

Study of Tea Ingredients for Reducing Fumonisin B₁ (FB₁)

Shiou-Ruei Lin Yu-Ju Huang Tien-Lin Liu Jia-Ru Dai

The contents of fumonisin B₁ (FB₁) of cereals and animal feeds which are commercial available have been analyzed by high-performance liquid chromatography (HPLC). The result showed the FB₁ content, 4 ppm, of unpolished rice was the highest one among nine cereals. FB₁ was normally present in eight kinds of animal feeds, especially it was higher in cattle and poultry feeds. The ability of detoxification of certain non-fermented (TTES No. 13) and partially fermented teas (TTES No. 1) were higher than other tea treatments. Theanine could be the key component for detoxification. According to the result, it could reduce the toxin uptake from foods in human body by drinking large amount of certain non-fermented and partially fermented tea. It seemed not only to reduce the toxin but increase the dissolution of FB₁ to exclude human body. It could also eliminate the health injury caused by FB₁ of raising animals by adding certain tea supplements into animal feeds and cut down the economic loss further.

Key words: Tea, Fumonisin B₁, High-performance liquid chromatography, Theanine

Study of Endophytic Fungi in Theaceae Plants

Shiou-Ruei Lin

Endophytic fungi normally exist in plants. Endophytic fungi not only symbiotic live within plants, but also promote plants growth, increase the tolerance of stress from environment and protect plants from pests. There is very less research about endophytic fungi in Theaceae plants in Taiwan. In this short-term research, *Camellia sasanqua* and *C. japonica* were considered as modeling plants for endophytic fungi study in order to apply in the research about *C. sinensis* in the future. Expect to achieve the goal which is to enhance the tea plants growth and decrease the damage from pests. Among ten kinds of made tea, the endophytic fungi isolation rate in white tea is 28.18% the highest one. The endophytic isolation rate is usually lower than 5% in other made teas. Detection fungi DNA in made tea by extraction and PCR showed that the fungi content in made tea influence by tea processing. The fungi content was reduced gradually as follow non-fermented tea, partially-fermented tea and fully fermented tea. According to this result we support "Rolling" in tea processing is the key factor influence the survival of endophytic fungi in made tea. However, there was no endophytic fungi isolated from the made tea after steeping in boiling water for five minutes. Endophytic fungi types are differ from different tissues. The morphotypes of endophytic fungi in roots are more than in leaves. The endophytic isolation rates of roots are more than 50% and correlated with the plant species. The endophytic fungi morphotypes from roots of *C. sasanqua* are usually more abundant than *C. japonica*. The endophytic isolation rates of leaves are increased with the plant age. The endophytic fungi isolation rate in leaves are usually high even more than 90%. The dominant endophytic fungi morphotype from leaves of testing Theaceae plants is *C.*

Key words: Endophytic fungi, Theaceae, Tea processing, Rolling

Selection of Low Methylxanthine Tea Cultivars

Chien-Ju Liu Chiou-fang Liu Yen-Shuo Su Shih-Kai Lo Chui-Feng Chiu
Hsien-Tsung Tsai

Caffeine acts as a stimulant for the heart, respiratory and the central nervous system and also a vasodilator (relaxes the blood vessels). There are certain side effects to the human, including the stimulation of central

nervous system, sleeping influence, increasing blood pressure, enhancement of Rheumatoid arthritis's prevalence rate, as well as causing babies to be prematurely delivered. Consumers prefer low caffeine tea, which could maintain the tea flavor and the nutrient. The breeding of low caffeine tea is one of the methods. Tea contains the methylxanthine, which was mainly contributed by caffeine (2-5%), with the few theobromine (approximately 0.05%) and the theophylline (approximately 0.002%). The theobromine and the theophylline are precursors of caffeine, and they also stimulate the functions of human body, central nervous system, palpitation and diuresis. We expected to select the cultivars or lines of tea trees with low content of caffeine, theobromine and theophylline, and then we could formulate the caffeine rank of different cultivars and lines of tea trees. The results showed that the content of caffeine and theobromine were the highest in autumn, followed by summer and spring. As for the content of theophylline, there was no significant difference among seasons and cultivars (lines). Compared to the preliminary Taiwan's existing cultivars and local strains caffeine contents were divided into three levels. In summer tea: the first level < 23.39 mg/g, the second level 23.39-29.85 mg/g, the third level >29.85 mg/g. In fall tea: the first level < 24.70 mg/g, the second level 24.70-31.56 mg/g, the third level > 31.56 mg/g. In spring tea: the first level < 24.34 mg/g, the second level 24.34-31.28 mg/g, the third level >31.28 mg/g. The caffeine contents of Gao-Lu, Wu-yi, Jin-gui and Wu-Gu-Zi were 18.01, 18.93, 19.26 and 19.53 (mg/g) were less than 20mg/g of all cultivars (lines), which were classified as the cultivar with low caffeine content.

