

Effects of Different Cultivar, Flowering Date and Manufacture Process on the Chemical Composition and Mineral Element Content of Tea Flowers

Hun-Yuan Cheng, Horng-Jey Fan

The study was conducted to understand the chemical composition and mineral element content in flowers of tea cultivated cultivars. The experimental results showed that the fresh weight, dry weight, chemical composition and mineral element content had significant difference among cultivars. The fresh weight, dry weight, fresh/dry weight ratio and water content of full blooming were higher than that before blooming. The soluble solid, polyphenols, catechins and soluble sugar content had the same result, however, caffeine content had contrary trend, and amino acid content had no significant difference. The polyphenols and catechins content of non-fermented and directly dried flowers were higher than that of the fermented manufacturing process, but also showing more significant difference. There are no significant difference and consistent change among other chemical compositions.

Key words: Flower of tea cultivated cultivar, Chemical composition, Mineral element

Collection, Selection and Growth of Cover Crops on the Tea Garden  
Hun-Yuan Cheng, Shin-Yan Chen, Horng-Jey Fan, Ching-Hsiang Hsieh

The study was conducted to collection, selection and growth of cover crops in the tea garden, the ideal cover crop selected should be able to need the demand of labor saving and easy for large scale of propagation. So that decreased cost of weed management and increased competition of the tea production. Four entries of cover crops were chosen, included perennial peanut (Golden Glory, treatment A), perennial peanut (Amarillo, treatment B), Trailing Indigo (treatment C), Asiatic Pennywort (treatment D), and cultivated in tea farm along with the control treatment (uncovered field, CK). The results showed that the survival rate of perennial peanut (Golden Glory) was highest, Asiatic Pennywort was lowest in the tea garden. The survival rate of perennial peanut (Amarillo) and Trailing Indigo were in between. Root of perennial peanut (Golden Glory) formed a dense inter-mingled network in soil, which can prevent soil erosion efficiently. Its rapid growth character was able to endure high mowing frequency, and possessed rapid recuperative rate to inhibit weed growth. Perennial peanut (Golden Glory) was the best cover crops in tea farm for this experiment, and recommendation can be made to investigate the model of long-term cover crops on tea cultivate management. This information provides consultations to farmers for application and promotion of this system in the future.

Key words: Tea garden, Cover crop, Collection, Selection, Growth

## The Development Investigation of Chrysanthemum Species in Taiwan

Chiou-Fang Liu

There are three color-type of chrysanthemums in Taiwan, including yellow, white and purple flower species, and the yellow and white flowers are the main cultivated species. In this investigation show that the height and width of plant, number of branches, stem base diameter and yield did not significantly vary among the chrysanthemums under the same management conditions of cultivation. According to our experimental results, there is a regression relationship between the yield of chrysanthemum flowers and the stem base diameter, and also the plant height and the number of branches. The regression formulas are as follows:  $\text{yield} = -2.88 + 0.31 \times (\text{diameter of stem base})$ ,  $\text{yield} = -6.62 + 0.18 \times (\text{height of plant})$ ,  $\text{yield} = -6.53 + 0.01 \times (\text{number of branches}) + 0.16 \times (\text{height of plant})$ , and the R<sup>2</sup> value of the yield is 0.5 or more show that flowers was highly correlated with these traits. Therefore, if there are appropriate environmental conditions for promoting the certain growth traits, the chrysanthemum production should be improved.

Key words: Chrysanthemum, Development

## Effects of Roasting Temperature, Duration and Times on Catechins and Caffeine Content of 'TTES No. 13' Paochung Tea

Chia-Chi Fan, Meei-Ju Yang, Iou-Zen Chen, Ying-Ling Chen, Chin-Lung Lee, Chun-Ta Wu, Su-Feng Ruan

Roasting methods profoundly influence the chemical composition of Paochung tea. In this study, Paochung tea were produced from TTES No.13. The processing parameters under investigation included temperature (80°C, 100°C, 120°C), duration (1, 3, 6, 9, 12 hr) and the number of times. Summer tea of 2008 was used and first roasting was done in autumn of 2008. Second and third roasting were done in 2009. The last roasting was in 2010. After roasting, caffeine and catechins were analyzed by HPLC. Caffeine content increased after roasting. Catechins content of tea increased slightly and then decreased with increasing of roasting temperature and times. Tea quality were getting lower after roasting temperature, duration and times increased, tea liquor colors were turned to yellow or deep yellow, tea appearance turned to dark with roasted flavors and taste.

