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# The Effects of Coffee and Korean Red Ginseng with Body Wrap Steam Bathing on Stress Markers and Lipid Profiles

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**Abstract** Coffee and red ginseng are recognized for beneficial health effects. Drinking coffee lowers the risk of developing type 2 diabetes mellitus, while red ginseng displays immune-stimulatory and anti-tumor activities. However, there has been no study about the effect of a topical application of red ginseng with body wrap steam bathing (BWSB) for stress release. With respect to types of treatment provided with BWSB, these subjects were divided into three groups: caffeine, red ginseng, and the control group. The same volunteer subjects (n=15) underwent these 3 BWSB tests for three non-consecutive days, at least one week apart. Before and after having BWSB, blood samples were taken for analysis of hormones, lipid profiles inclusive of total cholesterol, high density lipoprotein, low density lipoprotein, and triglycerides. The free oxygen radicals test (FORT) and free oxygen radicals defense (FORD) test were performed to analyze circulating oxidative stress instantaneously after taking blood samples. The results of this study revealed that cortisol levels of the red ginseng group were decrease (20%) than the control group (15.4%). On the contrary, the caffeine group showed a significant increase in cortisol or catecholamine levels after BWSB. Although the lipid profiles were unaffected, triglyceride levels significantly decreased (12% reduction) after BWSB in the red ginseng group. The extent of decrease was much greater (21%) in overweight subjects, while the triglyceride levels of subjects with a normal BMI showed no change.

***Keywords:*** *coffee, Korean red ginseng, stress relief, body wrap steam bathing*

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## 1. Introduction

As the reciprocal influences of the mind and body are confirmed and as holistic medicine advances, more people pay attention to their lifestyles and the effects of psychological factors, such as stress and relaxation on their health. Nowadays, there is considerable interest in stress control and relaxation. In a survey conducted by the Dutch healthcare appliance maker, Philips Healthcare, more than 90% of 1,065 Korean adults surveyed said they suffer from large amounts of stress every day. In analysis, data clearly indicate that modern societies are stress prone, and that many individuals perceive themselves as being unhealthy, though they may not actually be affected by any particular disease. Many people are also concerned about obesity, which is associated with a potential infliction of chronic diseases. The survey found that 43% of Koreans consider themselves to be overweight [1].

Stress reduces physical and mental tolerance (immune potential) of humans and induces progression of an existing illness or causes latent conditions, such as obesity to become active. Activation of free radical oxidation is one of the major reactions determining adaptation to stress. Prolonged exposure to stress leads to hyper-activation of free radical oxidation, which results in damage to cell membranes and progression of a pathological process. The nervous tissues are most susceptible to damage induced by free radicals due to their specific physiologic attributes. Accordingly, the control and suppression of stress are rather imperative in improving the quality of life and prevention of diseases.

Warm water bathing is a popular recreational pastime, and is frequently used in rehabilitative medicine. It has become a recognized relaxation and/or stress management activity. It is largely useful for maintaining hygiene, improving blood circulation and relieving muscular fatigue and pain. In addition, for centuries people have used many kinds of essential oils, including: lavender, lemon, jasmine, rose, lilac, and hibiscus during bathing to achieve a variety of aroma-therapeutic, physical and mental effects.

It was also discovered that salts in hot spring water have the effect of raising body temperature longer [2], and deep seawater was utilized for the thalassotherapy in the treatment of some diseases [3,4,5]. These results indicate that hot deep seawater improves the functions of the

human immune system, like bathing in the hot springs does good to one's body. On the basis of these studies, some of the most recent products, such as therapeutic bath products incorporating various ingredients, have been introduced. These incorporated ingredients are appealing, and also arouse interests in the aspects of emotional and physical condition.