Key words: Caffeine, Tea, Theobromine, Theophylline, Methylxanthine

Drought Injury Factor and Its Effect on Shoot Growth of Tea Tree

Hun-Yuan Cheng Chin-An Yu Horng-Jey Fan

This study was aimed at investigating the cause of drought injury and its effect on shoot growth of tea tree (*Camellia sinensis* (L.) Kuntze) in Hualien and Taitung in 2007 and 2013. Climatic factors change of drought period was analyzed and recorded during tea tree injury conditions, and also to investigate the effects of other non-climatic factors of drought injury and its effect on shoot growth, they may be the management, adjustment and tea tree production references. The results of this study showed that the primary factor causing drought injury was the climatic change, and the location of tea garden, tree vigor, cultivar, tree age, model of cultivation and management, pest and disease were all factors that affect the heavy or light injury of drought. Tea garden has a good ecological environment, planting drought resistant cultivars, drought of shading, pruning before the drought, was able to alleviate drought injury. Internode diameter was larger and shorter during drought season. Leaf area was also small. The leaf inward-folding degree of non-shading treatment was larger than those of shading treatment, the leaf greenness was lower in contrast. The leaf inward-folding degree of drought season was obvious for wild tea trees in Yung-Kang Mountain, and the leaf area was smaller. It was showed that self-adjustment ability on drought stress may be higher than other cultivars, the autumn tea production was significantly lower after drought season than those of non-drought season.

Key words: Tea tree, Drought injury, Shoot growth

Breeding of Taiwan New Tea Variety ‘TTES No. 22

Tair-Chyang Lee Chui-Feng Chiu Kuo-Jen Chen Iou-Zen Chen Chih-Yi Hu

The new tea variety, TTES No. 22, was generated from a cross “TTES No. 12” and “Chin-Shin Oolong” bred by Tea Research and Extension Station, Council of Agriculture, Executive Yuan in 1996. Through individual selection test, lines trial, and DUS testing, TTES No. 22 was approved the Plant Variety Right in 2015. TTES No. 22 was cultivated in Tea Research and Extension Station which was in moderate and low

altitude area. The plant type and vigor of TTES No. 22 are similar to TTES No. 12. Besides, TTES No. 22 was an early sprouting variety. Its shape of mature leaf is situated between Chin-Shin Oolong and TTES No. 12. In the yield per season, TTES No. 22 was greater than TTES No. 12 and Chin-Shin Oolong. The disease resistance of TTES No. 22 was akin to TTES No. 12. Also, Paochong tea made with of TTES No. 22 had intense floral scents and sweet taste. As for sensory test, TTES No. 22 had higher score comparing to Chin-Shin Oolong and TTES No. 12. Considering TTES No. 22 possessed the characteristics of strong flavor and superior growth potential, it could be developed in moderate and low altitude tea garden, which would increase the diversify of tea flavor, and provide for the renew of old tea gardens, increasing the tea farmers' incomes.

Key words: Tea, *Camellia sinensis*, Hybrid breeding, Paochong tea, TTES No.22

Development of DNA Identification Technology for a New Variety of Taiwan Tea Trees, TTES No. 22

Chih-Yi Hu Shih-Kai Lo Chui-Feng Chiu

The variety TTES No. 22 suitable for making Paochong tea was bred by Tea Research and Extension Station, and the Plant Variety Right was approved in 2015. The research was aimed to develop DNA fingerprinting for 13 tea varieties including the new tea variety, TTES No. 22, its parental lines, and other prevailing tea cultivars in Taiwan by SSR and CAPS markers. Among 41 polymorphic SSR markers, each primer pair could detect 6.2 alleles in average, and the average polymorphism information content (PIC) was 0.64. Using selected two core SSR markers could identify 13 tea varieties. Within 39 CAPS polymorphism markers, an average of 2.4 alleles was detected, and the average PIC was 0.32 per locus. For 13 investigated tea varieties, five core CAPS markers were sufficient for effective identification. Both of the markers had their own pros and cons. As a result, the choice of marker should depend on the equipments and operations of laboratory. The results of scientific identification could be a testimony to tea varieties, and used for clearing the ambiguity.

