Fact or Fiction?

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Chemicals in Tea

What do tea, bubbles in beer, and homeopathy have in common? Answer - recent highly technical papers by physicists and material scientists tackle these subjects and provide sophisticated insights on how these items function.[1-3]

My initial intent was to write a column including all three, showing how high-powered science was stepping into the fray. However, research on tea alone led to many side-tracks mostly regarding one of my favorite topics: multi-chemical foods and beverages. So, this month's topic is tea. Beer and homeopathy will have to wait until some future date.

Speaking of chemicals, tea, like many natural products, contains hundreds of compounds. Plants are capable of synthesizing tens to hundreds of thousands of primary and secondary metabolites with diverse biological properties and functions. To date, more than 7000 flavor volatiles have been identified and cataloged from foods and beverages.[4]

If someone offered you a cocktail of butanol, iso amyl alcohol, hexanol, phenyl ethanol, tannin, benzyl alcohol, caffeine, geraniol, quercetin, epigallocatechin-3-gallate and inorganic salts, would you take it? Or would you place it in a secure container and contact your friendly environmental activist for advice? If recent media coverage of environmentalists' concerns about our exposure to chemicals has left you feeling paranoid, then you might opt for the second option - or, as is more likely, you'd pour the mix down the drain and leave it for someone else to take care of.[5]

As a reader of this column, you wouldn't get alarmed but would drink the cocktail because you are clever

enough to know that the mixture is nothing other than a cup of tea. However, there are more chemicals than just these. In the aroma of tea alone, some 467 compounds have been identified. Ivon Flament classifies these products into their functional groups or their heterocyclic structures and comes up with 18 distinct families. Table 1 lists these chemical classes while comparing tea to coffee (655 compounds) and cocoa (462 compounds).[6]

Billions of people around the world drink tea regularly. It is the most widely consumed beverage after water. Three billion kilograms of tea are produced each year worldwide.[7] Different teas represent different processing, notes Thomas Gasiewicz:[8]

- White tea is very unprocessed, and likewise there are more beneficial chemicals or compounds associated with it.
- Green tea is a little bit more processed. It's been steamed a little bit more and oxidation of the chemicals occur.
- Black tea is the most processed of the tea leaves. The chemicals become more oxidized and there are fewer reported benefits from black tea than green or white tea.

Benefits of tea

The list of supposed benefits from drinking tea is seemingly endless. Recent research, for instance, suggests drinking tea may help everything from bad breath to Parkinson's disease. Some studies indicate it may even save lives. Here are some recent claims:[7-15]:

- Prevention of arthritis in older women
- Cancer prevention
- Immunity to flu
- Reduced cholesterol levels
- Reduced risk of heart disease
- Reduced blood pressure
- Protection against Parkinson's disease

Table 1
Partition of coffee, cocoa and tea flavor constituents into chemical classes.[6]

	Number of identified compounds		
Functionality	**Coffee**	**Cocoa**	**Tea**
Hydrocarbons	50	39	37
Alcohols	20	25	46
Aldehydes	28	22	55
Ketones	70	24	57
Acids	20	51	71
Esters	29	58	55
Lactones	8	7	16
Phenols	42	6	19
Furans	99	19	9
Thiophenes	26	---	1
Pyrroles	67	18	10
Oxazoles	27	15	2
Thiazoles	28	9	7
Pyridines	13	12	23
Pyrazines	79	94	22
Amines and N-containing products	24	45	18
Sulfides and S-containing products	16	10	5
Other compounds	9	8	14
Total	655	462	467

- Protection against Huntington's disease
- Prevention of cavities and gum disease
- Protection against bad breath
- Prevention of type-2 diabetes
- Defense against HIV

Sounds magical doesn't it? Here's some more detail. Joe Schwarcz suggests that we should be consuming more epigallocatechin-3-gallate (EGCG). That's because it may offer significant protection against cancer and heart disease. All this from drinking a cup of tea. Tea contains flavonoids or polyphenols, and a subclass of the flavonoids, are catechins, to which EGCG belongs. Besides being responsible for beneficial health benefits, EGCG is also responsible for flavor.[9]

