Effect of Chicken Soup Intake on Mood States and Peripheral Blood Flow in Humans

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Chicken soup has long been considered anecdotally healthful in Western and Southeast Asian countries. In this study, we examined the effects of a 2-week intake of chicken soup on mood states and of a single and 2-week intake on peripheral blood flow. Thirty healthy volunteers (7 men and 23 women aged 20.5 ± 1.4 years) participated in a randomized, double-blind, placebo-controlled crossover study with 2 weeks treatment and washout periods. They were randomly assigned to two groups, and daily received either chicken soup or placebo soup. Mood states by the Profile of Mood States (POMS) questionnaire and peripheral blood flow by a laser-Doppler blood flow imaging system were assessed before and after each treatment period. On the first day of the treatment periods, the effect of single intake on peripheral blood flow was investigated. The 2-week intake of chicken soup significantly reduced the tension-anxiety (T-A) score compared to the placebo soup ($p < 0.05$). The single intake of chicken soup significantly increased peripheral blood flow as compared with the base value (20 min after intake $p < 0.01$; 25, 30 and 45 min after intake $p < 0.001$) and that of the placebo soup (25, 30 and 60 min after intake $p < 0.05$; 45 min after intake $p < 0.01$). The 2-week intake of chicken soup also significantly increased peripheral blood flow over that of the placebo soup ($p < 0.001$). Chicken soup was considered to have improved mood states such as tension and anxiety and increased peripheral blood flow.

Key words —— chicken soup, mood state, blood flow

INTRODUCTION

Throughout the history of the world, chicken extract (including chicken bouillon and soup stock) obtained by boiling chicken has been used as a base in cooking and soup that can be eaten conveniently after the addition of a few spices. The reason for its popularity is due to the superiority of the taste of the chicken extract and its affinity to the taste of other food materials.

Chicken soup or extract is not only considered tasty, but is thought to promote health, and has been used to nourish persons who are ill or persons who would like to prevent illness. For example, in Western countries, chicken soup is traditionally eaten when an individual catches a cold,[1)] and chicken extract is used as a health-promoting drink in Southeast Asian countries.[2)] The physiological functions of chicken soup or extract have become a subject of study in recent years. Human study demonstrated such effects as improvement of nasal mucus secretion,[3)] sustaining strength in strenuous, repetitive exercise,[4)] enhancement of the metabolic rate,[5, 6)] improvement of the serum iron level recovery after blood donation,[7)] increases in beneficial contents in maternal milk,[8)] and improvement of skin conditions.[9)] Furthermore, in animal studies, inhibition of blood pressure increase[10, 11)] and attenuation of stress-induced response such as a decrease in blood glucose and lipid metabolism[12, 13)] have been reported. Thus, scientific evidence on the healthful effects of chicken soup or extract is gradually accumulating.

Since physical health is considered to affect mental health, the various effects of chicken soup or extract on physiological function might contribute to the improvement of mood states. In relation to this, Nagai *et al.* found that subjects felt more active and less fatigued during a task involving a heavy mental worklod after the 1 week intake of chicken extract.[2)] However, the effect of chicken soup or extract on mood states under ordinary daily stress,

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which is unlike the strong mental stress experienced under a heavy workload, have not been reported. Therefore, in the present study, we focused on the effects the daily consumption of chicken soup had on mood states under ordinary daily life.

Peripheral blood circulation plays an important role in maintaining organ function by the exchange of oxygen and nutrients between blood and tissues and by transducing heat to the peripheral tissue. Therefore, the increase of peripheral blood flow could contribute to the improvement of physiological function in many aspects. In addition, Nozawa *et al.* reported that the 2-week intake of dried-bonito broth, which is used as a base in cooking and soup in Japan in the same way that chicken extract is used in other countries, improved mood states and increased peripheral blood flow. They also described that the changes in mood states correlated with the change in peripheral blood flow.[14] Therefore, we also included the investigation of peripheral blood flow in the present study.

