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The Effect of Consuming Coffee from Different Preparation Methods on Body Lipids Profile

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ABSTRACT

Coffee is a popular drink that is considered one of the most consumed beverages around the world. It contains more than 1000 biologically active compounds such as caffeine, diterpene alcohols, and chlorogenic acid. The effect of coffee on health is controversial depending on the type and the amount consumed of coffee. This review was prepared to clarify the effect of different preparation methods on coffee lipids content, as well as to study the effect of consumption of coffee prepared by different methods on body lipids profile. Coffee can be prepared by several methods, but the most two popular methods are brew and espresso. Coffee lipids which are called diterpenoid alcohols (cafestol and kahweol) can influence the body's cholesterol level. The content of coffee lipids can be altered due to the methods of coffee preparation. Cafestol remains in the beverage of coffee when hot water is directly poured onto powdered coffee, when well-milled coffee is boiled in water a few times or when the metal filter is used instead of a paper filter, like in French Press. However, to good fortune, most of them are retained by the paper filter, which substantially reduces the cholesterol-raising effects potentially associated with coffee through consuming filtered coffee. Diterpenoids in unfiltered coffee cause an elevation of total cholesterol TC and low-density lipoprotein LDL cholesterol levels, whereas lowering the high-density lipoprotein HDL cholesterol levels in the body. However, consumption of filtered coffee slightly affects serum cholesterol levels. Also, the results of other studies revealed that the roasting degree of coffee is not related to an increase in the total cholesterol and the LDL cholesterol concentrations, but can be related to an increase in HDL cholesterol level after consumption of medium roasting MR coffee.

Keywords: Coffee Preparation; Diterpene Alcohols; Filtered Coffee; Brewed Coffee; Total Cholesterol; LDL and HDL cholesterol

INTRODUCTION

Coffee is one of the most consumed beverages around the world (Bohn et al., 2012). It originated in the Ethiopian region in Africa by Ethiopian goat herd when his herd dancing from one coffee shrub to another then it was taken to Arabia and then to Europe and is known as kaffa in Ethiopian (Butler, 1999; Caprioli et al., 2015; Khojah, 2016; Tanaka et al., 2009). It can be prepared by several methods, but the most two popular methods are brew and espresso. The major components in coffee which affect human health are caffeine, diterpene

alcohols, and chlorogenic acid. (Hulya & Piner, 2018). Coffee plants (Rubiaceae family) can be cultivated in certain areas in the world (coffee belt) 30 meters far from sea level. These plants are shiny and waxy and grow double leaves. When it's ripe, it blooms as jasmine. Then coffee is obtained from the seeds of red fruits and the fruits are separated from their pulp and rind. Finally, the seeds are roasted and ground to make coffee beverages as we all know (Esquivel & Jimenez, 2012).

There are two types of coffee that are commercially important. One is Coffee arabica Linn. (Arabika) which forms 70% of the coffee production in the world. The other type is Coffea canephora Pierre ex Froehner (Robusta) which represents the remaining 30% of the coffee production in the world (İşat, 2007). The first type is produced from greenish yellow oval Arabica seeds and it contains less caffeine, and a more delicious, and sweeter aroma compared to Robusta (İşat, 2007). Coffee Arabica has been grown for several centuries and represents three-quarters of the world country production. It includes different cultivars based on origin, climatic requirement tree size, yield pattern quality of end product, berry size, and disease resistance (Butler, 1999; Caprioli et al., 2015; Khojah, 2016; Tanaka et al., 2009). On the other hand, Robusta seeds have two times more caffeine content than Arabica (Hulya & Piner, 2018). Coffee Robusta was discovered in Congo in 1898 in Africa, Asia, and Indonesia it can grow to more than 12 m in height and is more resistant to pests. Usually, it's blended with another type due to its high content of caffeine (Butler, 1999, Caprioli et al., 2015, Khojah, 2016, Tanaka et al. 2009). Coffee intake has a positive or negative effect on human health (La Vecchia, 2005) according to the type and amount of coffee consumed (Işıksoluğu, 2001). Some studies in the past suggested that coffee and caffeine can affect health negatively and that increased coffee intake is often related to unhealthy attitudes such as smoking and a sedentary lifestyle (Willett et al., 1996; Manson et al., 1990). However, recent studies showed that coffee intake may reduce the risk of some chronic diseases associated with oxidative stress such as cancer, cardiovascular, inflammatory, and neurogenerative pathologies due to its antioxidant content such as phenolic compounds (Caprioli et al., 2015; Ascherio et al., 2001; La Vecchia, 2005). Furthermore, coffee consumption could improve the gut microbiome and modulate glucose and fat metabolism (Van Dam et al., 2020).

