行政院國家科學委員會專題研究計畫 成果報告

天然多酚對調節性細胞免疫反應之影響--從系統生物學到分子免疫學(第 3 年)
研究成果報告(完整版)

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行政院國家科學委員會補助專題研究計畫 ■ 成 果 報 告
□期中進度報告

（計畫名稱）

天然多酚對調節性細胞免疫反應之影響—從系統生物學到分子免疫學

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成果報告類型(依經費核定清單規定繳交)：□精簡報告　■完整報告

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中　華　民　國 100 年 10 月 20 日

Abstract

(Part I)

This study was aimed to investigate the acute effects of green tea consumption on selected salivary defense proteins, antibacterial capacity and anti-oxidation activity in taekwondo (TKD) athletes following intensive training. Twenty-two TKD athletes performed a 2-hr TKD training. After exercise, participants ingested green tea or equal volume of water. Saliva samples were collected before training, immediately after training but before drinking, and 30 min after drinking green tea or water. Results show that α-amylase activity and lactoferrin, sIgA concentrations were significantly increased immediately after intensive TKD training, however, salivary antibacterial capacity was not affected by intense training. Green tea consumption after training enhanced salivary antibacterial capacity and further stimulated α-amylase activity. Lactoferrin and sIgA concentrations returned to pre-exercise values after 30 min of rest. Additionally, we observed that salivary FRSA was markedly suppressed immediately after training and quickly returned to pre-exercise values regardless of which fluid was consumed. Our results demonstrated that green tea consumption exerts acute effect on the concentrations of salivary oral defense-related proteins and significantly enhances salivary antibacterial capacity.

Keywords: Antioxidants · Exercise physiology · Immune function · Physical stress · Sports and nutrition

(Part II)

The aim of this study was to investigate the cumulative effects of intensive resistance training on salivary immunoglobulin A (SIgA) and cortisol responses in elite male weightlifters. Eleven elite male Taiwanese weightlifters trained through three training stages before a national weightlifting competition and followed by a two-week recovery stage. Results showed (a) salivary TP concentrations were not significantly affected; (b) resting levels of SIgA, SIgA/TP, cortisol, and cortisol/TP were significantly higher in training stages than in recovery stage; (c) a positive correlation was revealed between the ratios of SIgA/TP and cortisol/TP; and (d) the resting salivary lactoferrin concentrations and the ratio of lactoferrin/TP were significantly lower in stage I than in recovery stage. The findings in this study suggest that prolonged, intensive resistance training exerts cumulative effects on SIgA and cortisol responses in elite weightlifters.

Key Words: Weightlifting · Stress response to exercise · Immune function · Exercise physiology

(Part I)
本研究針對跆拳道選手在高強度的訓練後攝取綠茶對於黏膜免疫、唾液中抗菌蛋白表現及抗氧化能力之影響。22 位跆拳道選手在進行 2 小時的高強度訓練後，攝取綠茶或是水當作對照組。分別在訓練前、訓練後及喝完綠茶後 30 分鐘收集唾液，進行分析。結果發現澱粉酶活性，乳鐵蛋白及免疫球蛋白 A 的濃度在高強度訓練後立即顯著增加，但是抗菌能力沒有明顯的改變。如果攝取綠茶者其抗菌能力及澱粉酶活性顯著增加，澱粉酶活性及免疫球蛋白 A 在休息 30 分鐘後都回到與訓練前差不多。另外我們發現唾液中抗氧化能力在訓練後立即下降但休息後又回到與訓練前的水準。我們發現攝取綠茶對抗菌能力有顯著的增強。
(Part II)
本研究針對舉重選手在連續高強度的訓練後對黏膜免疫系統功能之影響。11 位優秀的選手分別在比賽前三個不同的階段與比賽後休息的階段分別收集唾液，進行分析。結果發現唾液中總蛋白質的量不受影響；訓練期的免疫球蛋白 A、免疫球蛋白 A 對總蛋白質的比值、可體松及可體松對總蛋白質的比值顯著高過休息的階段；在免疫球蛋白 A 對總蛋白質的比值與可體松對總蛋白質的比值有顯著正相關的關係。這些發現顯示長時間、高強度的阻力訓練將影響舉重選手的免疫球蛋白 A 與可體松的反應。

關鍵字：綠茶、抗菌蛋白、免疫球蛋白 A、澱粉酶活性、抗氧化能力、黏膜免疫系統功能

前言

(Part I)

Green tea is a non-fermented/oxidized tea and contains various polyphenolic flavonoids, including epicatechin, epicatechin gallate, epigallocatechin and epigallocatechin gallate. Consumption of green tea has been reported having many beneficial health effects, such as anti-angiogenic, anti-carcinogenic and anti-diabetic activities

(Part II)

A primary objective of resistance training program for elite weightlifters is to increase the maximum muscle strength. Studies revealed that intensive resistance training acutely stimulated the secretion of anabolic hormones, such as growth hormone and testosterone.

研究目的

(Part I)

It has been suggested that the pharmacological properties of green tea may be mediated, at least partially, by its potent anti-oxidative activity, anti-inflammatory and immunomodulatory effects. Thus, it is plausible to assume that the detrimental effects caused by high-intensive exercise may be alleviated by consumption of green tea. Therefore, the aim of this study was to investigate the acute effects of TKD training on salivary defense factors and antibacterial capacity of male and female athletes. In addition, whether and how green tea consumption exerts effects on these salivary factors following TKD training were also examined.

(Part II)

Whether and to what extent intensive resistance training affects mucosal immune function and stress response in elite weightlifters are yet unclear.

文獻探討

(Part I)

Many factors presented in mucosal secretions serve as a first line of defense against microbial infection, including immunoglobulins (Igs), α-amylase and anti-microbial peptides (AMPs) (Amerongen and Veerman 2002; Thrane et al. 1991; West et al. 2006). Salivary IgA contributes to mucosal immunity by preventing adherence of microbes to the mucosal surface (Marcotte and Lavoie 1998). Amylase was shown to function as an antibacterial protein inhibiting bacterial growth and colonization in the oral cavity (Bortner et al. 1983; Jespersgaard et al. 2002). Lactoferrin, one of the most abundant salivary AMPs, exerts an antibacterial effect by sequestering iron, an essential nutrient for bacterial growth, as well as directly interacting and damaging bacterial membrane (Arnold et al. 1977; Ellison et al. 1988; Jenssen and Hancock 2009). Additionally, saliva constitutes various kinds of anti-oxidative systems that guard against oxidative damages induced by free radical-mediated oxidative stress (Battino et al. 2002). The salivary total antioxidant capacity can be estimated by measuring the free radical scavenging activity (FRSA) (Atsumi et al. 2008). However, salivary exertion of these defense factors can be affected by high-intensive exercise (Chicharro et al. 1998). Prolonged, strenuous exercise has been implicated in immunosuppression, induction of inflammatory response and increased production of free radicals (He et al. 2010; Laing et al. 2005; Sjodin et al. 1990). Therefore, development of nutritional strategies to alleviate the negative effects

of high-intensive exercise would seem particularly desirable.

Green tea is a non-fermented/oxidized tea and contains various polyphenolic flavonoids, including epicatechin, epicatechin gallate, epigallocatechin and epigallocatechin gallate (Graham 1992). Consumption of green tea has been reported having many beneficial health effects, such as anti-angiogenic, anti-carcinogenic and anti-diabetic activities (Cabrera et al. 2006; Jankun et al. 1997; Sabu et al. 2002). It has been suggested that the pharmacological properties of green tea may be mediated, at least partially, by its potent anti-oxidative activity, anti-inflammatory and immunomodulatory effects (Katiyar 2003; Serafini et al. 1996; Tipoe et al. 2007). Thus, it is plausible to assume that the detrimental effects caused by high-intensive exercise may be alleviated by consumption of green tea. In recent years, there is a growing interest to investigate the roles of green tea in the exercise performance and recovery from high-intensive exercise. Studies revealed that habitual consumption of green tea improves endurance capacity and exercise performance in mice (Murase et al. 2005; Murase et al. 2006). Murakami et al. (2010) recently demonstrated that oral supplementation of theanine, abundant in green tea, and cystine can significantly attenuate exercise-induced peripheral neutrophilia and lymphopenia. Although previous researches indicate that consumption of green tea can effectively alleviate some of the negative effects caused by high-intensity exercise, its effects on salivary defense proteins, antibacterial capacity and total antioxidant activity are still unclear.