Korean red ginseng (the steamed root of *Panax ginseng* C. A. Meyer) is a well known traditional medicinal remedy used through Asia, Europe, and the United States. Extensive reports point to ginseng as having many physiological and/or pharmacological effects on the immune, cardiovascular and central nervous system, as well as the endocrinal glands. Besides, ginseng also possesses anti-aging, anti-stress and anti-tumor properties [6,7]. In addition, several researches demonstrated that ginseng possesses anti-diabetic properties through lowering blood glucose levels and stimulating sugar metabolism [8].

Coffee also contains biologically-active compounds other than caffeine, which may alter glucose metabolism. For example, both regular and decaffeinated coffee acutely alter the secretion of gastrointestinal hormones that regulate glucose absorption, such that glucose is taken up more slowly [9]. According to Johnston and colleagues, chlorogenic acid may be responsible [9]. Chlorogenic acid is a phenolic compound and an antioxidant present in both decaffeinated and regular coffee. Recently, coffee consumption has been associated with reduction in the risk of several chronic diseases [10,11]. Coffee is one of the most popular and widely consumed beverages in the world, but clinical studies on drinking coffee before steam bathing are scarce. Coffee or red ginseng, together with BWSB, may decrease stress and body fat, and increase blood circulation. BWSB also stimulates the lymphatic system which produces antibodies to help the body's immune system.

Owing to the absence of information on the correlation between stress and relaxation in bathing, together with drinking coffee or ingesting red ginseng, this study evaluated the synergistic effect of steam bathing with drinking coffee or ingesting red ginseng. Free radical oxidation and antioxidative activation are the major reactions determining adaptation to stress. This study investigated free radical levels, stress-related factors including adrenaline and other stress hormones, immunoglobulin A, as well as lipid profiles.

# 2. Materials and Methods

## 2.1. Subjects

Fifteen healthy volunteers were selected from a group of university students for enrollment in this investigation. The exclusion criteria include individuals with a personal or family history of physical illness, psychiatric disorder or chronic drug use. An informed consent was obtained from each subject prior to participation in the experiment. The study was performed in accordance with the Declaration of Helsinki in 1964.

## 2.2. Procedure

This study consists of 3 types of treatment with SWSB, each type with one of three interventions: 1) the caffeine group with subjects drinking 200 mL of instant caffeinated coffee with 3 mg caffeine/kg body weight before BWSB, 2) the red ginseng group of subjects treated with 3 grams of red-ginseng-body-wrap cream (200 grams of the control body pack cream containing 3 grams of red ginseng), and 3) the control group with only BWSB (200 gram control body pack cream without red ginseng). Three types of BWSB tests were performed by the same volunteers (n=15) for 3 non-consecutive days, at least 1 week apart. The same group of healthy volunteers underwent all three interventions with BWSB. The experimental procedure was carried out as follows: Three experimental bathtubs (1.0 x 0.6 x 0.5 m depth) were set up, where the temperature was maintained at 42°±1 Celsius (Steam & Thermal Spa, Dermalife spa jet USA). Before having BWSB, BMI (InBody 720, Biospace, Korea) and blood samples (8 ml) were first collected. These subjects were then allowed to enter a warm-up room with a room temperature maintained at 27°±2 Celsius, where subjects relaxed for 20 minutes prior to the experiment. After relaxing for 20 minutes, a body wrap cream with or without red ginseng was applied to the entire body. An occlusive dressing of the body with a plastic wrap was used to maintain the body heat to facilitate skin absorption of the cream. After having BWSB for 40 minutes, these subjects were asked to take a shower and rest for 10 minutes. Thereafter, the second measurements of BMI and blood samples were taken.

## 2.3. Blood Collection and Analyses

Before and after having BWSB, blood samples were obtained and analyzed for serum hormones, lipid profile and glucose at the Laboratory of Green Cross Clinical Center using HPLC (Acclaim, Bio-Rad, USA) for epinephrine and norepinephrine. A γ-ray counter (Cobra 5010 Quantum, Packard, USA) was used for the measurement of cortisol, while Dimension (Dimension Vista 5000, Siemens, USA) used for immunoglobulin A, and Modular analytics (PE, Roche, Germany) was used for lipid profiles and glucose. For the lipid profile analysis, serum concentrations of total cholesterol (t-cho), high density lipoprotein (HDL), low density lipoprotein (LDL) and triglycerides (TG) were measured.