MATERIALS AND METHODS

Subjects—— Thirty healthy volunteers of both sexes (7 men and 23 women aged 20.5 ± 1.4 years) were recruited from students in Kobe Gakuin University (Kobe, Japan). This study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the ethics committee of Kobe Gakuin University. Each subject gave written informed consent after being informed about the study, both orally and in writing. All subjects completed the study.

Test Soups—— Chicken extract was produced by heating whole chickens under normal pressure. The extract was then lyophilized and powdered. Subsequently, 2.7 g of powdered chicken extract to which table salt was added was used as the chicken soup. The placebo soup was composed of chicken flavor, dextrin, caramel and table salt, which simulated chicken soup in flavor, appearance, calorie and salt content. Each serving of these test soups was packed in an aluminized pouch. Table 1 shows the nutritional contents of these soups.

Experimental Design—— The study was conducted from October through December 2005. The study was a randomized, double-blind, placebo-controlled, crossover study with 2 weeks treatment and washout periods (Fig. 1). The subjects were randomly assigned to two groups and received either chicken soup or placebo soup daily. They were asked to consume the test soup after reconstituting 1 serving of the soup powder with 150 ml of hot water between the evening meal and bedtime, except on the first day of the treatment period. All measurements were performed in a quiet room in which the temperature was kept constant at around 23°C. At least 2 hr after taking lunch, blood pressure, heart rate, peripheral blood flow, dietary intake, and mood states were assessed successively on the first day of the treatment periods and the day after the final day of the treatment periods. On the first day of the treatment periods, the test soups were taken during assessment, and peripheral blood flow was measured as follows: the reconstituted soups were cooled down to room temperature and the periph-

Table 1. Nutritional Contents of Test Soups

	Chicken soup	Placebo soup
Water (%)	1.35	1.64
Energy (kJ)	38.5	40.2
Protein (g)	1.98	0.00
Fat (g)	0.08	0.02
Carbohydrate (g)	0.15	2.35
Ash (g)	0.34	0.53
Sodium (g)	0.21	0.19
Anserine (mg)	135	ND
Carnosine (mg)	66	ND
Gelatin (mg)	997	ND

ND: Not detected.

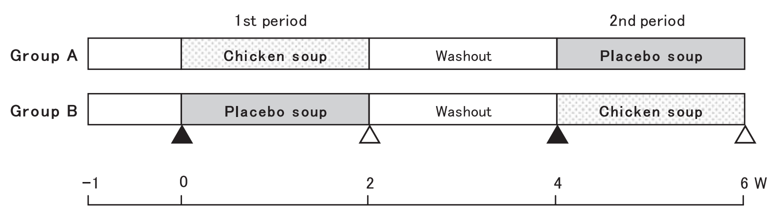

Fig. 1. Study Protocol

▲, POMS questionnaire and sequential peripheral skin blood flow measurements were performed. △, POMS questionnaire and single peripheral skin blood flow measurements were performed.

eral blood flow was measured immediately before and 0, 5, 10, 15, 20, 25, 30, 45 and 60 min after the intake of the test soups, in order to examine the effect of a single intake. The subjects were instructed not to alter their normal living practices during the experimental period with respect to meal contents, smoking and exercise. In addition, assessment training was performed one week before the start of this study.

Dietary Assessment —— Dietary assessment was conducted in order to certify total energy intake and energy derived from each of macronutrients unchanged over the course of the study. Dietary intake was assessed using a self-completed, quantified food frequency questionnaire (FFQ). According to FFQ, the intake of total energy, carbohydrates, protein, and fat were calculated by Wdiet for Windows ver. 1.0 software (E.G. Project Co., Osaka, Japan). Furthermore, the intake of meat, fish, and eggs were evaluated individually.

Measurement of Mood States —— Measurement of mood state was carried out by means of the Profile of Mood States, Japanese version (POMS No. 850, Kaneko Shobo, Tokyo, Japan). This questionnaire is comprised of 65 items in 6 scores of tension-anxiety (T-A), depression (D), anger-hostility (A-H), vigor (V), fatigue (F) and confusion (C). Raw scores were standardized as T scores by using the attached tables of normative data weighted for sex and age. A high V score reflected a good mood or emotion, and low scores in the other factors also reflected a good mood or emotion.