Taekwondo (TKD) is a high speed, high tension, full-contact combat sport and the training program for TKD athletes includes a series of intensified, vigorous physical exercises. Our previous results indicate that the cumulative effects of prolonged, strenuous TKD training in combination with rapid weight loss can significantly suppress the mucosal immunity of male and female TKD athletes (Tsai et al. 2010a; Tsai et al. 2010b). However, acute effects of TKD training on individual mucosa immunity with or without green tea consumption are still poorly understood. Therefore, the aim of this study was to investigate the acute effects of TKD training on salivary defense factors and antibacterial capacity of male and female athletes. In addition, whether and how green tea consumption exerts effects on these salivary factors following TKD training were also examined.

(Part II)

A primary objective of resistance training program for elite weightlifters is to increase the maximum muscle strength. Previous work indicated that intensive resistance training with intensity corresponded to 80 - 100% of 1 repetition maximum (RM) could be very effective for increasing the maximum strength of weightlifters. Studies revealed that intensive resistance training acutely stimulated the secretion of anabolic hormones, such as growth hormone and testosterone (15). This acute hormonal response has been recognized as an important factor in inducing the adaptation of neuromuscular system to resistance training, skeletal muscle growth and tissue remodeling (15). High-intensity resistance training as an anaerobic type of exercise was shown to increase energy expenditure (2) and resting metabolic rate (5) as well as decrease body fat mass (27). Although previous studies revealed that mucosal immunity of elite athletes can be affected by strenuous bouts of intense training (7,25), those researches were conducted on aerobic type of exercise, such as cycling. However, weightlifting mainly consists of anaerobic type of muscle contraction. Whether and to what extent intensive resistance training affects mucosal immune function and stress response in elite weightlifters are as yet unclear.

Secretory IgA prevents the attachment of external pathogens to mucosal surfaces and thus plays an

important role in mucosal immunity (21). Studies revealed that mucosal immunity of elite athletes may be affected by strenuous bouts of intensive exercise (7). Although SIgA concentrations usually return to resting levels within 24 h after intensive exercise, the recovery of elite athletes who undertake multiple training sessions in a single day may be affected and this may result in an accumulative mucosal immunesuppression (8). Recent studies reported that the no circadian variation was observed in SIgA response to exercise and the second identical exercise bout did not appear to further compromise the oral immunity compared with the first bout of exercise (19,33). Neville et al. (24) showed that the decline in an individual's relative SIgA over 3 weeks may contribute to upper respiratory tract infection (URTI) risk in thirty-eight elite America's Cup yacht racing athletes over 50 wk of training. Besides, the other studies have also reported that physical exercise leads to increased SIgA concentration. For example, Li and Gleeson (19) reported that SIgA concentrations of healthy male participants were significantly increased in response to a 2-hour cycling at 60% VO_{2max}. In addition, Sari-Sarraf et al. (32) showed that the average SIgA concentration and SIgA secretion rate of ten males participated in soccer-specific intermittent exercise were significantly increased immediately after exercise.

Cortisol is one of the most important stress hormones secreted from adrenal cortex in response to physical stress (3) and its level has been proved to increase immediately after strenuous exercise (31). Activated hypothalamic–pituitary–adrenal (HPA) axis possibly evokes delayed effect in inhibiting SIgA secretion and antigen-specific SIgA production after 24 hour (18). Furthermore, prolonged stimulation of β-adrenoreceptor may reduce the replenishment of SIgA into the glandular pool (28). Accordingly, prolonged elevation of cortisol levels caused by physiological and/or psychological stress during training period may affect mucosal immunity.

Lactoferrin is one of the most important antimicrobial proteins that play key roles in host defense against pathogen infections (17) and lactoferrin secretion is affected by intensive exercise. For example, Inoue et al. reported that blood and salivary levels of lactoferrin were increased shortly after strenuous exercise (13). Additionally, lactoferrin has been implicated as an immune modulator which plays key roles in maintaining immune homeostasis (1). Our previous work also observed a positive correlation between the secretion rates of SIgA and lactoferrin in basketball players during a basketball season (10). However, the possibly accumulative effects of training program on salivary lactoferrin levels are still unclear and inconsistent (34,38).

Although acute effects of exercise on mucosal immunity and stress response have been frequently demonstrated, only few studies have been done to examine the cumulative effects of intense training in elite athletes. Meanwhile, there are three reasons we chose to collect saliva samples instead of drawing blood from the participants. First, the authors considered that drawing blood from participants may cause pressure on the athletes which may affect the cortisol level. Second, previous studies showed that cortisol levels in blood can be accurately reflected by cortisol levels in saliva (11). Third, we are more interested to investigate the changes in mucosal immunity which can be readily assessed from the saliva. Therefore, we used a non-invasive method by collecting saliva to assess the cortisol and IgA levels in weightlifters to investigate the cumulative effects of resistance training on resting salivary levels of SIgA, lactoferrin and cortisol during the intensive training period.

研究方法

(Part I)

Participants

Twenty-two TKD athletes (thirteen males and 9 females) from the National Taiwan College of Physical Education TKD team volunteered to participate in this study. Physical characteristics of the participants at the beginning of the study are summarized in Table 1. This study protocol was approved by the Human Ethics Committee of the National Taiwan College of Physical Education before the start of this study. Written informed consent was obtained from each participant after detailed explanation of the study.

Study design

All participants performed a 2 hr TKD training session each day. The exercise intensity was maintained at 80-85% of predicted maximum heart rates. Approximately 50% of the training time was devoted to technique training and 50% was physical training. Technique training sessions included basic techniques, simulated fighting techniques and simulated matches. Physical training sessions included aerobic activities. Participants were allowed to drink water ad libitum during the training period. After training, TKD athletes were given a single oral dose of green tea (caffeine 6 mg/kg and catechins 22 mg/kg) or equal volume of distilled water on alternate weeks. Tea caffeine concentration in the green tea was measured as approximately 0.75 mg/ml. Therefore, participants who consumed green tea have taken approximately 6 mg/kg/day of tea caffeine.

Preparation of green tea

Dried non-fermented green tea leaves (Pi-Lo-Chun green tea) were purchased from Ten Ren Tea company (Taipei, Taiwan). Extraction was carried out by soaking 20 g of green tea leaves in 600 ml of distilled water at 25 ºC for 24 h. These infusions were then filtered through a tea strainer.

Determination of caffeine, gallic acid and catechin compositions of green tea

The quantization of caffeine, gallic acid and catechins compositions followed Yang's method with little modification (Yang et al. 2007). In brief, after filtered through 0.45 μm filter, 20 μl of sample were injected into a RP-18e column (LiChrospher, 250×4.0 mm, Merck, Darmstadt, Germany). Gradient elution was performed at a flow rate of 1 ml/min. The solvent system used was a gradient of solvent A (acetonitrile) and solvent B (0.9 % acetic acid). The gradient was as follows: 0-5 min, 5% A; 6-26 min, linear gradient 5 – 13 % A; within 27 min, linear gradient 13 – 27 % A; 28-39 min, 27 %A; within 40 min, linear gradient 27 % - 100 % A; 41-50 min, 100 % A; 51-60 min, 5% A.