Coffee Components

Coffee contains more than 1000 biologically active compounds. The roasted coffee seeds consist of volatile and non-volatile compounds. Caffeine is considered one of the most important non-volatile compounds which give coffee its bitterness, strength, and fullness (Bulduk & Ve Süren, 2007). It works as a strong central nervous system stimulant and bronchodilator (Bhatti et al., 2013). The quantity of caffeine in coffee varies according to the coffee type, coffee roasting degree, and method of preparation of coffee. A cup of coffee (240 ml) contains 72- 130 mg of caffeine (Crews et al., 2001).

Other coffee compounds include carbohydrates, lipids, nitrous compounds, vitamins, minerals, and phenolic compounds (Esquivel & Jimenez, 2012; Willett et al., 1996), flavonoids, melanoidin, lipid resoluble compounds, and diterpene alcohols (serum cholesterol stimulant) and chlorogenic acid (Bhatti et al., 2013). These components work as antioxidants especially chlorogenic acid which protects the human body from coronary heart disease (Cai et al., 2012; Ran et al., 2016).

The coffee lipids mainly are triacylglycerols, sterols, and tocopherols. Also, coffee oil contains diterpenes of the kaurene family in proportions of up to 20% of the total lipids (Speer & Kolling- Speer, 2006). Diterpenoid alcohols consist of cafestol and kahweol which are the lipids in coffee that may influence the body's cholesterol levels (Shirlow & Mathers, 2014).

Effects of Coffee Intake on Human Health

Coffee can pose beneficial effects or adverse influences on human health depending on the type and amount of coffee. The major constituent of coffee is caffeine whose main role is in the body as a central nervous system stimulator and an antagonist of adenosine

receptors. Adenosine is a neuromodulator that is synthesized endogenously in the central nervous system, vascular endothelium, heart, liver, adipose tissue, and the muscles to do its main role in starting and conducting sleep. Caffeine exerts an opposite effect by binding to adenosine receptors instead of adenosine (McCusker et al., 2003). Furthermore, it was found that acute caffeine consumption can elevate triglyceride levels specifically in men while chronic consumption of caffeine might slightly and positively associate with HDL cholesterol concentrations in women (Due et al., 2005).

Some studies reported that some coffee constituents such as Chlorogenic acids and caffeine have anti-inflammatory activity and showed positive effects in free radical scavenging and metal chelation as well as inhibition of lipid peroxidation. Therefore, coffee intake may reduce the risk of development and progression of atherosclerosis (Butt & Sultan, 2011), insulin resistance (Ranheim & Halvorsen, 2005; Van Dieren et al., 2009) also reduce elevated blood pressure (Yamaguchi et al., 2008; Medina-Remón et al., 2010). Also, it was shown by Epidemiological studies that regular coffee consumption is associated with a lower risk for cardiovascular disease and CVD (De Koning Gans et al., 2010; Andersen et al., 2006; Freedman et al., 2012). However, the coffee compounds responsible for this effect are still unknown (Bohn et al., 2012).