Key words: Tea (*Camellia sinensis*), TTES No. 22, DNA molecular marker, SSR, CAPS, DNA fingerprinting

Study of Tea Dregs Add to Degradable Plastics for Plug Manufacturing

Yen-Shuo Su Shih-Kai Lo Chiou-Fang Liu Chien-Ju Liu
Shun-Hong Wang Chui-Fong Chiu Hsien-Tsung Tsai

We use biodegradable polyesters include polylactic acid (PLA), polyhydroxyalkanoates (PHA), polybutylene succinate (PBS), polycaprolactone (PCL) and other materials, add tea dregs 20%, 25%, 30%, 20% tea powder and 25% starch, according to their tensile strength, elongation, Young's modulus, to select formulations to manufacture six plugs. Due to the physical characteristics of tea dregs and tea powder, the mixing ratio depends on the upper limit of 30% with the polyester. The heavy metal content analysis of plug has not yet exceeded the heavy metal content standards of States biodegradable plastic products. After two nurseries, the nutrient content of different formulations and heavy metal content of plug were not significant. The potassium and phosphorus content have decreased over time in the treatment with 20% tea powder. In media terms, although the content of phosphorus and potassium in plugs decreased in the treatment with 20% tea powder, but the phosphorus and potassium content of medium were not higher than other treatments. There are no significant differences in the content of each element among the other treatments, only the aluminum content of the medium in the treatment with 30% tea dreg is significant higher than other treatments for the second harvest. The potassium content of the medium in the treatment with tea dreg is higher than control check for the

second harvest, the trend of phosphorus content is also same. The plugs added with tea dregs are more fragile, but do not affect the operation, they could be reused up to 3-4 times. We imitate the possible handling ways those farmers aimed at abandoned plug at the end of the nursery. Plugs added with tea dregs and tea powders after use are buried in soil, compost and placed in a greenhouse, then they almost completely degraded after 180 days. The results show that biodegradable plastics added with tea dregs and tea powders and production of seedling materials have application potential. Related products should develop continuously, use effectively by products produced in tea production, increase production value and decrease the burden on the environment in the future.

Key words: Tea dreg, Degradable plastics, Plug

Effect of Different Waters on Chemical Compositions of Green Tea Liquor Brewed by Hot and Cold Water

Jia-Ru Dai Tien-Lin Liu Shiou-Ruei Lin Meei-Ju Yang Kuo-Renn Chen

In order to understand the effect of different waters and temperature on tea liquor compositions, seven kinds of water included reverse osmosis water (A), tap water (B), commercial packaged drinking water (C, G) and commercial packaged mineral water (D, E, F) were used to brew green tea by hot and cold water. The result showed that green tea liquors brewed by hot water with B, D, E treatments showed lower content of EGC, EGCG and total individual catechins than other treatments, while the content of GC, C and GCG were higher than others. Green tea liquors brewed by cold water with B, D, E treatment showed lower EGC, EC, EGCG, EGC and total individual catechins than A, C, F, G. When green tea brewed by hot tap water, the measurements of GC, EGC, C, EGCG and GCG in tea liquor were decreased with increasing time. After 20 hours, GC, EGC, C, EGCG and GCG decreased to 82.10 %、76.71 %、87.61 %、75.22 % and 88.37% while EC and ECG were relatively stable. The data showed that catechins were highly unstable in the liquor brewed by hot tap water. The main reason might be the combined effect of pH and ions in tap water.

Key words: Water quality, Catechins, Tea liquor

A Study on Heat Efficiency of the Improved Tea Dryer

Cheng-Hou Chang Wei-Yang Hwang Yi-Hao Lin
Ming-Chun Liu Chia-Chang Wu

The continuous type of tea dryer is popular and important machine in tea processing, but the excess energy consumption and heat lost in tea processing operations should be improved. The study would improve heat efficiency of the tea dryer by improved heat exchanger and recycled partial hot air and then operated preheated test for energy consumption evaluation. According to the results of experiments, the average temperature of combustion exhaust gas in tea dryer with improved heat exchanger was decreased 35.2°C and fuel consumption was reduced 7.8%. In tea dryer with recycled hot air, the average temperature of input air increased 10°C and fuel consumption reduced 17.9%, that showed the improved tea dryer which might increase heat efficiency and decrease heat lost. So the improved tea dryer could reduce fuel consumption and carbon dioxide emission.