A clinical chemistry analyzer (Selectra E, Vital Scientific, Netherland) was used for the analysis of lipid profiles: serum concentrations of t-cho, HDL, LDL, and TG. The blood sample, as set for the original protocol, was collected for the tests of both serum and plasma, which were stored continuously at -80 °C for the entire interval between completion of the original study and the time of analysis. The results obtained from the free oxygen radicals (FORT) test and free oxygen radicals defense (FORD) test were analyzed instantly after blood sampling. Reactive oxygen species were determined by using the FORT kit (Callegari, Parma, Italy), a colorimetric assay based on the ability of transition metals, such as iron, to catalyze the breakdown of hydroperoxides (ROOH) into derivative radicals, according to the Fenton reaction. The radical species produced by the reaction interact with an additive (phenylenediamine derivative, $2CrNH_2$) that forms colored, fairly long-lived radical cations evaluable by spectrophotometer at 505 nm (linear kinetic-based reaction). The intensity of the color

correlates directly to the quantity of radical compounds and to the hydroperoxides concentration and, consequently, to the oxidative status of the sample according to the Lambert-Beer law (Form CR, 2000, Callegari). The assay may be completed in 6 minutes while the data is available to suggest that the FORT test can satisfactorily assess the level of oxidative radicals in whole blood [12,13].

## 2.4. Statistical Analysis

Microsoft Excel 2010 (Microsoft Corp, Redmond, WA) was used for data entry, validation, restructuring, calculating changes in variables over time, reorganizing and reformatting results, and preparing the graph. Data were expressed as mean value ±SD (standard deviation) and the effect of BWSB was estimated using a paired t-test. *p* value of <0.05 was considered as statistically significant.

Statistical analysis was performed using the SPSS Base System ver. 19 (IBM SPSS Inc., Chicago, IL).

# 3. Results

These volunteer subjects (n=15) performed 3 types of interventions with BWSB for 3 nonconsecutive days, at least 1 week apart. The results before and after BWSB with coffee or RG were obtained from the same group of healthy volunteers. The baseline characteristics of subjects are shown in Table 1.

**Table 1. General characteristics of subjects (participants, n=15)**

| Variables | | Subjects (n=15) |
|---|---|---|
| | Age(mean) | 22.5 ± 1.8 years |
| | Males/Females | 7/8 |
| | Smokers/Nonsmokers | 2/13 |
| BMI ($kg/m^2$) | <25 (Standard Weight) | 8 |
| | >= 25 Overweight and Obesity | 7 |

Abbreviation: BMI, body mass index.

Figure 1 shows the plasma FORT concentration of participants before and after 3 types of interventions with BWSB. For the control group with no treatment, the levels of FORT after BWSB were largely higher than those after BWSB(Figure 1A).

In the control group, the levels of FORT were higher after BWSB than those before BWSB (229±45 mmol/L vs. 217±38 mmol/L Trolox, respectively). In the meanwhile, in the red ginseng group, the levels of FORT were lower after BWSB than those before BWSB (237±60 vs. 258±71 mmol/L Trolox, respectively, Figure 1C). In the caffeine group (Figure 1B), no difference were found after and before BWSB (248±59 vs 246±57 mmol/L Trolox, respectively). Figure 2 shows the mean cortisol levels in the serum. The serum cortisol levels were significantly lower after BWSB, except for the caffeine group (15.4% decrease in the control group; and 20% decrease in the red ginseng group). The decreasing effect of cortisol level was much greater after BWSB in the red ginseng group than in the control group. Whereas, the cortisol level was significantly higher (27%) in the caffeine group after BWSB, compared to either the control or red ginseng group. Caffeinated coffee consumption increased the cortisol levels rather than decreasing cortisol levels after BWSB.

