Organic tea has more health benefit and environmental adaptability than conventional tea

WEN-YAN HAN[1], MING-ZHEN YANG[2]

Key words: organic tea, quality, tea polyphenols, catechin, proline, health benefit

Abstract

Organic tea is booming in China since it is regarded as a high quality and healthy food. To confirm this believing, six pairs of organic and conventional teas from eastern China have been studied. The results show that organic tea had significantly higher polyphenols, including epigallocatechin gallate (EGCG), epicatechin gallate(ECG) and epigallocatechin(EGC), and water extracts, compared to the conventional tea. The concentrations of proline and γ-aminobutyric acid were also significantly higher in organic tea. It could conclude that organic tea has more health benefit and environmental adaptability than conventional tea. However, the amino acids, particular theanine were generally lower in organic tea, suggesting sufficient or/and N rich organic fertilizer should be applied in organic tea fields.

Introduction

Tea (*Camellia sinensis* (L.) O. Kuntze), next to water, is the most popular beverage consumed worldwide. In vitro and animal studies provide strong evidence that tea polyphenols may possess the bioactivity to affect the pathogenesis of several chronic diseases (Khan & Mukhtar 2007). Organic farming is booming in China, since it is regarded as a farming system that could contribute to climate mitigation and sustainable agriculture, but produce high quality and safety products as well. Many comparison studies reveal that the contents of minerals, vitamins, proteins and carbohydrates in organic food are not much different with conventional food, but the contents of defence-related secondary metabolites may be more in organic food (Brand & Mølgaard 2001). Tea is a product that the secondary metabolites such as polyphenols are quality parameters. Is organic tea more healthful? Such information is urgently needed for further promotion of organic tea production and consumption.

Material and methods

The selected tea farms are located in Zhejiang and Fujian provinces, eastern China. This region has a subtropical monsoon climate with a clear division of four seasons and abundant sunshine. All the farms have both organic and conventional tea gardens. The organic tea gardens were converted from conventional ones for more than 10 years. The five farms in Zhejiang province have been described previously in great detail (Han et al. 2013). The farm, Zhangzhou Tea Farm in Fujian province, has mean annual temperature of 21.0 °C, and mean annual precipitation of 1500 mm.

Three independent tea samples were taken from each site under organic and conventional management, respectively in spring 2011. Tea samples consisting of one bud and two leaves were made into Maofeng, a kind of green tea in each farm. The samples were then taken to the laboratory, oven dried and grounded into powder by a stainless steel grounder before analysis. Total tea polyphenols, caffeine, free amino acids and water extracts in all 36 samples were analyzed according to China National Standards. Tea samples from Jinhua site were analyzed for different kinds of catechins and free amino acids. The analysis of catechin was described in great detail by Wei et al. (2011). The amino acids were determined by Hitachi L-8900 automatic amino acid analyzer.

A one-way analysis of variance (ANOVA) was used to compute means and the least significant differences (LSD) with different management systems as a factor by SPSS 13 for Windows. The significance level was set at $p < 0.05$. The values in the Table and Figures are mean values and standard deviation (SD) of three replicates.

[1]Tea Research Institute, Chinese Academy of Agricultural Sciences. http://www.tricaas.com/, email: hanwy@tricaas.com.
[2]Same as above.

Results

1. Main tea quality components

The main quality components including tea polyphenols, free amino acids, caffeine and water extracts in organic and conventional tea products are listed in Table 1. The results show that organic tea was significantly higher tea polyphenols than conventional tea in all six farms. On the contrary, the total free amino acids were remarkably or significantly lower in organic tea. There were no different in caffeine concentrations. The water extracts of organic tea were also higher than that of conventional one.

Table 1: Concentrations of main tea quality components in organic and conventional teas from six pairs of farm in Zhejiang and Fujian provinces, eastern China (%)