Measurement of Peripheral Blood Flow and Other Haemodynamic Parameters —— A laser-Doppler blood flow imaging system (PeriScan PIM II, Perimed AB, Järfälla, Sweden) was used to measure the peripheral blood flow in the dorsal region of the right hand. This equipment takes advantage of the shift in the wavelength of the laser beam induced by a moving body (red blood cells, *etc.*) having a mass when colliding with the light. By measuring the wavelength shift between the irradiated laser light and the reflecting laser, the relative volume of the blood flow may be obtained.

Blood pressure and heart rate were measured by means of an automated digital sphygmomanometer (HEM-907, Omron Healthcare, Kyoto, Japan). The average values of the systolic and diastolic blood pressures were calculated from triplicate measurements.

Statistical Analysis —— All values were expressed as mean ± standard error (S.E.). The changes between the pre-intake and post-intake values of dietary assesment, mood factors, blood flow, blood pressure, and heart rate at the 2-week intake trial were assessed by analysis of variance (ANOVA) with treatment (chicken and placebo soup), period (1st period and 2nd period), and carry-over effect (group A and group B) as the within-subjects factors. Blood flow at the single intake trial was assessed by repeated-measures ANOVA, with treatment and time as the within-subjects factors. When appropriate, post-hoc comparisons were made by paired *t*-test except the comparisons of pre- and post-intake peripheral blood flow data at the single intake trial, which were adjusted by Bonferroni correction. The intake of fish, meat, and eggs were assessed by the Friedman test with pre- and post-intake of each period, and pre- and post-intake of each treatment. ANOVA of the 2-week intake trial was carried out with SAS Ver. 8.2 (SAS Institute, Cary, NC, U.S.A.) and other statistical analyses were carried out with SPSS Ver. 13.0 J (SPSS Japan, Tokyo, Japan). A p value < 0.05 (two-sided) was considered significant in all analyses.

RESULTS

Dietary Assessment

Dietary intake data are shown in Table 2. ANOVA revealed no significant treatment effects in the intake of total energy, protein, fat, and carbohydrates during the study. Multiple comparison of Freedman in the intake of fish, meat, and eggs did not show significant differences in the pre- and post-intake of each period (fish: $p = 0.22$, meat: $p = 0.55$, and egg: $p = 0.51$) and the pre- and post-intake of each treatment (fish: $p = 0.77$, meat: $p = 0.81$, and egg: $p = 0.58$). These results indicated that the dietary habits of the subjects did not change during the study.

Mood States at 2-week Intake Trial

Changes in the POMS are shown in Table 3. ANOVA revealed a significant treatment effect only in the T-A score [$F (1, 28) = 6.93$, $p = 0.01$]. No significant treatment effects were found in any other scores of the POMS. Within-treatment comparisons of the T-A score, a decrease in the T-A score in the chicken soup was significant after the 2-week intake ($p < 0.05$). In comparison with the placebo soup, the change of T-A score of the chicken soup between the pre- and post-intake values was signif-

Table 2. Dietary Intake during the Study

	Group	Pre-intake	Post-intake
Total energy (kcal)	Chicken soup	1686 ± 56	1745 ± 58
	Placebo soup	1782 ± 60	1738 ± 50
Protein (g)	Chicken soup	59.1 ± 2.3	64.4 ± 2.9
	Placebo soup	62.6 ± 2.3	62.5 ± 2.0
Fat (g)	Chicken soup	46.3 ± 1.8	49.7 ± 1.9
	Placebo soup	49.8 ± 2.2	50.3 ± 1.7
Carbohydrate (g)	Chicken soup	247.2 ± 8.8	251.3 ± 9.4
	Placebo soup	271.0 ± 13.6	248.6 ± 8.4

Values are means ± S.E.

