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Potential health benefits from coffee consumption

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Abstract

The history of coffee goes back to the 10th century. Currently, coffee is a widespread drink, with recent studies reporting a global consumption of 164,9 million 60-kg bags in 2020/2021. The effect of coffee on human health has been studied for many years. The active ingredients of coffee include polyphenols, lactones, diterpenes, niacin, the trigonelline (vitamin B_3 precursor), magnesium and potassium. Potential factors that could change its properties include the type of beans, the roasting process, the grinding process and the brewing process. Authors searched PubMed and Google Scholar using searchterms coffee, cardiovascular system disease, CVD, type II diabetes, Alzheimer's disease and caffeine. We manually searched the references of selected articles for additional relevant articles. We selected articles relevant to a general medicine readership, prioritizing systematic reviews, cases and clinical practice guidelines. The literature contains the latest reports on the impact of coffee on human health, including cardiovascular diseases, type II diabetes and Alzheimer's disease. Drinking coffee may reduce the risk of cardiovascular disease, because of the caffeine blocking A1 and A2A receptors. It may also contribute to decreasing the risk of type II diabetes, increasing the secretion of GLP-1 and increasing the sensitivity of tissues to insulin. The influence of coffee on the development of Alzheimer's disease is still being investigated. Coffee is a common drink for many people, so you should know its impact on human health. Contrary to appearances, coffee may have many health-promoting properties.
Keywords: coffee, CVD, cardiovascular, diabetes, alzheimer, caffeine

Introduction

The first written mention of coffee belongs to the work of Razes, a 10th century Arabian physician, however some scientists claim that the earliest references to the utility of

coffee are to be found in the Old Testament e.g. Genesis 25, 30; I Samuel 25, 18 and II Samuel 17, 28.[1]

Coffee, given its properties and the fast-paced lifestyle of most people in the 21st century, has become one of the most popular and widely consumed beverages.[2]

According to Coffee Market Report (August 2022), presented by International Coffee Organization (ICO), the latest provisional outlook for total production in the coffee year 2021/22 remains unchanged at 167.2 million bags, a 2.1% decrease as compared to 170.83 million bags in the previous coffee year. World coffee consumption is projected to grow by 3.3% to 170.3 million 60-kg bags in 2021/22 as compared to 164.9 million for coffee year 2020/21. In 2021/22, consumption is expected to exceed production by 3.1 million bags.[3]

It consists of multiple components, of which caffeine appears to be the most widely recognized. Nevertheless, coffee contains approximately 1000 described bioactive agents with a wide spectrum of physiological effects. Among phytochemicals included in coffee we can distinguish: phenols, lactones, diterpenes, niacin and the trigonelline (vitamin B_3 precursor). What's more, coffee is rich in macroelements such as: magnesium, potassium and vitamin B_3.[4,5]

What to keep in mind is that before coffee enters our bodies, it undergoes mechanical, thermal and chemical processing, so the type of beans, the degree of roasting and the brewing method, including the way the coffee is ground and the type of brew, all have a bearing on the final biochemical composition of the cup.[6]

It was a long road before coffee was seen as a potentially healthy beverage. Earlier concerns about the potential side effects associated with coffee and caffeine consumption, as expressed in epidemiological studies in the past, were likely overstated by confounding factors of relevance such as unhealthy behaviors that accompany coffee drinking e.g., cigarette smoking and physical inactivity. More recently, research reports indicate that coffee consumption is not only unhealthy but may have a role in lowering the risk of several chronic diseases.[7–11]

Currently available studies has investigated the correlation between coffee consumption and range of outcomes including cardiovascular, metabolic, neurological, musculoskeletal, gastrointestinal and liver diseases, along with potential effects associated with pregnancy or cancer.[2]

Our aim in this article is to review and assess high-quality evidence of the potential effects of coffee consumption on humans' health. We believe that this approach may help in contextualizing the quantity of the interdependence over outcomes and crucially evaluate the available data for any adverse effects that can be associated with coffee overconsumption.