Site	Manage-ment	Tea polyphenols	Total free amino acids	Caffeine	Water extracts
Jin-hua	Organic	31.6±1.1 a	4.25±0.17 a	2.76±0.16	43.6±0.9 a
	Conventional	27.1±1.0 b	4.81±0.22 b	2.99±0.07	39.8±1.0 b
Yiwu	Organic	22.7±0.7 a	3.46±0.28 a	2.68±0.16	35.8±1.9
	Conventional	20.5±1.0 b	5.30±0.03 b	2.99±0.37	33.8±0.7
Wuyi	Organic	22.6±1.0 a	4.33±0.25	3.27±0.34	37.5±1.3 a
	Conventional	18.1±0.5 b	4.72±0.24	3.19±0.17	34.7±1.7 b
Yuyao	Organic	28.8±0.4 a	2.78±0.10 a	2.64±0.32	39.6±1.2
	Conventional	25.5±0.7 b	3.15±0.16 b	2.50±0.14	38.8±1.9
Lishui	Organic	31.8±1.1 a	6.97±0.21 a	3.77±0.19	47.8±1.1 a
	Conventional	29.1±0.6 b	7.78±0.03 b	3.75±0.24	43.9±1.7 b
Zhang-zhou	Organic	23.6±0.7 a	2.40±0.24	2.72±0.23	35.1±1.2
	Conventional	19.5±0.8 b	3.28±0.68	2.61±0.19	32.8±2.1

Means ± SD are presented. The following different letters within a column in the same farm denote significant difference ($p < 0.05$) between organic and conventional teas

2. Constituents of catechins

Catechins are main components of tea polyphenols. The concentration of total catechins on average was 132.2 g kg^{-1} in organic tea, significantly higher than 115.7 g kg^{-1} in conventional tea. The main constituents of catechin were also significantly different between organic and conventional teas (Fig. 1). The epigallocatechin gallate (EGCG), epicatechin gallate (ECG) and epigallocatechin (EGC) were significantly higher in organic tea than its conventional counterpart. The concentrations of other catechin components were all relative higher in organic tea except for catechin (C).

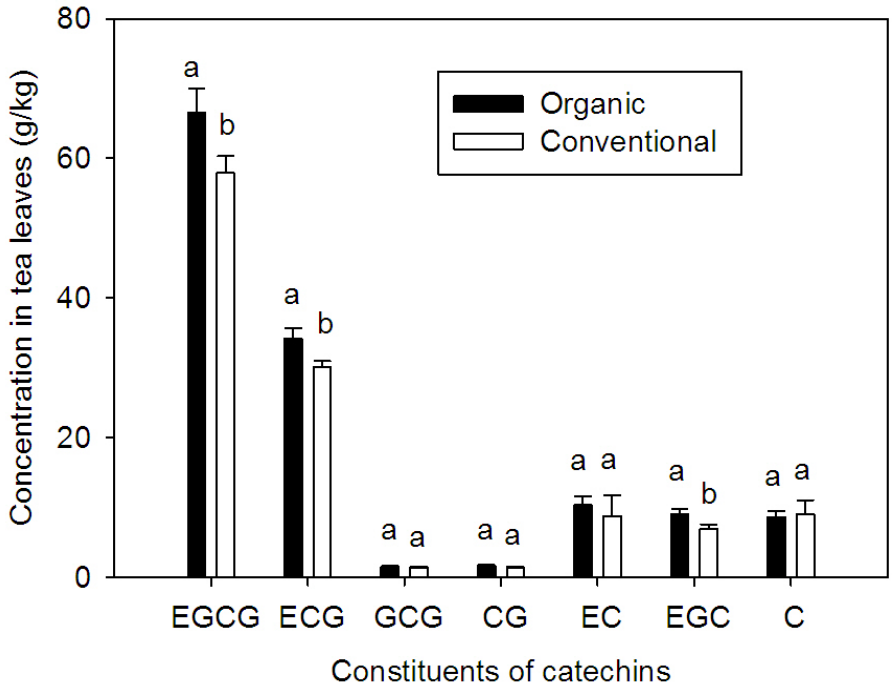

Figure 1. Concentrations of catechin components in organic and conventional teas from Jinghua farm. Vertical bars are standard deviations (SD). Different letters denote significant difference ($p < 0.05$) between organic and conventional teas in the same catechin.

3. Constituents of amino acids

The concentrations of different free amino acids in organic and conventional teas from Jinhua farm are presented in Fig. 2. The results show that aspartic acid (Asp), theanine (Thea) and arginine (Arg) were significant higher in the conventional tea. However, the proline (Pro) and γ -aminobutyric acid (GABA) were significantly higher in the organic tea. The other amino acids were not much different.

