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The Influence of Adaptogens on Ultraweak Biophoton Emission: a Pilot-Experiment

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In the present study, the effect of plant adaptogens (*Rhodiola rosea* and ADAPT-232) on human photon emission has been determined. In a randomized double blind placebo-controlled study, 30 subjects were randomly assigned to three groups: one group ($n = 10$) taking placebo pills, one group ($n = 10$) taking *Rhodiola rosea* (SHR-5) pills and one group ($n = 10$) taking ADAPT-232 supplements (the latter being a fixed combination of the following three adaptogens: *Eleutherococcus senticosus, Rhodiola rosea* and *Schisandra chinensis*). All subjects underwent measurements to determine ultra-weak photon emission (UPE) of the dorsal side of their hands using a photon-counting device, both before and after a week of taking the supplements. In addition, the experienced levels of stress and fatigue (tiredness) were evaluated. After 1 week of supplementation, the *Rhodiola* group showed a significant decrease ($p = 0.027$) in photon emission in comparison with the placebo group. Furthermore, after supplementation, a significant decrease ($p = 0.049$) concerning the experienced level of fatigue in the *Rhodiola* group was observed compared with the placebo group. No significant changes were observed between the ADAPT-232 and the placebo group. Copyright © 2009 John Wiley & Sons, Ltd.

Keywords: plant adaptogens; ADAPT-232; *Rhodiola rosea*; ultra-weak photon emission.

INTRODUCTION

Extracts of plant adaptogens (such as *Eleutherococcus senticosus, Schisandra chinensis* and *Rhodiola rosea*) have been shown to increase the resistance of a variety of organisms against the negative effect of different stress conditions (Wagner *et al.*, 1994; Boon-Niermeijer *et al.*, 2000; Panossian and Wagner, 2005; Wiegant *et al.*, 2008b) and to increase cellular defense against reactive oxygen species (ROS) in different cell types (Brown *et al.*, 2002; DeSanctis *et al.*, 2004; Wiegant *et al.*, 2008a). In addition, it has been shown that adaptogens (such as *Eleutherococcus* and *Rhodiola*) significantly increase longevity and stress resistance both in *C. elegans* (Wiegant *et al.*, 2006, 2008b) and in *Drosophila melanogaster* (Jafari *et al.*, 2007), probably by alleviating oxidative stress. Clinical evidence has suggested that a standardized extract of *Rhodiola rosea* (SHR-5) has antifatigue, antistress, antioxidant and immune-enhancing effects (Darbinyan *et al.*, 2000; Spasov *et al.*, 2000; Shevtsov *et al.*, 2003; Bystritsky *et al.*, 2008), whereas ADAPT-232, being a fixed combination of the following three adaptogens: *Eleutherococcus senticosus, Rhodiola rosea* and *Schisandra chinensis*, has been shown to increase the quality-of-life (Narimanian *et al.*, 2005).

Living organisms emit ultra-weak light, a phenomenon that is called ultra-weak photon emission (UPE) (Cohen and Popp, 2003; Van Wijk *et al.*, 2006a, 2006b). Already in 1980, Boveris (1980, 1981) suggested that the emitted photons do reflect ROS. The occurrence of UPE in species from bacteria to man and its relation to electron-excited states has raised the possibility of using UPE for recording oxidative processes non-invasively in mammals and human subjects (Kobayashi *et al.*, 1999; Hagens *et al.*, 2008; Khabiri *et al.*, 2008; Laager *et al.*, 2008; Van Wijk *et al.*, 2008).

Until now, no experiments have been performed to study the influence of adaptogens on human UPE. Since adaptogens seem to have a protective effect against ROS and since changes in ROS are reflected in photon emission, it is hypothesized that UPE may decrease in human subjects taking adaptogen supplements. Two different adaptogen preparations were tested: (1) ADAPT-232 and (2) *Rhodiola rosea* (SHR-5). In a randomized double blind placebo-controlled experiment, 30 individuals were randomly assigned to either one of the three groups (ADAPT-232, *Rhodiola* or placebo) of 10 individuals each. All subjects were measured before and after a period of 7 days in which the supplement (two pills/day) was taken. In addition, the effect of adaptogen supplements on the experienced levels of stress and of fatigue (tiredness) was studied.