Key words: Tea, Dryer, Heat efficiency

Study of Health Management and Production System of Chrysanthemum Flower: A Case of Tongluo Township, Miaoli County

Shiou-Ruei Lin Chin-An Yu Hsing-Kuang Tseng Chia-Chang Wu
Chiou-Fang Liu Yu-Ju Huang Chui-Feng Chiu

Chrysanthemum is a kind of natural and healthy beverage. However, farmers usually rely on pesticides to control pests. Therefore, it is an apprehension about pesticide residual. In this study, we applied the integrated pest management in chrysanthemum production. The result showed that bud-picking repeatedly could reduce the pest populations effectively during chrysanthemum growing period. Utilizing non-pesticide materials including *Bacillus thuringiensis*, sex pheromone and natural enemies were used to control moth larvae, moth, aphid, mite and whitefly for yield-maintaining and non-pesticide detecting. Subsequently, it could reach the goal of protecting consumers' health and increase the quality of chrysanthemums. The extended use of Formetanate to control mites in chrysanthemum, in this study, the developed pesticide-analysis method can be applied to analysis the Formetanate residual in chrysanthemum from the results of the recovery ratio, RSD value, LOD and LOQ.

Key words: Chrysanthemum, Integrated pest management (IPM), Pesticide residue

Effects of Different Cutting Days, Medium, Cells of Plug on the Rooting of Chrysanthemum Cuttings

Guo-Zhong Hsiao Siao-Yi Huang Meng-Chin Hsiao
Jai-Wei Lee Jyh-Shyan Tsai

This study was focused on the cutting propagation of chrysanthemum (*Chrysanthemum morifolium* Ramat.). The cuttings were cultivated with 7, 14, 21 and 28 days. We found the root number and root dry weight were low when cultivated with 7 and 14 days. After 21 days, the rooting of cuttings turned better. Cutting media experiments including peat moss mixed with perlite (1: 1 v / v), peat moss mixed with vermiculite (1: 1 v / v), peat moss mixed with sand (1: 1 v / v), sand and two kinds of commercial culture soil showed peat moss mixed with perlite stone and sand have benefits to root of chrysanthemum cuttings. But sand medium was difficult to transplant because loose. The cuttings remained 4 or 6 leaves were cultured respectively in the 70 or 128 cells of plug. A combination of remained 6 leaves and cultured in 70 cells had better rooting ($p < 0.05$).

Key words: Chrysanthemum, Cutting, Medium, Plug

Chrysanthemum Cultivars - Taiwan Hang Ju No. 1 and No. 2 Selection and Nomenclature

Chiou-Fang Liu Hsun-Yao Chang Chih-Chun Kuo Meng-Chin Hsiao
Yen-Shuo Su Chih-Yi Hu Chui-Feng Chiu Iou-Zen Chen

The chrysanthemum culture of Taiwan was come from China. The dried flowers were used for traditional Chinese herbal medicine or beverage. Even though chrysanthemums had planted in Taiwan for many decades, there is no coincidence for cognition of the 'chrysanthemum' naming. Our station worked with the Miaoli

District Agricultural Research and Extension Station to name chrysanthemum. White and yellow lines have officially named the "Taiwan Hang Ju No. 1" and "Taiwan Hang Ju No. 2." on November 24, 2014.

Taiwan Hang Ju No. 1 and No. 2 have no tubular flowers. The seedling almost was taken by natural division propagation. These two cultivars show stem erect, green leaves are serrated, dorsal leaves have white hair. The plant traits of them have similar appearance before blooming. After flowering, ray florets of Taiwan Hang Ju No. 1 are white, the fold ray florets are yellow. Ray florets of Taiwan Hang Ju No. 2 are yellow even it were open up.

The dried flower color of Taiwan Hang Ju No. 1 was light brown, the liquor color was yellowish, the aroma was evaporated, the taste was sweet; the dried flower color of Taiwan Hang Ju No. 2 was golden yellow, the liquor color was light yellow, the aroma was much evaporated than No. 1, the taste was clean and sweet. Use drying mode of stepwise heating, then compare total polyphenol and chlorogenic acid, all the data show that Taiwan Hang Ju No. 2 higher than No. 1, and have significant difference.

