

An -omics look at a Chinese tea

In collaboration with Chinese scientists, the UNCG Center for Research Excellence in Bioactive Food Components at the North Carolina Research Campus is currently conducting research on a Chinese tea called “Pu-erh”, for its regulatory effect on metabolic disorders. Pu-erh is one of the oldest tea products in China with a history of over 1,700 years that can be traced back to the Eastern Han Dynasty (25-220 AD). In olden days, the processed tea leaves, when compressed into 'tea bricks', were used as currency due to their value and popularity throughout ancient China and adjacent countries. Premium Pu-erh tea was offered as a tribute tea to the Emperor of China and to this day Pu-erh tea remains a highly valuable commodity, as a traditional medicinal tea with many health benefits.

Many people in the US pronounce it as “poor tea”, which sounds a bit odd. We suggest that it be pronounced as “pure tea”. The name of the tea comes from the region where the tea plant was first harvested, called “Pu-erh”, a small town in the Yunnan province. Not far from Pu-erh town in the areas of Xishuangbanna and Simao, south of Yunnan Province, the cultivation and processing of Pu-erh tea is still being carried out today. With elevations of up to 6,600 ft, the tea trees are high up in these mountains where the air is cool and crisp most of the year amidst scenes of unspoiled beauty and fertile lands. Boiled water is used for optimum brewing. The brewed tea is dark red, and has a bold, earthy taste that many find an acquired taste.

Drinking Pu-erh tea is purported to reduce blood cholesterol. This belief has been backed up by a number of scientific studies not only demonstrating experimental results of decreased low-density lipoprotein cholesterol in rats, but also discovering specific mechanisms through which chemicals in Pu-erh tea inhibit the production of cholesterol in our body. To date, there are a number of bioactive components identified in Pu-erh tea which include: catechin, epicatechin, epigallocatechin, epigallocatechin gallate (best known as EGCG), quercetin, and kaempferol, etc.

Unlike most other teas, Pu-erh is known for the fact that it is a fermented tea which typically ages well to produce a pleasant drink. Through storage, the tea takes on a darker color and mellower flavor. The tea leaves are pressed together during processing into a variety of shapes, such as tea cakes and bricks. It is believed that the quality of Pu-erh tea increases with age, in contrast to green tea, which is unfermented and best when consumed as fresh as possible.

Our group is conducting metabonomics studies (the investigation of total metabolites) of Pu-erh tea. The Journal of Agricultural and Food Chemistry recently published some of our findings regarding the chemical constituents of various teas and the quality of the Pu-erh teas of various ages, using a cutting-edge set-up of hyphenated detection systems - containing high-performance liquid chromatography and mass spectrometry. When we compared Pu-erh tea with two other big names – Longjing (Chinese green tea) and Lipton (black tea), it appeared that Longjing is rich in polyphenols and theanine, while Lipton contains more theaflavic acid and thearubigin. Pu-erh tea possesses characteristic components such as theabrownin (a group of water soluble polyphenols exhibiting brown color) and gallic acid. The high

concentration of the tea pigment, theabrownin, gives Pu-erh its characteristic brown color and this pigment is considered a beneficial component. Gallic acid, one of the main products of EGCG degradation during fermentation, is another active component in Pu-erh tea, and is reported to reduce blood sugar and lipids in humans and inhibit the synthesis of cholesterol by HepG2 cells. In contrast to black tea, Pu-erh tea contains almost no theaflavin or theaflavic acid, compounds that contribute to the astringency and bitterness of tea. As Pu-erh tea ages, a number of components such as catechins, theaflavin, thearubigin, theanine, soluble sugars and caffeine greatly decrease, while the theabrownin and epicatechin contents increase.

We also performed a study on human subjects to investigate the human metabolic response to Pu-erh tea intake over a 6-week period using a metabonomics platform technology. Participants received a daily dose equivalent to 5 cups of a commercial preparation of tea. Twenty healthy volunteers – our graduate students whose mean age was 25 ± 2 years (range 22–32), were enrolled in this study. The urinary metabolic profile of these 20 volunteers was greatly altered by Pu-erh tea, characterized by the depletion of creatinine and the elevation of 4-methoxyphenylacetic acid, inositol, myristic acid, and 5-hydroxy-tryptophan. In addition, the metabolic consequences of Pu-erh tea ingestion persisted for 2 weeks after subjects stopped drinking the Pu-erh tea, due to the fact that Pu-erh tea changed the structure of the resident gut microflora.

Pu-erh tea possesses antimicrobial activity. Since bacteria in our gut play a very important role in the development of metabolic diseases such as obesity: understanding the lipid-lowering effect of Pu-erh tea may lead to a potentially revolutionary therapeutic regimen, in which diseases are treated by modulating people's intestinal bacteria.

Our study is still on-going. With rates of obesity and related metabolic diseases reaching epidemic proportions world-wide, this type of “tea” research may be critically important in developing an alternative intervention that targets multiple metabolic pathways including our “unhealthy” gut microflora with minimum adverse effects.

The key to unlocking the secret of how bioactive plant components improve our health is not the “single compound - single target” approach as practiced in conventional phytochemical and pharmaceutical industries, but a systems approach to understand the interplay between plant components as a “whole” and our complex metabolic system. We believe that this is going to be an exciting area in nutrition research and disease prevention. From an old traditional lifestyle, we see new enlightenment and a new research strategy. As Tim Maxwell wrote in his poem “In Tea....”

If you analyze tea, you'll find chemical components,
but not a hint of Life.
Analysis is achieved through concentration,
Synthesis arrives through relaxation.
Tea relaxes the stomach,
but it revitalizes the Heart.