Key words: Tea roasting, Sensory Evaluation, Bitterness, Astringency

## Variation of Condense Water Quantity and Its Volatile Components during Low-humidity Drying of Paochung Tea

Meei-Ju Yang, Ming-Chun Liu, Teng-Feng Huang, Kuo-Renn Chen, Iou-Zen Chen

We investigated and analyzed the condensed water amount and the volatile components of TTES No.12 twisted paochung tea processed through the four steps of low-humidity drying machine

developed by Taiwan Tea Research and Extension Station. The result shows that there was fewer condensed water produced in the late drying stage and most condensed water was simultaneously formed at ten minutes after the drying beginning. During the low-humidity drying process, the condensed water collected from paochung tea with different water contents after panning all contained unique aroma of paochung tea, including linaloloxide, indole, cis-jasmone, nerolidol and geraniol. It indicates that the decreasing volatile components during the drying can bind to water molecules and be released as aromatic condensed water in the low-humidity drying process. For obtaining the maximum production, the aromatic condensed water should be collected right after the panning and rolling steps of paochung tea. If we view the volatile components as a measure of indicator, the low-humidity drying should proceed after panning step of Paochung tea for better tea aromatic condensed water production. However, further quantitative analysis of volatile components or sensory evaluation is still needed for the tea aromatic condensed water quality determination.

Key words: Partially-fermented tea, Paochung tea, Low-humidity drying, Volatile components

## Volatile Organic Compound Profiles in Cultivars and Relations to Ranking in Contest of White-tip Oolong Tea

Shu-Yen Lin, Kuo-Renn Chen, Iou-Zen Chen, Chun-Ta Wu, Su-Feng Roan

White-tip Oolong tea is a typical strong partially fermented tea in Taiwan. The tea is famous of its honey and fruity fragrances. The best choice of cultivar in good quality of White-tip Oolong tea was Chin-hsin-da-pan. It is necessary for a good quality of White-tip Oolong tea that buds and young leaves should be infected by green leafhopper (*Jacobiasca formosana*). The quality could be ranking by sensory evaluation. We analyzed the volatile organic compounds (VOCs) of the White-tip Oolong tea from different cultivars and different ranking in contest. Using headspace solid phase microextraction collected the VOCs and analyzing was conducted by GC-MS. Cultivars made for White-tip Oolong tea were including Chin-hsin-oolong, TaiCha No.12, TaiCha No.13, TaiCha No.17, Chin-hsin-da-pan, Shii-ji-chun, and Bai-mou-hou. The profiles between different cultivars suggested that linalool oxides, hotrienol, geranyl acetone, and trans- $\beta$ -ionone were the major compounds in White-tip Oolong tea's volatiles. Secondary metabolites analysis with clustering by UPGMA method showed the consistence to genetic similarity among cultivars. The VOCs also could be the effective chemical fingerprints in phylogenetic relation in analysis of cultivar's differences. The relation between VOCs and contest rankings with forward stepwise regression analysis was conducted. Linalool oxides, phenethyl alcohol, indole, trans- $\beta$ -ionone, and  $\alpha$ -farnesene are the positive correlation in the regression by the VOCs and contest ranking. The result revealed the possible compounds which were the important contributors to sensory evaluations.

Key words: Headspace solid phase microextraction (HS-SPME), Gas chromatography (GC), Cluster analysis, Forward stepwise regression, Sensory evaluation

