Note

Clinical Study on the Combined Effect of Capsaicin, Green Tea Extract and Essence of Chicken on Body Fat Content in Human Subjects

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Summary This study was conducted to assess the body fat content of free-living healthy human subjects taking a health supplement containing 0.4mg capsaicin, 625mg green tea extract (125mg catechins and 50mg caffeine) and 800mg essence of chicken (CGTE). Subjects were advised to maintain their regular dietary habits and routine physical activity throughout study duration. Their body fat content was measured before and throughout the trial duration using a hand-grip body fat monitor. After 2 wk of supplementation with CGTE, the mean body fat percentage of males and female subjects was significantly less than the initial value (p<0.05; t-test). 70.6% of volunteers showed a trend for decreasing body fat content with 4 subjects showing a significant decrease in body fat content over time. The findings suggested that the effects were more prominent in subjects with higher initial body fat content. It was also demonstrated that the resting energy expenditure (REE) of the subjects taking the test samples were significantly increased in groups supplemented with CGTE, compared to placebo group. Thus, the combined thermogenic effect of capsaicin, green tea extract and essence of chicken could translate to a positive clinical effect by reducing approximately 460g of body fat, following 2 wk of supplementation and the application of this natural health supplement for excess fat regulation, should be considered.

Key Words body fat, capsaicin, green tea extract, chicken essence, thermogenesis

"The difficult thing is not to eat little, but to eat little when the option of eating more is available", quoted from Garrow (1992) (1). So how do people become obese? Undoubtedly, modern lifestyle in which dietary energy intake exceeds energy expenditure coupled with complex genetic factors can lead to excess body fat which underlies the 'overweight/obesity' epidemic and epidemiological studies have shown that obesity is an established risk factor for coronary heart disease and diabetes (2, 3).

The development of obesity is a result of complex interactions in genetic, metabolic and environmental factors, which contribute to the eventual disease state. Leptin receptors and peripheral β-adrenoceptors exert thermogenic properties via their ability to transmit stimulatory signals to the sympathoadrenal system (4). Gene mutation of these receptors could in fact lead to obesity and it has been shown that in Asian countries such as Japan and Thailand, approximately 30% of Asians carry mutations in the β3-adrenergic receptor gene (5, 6).

BRAND'S essence of chicken is a popular health supplement in Asia consisting of a fat free, hot water extract of chicken, obtained by double boiling. Consumption of this chicken extract has been reported to stimulate the metabolic rate by an average of 5% to 12% in human subjects (7, 8). Other food substances, such as caffeine (9) and capsaicin (10, 11), increase thermogenesis via activation of the sympathetic nervous system. Green tea extract which is rich in catechin-polyphenols, potentiates sympathetic mediated thermogenesis more than would be expected for its caffeine content alone (12) and has been shown to increase 24-hour energy expenditure and fat oxidation (13). It is worthwhile to explore these food components as natural health supplements that can aid in reducing excess body fat for better health.

The objective therefore, was to assess the thermogenic effect of capsaicin, green tea extract and essence of chicken on the body fat content of free-living human subjects.

Materials and Methods

The study was a 2-wk, prospective, pre- and post-
intervention trial where subjects acted as their own control. Nine healthy male subjects and eight healthy female subjects gave written informed consent in accordance to the Declaration of Helsinki. No subjects were regular users of health supplements and they were advised to maintain their regular dietary habits and avoid medication/supplementation that could affect body fat metabolism.

Prior to the 2-wk study, a parallel, cross-over experiment was conducted to investigate the resting energy expenditure (REE) of the subjects. Six subjects acting as their own control were randomly selected from the participants for two different occasions (with 7 d wash-out period) in which their resting metabolic rates were measured before, and every 30 min for 2 h after consuming test sample tablets and placebo. Test subjects were administered 4 test sample tablets (CGTE) containing capsacin, green tea extract and essence of chicken (Cerebos Pacific Limited, Singapore), equivalent to the daily-recommended dose, whilst placebo group was administered 4 casein tablets. The subjects were instructed to avoid any food or beverages containing alcohol or caffeine after 10.00 p.m. of the day preceding the experiment. The room temperature of the laboratory was controlled at 24–25°C with a quiet environment and minimal arousal stimuli. The subjects rested for at least 20 min before the start of the experiment following which they remained in supine position for 2 h for the duration of the experiment.