In a study by Van Dam and his colleagues (2020), they stated that daily consumption of 3 to 5 cups of coffee reduced the risk of several chronic diseases. Coffee intake was associated with a slightly reduced risk of melanoma, nonmelanoma skin cancer, breast cancer, and prostate cancer (Micek et al., 2018). Also, it was found that Caffeine intake was related to reducing insulin sensitivity in the short-term using the euglycemic clamp (e.g., a 15% reduction after a dose of 3 mg per kilogram of body weight) (Van Dam et al., 2020).

Regarding liver health, coffee consumption was shown to lower the levels of enzymes reflecting liver damage as well as lowering the risk of liver fibrosis and cirrhosis (Wijarnpreecha et al., 2017).

The data regarding the effect of coffee on inflammation biomarkers are scarce and contradictory. It was reported an increase in inflammation biomarkers after coffee consumption for healthy individuals in one study (Zampelas et al., 2004). The constituents in coffee that cause the increase of these biomarkers are still unidentified. Another study showed an inverse relationship between coffee consumption and pro-inflammatory biomarkers (Kempf et al., 2010), whereas another study reported that coffee consumption is not associated with pro-inflammatory biomarkers (Lopez-Garcia et al., 2006).

In the study of Telma and her colleagues (2013), they reported an inflammatory effect related to coffee consumption. The study findings showed a significant increase in plasma fibrinogen concentration after consumption of medium roast paper-filtered coffee. In addition, they observed an increase in sE-selectin (soluble E-selectin) after medium light roast MLR, and in sVCAM-1 (soluble vascular cell adhesion molecule-1) after intake of medium light roast and medium roast paper-filtered coffee. Also, in Telma's study (2013), they noticed that the elevation of lipids and inflammatory biomarker concentrations was an acute effect of coffee consumption that is unrelated to a potential accumulative effect of longer periods of coffee consumption. In addition, they concluded that the intake of moderate paper-filtered coffee may lead to an undesirable effect on plasma cholesterol and inflammation biomarkers in healthy individuals regardless of its antioxidant content. However, there were no significant changes in oxidized LDL after consumption of both coffee roasts (medium roast and medium light roast). Therefore, they concluded that consumption of moderate filtered coffee in healthy individuals may lead to undesirable effects on cholesterol and inflammation biomarkers. Another observation in Telma's study was that coffee consumption had no significant change in glycemic biomarkers (Corrêa et al., 2013; Kempf et al., 2010).

In a study established in Istanbul-Keyifle Yaşam Healthy Nutrition and Diet Advice Center by Hulya & Pinar (2018) to examine the effect of coffee consumption on LDL cholesterol and total cholesterol values, 100 women with body mass index higher than 25kg/m2 between the ages of 18-65 were enrolled in the study. As a result of the study, they found that the frequency of coffee intake is significantly ($p=0,00<0,05$) associated with LDL cholesterol level and isn't related to total cholesterol level. LDL cholesterol levels increased with increasing coffee consumption. Also, they concluded that the type, extent, and daily consumed amount of coffee are not associated with LDL-cholesterol level or total cholesterol level. In another study, it was found that women who consumed more than 200 mg of coffee daily had a higher cholesterol level of 11 mg/dl compared to noncoffee-drinking women (Shirlow & Mathers, 2014). As a result of meta-analysis studies, it was found that consumption of 5 cups or more of coffee daily, could increase the risk of coronary heart disease. On the other hand, moderate coffee consumption (2-3 cups) daily doesn't increase the risk of coronary heart disease (Ran et al., 2016; Jousilahti et al., 2000). On the other hand, a result of another study showed that drinking equal to or more than four cups of coffee daily was associated with a significant decrease in the risk of cardiovascular disease based the study that included about 50 women. No difference was observed between caffeinated and non-caffeinated coffee in this study (Tofler et al., 2001). Furthermore, coffee can increase lipid oxidation and the thermic effect of nutrients in people with normal weight, therefore coffee is good for weight control for these people (O'Keefe et al., 2013). The same results were shown in another study that caffeine increases lipid oxidation in muscles and glycogen mobilization (Due et al., 2005).