Discussion

Tea polyphenols, caffeine, free amino acids are main tea quality parameters. The higher is the better to some extent. These secondary metabolites not only have defence effect for tea plants, but health benefit to tea consumers. Tea polyphenols, particularly catechins are antioxidant and has anticarcinogenic effect, can prevent or cure cancers, cardiovascular diseases, diabetes, obesity and other bacterial and viral diseases; Thea and GABA can improve brain functioning (Khan & Mukhtar 2007). Pro could prevent plant damage from environmental stresses (Ashraf & Foolad, 2007). The present study show that organic tea was significantly higher in tea polyphenols, EGCG, ECG, EGC, Pro and GABA compared to conventional tea. Therefore, organic farming is beneficial to improve tea quality and its health properties, and also helps to adapt the adverse environment. Other organic products e.g. strawberry and orange also had more phenolic compound and antioxidant properties than their counterpart (Fernandes et al. 2012; Roussos 2011). The low concentrations of free amino acids, especially Thea in organic tea is probably due to the lower mineral N contents in soils under organic management, which could be improved by higher or/and N rich organic fertilizer application (Han et al. 2013).

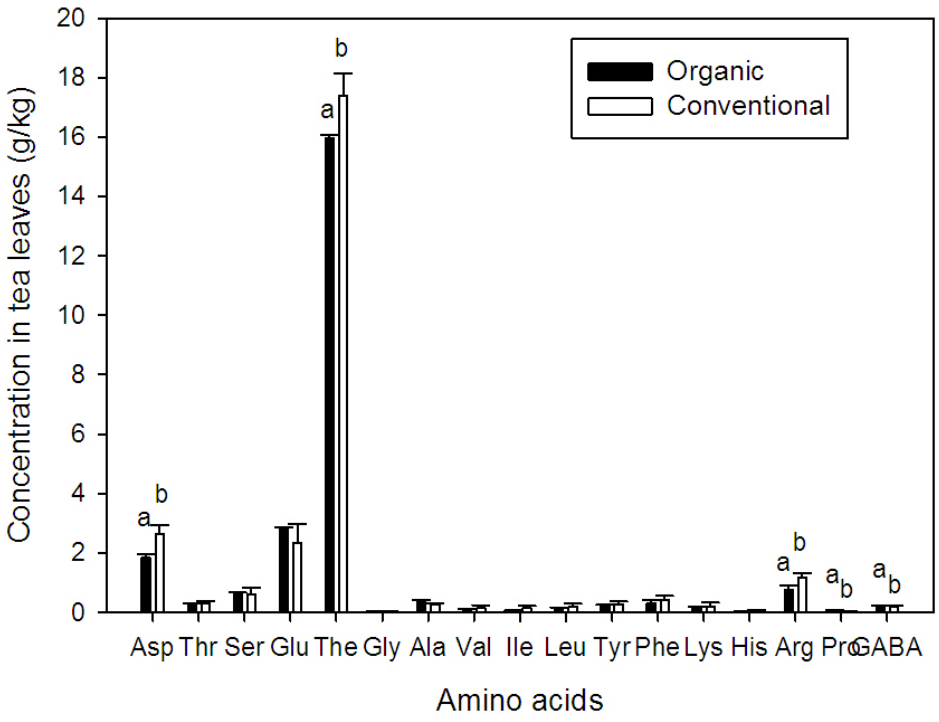

Figure 2. Concentrations of free amino acid constituents in organic and conventional teas from Jinghua farm. Vertical bars are SD. Different letters denote significant differences ($p < 0.05$) between organic and conventional teas in same amino acid.

References

Ashraf M & Foolad MR (2007): Roles of glycine betaine and proline in improving plant abiotic stress resistance. Environmental and Experimental Botany 59, 206-216.

Brandt K & Mølgaard JP (2001): Organic agriculture: does it enhance or reduce the nutritional value of plant foods? Journal of the Science and Food Agriculture 81, 924-931.

Fernandes VC, Domingues VF, Freitas VD, Delerue-Matos C & Mateus N (2012): Strawberries from integrated pest management and organic farming: Phenolic composition and antioxidant properties. Food Chemistry 134, 1926-1931.

Han WY, Xu JM, Wei K, Shi, RZ & Ma LF (2013): Soil carbon sequestration, plant nutrients and biological activities affected by organic farming system in tea fields. Soil Science and Plant Nutrition 59, 727-739.

Khan N & Mukhtar H (2007): Tea polyphenols for health promotion. Life Science 81, 519-533.

Roussos PA (2011): Phytochemicals and antioxidant capacity of orange (Citrus sinensis (l.) Osbeck cv. Salustiana) juice produced under organic and integrated farming system in Greece. Scientia Horticulturae 129: 253-258.

Wei K, Wang L, Zhou J, He W, Zeng J, Jiang Y & Cheng H (2011): Catechin contents in tea (Camellia sinensis) as affected by cultivar and environment and their relation to chlorophyll contents. Food Chemistry 125, 44-48.