Table 3. Changes of Factors of POMS at the 2-week Intake Trial

	Group	Pre-intake	Post-intake	Change	$p^{a)}$
T-A	Chicken soup	51.1 ± 2.0	48.3 ± 1.8*,#	−2.8 ± 1.1	0.01
	Placebo soup	49.3 ± 1.8	49.7 ± 1.9	0.4 ± 0.4	
D	Chicken soup	50.8 ± 1.7	49.8 ± 1.6	−1.0 ± 0.6	0.55
	Placebo soup	50.8 ± 1.6	50.4 ± 1.6	−0.4 ± 0.7	
A-H	Chicken soup	47.4 ± 1.4	48.1 ± 1.4	0.7 ± 0.9	0.20
	Placebo soup	48.1 ± 1.5	47.2 ± 1.3	−0.9 ± 0.8	
V	Chicken soup	46.2 ± 1.6	49.2 ± 1.8	2.9 ± 1.3	0.25
	Placebo soup	47.5 ± 1.7	48.6 ± 1.7	1.1 ± 0.7	
F	Chicken soup	52.2 ± 1.8	51.7 ± 1.8	−0.5 ± 0.9	0.61
	Placebo soup	52.2 ± 1.6	52.2 ± 1.7	0.1 ± 0.8	
C	Chicken soup	53.0 ± 1.8	52.7 ± 2.0	−0.3 ± 1.1	0.70
	Placebo soup	52.7 ± 1.8	51.8 ± 1.9	−0.9 ± 1.0	

Values are means ± S.E. * Difference compared to the pre-intake value at $p < 0.05$ (paired *t*-test). # Difference between treatments at $p < 0.05$ (paired *t*-test). *a*) *p*-value for treatments obtained by ANOVA.

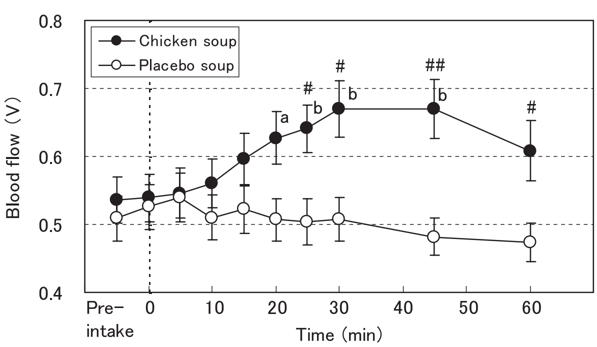

Fig. 2. Changes in Peripheral Blood Flow at the Single Intake Trial by means of a Laser-Doppler Blood Flow Imaging System

Values are means ± S.E. Significantly different between treatments (paired *t*-test), #: $p < 0.05$, ##: $p < 0.01$. Significantly different from the pre-intake value (paired *t*-test with Bonferroni correction), a: $p < 0.01$, b: $p < 0.001$.

icantly lower ($p < 0.05$).

Peripheral Blood Flow at Single Intake Trial

Changes in the peripheral blood flow at the single intake trial are shown in Fig. 2. ANOVA revealed a significant treatment and time effect in peripheral blood flow [F (9, 261) = 15.29, $p < 0.001$]. In comparing the results of the pre- and post-intake peripheral blood flow up to 60 min after the intake of the test soups, the chicken soup showed a significant increase comparing the pre-intake value from 20 min to 45 min after intake (20 min after intake $p < 0.01$; 25, 30 and 45 min after intake $p < 0.001$). In comparison with the placebo soup, the peripheral blood flow of the chicken soup was significantly greater from 25 to 45 min after intake (25, 30 and 60 min after intake $p < 0.05$; 45 min after intake $p < 0.01$).

Peripheral Blood Flow at 2-week Intake Trial

Changes in the peripheral blood flow and other haemodynamic parameters at the 2-week intake trial are shown in Table 4. ANOVA revealed a significant treatment effect in the peripheral blood flow [F (1, 28) = 47.93, $p < 0.001$]. No significant treatment effects were found in systolic blood pressure, diastolic blood pressure and heart rate. Within-treatment comparisons of peripheral blood flow, in-

Table 4. Changes in Peripheral Blood Flow and Other Haemodynamic Parameters at the 2-week Intake Trial

