffee of Arabica and Robusta can be easily contrasted by their contents in caffeine and total free amino acids [3]. Arabica coffee has a higher content of caffeine than Robusta coffees with a margin of 0.1-0.2% difference. However, with regards to the antioxidant activity of both green coffee bean of Arabica and Robusta, Robusta has as much as 2-fold higher antioxidant activity. The

difference becomes insignificant after roasting [4].

The familiar coffee bean which consumer is used to is actually only a small part of the plant. The original fruit of coffee has the same look and size of cherry with an outer fleshy portion of the pericarp. Beneath the flesh is tissue like parchment known scientifically as endocarp. Underneath endocarp is spermoderm which referred to silver skin that coat the entire endosperm (coffee bean) [5, 6]. Before roasting, the coffee bean needs to be prepared by removing the endosperm from both pericarp and endocarp [5, 6]. After roasting, the endocarp has become light, flaky and fragile substance. For the trading purpose, the roasted coffee is usually ground into a smaller piece to remove all the content from the chaff. The quality of coffee is determined by two ways: analytically and organoleptically. The test includes sensory reactions such as the appearance, the odor or aroma, and the taste or flavor. Usually for coffee analytical tests alone are not sufficient for quality checking. It needs for the application of sensory tests to ensure the coffee have reached its quality requirement [5, 6]. Therefore, this review highlighted the health properties of coffee bean.

2. The Composition of Coffee Bean

The coffee bean is composed of many components, including carbohydrate, proteins, lipids, tannin, polyphenols

and minerals [7]. Minerals include potassium, magnesium, calcium, sodium, iron, manganese, sulphate, zinc, copper, strontium, chromium, barium, nickel, cobalt, lead, cadmium, bromine, caesium, lanthanum, rubidium, scandium and phosphorus [3, 7, 8, 9]. Sugars such as sucrose, glucose, fructose, arabinose, galactose, and mannose are present [7, 10, 11]. Several amino acids such as alanine, arginine, asparagine, cysteine, glutamic acid, glycine, histidine, isoleucine, leucine, lysine, methionine, phenylalanine, proline, serine, threonine, tyrosine, and valine can also be found in these beans [7, 10].

Polyphenol is a very interesting chemical compound found in most plant subject. It is basically a compound possessing several hydroxyl groups attached with aromatic rings. This broad family of polyphenol contains approximately 8000 phenolic structure [12]. Polyphenol affects the taste and the color of the plant itself. It causes the astringency and bitter taste of plant subject to the mouth due to the interaction between phenolics compound such as procyanidin with the glycoprotein in our saliva.

Polyphenol is frequently drawn by our body through dietary intakes such as vegetables, fruits, and beverages such as tea, cocoa, coffee, and fruit juice [4, 13]. Polyphenol can be prevalently found in fruits and beverages but it is lower in content in vegetables, cereal, and dry legumes. Phenolic acid and flavonoid are the main class registered under polyphenol with flavonoid dominating two third of total intake and remaining one third belong to phenolic acid. These classes are determined by their nature of carbon skeleton [13].

Overall, plant polyphenol can be classified into phenolic acid, flavonoid, tannins while the less common polyphenol is stilbenes and lignans [12, 13]. The most detected phenolic acid is a caffeic acid which is an ester while the most detected caffeoyl ester is a chlorogenic acid which is present in vegetable, fruit, and coffee. Chlorogenic acid (CGA) is a water soluble ester of one or two trans-cinnamic acids such as caffeic acid and quinic acid (Figure 1). The most found CGA name based on IUPAC is 5-O-caffeoyl-quinic acid (5-CQA) [13, 14].

