Analysis of Meitan Cuiya Tea Aroma Components by GC-MS

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Abstract: The volatile components of Meitan Cuiya tea in Guizhou were determined, which provides theoretical basis to improve and enhance the aroma quality of Meitan Cuiya tea. Headspace solid-phase microextraction method (HS-SPME) combined with gas chromatography-mass spectrometry (GC-MS) was used for the analysis of aroma components from Meitan Cuiya tea. The relative contents of volatile substances in samples were determined and compared. Meitan Cuiya tea had 43 kinds of volatile compounds, among them, the predominant compounds were alcohols, esters, aldehydes, ketones, hydrocarbons and others, of which the major ones were ethanal (2.444%), methyl sulfide (5.264%), linalool (5.106%), trans-Geraniol (2.587%), dihydroactinidiolide (2.364%), hexadecane (3.605%) and caffeine (26.348%). The GC-MS method had the advantages of rapid, simple and accurate and it was suitable for the study of aroma components in Meitan Cuiya tea. It provides advanced technical support for further studies on the chemical composition of tea aroma components and formation mechanism of Meitan Cuiya tea aroma quality.

Introduction

Tea is one of the three famous drinks in the world, which is a natural healthy drink for the body. The present study shows that the aroma components of tea are the main indicators of anti-radiation, anti-allergy, anti-aging, anti-mutation and anti-cancer[1-2]. Up to now, nearly 700 aromatic substances have been isolated and identified[3]. The stimulant effect of tea is due to its inclusion of caffeine, while the volatile ingredients in tea are the main aroma source of tea[4]. The aroma of tea is one of the important indexes to evaluate the quality of tea, and it is also an important factor to make tea with different price. Therefore, the study of the chemical composition of tea aroma compounds not only can enrich the theoretical knowledge of tea biochemistry, but also has important significance for improving the aroma quality of tea.

Meitan Cuiya formerly known as Meijiang tea, flat tea in Guizhou Province, is named for its occurrence on the Meijiang River, has been 60 years of history [5]. Meitan Cuiya in 2011 won the "well-known trademark", and in 2014, it was protected by the national agricultural product geographic symbol, and the brand value reached 1.638 billion yuan in 2016. At the world expo in milan, Italy, in 2015, Meitan Cuiya won the golden prize of China famous tea of the centennial world expo[6]. Therefore, this study uses GS-MS to qualitatively and quantitatively analyze the

aroma components of Meitan Cuiya, to make a further study of the Meitan Cuiya tea aroma components. The aim of this study is to improve the cognition of the aroma composition of Meitan Cuiya tea, and to provide scientific basis for elucidating the chemical substance base of the aroma quality of Meitan Cuiya tea. It will provide theoretical basis and technical support for the further promotion of Meitan Cuiya in Guizhou.

Experimental

Materials and instruments

Meitan Cuiya tea sample was purchased of Meitan County in Guizhou Province, and has been identified as Camellia sinensis cv. Fuding-dabaicha by Professor Xiangpei Wang of Guiyang University of Traditional Chinese Medicine.

GC-MS analysis was carried out using an HP6890/5975C GC-MS spectrometer (Agilent USA) equipped with a ZB-5MSI 5%Phenyl-95%DiMethylpolysiloxane (30 m×0.25 mm×0.25 um) stone elastic capillary column, manual SPME (American Supelco company), the extracted fiber was 2 cm-50/30 umDVB/CAR/PDMS StableFlex.

Solid-phase micro extraction procedure.

The tea sample powder was accurately weighed (0.2 g) and placed into a 10 ml of solid phase microextraction sampling bottles, then, inserted into a manual injector with a 2cm-50 / 30umDVB / CAR / PDMS StableFlex fiber head. The temperature of headspace vial was kept at 120°C, exposed to the sample headspace for 40min. The extraction head was removed from sample vials and immediately inserted onto the GC injection port (temperature of 250°C), the sample thermal desorption for 3 min and then directly injected into GC.