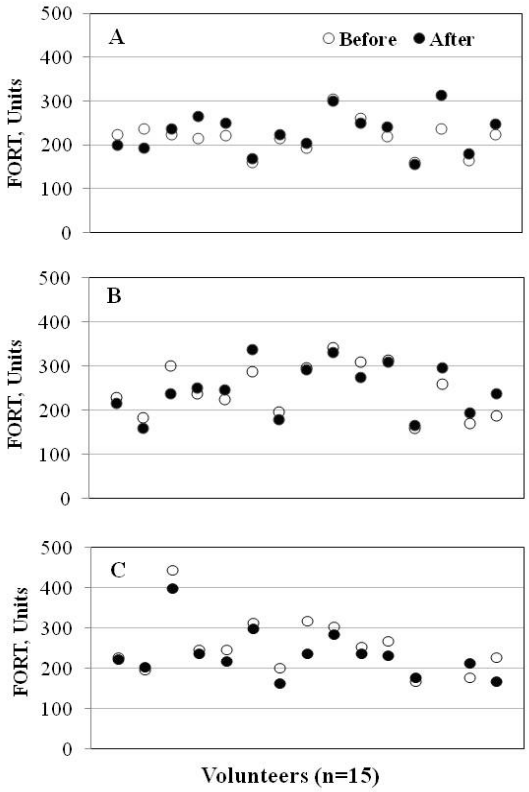


**Figure 1.** Changes in the free radical concentration (FORT) before( after 3 types of interventions with BWSB. For the control group intervention: (A) control group, undergoing only BWSB; (B) caffeine group, drinking coffee before BWSB; and (C) red ginseng group, applying red ginseng cream to the whole body before BWSB

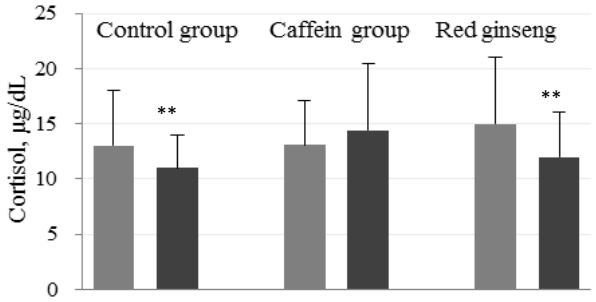


**Figure 2.** Changes in the serum cortisol levels before and after BWSB in 3 types of treatment groups: control group, caffeine group amd red ginseng group (3g/person). The data is expressed as the mean ± standard deviation(SD) (n=15). Statistical differences(**$p$<0.01) versus after BWSB.

The plasma levels of epinephrine and norepinephrine decreased in the control group and red ginseng group after BWSB. However, the decreased level of epinephrine was very significant while that of the norepinephrine was not significant (Table 2).

**Table 2. The mean plasma level of epinephrine and norepinephrine levels before and after BWSB. The data is expressed as the mean ± standard deviation (n=15); Statistical differences (*$p$<0.05, **$p$<0.01) versus after BWSB.**

| Epinephrine/ Norepinephrine (pg/mL) | Control group | | Caffein group | | Red ginseng | |
|---|---|---|---|---|---|---|
| | before | after | before | after | before | after |
| Epinephrine | 32±8* | 28±12 | 28±17 | 39±12** | 30±9 | 27±12* |
| Norepinephrine | 250±57 | 243±50 | 228±65 | 248±70 | 231±94 | 229±84 |

However, the levels of epinephrine or norepinephrine increased in the caffeine group after BWSB. Particularly,

the level of epinephrine increased significantly from 28 to 39 pg/mL (39%). The blood lipids including TC, LDL and HDL were unaffected after BWSB in 3 types of treatment. However, TG significantly decreased from 87 to 76 mg/dL (12%) in the red ginseng group after BWSB (Table 3). The most significant change was seen in the relationship between BMI and TG.