Identification of catechin compositions in tea infusions were carried out by comparing the retention time with catechin standards. Quantitative analyses for catechin compositions in green tea infusions were performed in triplicate. The content of caffeine, gallic acid and catechin compositions in the green tea were as follows: caffeine, 688.3 μg/ml; gallic acid (GA), 117.5 μg/ml; (-)-epigallocatechin (EGC), 1155.3 μg/ml; (+)-catechin (C), 90.1 μg/ml; (-)-epicatechin (EC), 228.6 μg/ml; (-)-epigallocatechin gallate (EGCG), 1030.3 μg/ml; (-)-epicatechin gallate (ECG), 137.4 μg/ml.

Saliva Collection

Saliva samples were collected before daily training and at least 2 hr after lunch at 15:00 hours. Then, athletes performed a 2 hr training session. Saliva samples were also collected immediately after training but before drinking, and 30 min after drinking green tea or water. Unstimulated whole saliva was collected as described previously (Tsai et al. 2010a). Briefly, all participants were asked to thoroughly rinse their

mouth with 30 ml of sterile distilled water before sample collection. Then, the water was expectorated to avoid potential contamination. Ten minutes later, each participant remained seated until all the saliva samples were collected into sterile plastic containers. The saliva samples were stored immediately at -80 until assay.

Assays

Levels of total protein, sIgA, and lactoferrin of each saliva sample were measured as described in our previous study. Total protein concentrations were determined using the Bio-RAD protein assay kit (Bio-RAD, Hercules, CA, USA). Salivary IgA concentrations were measured using an enzyme-linked immunosorbent assay (ELISA) as described in our previous study (Tsai et al. 2010a). A commercial ELISA kit (Calbiochem, Darmstadt, Germany) was used to assay salivary lactoferrin concentrations following the manufacturer's instructions. The α-amylase activity was determined using a kinetic reaction assay kit (Salimetrics LLC, State College, PA, USA) according to the manufacturer's instructions. FRSA was measured as described in our previous study (Tsai et al. 2010a).

All samples were measured in triplicate. The intra-assay coefficient of variation (CV) for the measurements of sIgA, lactoferrin and amylase activity was 3, 3 and 4%, respectively.

Statistical Analyses

All data are expressed as mean (SD). Statistical comparisons were analyzed using paired t-test. Significant difference was set at * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

(Part II)

Participants

Eleven male weightlifters from the National Taiwan College of Physical Education weightlifting team volunteered to participate in this study. The criteria for inclusion into this study include weightlifters with 4 to 10 years of weightlifting experience, normal physical examination without history of cardiovascular or endocrine/immunological diseases. The participants who need to take any medication during this study will be excluded. Meanwhile, they were asked to keep the similar diet habit and not to take new supplements. The physical characteristics (Table 1) of weightlifters were measured similar to our previous study (34). An eight-electrode bioimpedance analyzer InBody 3.0 (Biospace, Seoul, Korea) was used to measure the body weight, body fat and percent body fat. Body height was measured using a stadiometer (Holtain, UK) to the nearest 0.1 cm in standing position and without shoes. The stadiometer was calibrated using a metal measuring tape. Body mass index (BMI) was calculated as body weight (kg) divided by the square of height (m). Each participant was explained the potential risks and benefits associated with participation in the experiment prior to signing an inform consent form which was approved by the Human Ethics Committee of the National Taiwan College of Physical Education.

Training program

The entered weight class of these weightlifters and their best weightlifting records are shown in Table 2. All participants performed an intensive training program in preparation for a national tournament held in Taiwan in March, 2008 according to the coach's advice. The training protocol was adopted from Gonzalez-Badillo et al. (9). The study period was divided into four stages, including a five-week intensive resistance training period, a competition day and a two-week recovery period (Figure 1). The competition day was referred to as day 0. At stage I, from day -35 to day -22, the training intensity was set at 80-85% of 1RM (Table 3). Training load was increased to 70-90% of 1RM during stage II, from day -21 to day -6.

During stage III, from day -7 to day -1, training load was reduced to 80-100% of 1RM. Stage IV, from day 1 to day 14, was the recovery period. Training load was greatly reduced at stage IV. The accumulative effects of intensive training on the weightlifting athletes were assessed by comparing the responses of participants during the training period versus the recovery period (stage IV).

Collection of salivary samples

Saliva samples were collected at 30 days, 9 days, 2 days pre-competition and 8 days post-competition. These time points were referred to as -30 day, -9 day, -2 day and +8 day, respectively (Figure 1). Day 0 is the competition day. In order not to distract the weightlifters' attention from the competition, saliva samples were not collected on Day 0. On the other hand, due to different competition schedule, samples cannot be collected at the same time. We are more focused on the physiological changes before and after the competition. Additionally, to avoid the effects of meal and circadian variation that may cause changes in salivary parameters (4,26), saliva samples were collected at 3 pm, at least two hours after meal and before the start of daily training. In order to avoid possible contamination, each participant was asked to thoroughly rinse his mouth with sterile distilled water and then spit out the water. Ten minutes after having athletes rinse their mouth, participants were seated and un-stimulated whole-saliva specimens (2 ml) were collected into sterile plastic containers and stored immediately at -80 ºC until analysis.

Assays

Experimental procedures for detecting total protein, SIgA, cortisol and lactoferrin were basically the same as described in our previous report (34). Briefly, salivary TP concentration was determined by using Bio-RAD protein assay kit (Bio-RAD, Hercules, CA, USA), according to the manufacturer's instruction. Bovine serum albumin (BSA) was used as a standard. Enzyme-linked immunosorbent assay (ELISA) was used to measure the SIgA and lactoferrin concentrations. The assay was a two-step "sandwich" enzyme immunoassay in which samples and standards were incubated in a 96-well microplate coated with specific antibody for the test protein as the capture antibody. After the incubation time, the wells were washed, and a second detection antibody conjugated to enzyme was added. The plates were incubated, washed, and measured by adding a chromogenic substrate. The plates were then read at the appropriate wavelength (405-450 nm). About the concentration of SIgA, 100 μl of saliva aliquots (1:500 dilution) were added to microtiter wells that were coated with anti-human IgA antibody (I-9889, Sigma, Poole, UK). Secondary antibody was anti-human IgA conjugated with horseradish peroxidase (A3062, Sigma, Poole, UK). Assays were calibrated using serial dilutions of human colostrum IgA (I-2636, Sigma, Poole, UK). Besides, to determine the concentration of lactoferrin, saliva aliquots (100 μl) of 1:2000 dilution were added to microtiter wells that were coated with primary antibody (sheep anti-human lactoferrin; ab36303, ABcan, Cambridge, UK). Secondary antibody and tertiary antibody are rabbit anti-human lactoferrin (ab15811, ABcan, Cambridge, UK) and alkaline phosphotase-conjugated goat anti-rabbit IgG (816122, ZYMED, South San Francisco, CA), respectively. Lactoferrin concentration was calibrated by reference to a standard curve prepared from various dilutions of human lactoferrin (L0502, Sigma, Poole, UK). Cortisol levels in saliva were detected using a commercial ELISA kit (DRG Instruments, GmbH, Marburg, Germany) according to the manufacturer's instruction.

All samples were measured in triplicate and data were expressed as absolute concentrations and concentrations of assayed protein (SIgA, cortisol or lactoferrin) relative to TP concentration. The average

intra-assay coefficient of variation (CV) was 3% for SIgA, 4% for cortisol, and 4% for lactoferrin.

Statistical Analyses

Results are expressed as mean ± SD. The data were analyzed using one-way repeated measures ANOVA and LSD post-hoc comparisons. Significant difference between the values obtained at +8 day and other times was set at * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$. The relationships that existed between salivary variables were assessed by Pearson's correlation coefficient analysis. Statistical significance was set at $P<0.05$.