Farmers have proceeded to do pinching repeatedly, this practice has caused large canopy surface, and the stems were fractured easily by wind damage, so farmers should be appropriately to set up a fixed net. Because rainy season started in the north area of Hsinchu on November to December, to avoid poor quality of flower during main harvest period, we suggest that farmers should not conduct outdoor planting in these areas.

Key words: Chrysanthemum, Taiwan Hang Ju No. 1, Taiwan Hang Ju No. 2

The Survey of Tea Drinking Conditions for Young People and Its Application in Extension

Cheng-Nan Lai

Many research reports from many countries have showed that hot-brewed teas could extract lots of beneficial components from the tea liquors of first and second brewing. But the market value of tea drinks is 2.4 times for general teas, and major consumers for tea drinks are young people. This survey use purposive sampling method to sample randomly three hundred consumers from mail lists of extension booklets, activities and visitors. Then conduct questionnaire surveys to collect data. The objectives of this survey are to enquiry their understanding state of tea types, tea-drinking conditions (including the major types and drinking frequency), reasons of whether drink teas or not, marketing & propaganda methods, resource of tea related information and other suggestions for young people based on health appeal for "Drink teas constantly that is good for your health" and an increase in sale volume of Taiwan unique teas. This research has complied and concluded eight reviews and suggestions based on research results and related reference information. We hope these information could supplied as references of guiding and extending tea industry for related units, and supplied as references of drawing up marketing plans for proprietary of tea industry.

Key words: Young people, Tea drinking, Extension

The Study of Consumption Behavior of Taiwan Teas for Mainland China Tourists

Yi- Hao Lin Wei-Cheng Pan Ting-Mei Kuo Jin-Chih Lin
Cheng-Nan Lai Ku-Yuan Lee

To understand the situation of purchasing Taiwan teas for million mainland China tourists in every year, we have conducted sampling questionnaire survey of purchasing Taiwan unique teas for mainland China tourists in departure hall of International Taoyuan airport in 2013-2014. The results of 2013 show that 60.5% of tourists

bought teas, everyone pay average NT\$ 8,665 to buy 1.545 kg teas in 1,300 recovery questionnaires. The results of 2014 show that 56% of tourists bought teas, everyone pay average NT\$ 6,695 to buy 1.183 kg teas in 708 recovery questionnaires. The average purchasing volume of teas in 2014 has decreased 0.362 kg, and the average cost of teas in 2014 has decreased NT\$ 1,970 than those of 2013 respectively. We infer that these results should be related to the implement of the Chian Tourism Law. The major purchasing Taiwan unique tea is high-mountain tea for mainland China tourists (accounts for nearly 86%). The major purchasing place of Taiwan teas is surrounding areas of Mt. Ali led by tour guides (accounts for nearly 89%), the minority areas are scenery areas, airport and tourists bought teas from anywhere by themselves. The major purposes of purchasing Taiwan unique tea are drinking for themselves and presenting a gift for someone. These results show that mainland China tourists have a very high interesting for Alishan teas. Above survey results could let us understand the preferences and characteristics of purchasing Taiwan teas for mainland China tourists, they also could be a reference for planning extension & marketing strategy of Taiwan teas in future.

Key words: Unique Tea, Mainland China tourist, Purchase behavior

The Survey of Man-power Requirement Condition for Tea Industry

Yi- Hao Lin Wei-Cheng Pan Ting-Mei Kuo Jin-Chih Lin Cheng-Nan Lai

To understand the condition of man-power requirement for tea industry, this study use questionnaire survey to explore the tea industry most needed items for the work of man-power is hand-pluckers (87%) in spring, followed by tea manufacturers (5%), most of the times are all needs in April belonging to a seasonal labor-shortage. The majority of hand-pluckers are temporary workers, they are called in mainly by plucking teams' foreman. The good skilled hand-pluckers of Nantou & Cha-I Counties which possessed the largest tea planting area are about 92 (man × day) per hectare in April. More than half of tea farmers (about 53%) hope that Farmers' Association to set up human agency services platform, and the Council of Agriculture to negotiate with The Ministry of Labour to solve the problem of labor-shortage through the introduction of foreign workers.

Key words: Tea industry, Manpower, Hand-plucking