**Table 3. Changes shown in the mean levels of volunteers (n=15) TC, LDL, HDL and TG concentrations before and after red ginseng bathing. The data is expressed as the mean ± standard deviation (n=15); Statistical differences (*$p$<0.05) versus after BWSB**

| Variables | Red ginseng BWSB | |
|---|---|---|
| | before | after |
| TC (mg/dL) | 168±33 | 171±33 |
| LDL (mg/dL) | 96±30 | 98±30 |
| HDL (mg/dL) | 58±14 | 59±14 |
| TG (mg/dL) | 87±45 | 76±34* |

The subgroup analysis, on the basis of BMI, indicates a significant difference in the TG. A significant lower level of TG in the group with the mean BMI of 22 kg/m$^2$ was shown in comparison with a higher level of TG with the mean BMI of 27 kg/m$^2$ (Table 4 and Figure 3).

**Table 4. Changes of TG levels by the mean BMI values in the red ginseng group. The data is expressed as the mean ± standard deviation by mean BMI values of 22 (n=8) and 27 (n=7) respectively; Statistical differences (**$p$<0.01) versus after BWSB**

| Mean BMI value | TG (mg/dL) in Red ginseng group | |
|---|---|---|
| | before | after |
| 22±2.2 | 58±24 | 56±19 |
| 27±1.6 | 123±48 | 97±39** |

There was no difference in TG levels before and after BWSB in the normal BMI group (mean BMI of 22). However, changes of TG levels in the group with a higher mean BMI (mean BMI of 27) was significant. TG decreased by 21% after BWSB with red ginseng application.

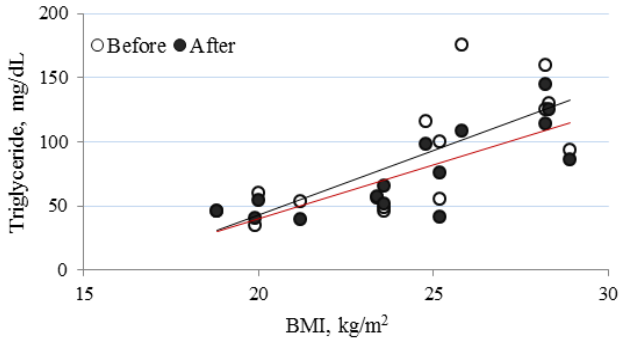


**Figure 3.** Changes of TG levels by the BMI values in the red ginseng group (n=15).

## 4. Discussion

Since ancient times, saunas have been used as a tool for whole body thermal therapy, especially in Finland [14]. Several studies have investigated the clinical effects of low-temperature sauna bathing, hot deep sea water and warm-water bathing as physiotherapy treatment modalities [15,16,17]. However, this is the first report on the efficacy of BWSB with body wrap cream including red ginseng, which was applied on the entire body. This study examined the health effects of BWSB with red ginseng from the viewpoint of free radical, stress hormones, and lipid profile in comparison with those of caffeinated coffee and control BWSB groups.

Our study showed that the levels of FORT in most participants of the red ginseng group (n=15) were lower after BWSB in comparison with before. However, in the caffeine group who drank instant coffee before BWSB, the level of FORT was somewhat increased after BWSB. The effective ingredients of red ginseng will be absorbed into the body through the skin during BWSB and affect blood antioxidant status, because red ginseng may be an effective free radical scavenger which protects against oxidative stress induced by free radicals. Generally, ginseng saponins, known as ginsenosides and the main active component in ginseng, are believed to play an important pharmacological role. In addition, there have been several studies about the antioxidant activity of ginsenosides [18]. The recent study [19] suggest that $CO_2$-enriched water immersion in patients with peripheral occlusive arterial disease had a positive effect, reducing free radical plasma levels and raising the levels of antioxidants, suggesting an improvement in microcirculation.