結果與討論（含結論與建議）

(Part I)

Anthropometric differences between male and female participants

Male TKD athletes were significantly taller, heavier and had a lower percent body fat than the female TKD athletes, but BMI was not significantly different between male and female athletes (Table 1).

Ingestion of green tea enhances salivary antibacterial capacity

Salivary antibacterial capacity of male and female participants was not significantly different before and after intensive TKD training (Fig. 1; BT vs. AT) as well as 30 min after ingestion of distilled water (Fig. 1; BT vs. Rest-W). However, consuming green tea significantly stimulated the salivary antibacterial capacity of participants (Fig. 1; BT vs. Rest-T). A similar response pattern was observed in male and female athletes (Fig. 1a and Fig. 1b)

Salivary total protein concentrations were increased following TKD training

Results show that immediately after TKD training, salivary total protein concentrations of male and female athletes were significantly increased (Table 2, TP; BT vs. AT). Total protein concentrations of athletes returned to pre-exercise values at 30 minutes following ingestion of water (Table 2, TP; BT vs. Rest-W), but not after green tea (Table 2, TP; BT vs. Rest-T).

Salivary defense factors were affected by TKD training and/or green tea consumption

As shown in Table 2, α-amylase activity was significantly increased immediately after training (Table 2, α-amylase; BT vs. AT) and this effect lasted for at least 30 min (Table 2, α-amylase; BT vs. Rest-T and BT vs. Rest-W). Ingestion of green tea further stimulated α-amylase activity (Table 2, α-amylase; BT vs. Rest-T). Absolute concentrations of lactoferrin were increased immediately after training (Table 2, lactoferrin; BT vs. AT). However, levels of lactoferrin returned to its basal level after 30 min of rest (Table 2, lactoferrin; BT vs. Rest-T and BT vs. Rest-W). Concentrations of sIgA was significantly increased immediately after training (Table 2, sIgA; BT vs. AT) and returned to its basal level after 30 min of rest (Table 2, sIgA; BT vs. Rest-T and BT vs. Rest-W). With regard to responses of α-amylase activity, sIgA and lactoferrin concentrations to TKD training and green tea consumption, no significant differences between male and female athletes were evident (Table 2; male vs. female).

FRSA was suppressed by acute intensive TKD training and rapidly recovered

Results show that FRSA levels of male and female athletes were significantly decreased immediately after TKD training (Fig. 2; BT vs. AT). However, FRSA levels returned to pre-exercise values at 30 min after training regardless of which fluid was consumed (Fig. 2; BT vs. Rest-T and BT vs. Rest-W).

The present study revealed that intensive TKD training affects salivary concentrations of total protein, sIgA, lactoferrin as well as salivary antibacterial capacity, total antioxidant and α-amylase activities. Additionally, green tea consumption following intensive training exerts acute effects on salivary antibacterial capacity, α-amylase activities and total protein concentrations. In this study, no significant differences between male and female athletes were observed on responses of the above salivary factors to TKD training and/or green tea consumption.

Green tea consumption enhances salivary antibacterial activity as well as α-amylase activity

Results show that intensive TKD training did not affect the antibacterial capacity of participants. This result is in line with a recent study conducted by Davison et al. (2009) who reported that although salivary defense factors were increased, salivary antibacterial capacity was not changed following prolonged exercise. These results suggest that there may exist a complex interaction between salivary defense factors. Therefore, prolonged, intense exercise may alter the exertion of individual components, but not salivary antibacterial capacity.

On the other hand, our results demonstrate that salivary antibacterial capacity was significantly enhanced 30 min following ingestion of green tea, but not water. Green tea and its major components have been previously shown to exhibit antibacterial effects (Taylor et al. 2005). However, the increased antibacterial capacity observed here was not due to remains of green tea in the oral cavity, because saliva collected 30 min after rinsing oral cavity with green tea without drinking it showed no effects on salivary antibacterial capacity as well as non-detectable levels of tea catechins (data not shown). Therefore, the increased salivary antibacterial capacity is most probably due to salivary defense factors affected by green tea consumption.

Results revealed that α-amylase activity was stimulated by TKD training and further markedly enhanced by ingestion of green tea. Previous studies also showed that α-amylase activity was stimulated following psychological stress or physical exercise (Allgrove et al. 2008; Nater et al. 2006). Therefore, our results are in line with previous findings that intensive exercise stimulates α-amylase activity. Thirty minutes after exercise, salivary α-amylase activity of individuals who ingested green tea was further markedly elevated. However, α-amylase activity of participants who ingested water declined to the pre-exercise level. This trend of changes in α-amylase activity was similar to that of salivary antibacterial activity. Besides starch hydrolysis activity, α-amylase was shown to function as an antibacterial protein by inhibiting bacterial growth and colonization in the oral cavity (Bortner et al. 1983; Jespersgaard et al. 2002). Therefore, we regard that the increased salivary antibacterial capacity after green tea consumption may be at least partially explained by the elevated α-amylase activity. However, complex interactions between host defense factors make it difficult to evaluate the influence of individual components to host antibacterial capacity (Bals 2000). Therefore, further experiments are required to elucidate the role of α-amylase in salivary antibacterial capacity.

Salivary total protein concentrations were increased following TKD training

Levels of total protein were significantly increased immediately after TKD training. Thirty minutes after water ingestion, total protein concentration returned to the pre-exercise level. The changes in total protein concentration were most probably due to acute dehydration induced by intense exercise and followed by water ingestion which efficiently relieved dehydration (Walsh et al. 2004a). However, total protein concentrations remained relatively high 30 min after consumption of green tea. It is known that

α-amylase is one of the most abundant proteins in saliva (Zakowski and Bruns 1985). Our results showed that levels of α-amylase were markedly stimulated by consumption of green tea. Therefore, elevated total protein concentration may be due to marked increases of α-amylase stimulated by green tea ingestion.

sIgA and lactoferrin levels were affected by intensive TKD training

Levels of sIgA and lactoferrin were stimulated by TKD training and returned to the pre-exercise level after 30 min of rest, regardless of which fluid was consumed. Although absolute concentrations of sIgA and lactoferrin were increased after intensive exercise, it is probably due to the acute dehydration caused by intense exercise (Walsh et al. 2004b). In addition, our results indicate that the changes in lactoferrin and sIgA concentrations were not correlated with salivary antibacterial capacity. Therefore, although concentrations of salivary lactoferrin and sIgA were modulated by intense TKD exercise, these salivary factors may not play a direct role in the salivary antibacterial capacity. The basal levels of sIgA detected in this study are similar to those of basketball players (He et al. 2010) and TKD athletes without performing rapid weight reduction (Tsai et al. 2010b). However, elite TKD athletes with rapid weight reduction showed higher basal levels of sIgA (Tsai et al. 2010a; Tsai et al. 2010b). Besides the differences caused by experimental design, the basal levels of sIgA and lactoferrin measured in this study were modestly different from those of our previous studies (He et al. 2010; Tsai et al. 2010a; Tsai et al. 2010b). This may be accounted for by the individual variances between different participants.

Total salivary antioxidant activity was suppressed by intensive TKD training and rapidly recovered

Results of FRSA indicate that total salivary antioxidant activity was significantly elevated immediately following intense TKD training. However, FRSA reduced to the pre-exercise level after 30 min of rest. Ingestion of green tea did not significantly affect total salivary antioxidant activity during the study period. Our previous study found that no accumulative effects were observed in total salivary antioxidant activity on elite TKD athletes during intense training and competition period if saliva samples were collected after at least 12 hr of rest (Tsai et al. 2010a). In this study, we now demonstrate that total salivary antioxidant activity was acutely stimulated by intense exercise and then returned to its pre-exercise level. Atsumi et al. (2008) reported that immediately following moderate exercises, total salivary antioxidant activity was significantly decreased. However, these authors also revealed that increased mental stress significantly stimulates FRSA. Therefore, the transitory increase in total salivary antioxidant activity observed here may be due to the relatively higher exercise intensity used in this study and/or more intense psychological stress. However, detailed mechanisms underlying effects of green tea ingestion on total salivary antioxidant activity are still unclear and require further investigation.