Bioactive components

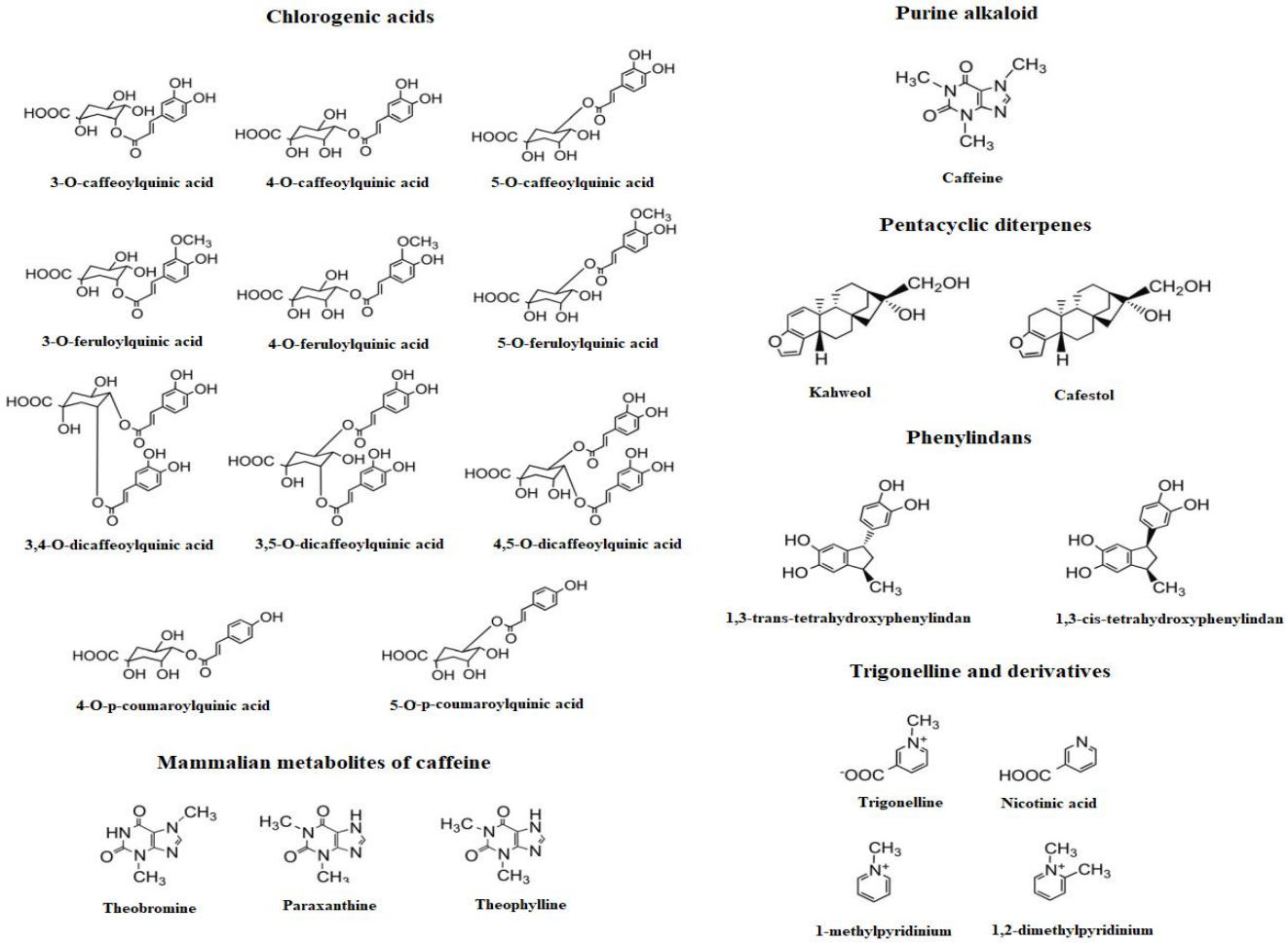
As previously mentioned, coffee is a complex mixture of over a thousand compounds. When green coffee beans are are exposed to high temperature, non-enzymatic reactions, known as Maillard reactions, between amino acids and carbohydrates, lead to formation of vast amount of unique components.[12]

Among the phytochemicals contained in coffee, we can distinguish the groups of phenolic compounds (e.g., chlorogenic acids (CGAs) and its derivatives), diterpenes (cafestol and kahweol), methylxanthines (e.g., caffeine, theobromine, and theophylline), nicotinic acid (vitamin B3), and trigonelline.[13] Its complex structure can manifest itself through several health implications in regular coffee consumers, what was presented in Table 1.[14–18]

Tab. 1 Bioactivity of the individual coffee ingredients.[14–18]

Compound	Potential properties and benefits
Chlorogenic acids	Increasd expression of enzymes involved in inhibition of DNA methyltransferase Potent antioxidant activity
Diterpenes	Anticarcinogenic activity
Trigonelline	Hypoglycemic activity Neuroprotective proporties Antibacterial
Caffeine	Induces lipolytic and thermogenic activities, Increases dopamine level what leads to boosting metabolic rate Improves protection against free radicals
Phenylidans	Potent antioxidant activity Neuroprotective properties
Nitrogenous compounds	Potent antioxidant activity Anticarcinogenic activity Inhibition of matrix metalloproteases (MMPs) Antibacterial

Fig. 1 Phytochemical content of coffee.[18]