The gas exchange parameters were analyzed and measured by indirect calorimetry, using a Vmax Calorimeter (Sensormedics Corporation, Yorba Linda, CA, USA) connected to a computerized system. REE was calculated from the oxygen consumption (VO2) and respiratory quotient (RQ), calculated as the carbon dioxide (CO2) produced to O2 consumed by using the formula:

\[
\text{REE (kcal/min)} = \left[4.686 + \left(\frac{(RQ-0.707)}{0.293}\times0.361\right)\times V O_{2}\right] \times 2 \times 4.686 \text{ kcal/L}
\]

where 4.686 kcal/L is the energy value of 1L of oxygen at a non-protein RQ of 0.707; RQ is the measured respiratory quotient; 0.707 is the RQ when only fat is oxidized; 0.293 is the difference between the RQ for carbohydrate and fat oxidation; 0.361 is the difference in energy value of 1 L of oxygen between an RQ of 1 and that of 0.707; and O2 (L/min) is the rate of oxygen consumption at resting conditions. The statistical difference in the mean REE between the 2 groups over 2 h were assessed by repeated measure, two-way ANOVA while that of the female subjects was higher than 33%.

In the 2-wk study, each subject consumed 2 tablets, twice daily to achieve a daily dose of 0.4 mg capsacin, 625 mg green tea extract (50 mg caffeine, 125 mg catechins) and 800 mg spray-dried essence of chicken. The statistical difference between mean body fat of test subject before and after CGTE supplementation were assessed by paired t-test while the trend on percent body fat over 2 wk was analyzed by linear regression using the statistical package SPSS.

### Results and Discussion

Physical characteristics of all subjects are summarized in Table 1. All male subjects, except one, were overweight (BMI>25) whereas only half of the female subjects had a BMI greater than 25. As expected, female subjects had higher body fat indices than male subjects.

There was an initial rise in REE levels from base line to time 0, which was observed in both CGTE and placebo groups. This is not unexpected and reflects the adaptation period for the subjects movement from sitting to supine position at time 0, subsequently resulting in the higher REE values.

The mean REE of subjects taking the CGTE samples were significantly higher than those taking placebo as shown in Fig. 1 (p<0.0001; Bonferroni test after repeated measure two-way ANOVA).

The mean final body fat percentage was significantly less than the pre-study value as shown in Fig. 2 (p<0.05; t-test). Amongst the 17 subjects, 12 of them (70.6%) showed a trend of decreased body fat with 1

### Table 1. Physical characteristics of male and female participants.

<table>
<thead>
<tr>
<th>Participants</th>
<th>Mean BMI (kg/m²)</th>
<th>Initial mean body fat (%)</th>
<th>Final mean body fat (%)</th>
<th>Initial mean body weight (kg)</th>
<th>Final mean body weight (kg)</th>
<th>Mean height (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male (n=9)</td>
<td>27.4±0.8</td>
<td>30.8±0.7</td>
<td>30.2±0.7</td>
<td>81.0±3.2</td>
<td>80.5±3.2</td>
<td>1.72±0.02</td>
</tr>
<tr>
<td>Female (n=8)</td>
<td>24.5±0.7</td>
<td>35.9±0.6</td>
<td>35.2±0.5</td>
<td>63.6±1.4</td>
<td>63.2±1.4</td>
<td>1.61±0.02</td>
</tr>
</tbody>
</table>

BMI, body mass index [(body weight, kg)/(height, m)²].
Fig. 1. The resting energy expenditure (REE) of 6 subjects taking a single dose of CGTE (4 tablets of capsaicin, green tea extract and essence of chicken) versus placebo. *p<0.0001; Bonferroni test after repeated measure, two-way ANOVA.

Fig. 2. The mean body fat percentage of 17 subjects before and after the 2-wk supplementation period. Values are expressed as mean±sem.*p<0.05; t-test.

Fig. 3. Linear regression plot showing the body fat percentage of (a) male subjects and (b) female subjects over the 2-wk supplementation period. M7: r=0.76, p<0.05; F2: r=0.80, p<0.05; F7: r=0.91, p<0.05; F8: r=0.78, p<0.05. Mean: Linear regression of mean body fat percentage over 14 d of supplementation.
male and 3 female subjects showing a statistically significant decrease in body fat content (Fig. 3a and 3b) over 14 d. Among the men, 6 out of 9 (66.7%) showed a trend of decreased body fat (Fig. 3a) while 6 out of 8 female participants (75%) showed a trend of decreased body fat content as time progressed (Fig. 3b).