(Part II)

Eleven well-trained weightlifters (age, 26.7 ± 2.8 years, height, 170.5 ± 5.6 cm, weight, 77.8 ± 10.1 kg, body fat, 14.8 ± 6.1 kg, body fat percentage 18.6 ± 5.2%, and BMI, 26.7 ± 2.8 $kg \cdot m^{-2}$) were participated in this study (Table 1).

To minimize the residual effects of acute exercise, salivary samples were collected after at least 12 h of rest and before the start of daily training. Results revealed that the absolute concentrations of salivary TP were not significantly changed during the entire study period (Table 4; TP). Salivary IgA concentration (Table 4; SIgA, days -30 and -9), the ratio of SIgA/TP (Table 4; SIgA/TP, days -30, -9, and -2), salivary cortisol concentrations (Table 4; cortisol, days -30, -9, and -2) and the ratio of cortisol/TP (Table 4; cortisol/TP, days -30, -9, and -2) were significantly higher over training stages compared with levels in

recovery period (Table 4, day +8). Whereas salivary lactoferrin concentration and the ratio of lactoferrin/TP measured on -30 days were significantly lower than concentrations measured on +8 days after the competition.

A significant positive correlation between the ratios of SIgA/TP and cortisol/TP ($r = 0.568$; $p < 0.01$; Table 5) was found by Pearson's correlation coefficients.

The present study firstly demonstrates that the intensive resistance training acts accumulative effects on the immunoendocrine responses in elite weightlifters. In order to investigate the accumulative effects of prolonged, intensive training on weightlifters during different training stages, results were compared to levels measured in recovery period. Therefore, this study did not include sedentary controls. In this study, we have shown that while salivary TP concentrations were not significantly affected, resting levels of SIgA, SIgA/TP, cortisol, and cortisol/TP were significantly higher during the training stages versus the recovery period. A positive correlation between the ratios of SIgA/TP and cortisol/TP was revealed. In addition, we also observed that the resting salivary lactoferrin concentration and the ratio of lactoferrin/TP were significantly decreased during stage I versus stage IV.

The alterations in salivary concentrations of TP can be adopted to evaluate hydration status of human body (37). The results of this study showed there were no significant alterations in TP concentrations over the experimental period, which suggested that the hydration status of the elite weightlifters remained constant over the entire period. Although some athletes tried to reduce their body weight in order to compete in certain weight classes, the amount of weight loss was modest (data not shown).

Resting salivary cortisol concentrations and the ratio of cortisol/TP were found significantly higher in training period than in recovery period (+8 day). Cortisol is the predominant HPA hormone released from the adrenal cortex in response to physiological and/or psychological stress and its level is tightly regulated via negative feedback loop (3). McGuigan et al. (23) previously reported that salivary cortisol levels were significantly elevated immediately after resistance exercise and quickly returned to normal levels subsequently. However, our data demonstrated mildly sustained high levels of salivary cortisol over the training period in the elite weightlifters. The elevation of resting salivary cortisol levels over the training period in this study may be partly attributable to the accumulative effect of repeated stimulation of HPA-axis induced by intensive resistance training.

Many studies indicated that prolonged intensive exercise suppressed SIgA secretion in elite athletes (16,36). On the contrary, our data showed that resting levels of SIgA and the ratio of SIgA/TP remained higher in intensive training period than in recovery period. The α-adrenoreceptor agonist phenylephrine has been demonstrated to stimulate the secretion of SIgA and protein via β-adrenoreceptor-dependent pathway with a manner of dose-independent above a certain threshold (28). Whereas the acute decrease in SIgA secretion rate was mediated by α1-adrenergic mechanisms (30). According to the data of cortisol levels in the present study, the HPA-axis in the elite weightlifters might be mildly activated repeatedly and persistently over the training period. Although we have no evidence to prove, the degree of HPA activation in this study may overtake the threshold to stimulate the secretion of SIgA and protein as described above by Proctor et al. (28). Different types of exercise may elicit diverse activations of HPA-axis. Additionally, previous studies indicate that glucocorticoids up-regulate the transcriptional expression of polymeric IgA receptor (20,29) that mediates rapid active transport of polymeric IgA complex across epithelia cells (14). Therefore, the elevated resting SIgA levels may be due to increased transepithelial transport of saliva IgA.

To the best of our knowledge, no studies have been carried out to depict the diversity of SIgA and cortisol levels between anaerobic and aerobic sports, which warranted further investigations.

A positive correlation between the ratios of SIgA/TP and cortisol/TP was found in these well-trained weightlifters during the training stages. Cortisol has been indicated to play an important role in inhibiting SIgA mobilization (12) and in reducing SIgA level at 24 h after a single injection of dexamethasone (39). Previous studies reported either an inverse correlation (6,12) or no correlation (22) between salivary levels of SIgA and cortisol. The positive correlation between the ratios of SIgA/TP and cortisol/TP in this study may support the speculation which was the degree of HPA activation in this study may exceed the threshold and boost the secretion of SIgA and protein via β-adrenoreceptor-dependent pathway. The detail mechanisms need more investigation.

Resting levels of salivary lactoferrin and the ratio of lactoferrin/TP were significantly lower at -30 days than levels measured at +8 days in this study. This result is in line with those of West et al. who reported that lactoferrin concentrations of elite rowers undergoing prolonged training were markedly lower than sedentary individuals (38). It indicates that prolonged intensive training may exert an inhibitory effect on the salivary lactoferrin secretion in elite athletes. However, this assumption is not always valid. For example, our previous study in elite taekwondo athletes showed that salivary lactoferrin concentrations were not affected during intensive training and competition period (34). Therefore, we speculate that whether or not the secretion of salivary lactoferrin is affected may depend on multiple factors, such as type, duration, frequency and intensity of exercise.

Comparison of the current finding with our previous results, we find that the absolute concentrations of resting SIgA measured in weightlifters during intensive training period are similar to those of basketball players (10) and taekwondo athletes without performing rapid weight reduction (35). However, taekwondo athletes with rapid weight reduction showed higher levels of resting SIgA (34,35). These results indicate that intensive training in combination of additional physiological stress may further stimulate the secretion of SIgA. Besides Additionally, the basal levels of SIgA, cortisol and lactoferrin measured in this study were modestly different from those of our previous studies (10,34,35). This result may be accounted for by the differences caused by experimental design and/or individual variances between different participants.

計畫成果自評部份：

Our experiments demonstrated that salivary antibacterial capacity of participants was significantly enhanced by ingestion of green tea. In addition, the enhanced antibacterial capacity may be partially mediated by increased α-amylase activity. We also observed that salivary total antioxidant activity was significantly stimulated immediately following intense TKD exercise and rapidly reduced to a basal level. Therefore, our results suggest that green tea consumption exerts beneficial effects on athletes following intense exercise by enhancing salivary defense against microbial pathogens.

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(Part II)

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(Part I)

Table 1 Participant characteristics

Group	Male	Female
Number of athletes	13	9
Age (years)	20.5 ± 1.2	19.9 ± 1.5
Height (cm)	175.7 ± 6.6	166.3 ± 6.4
Body weight (kg)	68.9 ± 10.0	58.4 ± 5.6
Body fat (kg)	10.7 ± 5.5	12.7 ± 3.4
Body fat (%)	15.1 ± 4.9	21.7 ± 4.8
BMI (kg/m^2)	22.2 ± 2.2	21.1 ± 1.7

Values are mean ± SD.