## Effects of Water Quality and Temperature on Tea Liquor Quality and Chemical Compositions

Jia-Ru Dai, Ten-Lin Liu, Kuo-Renn Chen, Jin-Chih Lin

Wenshen Paochung tea, High-mountain Oolong tea and Dongding Oolong tea were brewed by four packaged mineral water (AM, BM, CM and DM), one packaged drinking water (PD), tap water (TW) and reverse osmosis water (RO). The results indicate that the higher pH of the brewing water the higher pH of tea liquor. When brewing with DM, PD and RO, tea liquors showed normal liquor color. The others were darkish and yellow. Wenshen Paochung tea, High-mountain Oolong tea brewed by DM, PD and RO had higher concentration of total catechins in tea liquors except for the Dongding Oolong tea. In sensory test, tea liquors prepared by BM, PD and DM were the top three of flavor and taste, CM, TP and RO had astringent and grassy flavor. Green tea (Biluochun), Wenshen Paochung tea, High-mountain Oolong tea, Dongding Oolong tea, Oriental Beauty tea and Black tea were brewed by three kinds of water temperature. The results indicate that the concentration of caffeine, total catechins, free amino acid and electronic conductivity and “b” values of liquor color increased with water temperature, but the “L” values were decreased with temperature.

Key words: Brewing, Caffeine, Total catechins

## Analysis of Six Phthalate Esters Residues in Tea by Liquid Chromatograph with Tandem Mass Spectrometer

Zheng-Wei Lin, Ming-Hua Tsai, Ming-Lun Sie, Yu-Ju Huang, Chia-Chang Wu, Iou-Zen Chen

We tried to establish the analysis method of the PAEs in tea by using LC/MS/MS. The PAEs were extracted from tea sample with methanol and then purified with high-speed centrifuge. As well as used multiple reaction monitoring mode (MRM), the PAEs were quantified and identified by the most abundant and character fragment ions. Limits of detection varied from 0.025-0.5 mg/L, limits of quantification were 0.02 mg/L. That consistent with the Taiwan Food and Drug Administration (TFDA) proposed 1 mg/L detection limits. The relative standard deviations were lower than 11%. Good linear relationships were observed with the correlation coefficients  $r^2 > 0.995$  for all analyses. The lowest recovery is 78% (DNOP) and the highest is 113% (DEHP) for the PAEs at 1 mg/L spiked concentration level. The proposed method provides an accurate, sensitive and appropriate for determination of 6 PAEs in tea samples.

Key words: Plasticizer, Phthalate, LC/MS/MS

## Dissipation of Chlorfenapyr in Tea Plants and Safety Assessment of Dietary Intake of Chlorfenapyr

Yu-Ju Huang, Chia-Chang Wu, Ya-Hui Chuang

The aim of this study is to evaluate the dissipation of chlorfenapyr in tea plants and risk assessment on human health. The Chin-shin Oolong and TTES No. 12 was investigated in this study.

Degradation rate of pesticide was determined by the residues of chlorfenapyr in leaves which

sampled at different intervals. Safety assessment of dietary intake of chlorfenapyr was evaluated by calculating the theoretical maximum residue contribution (TMRC) and actual residue contribution (ARC). It reveals that the half-life of chlorfenapyr in Chin-shin Oolong and TTES No. 12 was 4.8 and 4.4 days, respectively. It showed no different degradation rate of chlorfenapyr between Chin-shin Oolong and TTES No. 12. According to the tea pesticide residue analyzed results from 2007 to 2009, the TMRC and the ARC of chlorfenapyr were  $1.19 \times 10^{-4}$  and  $1.05 \times 10^{-5}$  mg/day/kg BW, respectively. It suggested that when residue of chlorfenapyr were lower than its MRL, it may not cause threaten to human health.

Key words: Tea, Chlorfenapyr, Dissipation

### Current Status, Breeding, and Promotion Strategy of Tea Industry in Japan

Chun-Liang Chen, Ju-Hung Lin, Jia-Ru Dai, Jin-Chih Lin

Japan and Taiwan have similar tea cultivation status and drinking culture and also face the same problems. The cultivated area of Yabukita is too large (76%), tea prices continue to fall, the cultivated area continues to decrease, factory utilization is too low, and most young people do not like brewing tea. Faced with these problems, Japanese tea industry holds all kinds of extension activities to promote tea sales. At the same time, definite strategy for the breeding of new cultivar was developed, and hoping to solve these problems. This paper was collated by visiting farmers and research and extension stations, participating in conference and collecting data during more than two months in Japan. Hoping this experience can be the reference of promoting Taiwan's tea industry.

Key words: Japan, Tea, Breeding, Extension