In a study by Ismail and his partners (2015), they compared different preparations of coffee on body weight among Albino rats. The control group was kept on the basal diet only. The first group received a single oral dose of Turkish coffee medium roasting (4.3 mg/ 100 g/day). The second group received a single oral dose of Turkish coffee dark roasting (4.3 mg/ 100 g/day). The third group received a single oral dose of Instant coffee (14.3 mg/ 100 g/day). The fourth group received a single oral dose of Arabian coffee (8.6 mg/ 100 g/day). They noticed that rats who were fed different preparations of coffee had lower weight gain than the control group. Moreover, they found that the rat group who fed Instant coffee lost significant body weight compared to other groups. This is because the Instant coffee group had the lowest food intake among the studied groups. This result means that drinking Instant coffee may reduce body weight.

Lopez-Garcia et al., (2006) suggested that coffee intake had adverse effects on body weight, and attributed that effect to caffeine intake. The effects of coffee consumption on body weight can be explained by the influence of caffeine as an adenosine-receptor antagonist. Therefore, all tissues that have adenosine receptors will be affected by caffeine (Van Soeren & Graham, 1998). On the other hand, Astrup et al., (1990) noticed an increase in the basal metabolic rate with caffeine consumption in a dose-dependent manner among healthy individuals who had moderate caffeine consumption. This effect of caffeine was attributed to an increase in lactate and triacylglycerol production, as well as an increase in vascular smooth muscle tone. Another explanation was made by Acheson et al., (2004) who reported that caffeine could stimulate thermogenesis by increasing lipid turnover. All of these suggested mechanisms can explain the relationship between caffeine consumption and body weight. In addition, cohort studies showed that caffeine intake was related to slightly less long-term weight gain (Larsen et al., 2018). Also, it was found that increasing coffee consumption to more than 9 cups a day (600-900 mg of caffeine) in adult men and women led to elevated serum homocysteine levels which is a risk factor for heart diseases compared to people who don't consume that amount of coffee (O'Keefe et al., 2013). In addition, high consumption of highly caffeinated coffee may cause throb, anxiety, and sleep disorders, as well as increase the heart rate and blood pressure. Also, high levels of caffeine (>750 mg/day) lead to an increase the urination and loss of large amounts of calcium and magnesium from the

body which affects bone health negatively. However, regular intake of coffee doesn't cause these symptoms (O'Keefe et al., 2013). Also, it was reported that consumption of caffeinated coffee but not non-caffeinated coffee may affect the total cholesterol, LDL-cholesterol, and triglyceride. In addition, the amount consumed coffee affects serum lipids in women significantly (Cornelis & El-Sohemy, 2007).

It was found that the antioxidant effects of coffee due to some of its constituents like chlorogenic acid can improve glucose metabolism and insulin sensitivity (Takami et al., 2013). Some researchers suggested that decaffeinated coffee reduces the risk of Type 2 diabetes mellitus. Coffee components such as chlorogenic magnesium and caffeic acid are known to have antioxidant effects. Chlorogenic acid reduces insulin sensitizing by reducing intestinal sugar absorption. It was found that a cup of coffee (240 ml) contains 72-130 mg of caffeine, 85-420 mg of chlorogenic acid, and 7 mg of magnesium which help to reduce the risk of type 2 diabetes mellitus. (Bhupathiraju et al., 2013). It was found that every cup of coffee drunk per day, reduces the risk of Type 2 DM by 7% (Buffo & Cardelli-Freira, 2004).

Methods of Coffee Preparations

The components in coffee beans undergo significant changes during roasting and cooking. Several reactions occur during the roasting process which leads to creating compounds that give the coffee its taste (İşat, 2007). The caffeine isolate by liquid extraction technique and analyze by

Gas chromatography by nitrogen phosphorus detection, so the previous studies on coffee found that espresso coffee has a higher amount of caffeine than brew coffee. Also, it was found that the concentration of caffeine in regular coffee is 10.6-16.5 mg\g and 0.34-.0.47 mg\g in decaffeinated coffee (Fujioka & Shibamoto, 2008).