BMI, body mass index.

Table 2 Absolute concentrations of salivary total protein, lactoferrin, sIgA and α-amylase activity

Group		Total protein (μg/ml)	α-amylase (U/ml)	Lactoferrin (ng/ml)	sIgA (μg/ml)
Male					
	BT	836 ± 383	25.2 ± 15.8	2354 ± 575	198 ± 79
	AT	1304 ± 654*	41.6 ± 22.6***	3037 ± 578**	277 ± 110**
	Rest-T	1298 ± 659**	62.2 ± 33.0***	2544 ± 300	180 ± 96
	Rest-W	809 ± 267	43.0 ± 27.0*	2583 ± 336	223 ± 73
Female					
	BT	756 ± 310	22.8 ± 11.7	2651 ± 337	150 ± 74
	AT	1138 ± 467**	32.6 ± 20.7*	2918 ± 396*	190 ± 60*
	Rest-T	1150 ± 324***	54.0 ± 28.5**	2473 ± 271	123 ± 60
	Rest-W	846 ± 267	34.6 ± 18.1*	2406 ± 165	143 ± 63

Values are mean ± SD.

$^{*}P < 0.05$; $^{**}P < 0.01$; $^{***}P < 0.001$, significantly different from BT.

sIgA, salivary immunoglobulin A; BT, before training; AT, after training; Rest-T, 30 min of rest following ingestion of green tea; Rest-W, 30 min of rest following ingestion of water.

Fig. 1 Antibacterial activity of saliva collected from (a) male and (b) female athletes at various time points.

Significant difference between each sampling time and the initial condition (BT) was set at $^{**}P < 0.01$ and $^{***}P < 0.001$. BT, before training; AT, after training; Rest-T, 30 min of rest following ingestion of green tea; Rest-W, 30 min of rest following ingestion of water.

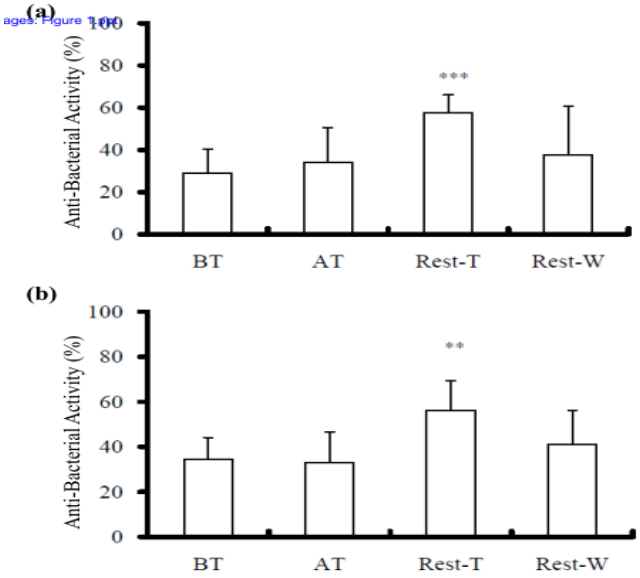
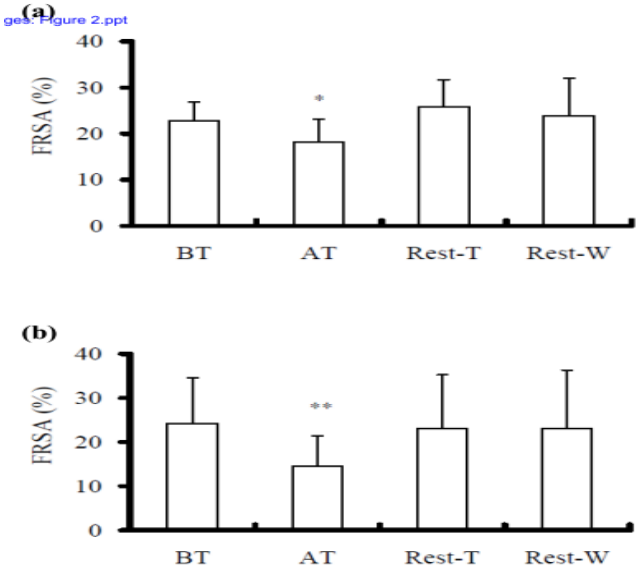


Fig. 2 Total antioxidant activity (FRSA) of saliva collected from (a) male and (b) female athletes at various time points. Significant difference between each sampling time and the initial condition (BT) was set at $^{*}P < 0.05$ and $^{**}P < 0.01$. BT, before training; AT, after training; Rest-T, 30 min of rest following ingestion of green tea; Rest-W, 30 min of rest following ingestion of water.



(Part II)

TABLE 1. Participant characteristics (mean ± SD).

Number of Participants	11		
Age (years)	26.7	±	2.8
Weightlifting experience (years)	7.5	±	1.8
Height (cm)	170.5	±	5.6
Body weight (kg)	77.8	±	10.1

Body fat (kg)	14.8	±	6.1
Body fat percentage (%)	18.6	±	5.2
BMI ($kg \cdot m^{-2}$)	26.7	±	2.8

TABLE 2. Best records of the participants.

ID	Weight Class (kg)	Snatch (kg)	Clean and Jerk (kg)	Total (kg)	Training Experience (years)
1	62	100	125	225	7.0
2	69	117	140	257	9.0
3	69	105	140	245	7.5
4	69	117	145	262	6.5
5	77	125	150	275	4.0
6	77	110	140	250	6.0
7	85	115	155	270	8.5
8	85	140	170	310	10.0
9	85	130	154	284	8.0
10	94	125	160	285	10.0
11	105	125	151	276	6.5

TABLE 3. Progressive resistance training protocol.

	Stage I	Stage II	Stage III	Stage IV
	rep set RI (%)	rep set RI (%)	rep set RI (%)	rep set RI (%)
Snatch	2 × 5 × 80	3 × 5 × 80	2 × 3 × 90	
Clean & jerk	2 × 5 × 80	2 × 8 × 70	2 × 3 × 90	
Power snatch	3 × 5 × 80	3 × 5 × 70	2 × 4 × 80	3 × 4 × 70
Power clean	3 × 5 × 80	3 × 6 × 80	2 × 4 × 80	3 × 5 × 70

Jerk	2 × 5 × 80	2 × 6 × 80	2 × 4 × 80	
Push jerk	2 × 5 × 80	3 × 6 × 80	2 × 2 × 80	
			1 × 2 × 90	
Snatch pull	3 × 5 × 80	3 × 6 × 80	3 × 4 × 90	
Clean pull	2 × 5 × 100	3 × 6 × 90	2 × 3 × 100	
Back squat	3 × 3 × 85	3 × 3 × 80		
		2 × 3 × 90		
Front squat		3 × 2 × 80	3 × 3 × 80	5 × 5 × 70
		2 × 2 × 90	2 × 3 × 90	

rep: repetition; set: sets; RI (%): maximal relative intensity expressed in percentage of 1 repetition maximum

TABLE 4. Absolute concentrations of salivary total protein, **SIgA**, lactoferrin and cortisol as well as ratios of SIgA, lactoferrin and corti

protein (mean ± SD).