Impact of coffee on cardiovascular system

There are many conflicting theories about how coffee affects cardiovascular system diseases (CVD). This relationship has been studied since the 1960s as it was noticed that at that time both coffee consumption and the incidence of cardiovascular diseases were high.[19] Short-term studies have shown the occurrence of arrhythmias, increased blood pressure and an increase in catecholamines in the blood due to caffeine consumption.[20,21] In the 1980s, coffee consumption was shown to lower blood cholesterol levels. Interestingly, it depended on how the coffee was brewed: unfiltered or boiled.[22] However, this has not been confirmed in subsequent studies which concluded that boiled coffee may cause an increased concentration of cholesterol in the blood.[23] Over the next twenty years, low-value studies found an association between coffee consumption and CVD risk.[24–26] However, researchers who did more valuable meta-analyses did not confirm this relationship.[27,28] In the new millenium, after the 2000s, more and more research has begun on the relationship between coffee consumption and mortality from CVD, stroke and heart failure. However, meta-analyzes did not confirm the relationship.[29–31] Malerba et al. in 2013 showed in their meta-analysis that there was no association between high coffee consumption and the CVD risk.[32] Also in 2013, Liu et al. in their worthy cohort studies, found out that in those under 55 years old, consumption of four cups of coffee a day was associated with higher cardiovascular system disease mortality.[33] In 2014, Ding et al., found out that consuming a minimum of six cups of coffee per day had no effect of CVD risk, while consuming three to five cups per day might even lower the risk of CVD.[34] The structure of caffeine is similar to adenosine, therefore it may block A1 and A2A receptors. Its low concentration is enough to block the receptors, which may be achieved after consuming one cup of coffee.[35] Activation of A1 receptors causes a decreased effect of catecholamines on heart and decrease in the contractility of the heart. Activation of A2A receptors leads to the widening of the lumen of the coronary arteries.[36] As a result, caffeine binding to A1 and A2A receptors may reduce risk of CVD.[37,38]

Coffee and Alzheimer risk

Alzheimer's disease is responsible for approximately 60% of dementia cases.[39] In 2015, about 50 million people suffered from dementia and this number is expected to increase every year.[40] Alzheimer's disease is the deposition of tau tau protein inside the neurons and amyloid on the outside.[39] It has been shown that caffeine in coffee easily crosses the blood-brain barrier, which may contribute to decreasing the risk of Alzheimer's disease. Caffeine has also been shown to reduce the production of beta-amyloid in the brain and may prevent memory impairment.[40–42] Scientific research does not conclude that coffee consumption contributes to decreasing Alzheimer's disease risk. Liu showed that there is a positive relationship between coffee consumption and the risk of Alzheimer's disease. However, there was no evidence of an effect on the incidence of dementia.[33] Wu et al. showed that consuming 1-3 cups of coffee a day lowered the risk of Alzheimer's risk and dementia.[43] Larsson et al. in their worthy meta-analysis said that there was no statistically significant relation between high coffee consumption and risk of dementia and Alzheimer's disease.[44] Further research needs to be done, because there is no consensus in the studies, but the results are promising.

Coffee and diabetes type II

The properties of coffee have also been noticed and studied in the course of type II diabetes.[45] Most studies confirmed an inverse relationship between coffee consumption and incidence of type II diabetes. Ding et al. in their meta-analysis looked at over 1 million participants, including over 40 000 patients with type II diabetes. He found that six cups of

coffee a day was associated with a 33% lower risk of type II diabetes, compared to people who did not drink coffee.[46] Morimoto in his cohort study proved that the reduction of the risk of type II diabetes is 20% higher in women than in men (women 34%, men 14%).[47] There was no difference in the protective efficacy between caffeinated and decaffeinated coffee.[46,48] Coffee has been studied to increase insulin secretion and increase tissue sensitivity to insulin.[49] Coffee appears to have a strong influence on blood glucose homeostasis after the meal.[50] Not only caffeine coffee has protective effects. Polyphenols, acting as antioxidants, attract a lot of attention.[51] Polyphenols stimulate GLP-1, which is responsible for the activation of insulin secretion from beta cells, induced by glucose.[52] It has been proven that the chronic activation of GLP-1 secretion reduces the risk of developing typ II diabetes. Additionally, polyphenols may help to reduce body weight. More research needs to be done, but so far coffee and its polyphenols have been shown to protect against the risk of diabetes and support its treatment.[53]

Conclusion

Coffee is widely present all over the world. The ritual of drinking coffee has been known for millennia. Common opinion is about the negative effects of coffee on human health, while research shows otherwise. Coffee contains a number of health-promoting substances, such as polyphenols, lactones, diterpenes, niacin, the trigonelline (vitamin B_3 precursor), magnesium and potassium. It may contribute to reducing the risk of cardiovascular diseases, type II diabetes and even Alzheimer's disease, but this still needs to be investigated.

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