Battling bitter coffee -- chemists vs. main source of coffee bitterness

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In a discovery that could lead to better tasting coffee, chemists report finding the compounds that are most responsible for the brew's bitter taste. Credit: American Chemical Society

Bitter taste can ruin a cup of coffee. Now, chemists in Germany and the United States say they have identified the chemicals that appear to be largely responsible for java's bitterness, a finding that could one day lead to a better tasting brew. Their study, one of the most detailed chemical analyses of coffee bitterness to date, was presented today at the 234th national meeting of the American Chemical Society.

Research by others over the past few years has identified an estimated 25 to 30 compounds that could contribute to the perceived bitterness of coffee. But the main cause of coffee bitterness has remained largely unexplored until now, the researchers say.

"Everybody thinks that caffeine is the main bitter compound in coffee, but that's definitely not the case," says study leader Thomas Hofmann, Ph.D., a professor of food chemistry and molecular sensory science at the Technical University of Munich in Germany. Only 15 percent of java's perceived bitterness is due to caffeine, he estimates, noting that caffeinated and decaffeinated coffee both have similar bitterness qualities.

"Roasting is the key factor driving bitter taste in coffee beans. So the stronger you roast the coffee, the more harsh it tends to get," Hofmann says, adding that prolonged roasting triggers a cascade of chemical reactions that lead to the formation of the most intense bitter compounds.

Using advanced chromatography techniques and a human sensory panel trained to detect coffee bitterness, Hofmann and his associates found that coffee bitterness is due to two main classes of compounds: chlorogenic acid lactones and phenylindanes, both of which are antioxidants found in roasted coffee beans. The compounds are not present in green (raw) beans, the researchers note.

"We've known for some time that the chlorogenic acid lactones are present in coffee, but their role as a source of bitterness was not known until now," Hofmann says. Ironically, the lactones as well as the phenylindanes are derived from chlorogenic acid, which is not itself bitter.

Chlorogenic acid lactones, which include about 10 different chemicals in coffee, are the dominant source of bitterness in light to medium roast brews. Phenylindanes, which are the chemical breakdown products of chlorogenic acid lactones, are found at higher levels in dark roasted coffee, including espresso. These chemicals exhibit a more lingering, harsh taste than their precursors, which helps explain why dark-roasted coffees are generally more bitter, Hofmann says.

The type of brewing method used can also influence the perception of bitterness. Espresso-type coffee, which is made using high pressure combined with high temperatures, tends to produce the highest levels of bitter compounds. While home-

brewed coffee and standard coffee shop brews are relatively similar in their preparation methods, their perceived bitterness can vary considerably depending on the roasting degree of the beans, the amount of coffee used, and the variety of beans used.

Some instant coffees are actually less bitter than regular coffee, Hofmann says. This is because their method of preparation, namely pressure extraction, degrades some of the bitter compounds. In some cases, as much as 30 to 40 percent fewer chlorogenic acid lactones are produced, leading to a reduced perception of bitterness, he says.

"Now that we've clarified how the bitter compounds are formed, we're trying to find ways to reduce them," Hofmann says. He and his associates are currently exploring ways to specially process the raw beans after harvesting to reduce their potential for producing bitterness. They are also experimenting with different bean varieties in an effort to improve taste. But so far, none of these approaches - details of which are being kept confidential by the researchers - is ready for commercialization, he notes.

But the researchers are optimistic that a better cup of Joe is just around the corner. Perhaps no one could be happier about the news than Hofmann, who admits that he is an avid coffee-drinker with a passion for the dark-roasted varieties.

Source: American Chemical Society