Day	TP ($\mu g \cdot ml^{-1}$)	SIgA ($\mu g \cdot ml^{-1}$)	SIgA/TP ($\mu g \cdot mg^{-1}$)	Lactoferrin ($ng \cdot ml^{-1}$)	Lactoferrin /TP ($ng \cdot mg^{-1}$)	Cortisol ($ng \cdot ml^{-1}$)
-30	1768.8 ± 760.9	231.4 ± 85.8**	141.2 ± 44.3*	8463.0 ± 5075.8*	5188.6 ± 3590.9*	46.3 ± 5.3**
-9	1526.5 ± 628.2	210.8 ± 73.8*	150.2 ± 57.6**	11850.4 ± 9246.8	8255.8 ± 5610.4	44.1 ± 6.0*
-2	1567.6 ± 689.4	206.0 ± 79.2	139.2 ± 56.9*	9313.4 ± 4537.7*	7324.0 ± 4546.5	45.6 ± 5.2*
+8	1945.7 ± 715.0	165.8 ± 44.5	93.6 ± 38.4	15163.5 ± 9336.3	7685.2 ± 4099.4	39.3 ± 7.7

TP: total protein; Significantly different from +8 day (* $P<0.05$, ** $P<0.01$, *** $P<0.001$).

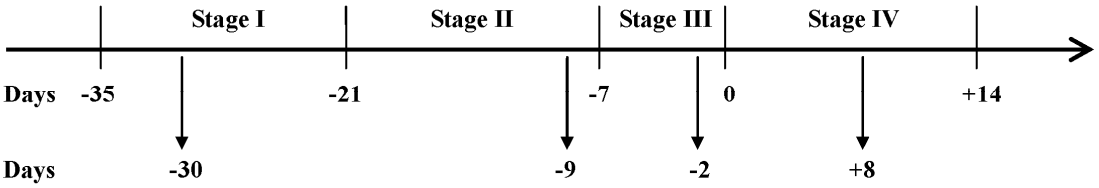


Figure 1. Schematic diagram of intense resistance training stages. The competition day is referred to as day 0. Stage I started from day -35 to day -22. Stage II started from day -21 to day -8. Stage III started from day -7 to day -1. Stage IV started from day 1 to day 14. Closed arrowheads indicate the days on which saliva samples were collected.

附錄

Tsai ML, Chou KM, Chang CK, ***Shih-Hua Fang.** Changes of mucosal immunity and antioxidation activity in elite male Taiwanese taekwondo athletes associated with intensive training and rapid weight loss. **British Journal of Sports Medicine.** 2011; 45: 729–734. {SCI} (IF: 3.5, Sport Sciences, Ranking: 6/79 =7.6 %)

Chia-Yang Li, Hung-Chih Lin, Chih-Ho Lai, John Jenn-Yenn Lu, Shu-Fen Wu, ***Shih-Hua Fang**. Immunomodulatory Effects of Lactobacillus and Bifidobacterium on Both Murine and Human Mitogen-Activated T Cells. **Int Arch Allergy Immunol** 2011; 156: 128–136. {SCI}(IF: 2.2, Allergy, Ranking: 11/22 =50.0 %)

He CS, Tsai ML, Ko MH, Chang CK, ***Shih-Hua Fang.** Relationships among salivary immunoglobulin A, lactoferrin and cortisol in basketball players during a basketball season. **European Journal of Applied Physiology**. 2010; 110: 989-995. {SCI} (IF: 2.2, Sport Sciences, Ranking: 23/79 =29.1%)

國科會補助專題研究計畫項下出席國際學術會議心得報告

日期：___年___月___日

計畫編號	NSC 97－2320－B－028－001－MY3		
計畫名稱	天然多酚對調節性細胞免疫反應之影響—從系統生物學到分子免疫學		
出國人員 姓名	方世華	服務機構 及職稱	臺灣體育學院　競技運動學系 教授
會議時間	100 年 7 月 11 日 至 100 年 7 月 13 日	會議地點	英國 牛津
會議名稱	(中文)第 10 屆運動免疫國際研討會 (英文)10th Conference of the International Society of Exercise and Immunology		
發表論文 題目	(中文)綠茶攝取對高強度跆拳道訓練後唾液中防禦因子與抗菌能力的影響 (英文) Acute effects of green tea consumption following intensive taekwondo training on salivary defense factors and antibacterial capacity		

一、參加會議經過

國際運動免疫學會每兩年都會舉辦運動免疫學學術研討會，每次都吸引來自不同國家的運動生理學家、醫師、運動免疫學家、研究生及相關專業產業的人士來參與。這次第 10 屆運動免疫國際研討會的主題包括：The genetics of exercise and immunology; Exercise, metabolism and inflammation; Exercise and the intestinal microbial: Function and immunity; Exercise and neural inflammatory diseases 涵蓋的領域相當廣也相當豐富。

7/11-7/13 期間大會每天早上先安排 keynote presentation，以目前國際學術上最重要的發展方向：“Understanding the mechanisms that control host defence responses and genetic programming of the immune response”； “Physical inactivity, inflammation and metabolism” ；“The anti-inflammatory potential of exercise: implications for health and disease”； “Diet, genetics, and the mammalian microbiome”;“Exercise and neural inflammatory diseases”； “Exercise as a means of reducing acute and

chronic inflammation: Impact on health”；” Immunodepression and intensive exercise: the evidence”；” Immune depression in response to intense exercise - the practical implications for athletes and coaches ”；” The effect of psychological stress and exercise on immunity: Qualitatively distinct or just a question of magnitude?”；” Exercise produces stress resistance: Benefits for mental and physical health”；” Optimizing immune function: do we know what to measure and how to interpret? ”。下午則先安排口頭論文發表，接著由各國運動免疫學專家帶領大家一起討論壁報論文，經由每位壁報論文的報告者簡短的說明，讓與會人士更加容易了解並有充分的時間可以進行學術交流。隨著近幾年來大家已將運動當做預防醫學的一部份，藉由這次的參與，大會安排各個領域的研究成果口頭論文發表與壁報論文發表，三天密集的呈現超過千篇各個不同領域的論文，研究資訊豐富又新穎，獲益良多。對於未來進行跨領域的研究，具有相當大的助益。

二、與會心得

感謝國科會的補助得以有機會到英國牛津參與國際運動免疫學會年度國際盛會，各國運動免疫學專家齊聚一堂，了解國際上研究之趨勢，尤其更深入了解運動免疫與免疫調節藥物發展的方向，對本身的研究領域專長有相當大的啟發，同時也藉由壁報論文的發表，與相關研究人員交換經驗，有助於提高台灣學術研究國際知名度。

三、考察參觀活動(無是項活動者略)

四、建議

五、攜回資料名稱及內容

六、其他

RE: ISEI-Abstract-Fang-Shih-hua
Mike Gleeson [M.Gleeson@lboro.ac.uk]

Dear Shih-Hua

Thank you for submitting your abstract (title and authors shown below) for the ISEI conference in Oxford 11-13 July 2011. Your abstract has been reviewed by the ISEI-2011 Scientific Programme Committee and I am pleased to tell you that it has been **accepted** for inclusion in the conference programme as a POSTER presentation.

The poster boards are portrait style being 1.0 m wide and 2.0 m high. Therefore, your posters must be prepared in portrait (not landscape) style. It is strongly recommended that your poster is prepared in portrait format A0 size (0.841m width x 1.189 m length) or occupies a space no larger than 0.9 m width x 1.2 m length). Please include the title at the top followed by author names and affiliations. Please ensure that the text is large enough to be easily readable from a distance of 2 metres away.

Best wishes,
Prof Mike Gleeson

ABSTRACT FORM

Title (up to 30 words, Arial, 11 pt, single line spaced, in sentence case. Like this:	Acute effects of green tea consumption following intensive taekwondo training on salivary defense factors and antibacterial capacity
Authors (Underline the presenting author if known)	Shih-Hua Fang, Shiuan-Pey Lin & Kuei-Ming Chou
Department, Institution, Country	Institute of Athletics, National Taiwan College of Physical Education, Taiwan.
Address Corresponding Author	Dr. Shih-Hua Fang, Institute of Athletics, National Taiwan College of Physical Education,No 16, Sec 1, Shuan-Shih Road, Taichung, 40404, Taiwan.