Gas Chromatography–Mass Spectrometry analysis

The analysis of gas chromatography was using a ZB-5MSi (5% phenyl-95% dimethylpolysiloxane) fused silica capillary column (30 m×0.25 mm×0.25 mm). High purity helium (purity 99.999%) was used as carrier gas with a flow rate of 1.0 ml / min, samples were injected in splitless mode. The injector temperature were set at 250°C. The GC oven temperature was programmed to hold at 40°C for 2 min and then to increase to 255°C at 5°C / min, running 45min. The pre-column pressure was 7.62psi and the solvent delay was 1 min.

The Aglient 5975C mass spectrometer was operated in the electron impact (EI) mode using an ionisation energy at 70eV with a ionisation source temperature of 230°C and a quadrupole temperature set of 150°C. The emission current was 34.6uA, the multiplier voltage was 1482V, the interface temperature was 280°C and mass range was 29-500.

Data analysis

The peaks in the total ion flow map were retrieved by the mass spectrometer computer data system and identified by comparison to reference mass spectra in the Nist2005 and Wiley275 databases. The instrument Chemstation data processing system was used to determine the relative concentrations of the analytes by the peak area normalization method.

Results and Discussion

A total of 43 volatile components were identified in tea samples by GC-MS analysis(Fig.1), including 35 heterocyclic compounds (35.576%), 7 hydrocarbons (5.885%), 11 alcohols (14.758%), 4 ketones (5.267%), 3 esters (2.104%), 8 aldehydes (7.42%), and phenol only detected 2,4-di-tert-butyl phenol (0.342%), acid only detected butyl phthalate (0.166%), nitrogen compounds only detected caffeine (26.348%), the sulfuric compounds detected only dimethyl sulfide (5.264%). Oxygen heterocyclic compounds mainly linalool, ethanal; in hydrocarbon compounds, the saturated

hydrocarbon is dominated by hexadecane and unsaturated hydrocarbon mainly α-copaene and α-ionene; alcohol component mainly linalool and trans-Geraniol; ketone components mainly 2,3-octanedione and hexahydrofarnesyl acetone; ester component is methyl palmitate; aldehyde component is mainly ethanal. The corresponding volatile components are listed in Table 1.
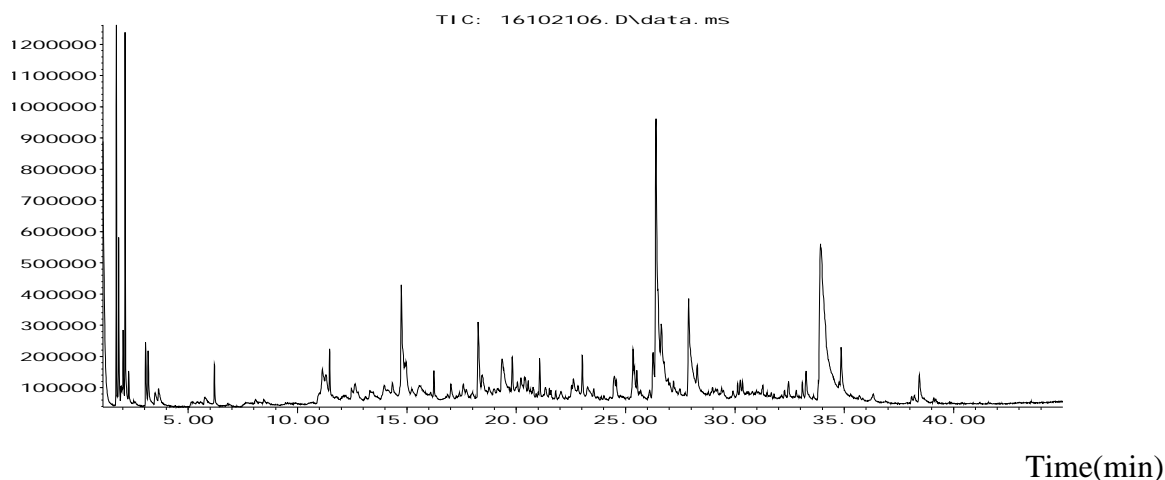