1-Preparation of Boiled Coffee Brew

Turkish coffee is the earliest method for brewing coffee. It can be prepared by grinding the beans to a fine powder then adding water and letting it boil (Caprioli et al., 2015). Other methods of brewing coffee include dipping the coffee in a machine for brewing such as French espresso. This method can be achieved by combining ground coffee with boiling water in a cylindrical vessel and letting it boil for a few minutes. In this machine there is a circular filter that is fixed to the plunger and fits tightly in the cylinder, then it is pushed down from the top by the liquid to force the ground to the bottom of the vessel, by this process ground coffee becomes in direct contact with the water and the most of coffee active substances will be transferred to the coffee beverage. These active substances will make the coffee stronger with low residues compared to other types of making coffee machines. finally, the coffee is filtered by a filter and the remaining ground coffee will go to the bottom (Caprioli et al., 2015).

2- Preparation of Pressurized Coffee Brew (EC)

This method is widespread in south Europe, Central America, and other areas. The EC machine produces a suitable pressure on roasted ground coffee beans and percolates a limited amount of hot water in a short time to give a concentrated foamy cup of coffee. This method can be affected by many factors such as water composition and other technical conditions related to the machine (Caprioli et al., 2015; Andueza et al., 2003; Navarini et al., 2001; Petracco, 2001). The EC machine contains a volumetric pump that provides a continuous flow of water (Odello & Odello, 2006) to reach the desired pressure, then forced to heat exchanger to reach the desired temperature (91-96 degrees Celcius), after that water enters the filter unit and spread equally over the coffee surface inside the filter, then coffee particles absorb the water and swell when pre-infusion to a few second take place. During this time the coffee reaches to desired permeability and extracts the most prized ingredient in espresso. This method produces coffee with a strong taste of coffee with a distinctive flavor and cream, also a layer of emulsified oil (Caprioli et al., 2012; Odello & Odello, 2006).

Influence of Espresso and Brew Coffee Preparation On the Content of Caffeine and Chlorogenic Acid In the Coffee

The bioactive compound content of coffee is the main factor that determines the health benefit of coffee. Caffeine is the most abundant bioactive compound and it plays a crucial role in central nervous system stimulation, influences human performance, affects the cardiovascular system and has antioxidant activity, and reduces free radicals (Peters, 1991; Petracco, 2001; Petracco, 2005).

Chlorogenic acids are other abundant bioactive compounds found in coffee obtained when coffee beans are roasted and produce bitterness in coffee and formed from the ester bond between caffeic acid and quinic acid. It plays a role as an antioxidant, antitumor, antimutagenic, and anticarcinogenic agent and has a neuroprotective effect against neural cell death which protect the brain from some diseases such as Alzheimer's disease, Parkinson's disease, and ischemia.

There are two characteristics found in coffee related to sensory quality, the first one is acidic content such as citric acid, malic, chlorogenic, and quinic acids and the second one is sourness together with aroma and bitterness. Through roasting, the amounts of citric, malic, and chlorogenic acids will be decreased and quinic acid will be increased due to the degradation of chlorogenic acid (balzer, 2001). In the case of green coffee, the content of chlorogenic acid also changes because it converts to lactone through light and medium roasting conditions (Farah et al., 2005).

The caffeine content (dry matter basis of the green coffee bean) varies between and within species such as coffee canephora var. robusta (Robusta coffee), coffee brevipes, and coffee stenophyllaare which contain a high amount of caffeine content, whereas coffee pseudozanguebariae and coffee humblotianaare almost contain no caffeine. Also its worth mentioning that robusta coffee contains a higher amount of caffeine (314-762 mg\l) and chlorogenic acid rather than Arabica coffee (174-310mg\l) (Belitz et al., 2009; Farah et al., 2005; Ludwig et al., 2012; Rodrigues et al., 2007).