	Group	Pre-intake	Post-intake	Change	$p^{a)}$
Peripheral blood flow (V)	Chicken soup	0.58 ± 0.03	0.66 ± 0.03***,###	0.08 ± 0.01	< 0.001
	Placebo soup	0.57 ± 0.03	0.59 ± 0.03**	0.02 ± 0.01	
Systolic blood pressure	Chicken soup	102.4 ± 2.0	103.0 ± 1.4	0.6 ± 1.1	0.62
(mmHg)	Placebo soup	103.0 ± 1.9	102.9 ± 1.7	−0.1 ± 0.7	
Diastolic blood pressure	Chicken soup	58.7 ± 1.3	58.7 ± 0.7	0.0 ± 1.1	0.76
(mmHg)	Placebo soup	59.3 ± 1.2	58.8 ± 1.3	−0.5 ± 1.0	
Heart rate (bpm)	Chicken soup	68.9 ± 1.8	69.4 ± 1.9	0.5 ± 1.6	0.60
	Placebo soup	70.0 ± 1.9	69.5 ± 1.6	−0.5 ± 1.1	

Values are means ± S.E. ** Difference compared to the pre-intake value at $p < 0.01$ (paired t-test). *** Difference compared to the pre-intake value at $p < 0.001$ (paired t-test). ### Difference between treatments at $p < 0.001$ (paired t-test). *a*) p-value for treatments obtained by ANOVA.

creases in the blood flow in both the chicken soup and placebo soup were significant after the 2-week intake (chicken soup $p < 0.001$; placebo soup $p < 0.01$). In comparison with the placebo soup, the peripheral blood flow of the chicken soup after the 2-week intake and the changes between the pre- and post-intake values were significantly greater ($p < 0.001$ in both cases).

DISCUSSION

In the present study, the 2-week intake of chicken soup induced a decrease in the T-A score in the POMS. Furthermore, the single and 2-week intake of chicken soup induced a peripheral blood flow increase. Since the amount of chicken extract consumed in this study was 2.7 g in the solid form, an amount which is certainly appropriate as a part of any ordinary meal, the results described above were interesting.

Nagai *et al.* found that an increased tension and a reduced vigor score in the POMS due to mental workload were significantly smaller after the 1 week intake of chicken extract than after the intake of placebo.[2] In the present study, the 2-week intake of chicken soup resulted in the reduction of tension and anxiety under ordinary daily stress, which is unlike the strong mental stress experienced under a heavy workload. Therefore, it was considered that chicken extract had the effect of placing the subjects in a positive mood state either with or without strong mental stress.

An increase in peripheral blood flow accompanies an increase in systolic output (*e.g.*, an increase in cardiac power output or heart rate) or a reduction in peripheral resistance (*e.g.*, vasodilation or increased blood fluidity). In relation to these factors, blood pressure and heart rates were measured in the present study, and no significant effect of the chicken soup intake was found on them. Correlations between the peripheral blood flow and blood pressures/heart rate were also calculated in the present study, but no significant correlation was found (data not shown). These findings imply that the increase in the peripheral blood flow due to the intake of chicken soup is caused by factors other than the increase in blood pressure or heart rate.

The improvement of mood states and the increase of peripheral blood flow have also been reported with bonito broth, which is used as a base in cooking and soup in Japan. The 2-week intake of 5 g dried-bonito broth improved all POMS scores in young female subjects.[14] Furthermore, the 4-week intake of 2.45 g dried-bonito broth improved the V score of POMS at 2 weeks in middle aged subjects.[15] Thus, although the mood state items which were improved by the intake of dried-bonito broth was not constant between these 2 trials, probably due to the difference in the profile of the subjects or the amount of bonito broth consumed, it appeared to improve the mood states. On the other hand, the intake of dried-bonito broth increased the peripheral blood flow in young female subjects after both a single and 2-week intake.[14, 16] Therefore, the effect of improving the mood states and the increase of peripheral blood flow might be common features of the base in cooking and soup derived from animals.

In the present study, the age-old belief that chicken soup is healthy was upheld in that it improved mood states and increased peripheral blood flow. However, the present study did not identify the effective constituents or clarify the mechanisms of the improvement, leaving these tasks to be accomplished in the future.

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