Schwarcz also adds, "If you're still not rushing to put the kettle on, listen to this: Tea catechins impair the activity of the bacteria in the mouth that produce cavity-causing acids, tea contains fluoride, which strengthens teeth, and there's more - you can even dye your hair with tea or soak your feet in it to reduce odor."[9]

FDA disclaimer

In spite of all the claims about health benefits of tea, the Food and Drug Administration (FDA) takes issue with some of them. Michael Landa of the FDA writes the following, "FDA concludes that there is no credible evidence to support qualified health claims for green tea consumption and a reduced risk of gastric, lung, colon/rectal/ esophageal, pancreatric, ovarian and combined cancers. However, FDA concludes that there is very limited credible evidence for qualified health claims specifically for green tea and breast cancer and for green tea and prostate cancer, provided that the qualified claims are appropriately worded so as to not mislead consumers."[16]

Landa does add that perhaps future scientific evidence might become available that would support some of the health claims that the FDA denied. In other words, stay tuned.

The British and tea

The British are famous for tea which was introduced to their country in 1652. Along the way, some strange things were done with this beverage. Henry Hobhouse reports, "In the 1770s, a Mr. Twining, head of a firm of tea importers which still carries his name, wrote a pamphlet in which he claimed that there was a village near London whose primary product was material for adulterating tea. The village produced 20 tons of this material a year, and sold it to the trade at half the going price of tea itself. The adulterants were 'ash leaves, collected by children and boiled in a copper with sheep's dung. The mixture is then trod upon to exclude the water, dried, and carefully roasted till the product resembles tea leaves. For scented teas of a finer nature, the children are set to collect elderberry flowers, which are dried and roasted and sold at twice the price . . .' More generally available, and more generally used, even in the memory of people still living today, were iron filings. The fact that adulterants were such big business shows just how necessary a commodity tea had become to the British."[17]

What is the proper way to make a cup of tea? Marc Abrahams notes that the question has many answers, but only one of them is the official British standard. He reports, "The tea standard was issued by the British Standards Institution , an organisation known, as affectionately as a standards institution can be known, as 'the BSI'. The tea standard has a formal name, and it has a number. 'Method for Preparation of a Liquor of Tea for Use in Sensory Tests' is standard number BS 6008. (Liquor in this case has no attachments to alcohol or spirits, instead meaning a 'solution prepared by extraction of soluble sub-

stances'.) BS 6008 has stood unchanged since 1980. In printed form it is six pages long," and is expensive at 24 pounds. "For their six-page classic, the British Standards Institution was awarded the 1999 Ig Nobel Prize in the field of literature."[18] For the purists, please note that if you check BS6008:1980 on the Web, it states that the length of the document is approximately eight pages, not the six that Abrahams reports.[19]

Lastly, somewhat also related to the British, Hobson reports, "Ever since the American Revolution, tea has had a slightly un-American feel about it, and loyal Canada has drunk four times as much tea per head as the independent United States. Tea is identified as the principal nonalcoholic drink of Anglo-Saxons everywhere except in the United States."[20]

Compost tea

Roger Freed reports, "On NPR a while back, a group in Portland, Oregon, gave a recipe for compost soup, or as some call it, compost tea. Now I know it's good to be organic, but I thought this sounds just a little TOO organic. They mentioned that it is quite nutritious, but I feel we only need so much nutrition. Then they said the ingredients - worm castings, bat and seagull guano, processed for 12 hours. For those who don't know what the literally correct term of "castings" means, it stands for "poop." Yes, that is right, worm poop. And bat and seagull guano is also poop, but of a higher evolved form. As I listened on, I realized that the concoction was actually intended for plants."[21]

Indeed, compost tea is not for human consumption. It's a liquid solution or suspension made by steeping compost in water, and alleged to return necessary microbes back into the soil.

There are several kinds of compost tea, depending on the method and ingredients with which the tea is made: fresh compost tea, modern compost tea, actively aerated compost tea, fermented compost tea, compost leachate, and manure tea (This is created by suspending a bag of manure in water for several weeks. Using manure is asking for pathogenic problems and, especially under anaerobic conditions, virtually assures the presence of *E. Coli*.).

Although the popular press and internet have exploded with kudos for aerated compost tea as a disease control agent, the bottom line is that there is no "silver bullet" for plant health problems caused by poor soil health and improper plant selection management. P&SF

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