Influence of Different Types of Coffee Preparation on Aroma Profiles

The type of coffee either coffee Arabica or coffee Robusta determines the flavor of coffee, also there are different aromatic compounds in the coffee brew which were identified. The first coffee volatiles identified were methylamine and pyrrole. Then, many other components of coffee aroma were discovered such as aldehydes, ketones, furans, pyrazines, pyridines, phenolic compounds, indoles, lactones, esters, and benzothiazines. These compounds are produced through the roasting process by Millard reaction, sticker degradation, and degradation of lipid and sugar. Also, there are natural volatile compounds in coffee beans. There are two methods for the characterization of coffee aroma which are: chemical and sensory methods.

The first method was discussed by Holscher and his colleagues (1990). They identified the coffee aroma of roasted coffee and the odor potency of each compound in a method termed flavor dilution which is aroma extract dilution analysis using gas chromatography – olfactometry technique and there are trained testers to establish a sensory evaluation of eluting out from the chromatographic column. They are especially important to the action of the original sample than to the original sample diluted with predetermined injection volume, and finally to reach the flavor dilution factory by the ratio of the concentration of the largest and smallest injection volume which still detectable. However, there is an impediment to this method which is the odorant boiling is higher than the solvent used. This problem can be overcome by injecting the sample with different head space injection volumes, then calculating the flavor dilution factor as previously reported. However, there was a need for a more accurate method. Therefore, semmelroch and his colleagues introduced a new procedure which is a stable isotope dilution assay that provides high accuracy and sensitivity by label internal standard, as well as providing odor activity value) calculated by the ratio of the concentration of odor threshold in water and the concentration of compound obtained by stable isotope dilution assay. But the problem

with this method is the need a laborious work to analyze a large amount of coffee aroma.

There was a combination approach used by a panelist to perform a sensory evaluation and characterize a specific odorant as well as identify the effect of the overall coffee aroma. In the beginning, the results that appeared in the isotope dilution assay were taken and a model mixture smelling clearly coffee-like was prepared, then the contribution of every single component was evaluated by the omission test (Holscher et al., 1990).

Influence of Type of Coffee Preparation on Coffee Content of Diterpenoid Alcohols

Some antioxidants are formed during the roasting process of coffee in addition to that are naturally present in the coffee beans (Kempf et al., 2010). Some of the coffee components are called diterpenoid alcohols (cafestol and kahweol) which are the lipids in coffee that may influence the body's cholesterol level.

In case of boiling the well-milled coffee with water a few times or using the metal filter instead of a paper filter, like in the French Press (a glass container for making coffee, in which hot water is poured into coffee and then a filter is pushed down into the container to keep the solids at the bottom), the cafestol will remain in the coffee beverage. However, cafestol can't pass into a coffee case if a paper filter is used (Preedy, 2014). Obviously, the concentrations of these coffee lipids can be altered due to the methods of coffee preparation. Fortunately, most of them are retained by the paper filter, which substantially reduces the cholesterol-raising effects potentially associated with coffee through consuming filtered coffee (Thelle & Strandhagen, 2005; Strandhagen & Thelle, 2003).

The diterpenes content retained by the paper-filtered is influenced by several factors such as coffee species, geographical distribution, roasting degree, grind sizes, extraction time and temperature, the porosity of the paper filter, and coffee-to-water ratio (Naidoo et al., 2011; Zhang et al., 2012). Filtered coffee contains less than 0.1 mg/100 ml of diterpenoid alcohol, while it's between 0.2 and 18 mg/100 ml in unfiltered coffee (Bhupathiraju et al., 2013).