It appears that the subjects with a higher initial body fat content tended to respond more positively to the intake of the test tablets. Similarly the male subject who responded significantly had the highest body fat of 34.3% among the men. Two of the 3 female subjects who responded significantly had high body fat content of above 37%. As shown in Table 1, the mean reduction of body fat content in males was 0.6% compared to 0.7% for females. Based on initial body weight, this corresponds to a reduction of about 486 g and 445 g in body fat in male and female subjects, respectively. Capsaicin (3 mg) in the form of a test meal, has been shown to increase the energy expenditure in obese subjects, by 81 kcal per day (equivalent to 9 g of fat; 1 g of fat approximates to 9 kcal) (11). Arciero et al (15) reported that 350 mg caffeine (5 mg/kg fat-free mass) could raise the resting metabolic rate (1.38 kcal per min) by 11% to 0.141 kcal per min over 90 min, which is equivalent to the burning of 1.41 g of fat. Intake of 2 tablets of chicken essence (1.54 g) has been reported to increase the resting metabolic rate by 3.9 kcal for an hour, equivalent to 0.43 g of fat (personal communication with Dr Moritani T). Thus, the theoretical sum of additional energy expenditure for 2 wk would be equivalent to the utilization of nearly 152 g of fat. The amount of fat reduction induced by the test tablets was about 3-fold greater than the predicted theoretical amount of 152 g fat although the daily dosage of each ingredient was lower than that used in previous studies by other groups. This suggests a potential synergy between capsaicin, green tea extract and chicken essence in reducing body fat content.

The measurement of body fat percentage has advantages over using body mass index (BMI) as the sole indicator of health risk. Body fat content is a more direct assessment of body fatness and healthy weight because it distinguishes fat from muscle. It helps to identify people at increased health risk who despite lying within "healthy" BMI ranges of less than 25, have excess body fat content. A recent study has shown a correlation of body fat percentage to BMI in 3 separate major ethnic groups, African, Asian and Caucasians (16).

On the basis of their mechanisms of action, these ingredients appear to complement each other by acting on the various pathways of the sympathetic nervous system at the cellular and molecular level. Tea catechins prolong the effect of norepinephrine-mediated thermogenesis by suppressing catechol O-methyltransferase (COMT) and inhibiting the degradation of norepinephrine at the synaptic cleft (17). It is likely that epigallocatechin gallate (EGCG), which constitutes about 50% of the total tea catechins, is the pharmacologically active tea catechin (18). Caffeine in green tea extract also prolongs the thermogenic signal of norepinephrine by inhibiting phosphodiesterase-induced degradation of intracellular cyclic AMP (cAMP) (19).

Capsaicin increased energy metabolism via β-adrenergic pathway and thermogenic action can be abolished with a β-adrenergic blocker (10, 20). In human studies, test-meals enriched with capsaicin also increased both energy expenditure and lipid oxidation (10, 11). Based on the report that 30% of Asians have defective β-adrenergic receptors, it is a reasonable finding that 70.6% of participants responded positively to the supplement (5, 6).

Based on the Singapore National Nutrition Survey of 1998, the daily energy intake for 90% of males ranges from 1, 062 kcal to 3, 356 kcal with a mean of 2, 122 kcal, whereas for females, it ranges from 880 kcal to 2, 832 kcal with a mean daily energy intake of 1, 695 kcal (21). The mean fat intake accounts for 31.1% of dietary energy. In order to observe the effects of CGTE on body fat under real life circumstances, no dietary restrictions or monitoring of dietary intake was conducted. However, this creates limitations in addressing variability in diets between individuals and between the cross-over period. We plan to address the limitation of this study by including a record of food energy intake in future research.

During the study, the participants were regularly interviewed and counseled to ensure that they adhered to their routine dietary and physical activity. The only possible known significant change in their diet was the consumption of the health supplement comprising of capsaicin, green tea extract and essence of chicken. Thus, a decrease in the body fat during the 2-wk study could positively be explained by the change in the health supplement. The positive results of this study, albeit with its design limitations, warrants further investigation, preferably with a larger sample size, longer duration of study and detailed monitoring of dietary habits and physical activities.

To date, we believe this is the first human study that demonstrates the potential benefit of combining natural thermogenic inducing food ingredients on body fat. Although this was only a 2-wk study, the combined thermogenic effect translated to a positive clinical effect by reducing approximately 460 g of body fat. Thus, the possibility of increasing sympathetic-mediated thermogenesis using a 'cocktail' of capsaicin, green tea extract and chicken essence is an attractive adjunct approach to regulate excess body fat for better health.

REFERENCES