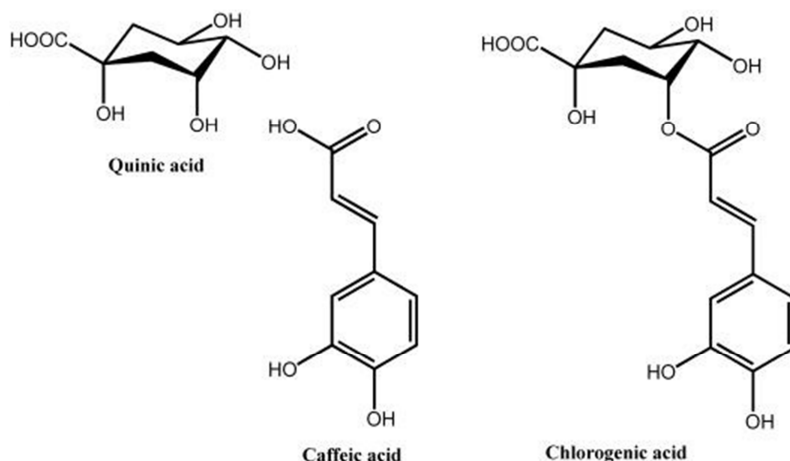


Figure 1. Chlorogenic acids; a family of esters of hydroxycinnamic acids such as caffeic acid and quinic acid. Caffeoylquinic acids are the most abundant and are present as 3 forms of isomers, esterified at positions 3, 4 or 5.

The most consumable source of polyphenol comes from coffee [15]. Based on Liquid chromatography–mass spectrometry (LC-MS), GCB particularly *C. robusta*, was found to have 30 CGA structures [16, 17]. The structures that had been identified are three caffeoylquinic acids (CQA) isomers (3-CQA, 4-CQA and 5-CQA), three dicaffeoylquinic acids (diCQA) isomers (3,4-diCQA; 3,5-diCQA; 4,5-diCQA), three feruloylquinic acids (FQA) isomers (3-FQA, 4-FQA and 5-FQA), three p-coumaroylquinic acids (pCoQA) isomers (3-pCoQA, 4-pCoQA and 5-pCoQA), six caffeoylferuloyl-quinic acids (CFAQ) isomers (CFAQ-1, CFAQ-2, CFAQ-3, CFAQ-4, CFAQ-5 and CFAQ-6), three dimethoxycinnamoylquinic acids isomers, three caffeoyl-dimethoxycinnamoylquinic acids isomers, three diferuloylquinic acids isomers and three feruloyl-dimethoxycinnamoylquinic acids isomers.

The three isomer that is predominant can be easily identified in GCB extract by NMR spectroscopy without separation would be the three caffeoylquinic acid (CQA) which is 3-CQA, 4-CQA and 5-CQA [18]. The CQA was

reported by Farah [19] catered for 80% and 76% of total CGA in *C. arabica* and *C. robusta* respectively with 5-CQA dominating at 62% and 56% respectively followed by diCQA representing 15% and 18% respectively and FQA representing 5.2% and 6.2% respectively. Whereby the compound of *C. robusta* GCB found in small amount would be 3-O-dimethylcinnamoyl, 5-O-caffeoylquinic acid, 4-O-dimethoxycinnamoyl, 5-O-caffeoylquinic acid, 3-O-dimethoxycinnamoyl, 4-O-feruloylquinic acid, 3-O-dimethoxycinnamoyl, 5-O-feruloylquinic acid, 4-O-dimethoxycinnamoyl, and 5-O-feruloylquinic acid [17]. The 3-CQA in green coffee bean (Vietnamese (Arabica and Robusta) and Philippine (Liberica and Robusta)) was reported to be an average of 3.7mg/g [20].

