

Comparison of Dark Roast Coffee to Other Blends and Their Affects on Health

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ABSTRACT

Purpose This review examines dark roast coffee and its benefits on health as compared to medium and light roast coffee beverages.

Methods Research was examined comparing dark roast coffee consumption to other blends in 4 studies. Pubmed was searched in September 2015 for articles that addressed the effects of coffee roasting degree on health benefits of coffee beverages. Only original research articles were included; all previously written review papers on the topic were excluded. The search terms included coffee, coffee roast, roast, blend, health, health status, dark roast, medium roast, and light roast. The research was limited to light, dark, and medium roasts while excluding benefits of non-specified blends.

Results It was concluded that dark roast coffee is the preferred blend to consume in regards to antioxidant effects on the body and lowering gastric acid secretion. However, there is no evidence to support one roast type over the other when it comes to cardiometabolic effects and glucose tolerance. Overall, dark roast has more positive health benefits than light and medium roast blends.

Conclusions Even though the glucose tolerance and cardiometabolic effects studies did not support dark roast exceedingly above others, dark roast coffee may have more health benefits when compared to light and medium roasts.

INTRODUCTION

Caffeine consumption is very high in the United States. Sources of caffeine come in several different forms, however coffee beverages are highly consumed, accounting for over half of the caffeine intake for the adult U.S. population¹. Of the 318.9 million American's in the United States, over 50% of them drink coffee beverages every day¹. Coffee consumption over the years has remained steadily above the 50% mark since the 1980's. Intake peaked in 2007 when 57% of Americans recorded daily coffee consumption¹. Not only are citizens simply drinking coffee everyday, they are consuming an average of 3.3 cups of coffee per day². This amount of average daily coffee intake amount has remained constant since 2003. However, such high coffee consumption is not necessarily a health problem for the United States as far as health is concerned. Frequent coffee consumption has been shown to decrease the risk of metabolic syndrome in individuals³. Coffee consumption has also been shown to decrease risk of certain cancers including hepatocellular carcinoma and diseases like chronic liver disease as well⁴.

The association between coffee consumption and the reduction of multiple diseases and cancers has to do with the beverage's chemical composition. Coffee contains several enzymes, antioxidant factors, and organic compounds that attribute to good health. Superoxide dismutase (SOD) is an enzyme in coffee that neutralizes free radicals in the body¹⁵. By neutralizing free radicals, it helps prevent damage to the cells that can lead to cancers and disease states. High SOD levels indicate that many free radicals need to be reduced, thus requiring more SOD than normal. Low SOD levels are considered healthy and indicate less oxidative stress. Glutathione peroxidase (GPX) and catalase (CAT) are enzymes that reflect levels of peroxidases in the body system¹⁵. High

levels of GPX and CAT have negative effects as these levels would mirror a high level of peroxidase in the body. Peroxidases are used to neutralize peroxides, which is harmful to the body. High peroxidase levels would indicate that there are many peroxides to neutralize, which would mean there is much oxidative stress occurring. Malondialdehyde (MDA) is an organic compound found in coffee beverages that is a marker of lipid peroxidation and oxidative stress⁵. High levels of MDA are considered detrimental because it is the byproduct that forms in the body when something is oxidized. Total glutathione (tGSH) is a major antioxidant found in coffee⁵. Additionally, tocopherol, a vitamin E compound, is a strong antioxidant that is also found in coffee⁶. Ochratoxin A (OTA) is a toxin present in food that is not stored properly⁷. OTA levels can be present in higher concentrations in coffee beans prior to roasting. Upon roasting, OTA levels decrease, making roasted and brewed coffee better to consume than raw beans. All of these compounds in levels present after roasting are associated with the positive health benefits of coffee.

While all of these compounds are present in coffee beans and grounds, coffee beverage preparation can significantly affect these levels in the product. When brewing, there are several key factors to consider such as water quality, coffee-to-water ratio, brewing time, and water temperature⁸. There are several methods to prepare coffee including moka, auto-drip, espresso, and many more. One main chemical in coffee that is affected by preparation method is ochratoxin A (OTA). When comparing the three preparation methods previously mentioned, OTA levels are highest when using the espresso preparation method and lowest with moka brewing⁹. Although OTA levels

change with preparation method, they do not change with roasting degree of the coffee beans as many other bioactives do¹⁰.