Time(min)

Fig1. TIC of volatile components extracted from Meitan Cuiya

Table1. Percentages of volatile components extracted from Meitan Cuiya

No.	Retention time	Volatlie components	Relative percentage proportions (%)
1	1.82	ethanal	2.444
2	1.92	ethanol	0.206
3	2.11	dimethyl sulfide	5.264
4	2.28	2-methyl-propanal	0.473
5	2.51	butanal	0.044
6	2.59	2-methyl-furan	0.036
7	3.05	3-methyl-butanal	1.418
8	3.17	2-methyl-butanal	1.578
9	3.48	1-penten-3-ol	0.518
10	3.64	pentanal	0.626
11	5.15	1-pentanol	0.284
12	5.77	hexanal	0.568
13	11.14	2,3-octanedione	1.734
14	11.30	2-pentyl-furan	0.979
15	12.63	2-ethyl-1-hexanol	0.524
16	14.34	trans-linalyl oxide	0.375
17	14.74	linalool	5.106
18	14.97	2,6-dimethyl-cyclohexanol	1.258
19	15.57	benzeneethanol	1.261
20	17.02	epoxylinalol	0.608
21	17.72	safranal	0.269
22	19.36	trans-geraniol	2.587
23	21.80	α-copaene	0.242

24	22.05	α-ionene	0.275
25	23.02	tetradecane	1.174
26	24.49	(E)-geranylacetone	0.982
27	25.35	β-ionone	1.161
28	25.51	pentadecane	0.582
29	26.10	2,4-di-tert-butyl-phenol	0.342
30	26.63	dihydroactinidiolide	2.364
31	27.88	hexadecane	3.605
32	28.28	α-cedrol	1.191
33	30.13	heptadecane	0.247
34	32.45	phytane	0.496
35	33.09	neophytadiene	0.438
36	33.26	Hexahydrofarnesyl-acetone	1.219
37	33.82	Diisobutyl-phthalate	0.385
38	33.92	caffeine	26.348
39	34.86	methyl-palmitate	1.676
40	35.69	butyl-phthalate	0.166
41	38.09	methyl-linoleate	0.191
42	38.21	methyl-linolenate	0.237
43	38.44	phytol	1.421

Conclusions

Aldehydes, alcohols, esters and enols have a good aroma quality. Aldehydes have a close relationship with the formation of aroma of food and various specific fragrances[7]. Alcohol compounds generally present flowers, fruit aroma and bouquet, ester compounds are mostly mild fruit aroma[8]. The relative quantitative analysis of aroma components in this experiment showed that ethanal, methyl sulfide, 2-methylbutanal, 2,3-octanedione, linalool, trans-geraniol, dihydroactinidiolide, hexadecane and methyl palmitate were prominent compounds. These components may play a direct role in promoting Meitan Cuiya tea aroma quality formation.

Based on the exploration of volatile components of Meitan Cuiya tea, the purpose of this study is to deepen the understanding of the physical and chemical constituents of the Meitan Cuiya tea. The experiment failed to identify certain ingredients from Meitan Cuiya tea, which may be related to our extraction method.The headspace solid phase microextraction (SPME) is a new technique of extraction, enrichment, and sample of solvent-free samples, which can be used to analysis and identification of tea with good performances[9]. However, the volatile component of Meitan Cuiya failed to fully optimize, to a certain extent, the volatile components of Meitan Cuiya were not volatile completely. Therefore, it should be combined with other extraction methods, such as simultaneous distillation extraction method for detection and analysis in order to explore the volatile aroma components of Meitan Cuiya tea.

Acknowledgements

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