Another alkaloid group present is caffeine. Caffeine (1,3,7-trimethylxanthine) is a purine alkaloid that constitutes the natural content of coffee beans (Figure 2). Caffeine has bitter taste [21] and obtainable in a various source such as coffee and tea. According to the food and drug administration (FDA), intake of caffeine from beverages for teenagers and

adults is more than 97% and for children, 2 to 13 is about 95%. Dietary caffeine intake from solid food supplies contributes only a very small amount too. The mean daily caffeine intake of the adult population older than 22 was 300 mg in 2008 [22]. The average content of caffeine of green coffee bean from Brazil, Colombia, Ethiopia and Kenya between 4.36 mg/g dw to 4.99 mg/g dw [23], specifically green coffee bean from Ethiopia is around 1.01 (w/w%) to 1.19 (w/w%) [24]. Intake of 38mg to 400 mg per day of caffeine equal to 0.3 to 4 cups of brewed coffee per day could minimize risk and maximize the benefit of caffeine intake [25].

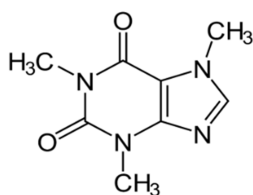


Figure 2. Caffeine Chemical Structure.

3. Health Benefit of Coffee Bean

The most coffee we consumed have been roasted, a process that changes the color, flavor, and odor of green coffee bean to become roasted coffee that will be ready to brew. However, the roasting process introduced causes 8-10% chlorogenic acid degradation and transformation per each 1% loss of dry matter [14] and 11 to 45% polyphenol degradation [26].

In term of weight loss, oral administration of green coffee bean extract to the rats was found to reduce visceral fat and body weight. This anti-weight gain property is due to the activation of fat metabolism in the liver and by inhibition of fat absorption which is governed by green coffee bean extract constituents [27]. The inhibition of fat absorption is caused by caffeine while chlorogenic acid was proposed to play a secondary role to green coffee bean extract in suppressing effect that caused a reduced level of hepatic triglyceride. Carnitine palmitoyltransferase (CPT) which is a rate-limiting enzyme that catalyzes the transportation of fatty acid to mitochondria for β -oxidation, was enhanced by green coffee bean extract. This activity can be enhanced by phenolic compounds such as feruloylquinic acid and neochlorogenic acid mixture [27]. The ability of green coffee bean extract in lowering body weight is also supported by Onakpoya, [18] and Dellalibera, [28]. Other researcher found instant coffee enriched with chlorogenic acid had a significant effect on the glucose absorption and utilization which may result in reduced body weight [29].

Coffee intake is associated with alertness, emotion and mood enhancing [30-31]. Coffee constituent such as caffeine, caffeic acid, chlorogenic acid, and ferulic acid are possible compound playing role of decreasing depression risk [32]. Caffeine in coffee might partly responsible for a potentially lower the risk of depression and as consumption of coffee might act as an independent protective factor for depression [33]. Coffee can also help in increasing alertness thus reducing driving impairment during highway-driving at night [34].

People who have a higher intake of caffeine (from coffee) has significantly lower incidence of cataract blindness compared to lower intake group. The amount of caffeine intake varies, for higher intake group is around 213.83 mg/day with 5.21% of cataract incidence while for lower higher intake group is around 0 mg/day with 55.25% of cataract incidence [35].

Green coffee extract daily intake effectively decrease blood pressure in hypertensive subjects in rats and humans and may help to prevent stroke [36-37]. This property was claimed due to the presence of chlorogenic acid in green coffee bean extract [36].

Green coffee also exhibits anti-cancer property due to antioxidant property of chlorogenic acid content and also plausibly due to direct modulation of chlorogenic acid and polyphenol that increase the detoxification activity of phase II enzyme while inhibiting the activity of the enzyme that activates carcinogen [38].

4. Conclusion

The polyphenol inside green coffee green had a number of health benefits such as decreasing blood pressure, high antioxidant activity, and provides some cardiovascular and weight loss support. Besides, the green coffee bean has the potential to be a better source of polyphenol compounds than a roasted coffee bean. Green coffee bean can be used to support healthy lifestyle as well as emotion and mood change. Therefore, more trials are needed to assess the effectiveness of green coffee extract on human health and take into consideration the individual differences in the physiological response to natural components present in green coffee.

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