In addition to the preparation method of coffee, roasting blend of the coffee bean greatly affects the biochemical makeup of the bean. Initially, harvested coffee beans are referred to as “green” coffee beans and can be kept in this form without loss of flavor or quality¹¹. Once roasted, the bean is chemically changed into its more commonly known appearance and texture and referred to as light, medium, or dark roast coffee. The roasting process rids the beans of moisture and makes them crunchy to bite and full of the well-identified coffee aroma. When roasted to the correct temperature, the beans are rapidly cooled to stop any further changes that may occur. The difference between the perfect roast and somewhere in between is a matter of seconds¹¹. Roasting the coffee beans also “degrades chlorogenic acids to form potent antioxidants” and contributes to the high amount of antioxidants in coffee¹². The degree to which the bean is roasted is directly related to the antioxidant activity the coffee will have¹². Trigonelline, caffeoylquinic acid, and N-methylpyridinium levels in coffee have been shown to correlate with roasting color as well¹³. Light roast coffees are high in trigonelline and caffeoylquinic acids and dark roast coffees are high in N-methylpyridinium levels¹³. Overall, the total antioxidant capacity of the coffee increases as the degree of roasting gets darker¹⁴.

With over 50% of the United States population drinking coffee an average of 3.3 times a day, the type of coffee being consumed could have a large impact on health status¹³. The purpose of this review article is to examine the potential health advantages of different types of coffees based on roasting degree.

METHODS

Pubmed was searched in September 2015 for articles that addressed the effects of coffee roasting degree on health benefits of coffee beverages. Only original research articles were included; all previously written review papers on the topic were excluded. The search terms included coffee, coffee roast, roast, blend, health, health status, dark roast, medium roast, and light roast. The research was limited to light, dark, and medium roasts while excluding benefits of non-specified blends.

RESULTS

There have been multiple studies conducted comparing light and dark roast coffees centered on potential health benefits. Of the studies described below, the most impactful was a randomized, longitudinal, interventional study that examined different levels of antioxidants in coffee blends¹⁵. This study asked 30 participants to consume 500 mL of a selected coffee blend for 12 weeks and compared the results. A second randomized parallel study discussed roasting blend of coffee and cardiometabolic effects¹⁶. This study compared the results of 118 participants who all consumed at least 3 cups of coffee per day. A randomized, double-blinded intervention study examined coffee roast and gastric acid secretion in 9 participants¹⁷, while a three-arm, randomized crossover design study with 13 participants examined coffee roast and glucose tolerance¹⁸.

Antioxidant Levels in Serum

A randomized, longitudinal, interventional trial lasting 12 weeks examined multiple antioxidant parameters in differing coffee blends¹⁵. Each of the 30 healthy volunteers were asked to consume a low polyphenol diet and were given 500 mL of light or dark roast coffee everyday for a period of time. Each participant drank light roast coffee for the first 4 weeks, underwent a 2-week washout period, and drank dark roast coffee for the last 4 weeks of the study. Upon completion of each four-week cycle, blood and urine samples were taken to examine levels of ascorbic acid, tocopherol, superoxide dismutase (SOD), glutathione-peroxidase (GPX), catalase (CAT), antioxidant capacity (AOC), total glutathione (tGSH), and malondialdehyde (MDA)¹⁵. Increased levels of SOD, GPX, and CAT occurred after the light roast coffee when compared to levels measured after the dark roast coffee consumption (5.8% and 16% decrease in SOD and GPX activity, respectively; p-value ≤ 0.05)¹⁵.