The Effect of Consuming Coffee from Different Preparation Methods on Body lipids Profile

Several studies have been done to examine the effects of coffee intake on human health specifically human lipids. Some studies found that cholesterol and LDL-C increased significantly after coffee consumption (Strandhagen & Thelle, 2003; Jee et al., 2001). Other researchers reported a positive association between filtered coffee consumption and an increase in HDL-C concentration (Kempf et al., 2010; Fried et al., 1992). The most cholesterol-raising content in the coffee brew is the cafestol. The mechanism of action of cafestol on increasing the plasma cholesterol concentration is still unclear. However, Ricketts et al., (2007) suggested that Cafestol activates the nuclear hormone receptors pregnane X receptor (PXR) and farnesoid X receptor (FXR) in the small intestine. Then, PXR activates Cyp27A1 and ABCA1 expression, increasing the efflux of cholesterol to the liver. In addition, FXR activates the intestinal bile acid-binding protein (IBABP), a bile acid transporter, increasing the transportation of bile acids into the portal circulation. PXR and FXR are responsible for the inhibition of bile acids synthesis in the liver (bile acid synthesis is a major pathway for hepatic cholesterol catabolism). Also, FXR suppresses the expression of Cyp7A1, Cyp8B1, and NTCP in the liver resulting in the reduction of bile acids synthesis, therefore increasing the cholesterol concentrations. In a study by Huxley et al., (2009) and O'Keefe et al., (2013) they also found that diterpenoids in unfiltered coffee caused an elevation of LDL cholesterol and lowered HDL cholesterol levels.

According to a study established at Holland Wageningen Agriculture University, it was noticed that consumption of non-filtered coffee increases cholesterol levels. In a meta-analyze study that covered fourteen randomized controlled trials, it was found that consumption of boiled coffee was associated with increased serum total cholesterol and HDL levels while filtered coffee increased the serum total cholesterol very slightly. As it will be known increasing cholesterol levels can increase the incidence and prevalence of coronary

heart disease (Oğuz & Erdoğan, 2016). Jee and his colleagues (2001) established research to study the influence of coffee on serum lipids levels for 107 adults who were having normal cholesterol blood levels. The participants were followed for 12 weeks. They were divided into 3 groups in 9 weeks period. The first group contained people who drank 4-6 cups of filtered coffee daily, the second group contained people who drank 4-6 cups of boiled coffee daily and the third group included people who don't drink coffee. The results revealed that there was a significant increase in serum cholesterol levels in the group who consumed boiled coffee, whereas there wasn't a static difference in LDL cholesterol levels between the three groups (Jee et al., 2001).

In a meta-analysis that contained fourteen randomize-controlled studies, the results showed that consumption of boiled coffee increases serum LDL (23 mg/dl) and total cholesterol concentrations (14 mg/dl) in a dose-dependent manner, whereas consumption of filtered coffee slightly affects the serum cholesterol (3 mg/dl) levels (Cai et al., 2012). In a study established by Telma and her colleagues (2013), they noticed that total cholesterol TC and low-density lipoprotein cholesterol LDL-C concentrations but not the triacylglycerols were increased after the consumption of medium light roast and medium roast paper-filtered coffee compared with the baseline. However, there were no significant differences between the two coffee roasts. They concluded that the roasting degree is not related to an increase in the total cholesterol and LDL cholesterol concentrations. The reason for the increased concentration of TC and LDL- C after consumption of medium light roast and medium roast paper filtered coffee is that the higher cafestol levels obtained in this study compared to those found for the paper-filtered coffee in other studies (Silva et al., 2012; Sridevi et al., 2011; Naidoo et al., 2011). This is because the diterpenes are only partly removed by the paper filter (Thelle & Strandhagen, 2005; Strandhagen & Thelle, 2003). In addition, Telma and her colleagues (2013) observed an increase in HDL cholesterol after consumption of medium roasting medium roast coffee. HDL is considered an anti-atherogenic particle in the body. This is because HDL can reverse cholesterol transport, inhibit LDL cholesterol oxidation, reduce blood viscosity, regulate prostaglandins and thromboxane synthesis, activate fibrinolysis, inhibit adhesion molecules and monocytes to endothelium, and stimulate nitric oxide release (National Cholesterol Education Program (NCEP), 2002). However, other researchers found that increased plasma TC and LDL-C are more pronounced with unfiltered coffee, whereas paper-filtered coffee was less frequently reported to raise these lipids (Ranheim & Halvorsen, 2005).