Your Topic: __session 7_____
(match this to one of the themes of the symposium sessions if possible)

Preferred Presentation Form: ☐ Oral communication ■ Poster
(note that final decisions will be made by the Scientific Committee)

Is the presenter eligible for the Early Career Researcher Award? ☐ Yes ■ No
(Eligible persons are those studying for a higher degree – MSc, MPhil or PhD – or who have completed their PhD within the last 3 years)

Please send the completed Abstract Form by the Deadline of 28th February 2011 to:

E-Mail: m.gleeson@lboro.ac.uk

Subject: ISEI-Abstract-your last name-your first name

(*e.g.* ISEI-Abstract-Gleeson-Michael)

After receipt of the Abstract Form, a confirmation will be sent to you.

Notification of acceptance will be sent by e-mail in March 2011.
Further information on presentation format (oral/poster) will be sent by e-mail in May 2011

TEXT (up to **350 words**, Arial, 11 pt, single line spaced, justified left and right). Like this:

Many factors presented in mucosal secretions serve as a first line of defense against microbial infection, including immunoglobulins (Igs), α-amylase and anti-microbial peptides (AMPs) [1]. Salivary immunoglobulin A (sIgA) contributes to mucosal immunity by preventing adherence of microbes to the mucosal surface [2]. Amylase was shown to function as an antibacterial protein inhibiting bacterial growth and colonization in the oral cavity. Lactoferrin, one of the most abundant salivary AMPs, exerts an antibacterial effect by sequestering iron, an essential nutrient for bacterial growth, as well as directly interacting and damaging bacterial membrane [3]. This study was aimed to investigate the acute effects of green tea consumption on selected salivary defense proteins, antibacterial capacity and anti-oxidation activity in taekwondo (TKD) athletes following intensive training. Twenty-two taekwondo athletes performed a 2-hr TKD training. After exercise, participants ingested green tea or equal volume of water. Saliva samples were collected before training, immediately after training but before drinking, and 30 min after drinking green tea or water. Levels of salivary total protein, IgA, lactoferrin, free radical scavenger activity (FRSA), α-amylase activity and salivary antibacterial capacity were measured. Results show that immediately after intensive TKD training, concentrations of lactoferrin, sIgA and α-amylase activity were significantly increased; while salivary antibacterial capacity was not affected by intense training. Levels of sIgA and lactoferrin returned to pre-exercise values after 30 min of rest. However, consumption of green tea after training further stimulated α-amylase activity and enhanced salivary antibacterial capacity. Additionally, we observed that salivary FRSA was markedly suppressed immediately after training and quickly returned to pre-exercise values regardless of which fluid was consumed. Our results demonstrated that consumption of green tea exerts acute effect on the concentration of salivary oral defense-related proteins and significantly enhances salivary antibacterial capacity. However, detailed mechanisms underlying effects of green tea ingestion are still unclear and require further investigation.

References

1. Amerongen A.V. & Veerman E.C. *Oral Dis* 2002: **8**: 12-22.
2. Marcotte H. & Lavoie M.C. *Microbiol Mol Biol Rev* 1998: **62**: 71-109.
3. Jespersgaard C et al. *Infect Immun* 2002: **70**: 1136-1142.

國科會補助計畫衍生研發成果推廣資料表

日期:2011/08/03

國科會補助計畫	計畫名稱: 天然多酚對調節性細胞免疫反應之影響－-從系統生物學到分子免疫學
	計畫主持人: 方世華
	計畫編號: 97-2320-B-028-001-MY3　　學門領域: 中醫藥

無研發成果推廣資料

97 年度專題研究計畫研究成果彙整表

計畫主持人：方世華	計畫編號：97-2320-B-028-001-MY3
計畫名稱：天然多酚對調節性細胞免疫反應之影響－-從系統生物學到分子免疫學	

成果項目			量化			單位	備註（質化說明：如數個計畫共同成果、成果列為該期刊之封面故事...等）
			實際已達成數（被接受或已發表）	預期總達成數(含實際已達成數)	本計畫實際貢獻百分比		
國內	論文著作	期刊論文	0	0	100%	篇	
		研究報告/技術報告	0	0	100%		
		研討會論文	0	0	100%		
		專書	0	0	100%		
	專利	申請中件數	0	0	100%	件	
		已獲得件數	0	0	100%		
	技術移轉	件數	0	0	100%	件	
		權利金	0	0	100%	千元	
	參與計畫人力（本國籍）	碩士生	3	0	50%	人次	
		博士生	0	0	100%		
		博士後研究員	1	0	100%		
		專任助理	1	0	100%		
國外	論文著作	期刊論文	3	0	100%	篇	
		研究報告/技術報告	0	0	100%		
		研討會論文	2	0	100%		
		專書	0	0	100%	章/本	
	專利	申請中件數	0	0	100%	件	
		已獲得件數	0	0	100%		
	技術移轉	件數	0	0	100%	件	
		權利金	0	0	100%	千元	
	參與計畫人力（外國籍）	碩士生	0	0	100%	人次	
		博士生	0	0	100%		
		博士後研究員	0	0	100%		
		專任助理	0	0	100%		

其他成果 (無法以量化表達之成果如辦理學術活動、獲得獎項、重要國際合作、研究成果國際影響力及其他協助產業技術發展之具體效益事項等，請以文字敘述填列。)	無

	成果項目	量化	名稱或內容性質簡述
科教處計畫加填項目	測驗工具(含質性與量性)	0	
	課程/模組	0	
	電腦及網路系統或工具	0	
	教材	0	
	舉辦之活動/競賽	0	
	研討會/工作坊	0	
	電子報、網站	0	
	計畫成果推廣之參與（閱聽）人數	0	

國科會補助專題研究計畫成果報告自評表

請就研究內容與原計畫相符程度、達成預期目標情況、研究成果之學術或應用價值（簡要敘述成果所代表之意義、價值、影響或進一步發展之可能性）、是否適合在學術期刊發表或申請專利、主要發現或其他有關價值等，作一綜合評估。

1. 請就研究內容與原計畫相符程度、達成預期目標情況作一綜合評估

■達成目標

□未達成目標（請說明，以 100 字為限）

□實驗失敗

□因故實驗中斷

□其他原因

說明：

2. 研究成果在學術期刊發表或申請專利等情形：

論文：■已發表 □未發表之文稿 □撰寫中 □無

專利：□已獲得 □申請中 ■無

技轉：□已技轉 □洽談中 ■無

其他：(以 100 字為限)

British Journal of Sports Medicine. 2011； 45: 729–734. {SCI} (IF: 3.5, Sport Sciences, Ranking: 6/79 =7.6 %)

Int Arch Allergy Immunol 2011； 156: 128–136. {SCI}(IF: 2.2, Allergy, Ranking: 11/22 =50.0 %)

European Journal of Applied Physiology. 2010； 110: 989-995. {SCI}(IF: 2.2, Sport Sciences, Ranking: 23/79 =29.1%)

3. 請依學術成就、技術創新、社會影響等方面，評估研究成果之學術或應用價值（簡要敘述成果所代表之意義、價值、影響或進一步發展之可能性）(以 500 字為限)

以科學化的研究方法證實中草藥的抗發炎功能及影響免疫調控反應，長期以來的研究都以此為主軸，近年來將此概念應用在運動免疫學，這部份的研究成果已被國際知名運動科學期刊接受，顯示這方面的研究具有國際學術參考價值。過去主持人已有連續 10 年的國科會計畫執行經驗與近五年內研究表現指數(RPI)達 92.9 分之成果，卻無法再得到國科會的補助，造成研究中斷，相當遺憾。除了整體研究經費刪減之影響外，核定計畫通過的標準應更合理化，才能使研究者安心從事研究及教育下一代研究人才之重責大任。