Cardiometabolic Effects

In a randomized parallel study with 118 overweight individuals, each participant was asked to consume dark or medium roast coffee for three months after a washout period of four weeks¹⁶. Medium roast coffee was consumed by 58 participants, and 56 participants consumed the dark roast¹⁶. On average, each participant consumed about 4-5 cups of coffee a day, with the dark roast group mean of 4.8 ± 1.1 cups per day vs. 4.6 ± 1.3 at baseline; $p = 0.008$ ¹⁶. The medium roast mean of 4.5 ± 1.3 cups per day at baseline and 4.6 ± 1.1 during the study period, showing that the consumption of coffee did not significantly differ¹⁶. The parameters measured at baseline included body mass index (BMI), waist circumference, weight, blood pressure, high-density lipoprotein (HDL) levels, triglyceride levels, and insulin levels. Overall between medium and dark roasts

before and after intervention, BMI did not change significantly (32.4 ± 4.4 vs. 32.5 ± 4.8 and 33.9 ± 4.6 vs. 33.9 ± 4.7 , respectively). Weight between medium and dark roasts before and after intervention did not change significantly (95.3 ± 18.3 vs. 95.6 ± 19.5 and 100.3 ± 16.6 vs. 100.3 ± 16.7 , respectively). Insulin level between medium and dark roasts before and after intervention did not change significantly (10.4 ± 6.8 vs. 10.5 ± 5.6 and 9.8 ± 5.3 vs. 10.1 ± 5.5 , respectively). Waist circumference between medium and dark roasts before and after the intervention were not significantly different throughout the study between the two groups with differing coffee blend consumption (105.5 ± 13.8 vs. 105.8 ± 14.1 and 107.2 ± 9.5 vs. 107.4 ± 9.0 , respectively)¹⁶. Blood pressure decreased with dark roast coffee (126.7 ± 11.6 before intervention and 121.4 ± 12.6 after intervention; $p\text{-value} = < 0.05$)¹⁶. Consequently, triglyceride levels increased with dark roast consumption as well (123.8 ± 65.2 before intervention and 134.8 ± 62.8 after intervention; $p\text{-value} = < 0.05$)¹⁶. HDL levels increased significantly with medium roast (58.2 ± 15.1 before intervention and 60.3 ± 15.8 after intervention; $p\text{-value} = < 0.05$)¹⁶.

Gastric Acid

In a randomized, double-blinded intervention study, comparison of dark and medium roast blends of coffee and their outcomes on gastric acid secretions leading to stomach discomfort were measured in nine healthy volunteers. Participants consumed 200 mL of a coffee beverage of either dark or medium roast¹⁷. Levels of N-alkanoyl-5-hydroxytryptamides (C5HT), N-methylpyridinium (N-MP), trigonelline, chlorogenic acids (CGAs), and caffeine were initially measured in each blend of coffee. Caffeine levels were the same in each blend, but the dark blend contains higher levels of N-MP, whereas medium roast coffee has higher levels of C5HT, CGAs, and trigonelline¹⁷.

Stomach pH with tap water alone after the bicarbonate alkaline solutions did not change significantly (pH 0.53 ± 0.09 before vs 0.54 ± 0.13 after)¹⁷. When the individuals consumed the coffee beverages after 2mL of bicarbonate solution, medium roast, and dark roast there was a difference in stomach pH (0.52 ± 0.22 , 0.97 ± 0.36 , and 0.26 ± 0.17 , respectively). It was noted that the dark roast blend slowed gastric acid secretion compared to when the bicarbonate was administered¹⁷. The change in pH/minute of the subjects with medium and dark roast coffee beverages was 0.97 ± 0.36 and 0.26 ± 0.17 , respectively¹⁷. This shows that roasting degree effects C5HT and CGA levels, and therefore directly effects gastric acid secretion.

Glucose Tolerance

A three-arm, randomized crossover design study examined different coffee blends and their effects on glucose response and regulation. 11 volunteers underwent an oral glucose tolerance test following consumption of 300 mL of either dark or light roast coffee¹⁸. Blood samples were also taken at different intervals to examine glucose and insulin response after coffee consumption. Although there were not many differences between roasting degree and blood glucose levels, post hoc testing did show that the subjects who consumed dark roast coffee had higher glucose concentrations compared to the control than the light roast consumers when compared to the control (0.7 ; p-value = 0.01 with 95% CI and 0.2 ; p-value = 0.42 with 95% CI, respectively)¹⁸. In addition, post hoc testing also revealed that serum insulin was higher after dark roast consumption when compared to the control as well (1.2 ; p-value = 0.004 with 95% CI)¹⁸. Although these two observations were observed, the differences between light and dark roast were

not significant in glucose concentration and insulin concentration (p-value = 0.06 and 0.59, respectively)¹⁸.