Conclusion

The findings of this review revealed that consumption of coffee can affect the body lipids profile based on the methods used in preparing coffee. The most cholesterol-raising content in the coffee brew is the cafestol. Diterpenoids in unfiltered coffee caused an elevation of LDL cholesterol and lowered HDL cholesterol levels. However, results of other studies showed that consumption of boiled coffee was associated with increasing both serum total cholesterol and HDL levels while filtered coffee increased the serum total cholesterol very slightly. Consumption of boiled coffee increased serum LDL and total cholesterol concentrations in a dose-dependent manner.

On the other hand, there is a positive association between filtered coffee consumption and an increase in HDL-C concentration. The roasting degree is not related to an increase in the total cholesterol and the LDL cholesterol concentrations in paper-filtered coffee.

However, even paper-filtered coffee can cause an elevation in total cholesterol and LDL cholesterol concentrations if the diterpenes (cafestol) were partly removed by the paper filter.

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تأثير استهلاك القهوة المعدة بطرق إعداد مختلفة على مستويات الدهون في الجسم

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ملخص

تعتبر القهوة مشروب شائع والذي يعتبر واحد من أكثر المشروبات المستهلكة عالمياً. تحتوي القهوة على أكثر من ١٠٠٠ مركب فعال حيوي كالكافيين، ثنائي التربين وحمض الكلوروجين. يُعد تأثير القهوة على الصحة جدلي بالاعتماد على نوع وكمية القهوة المستهلكة. تم إعداد هذه المراجعة العلمية بهدف توضيح تأثير طرق التحضير المختلفة على محتوى دهون القهوة، بالإضافة إلى دراسة تأثير شرب القهوة المُعدّة بالطرق المختلفة على فحص دهنيات الجسم. يمكن إعداد القهوة بواسطة عدة طرق ولكن الطريقتان الأكثر شيوعاً في إعدادها هي الغلي والقهوة السريعة (الاسبرسو). تستطيع دهون القهوة والتي تسمى كحول ثنائي التربين (الكافيستول والكاهيوول) التأثير على مستوى الدهون في الجسم. يمكن لمحتوى الدهون في القهوة أن يتغير بواسطة طرق إعداد القهوة.تبقى مادة الكافيستول في المشروب عند صب الماء الساخن بشكل مباشر على بودرة القهوة، وعند غلي القهوة المطحونة جيداً في الماء لعدة مرات، أو عند استخدام المُنقّي المعدني بدل المُنقّي الورقي كما في حالة القهوة الفرنسية. وعلى الرغم من ذلك، لحسن الحظ يتم الاحتفاظ بأغلب دهون القهوة في المنقي الورقي، والذي يحد لدرجة كبيرة من التأثير الرافع للكوليستيرول والذي من المحتمل أن يكون مرتبط باستهلاك القهوة المعدة باستخدام المنقي. يؤدي ثنائي التربين في القهوة المعدة بدون المنقي إلى زيادة مستويات الكولسيتيرول الكلي والبروتينات الدهنية المنخفضة الكثافة، بينما يؤدي إلى خفض مستويات البروتينات الدهنية مرتفعة الكثافة في الجسم. وعلى الرغم من ذلك فإن استهلاك القهوة المعدة باستخدام المنقي بالكاد يؤثر على مستويات الكوليستيرول في مصل الدم. كذلك كشفت نتائج دراسات أخرى أن درجة تحميص القهوة ليست مرتبطة بزيادة تراكيز الكوليستيرول الكلي والكوليستيرول منخفض الكثافة، ولكن يمكن أن ترتبط بزيادة مستوى الكوليستيرول المرتفع الكثافة بعد استهلاك القهوة متوسطة درجة التحميص.

الكلمات الدالة: تحضير القهوة كحول ديتربين قهوة مفلترة القهوة المعتقة؛ الكولسترول الكلي؛ كوليسترول LDL و HDL.