A significant decrease in cortisol level was shown after BWSB except for the caffeine group. Very similar results with cortisol were observed in catecholamine levels (epinephrine and norepinephrine). A decrease of epinephrine and norepinephrine was observed in both the control and red ginseng group after BWSB. Moreover, the red ginseng group had a relatively greater reduction in cortisol level (20% decrease) than the control group (15.4% decrease). Thus, these finding suggest that BWSB does relieve stress and BWSB with red ginseng may be a synergy effect with BWSB. In the caffeine group, by contrast, cortisol and catecholamine levels after BWSB showed a significant increase. Consistent with this, acute administration of 3.3 mg caffeine/kg body weight increased cortisol concentrations 1 hour following administration [20], whereas administration of 200 mg of caffeine twice per day had no effect on cortisol levels after 7 days [21]. Lane *et al.* [22] found that caffeine increased cortisol concentrations when combined with mental arithmetic but not during rest. Our results also indicate that a caffeine beverage with BWSB is not good for stress relief. A recent study by Huang *et al.* [23] showed that elevated oxidative stress during physical and psychological stress was positively correlated with epinephrine and norepinephrine. Baez *et al.* [24] also demonstrated that catecholamine metabolism generates free radicals and other reactive species. These results are consistent with our results that increased levels of FORT, cortisol, epinephrine and norepinephrine in the caffeinated coffee group after BWSB. This result supports a previous study by Cosentino *et al.* [25] who demonstrated that elevated oxidative stress during psychological stress could be the effect of high circulating levels of catecholamines.

Although blood lipid including TC, LDL and HDL was unaffected, the change in TG was significantly decreased from 87 to 76 mg/dL (12%) after BWSB in the red ginseng group. The decrease rate was much greater in the group of overweight subjects (mean BMI 27 kg/m$^2$), while

that in normal BMI 22 kg/m$^2$ showed no difference. TG decreased by 21 % after BWSB with red ginseng in the higher BMI group. Thus, it is possible that bioactive components in red ginseng functioned as an anti-hyperlipidemic activity. It has been reported that red ginseng acidic polysaccharide, isolated from Korean red ginseng, displays anti-hyperlipidemic effects [26]. They found that red ginseng polysaccharide treatment reduced both levels of TG in serum and the liver, and increased the activity of lipoprotein lipase (LPL), in serum, indicating that RGAP may diminish the levels of TG through activation of LPL.

The ingredients in hot springs are absorbed into the body through the skin. It is well known that the muriated hot springs have an advantage over mineral water in maintaining a constant body temperature [2]. The ingredients of red ginseng also were absorbed into the body through the skin by BWSB and had positive effects such as lower FORT, cortisol, epinephrine, norepinephrine and TG levels after BWSB compared with before BWSB. These findings suggest that BWSB with red ginseng may enhance relaxation and/or stress management activity. Previous research by Sivonova *et al*. [27] has shown that elevated oxidative stress during psychological stress could be the effect of high circulating levels of epinephrine and norepinephrine. Previous studies have also demonstrated that a significant decrease in cortisol levels after spa bathing or forest bathing, and reduction was much higher in the high-stress group than the low-stress group [28,29].

The limitation of our study is a small sample size, which renders us unable to generalize our study findings to other populations. The important findings presented in this study will require further investigation in larger trials that should be carefully designed to include study duration and subject characteristics.

## 5. Conclusion

Red ginseng treatment with BWSB lowered the levels of cortisol, a stress hormone, and also suppressed activation components of the sympathetic nervous system, epinephrine and norepinephrine, having a stress relieving effect. Particularly, red ginseng treatment with BWSB demonstrated the effect of largely decreasing TG levels in subjects with a high BMI (the mean BMI of 27 kg/m$^2$). Drinking caffeinated coffee had the effect of increasing cortisol levels and sympathomimetic activation after BWSB as opposed to before BWSB. Therefore, it demonstrated that drinking a caffeinated beverage before sauna or steam bathing does not help relieve stress.

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