DISCUSSION

The purpose of this review article is to examine the different types of coffee blends and their effects on different health aspects. Studies were assessed to review dark roast coffee versus other blends based on antioxidant capacity, cardiometabolic effects, gastric acid secretion, and glucose tolerance^{15,16,17,18}. As examined, decreased SOD, GPX, and CAT levels in dark roast coffee indicate that there are less radicals present in the body due to the high antioxidant power of the darker roast¹⁵. Since the diet over the course of the study remained relatively steady, it is assumed that the dark roast coffee blend had higher antioxidant levels and therefore, lower SOD, GPX, and CAT levels since there were not as many radicals present. It was concluded that dark roast coffee is the preferred blend to consume in regards to antioxidant effects on the body. This study's results based on the chemical and enzyme levels could have been stated more clearly and more background information on the compounds would help the reader understand the different compounds being discussed. In addition, the results were based on the chemical and enzyme levels alone, instead of observable or measureable positive effects on the body based on the increased antioxidant levels. Cardiometabolic effects including BMI, waist circumference, and insulin levels did not change significantly during the comparison of medium and dark roast coffee beverages. However, a noted increase of triglyceride levels found in dark roast coffee when examining cardiometabolic effects compared to the medium roast could lead to potential health complications. The results on roasting blend

of coffee and cardiometabolic effects alone do not indicate whether there is a particular roast that would be better for health¹⁶. Additionally, the participants were asked to consume 4-5 cups of the specified blend a day, which is an unreasonable amount of coffee to drink for the average citizen based on the average coffee consumption of 3.3 cups per day². Therefore, it would be hard to see significant results in a participant consuming an average amount of coffee. When trying to lower gastric acid secretion, the results indicate that dark roast coffee consumption will lower gastric acid secretion and stomach discomfort when compared to medium roast¹⁷. It was concluded that dark roast coffee in the preferred blend to consume in regards to gastric acid secretion levels. This study had a small sample size of only 9 participants, and there was not considerable information on how the participants were gathered, only that they were habitual coffee consumers and did not have *Helicobacter pylori* infection. The study measuring glucose tolerance levels showed that there was no different affect on glucose or insulin response between the coffee beverages in participants¹⁸. These results of that study did not indicate whether there is a preferred blend of coffee to consume when choosing between light and dark roasts based on glucose tolerance. This study did a very good job at choosing participants of all ages and body weights, making their results diverse enough to apply to most of the general population of coffee consumers. The study also practiced adequate control procedures including regimented meal patterns and coffee consumption and carefully collected their data, minimizing error where possible. Results supported that coffee consumption in general increased certain aspects of health, such as decreased risk for liver cancer and chronic liver disease⁴. Some limitations to the four studies include differing comparisons of dark coffee to both light and medium roasts. The results would

have been more cohesive overall if each study examined only dark versus light roasts or dark versus medium roasts. A strength of the four studies is that the results for each were gathered from real human subjects consuming controlled amounts of the coffee beverages. This ensures that the results can be seen in humans and are not just applicable in the laboratory.

CONCLUSION

The results from all of the studies concluded that dark roast can help increase antioxidant capacity in the body leading to overall better health. The results conclude that dark roast is more beneficial in providing the body with antioxidants, and therefore preventing oxidative damage that may occur. While the antioxidant study focused mainly on antioxidant capacities between the two blends, it additionally noted that participants that were on the cusp of being overweight noted a decrease in body weight while drinking the dark roast blend, another potential benefit of the coffee blend¹⁵. It was also concluded that dark roast is the most beneficial in lowering gastric acid secretions. In regards to glucose tolerance and cardiometabolic effects however, no results can be concluded on whether dark roast is the preferred coffee blend. Further research needs to be done to draw more conclusions on light versus dark roast coffee consumption and its effects on body weight¹⁵. Additional research may also need to be conducted to compare light and medium roasts to each other to determine if there are any significant health differences in their consumption. This review was done to inform coffee consumers on the health effects that roast type has when consuming coffee beverages. Even though some studies did not show overwhelming support for dark, light, or medium roast; dark roast has more

positive health benefits than adverse health outcomes when compared to light and medium roasts.

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