MATERIALS AND METHODS

Participants. Students at University College Utrecht, which is the Honors College of Utrecht University, participated in a randomized double blind experiment ($n = 30$). Subject characteristics were registered such

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Table 1. Mean value (±SD) of subject characteristics of each group

Variable	ADAPT (n = 10) Mean ± SD	*Rhodiola* (n = 10) Mean ± SD	Placebo (n = 10) Mean ± SD
Age	20.00 ± 0.47	23.30 ± 10.11[a]	19.90 ± 1.20
Male:female	3:7	5:5	5:5
BMI (body mass index)	22.20 ± 2.09	21.70 ± 2.46	22.50 ± 2.34
WHI (waist:hip ratio)	0.78 ± 0.08	0.87 ± 0.19	0.87 ± 0.16

[a] One outlier of 52 years old.

as: age, gender, body-mass-index (BMI) and waist-to-hip ratio (WHI). The mean values of these characteristics are shown in Table 1. One-way ANOVA analysis showed that these groups were not significantly different with respect to age, BMI and WHI.

Adaptogens and placebo. Adaptogens (*Rhodiola* and ADAPT-232) as well as placebo tablets were kindly provided by Dr A. Panossian from the Swedish Herbal Institute. In this study, a three-group design (one placebo group and two different adaptogen groups) was selected.

The *Rhodiola* tablet (round and weighing 390 mg) contains as an active ingredient 144 mg of the proprietary SHR-5 extract of *Rhodiola rosea* L., roots. In laboratory analysis, it was established that each tablet contained the following active ingredients: 2.3% salidroside, 0.4% *p*-tyrosol and 2.7% rosavin as measured by HPLC.

The ADAPT-232 tablet (elongated and weighing 456 mg) contains as an active ingredient 140 mg of the proprietary blend ADAPT-232, which is the fixed combination of standardized extracts of the following three adaptogens: *Rhodiola rosea* L., roots (SHR-5), *Eleutherococcus senticosus* (Rupr. et Maxim) Harms, roots (SHE-3) and *Schisandra chinensis* (Turcz) Baill., fruits. In laboratory analysis, it was established that each tablet contained the following active ingredients: 0.5% schisandrin, 0.47% salidroside, 0.59% rosavin, 0.11% eleuth B and 0.19% eleuth E as measured by HPLC.

Placebo tablets came in transparent capsules and contained as inactive ingredients lactose, potato starch and microcrystalline cellulose.

Recording of biophoton emission of hands. The detector head (with a photomultiplier) was located in a dark chamber and was shielded from any surrounding light. The dark chamber was free from any phosphorescent or synthetic colour. The chamber was controlled for temperature and humidity. The working temperature in the chamber was 17 °C. The single-photon counting photo-multiplier had a 48 mm diameter cathode with a spectral sensitivity in the range 200–650 nm. The background noise was 4–5 cps (counts/s) at a working temperature of 17 °C (Van Wijk *et al.*, 2006a). A computer was used, both for the control of the technical aspects of the experimental arrangement and for the data acquisition. Participants had to adapt for at least 20 min in a poorly lit room before measurements were performed. For the recording of photon counts in time, both the maximal duration of recording and the dwell time were set. Spontaneous UPE was recorded for 5 min, including 6000 measurement periods of 50 ms (Van Wijk *et al.*, 2006b). Photon emission values were corrected for background values which were recorded immediately prior to measuring each subject. Basal ultraweak photon emission was measured on the dorsal side of each hand.

Experimental design and procedure. Thirty subjects were randomly assigned to one of the three different treatment groups (ADAPT-232, *Rhodiola* or placebo). Each group consisted of 10 individuals. Data were obtained before and after this period of 7 days in which the supplements (two pills/day) were taken. After the experimental data were collected for all individuals, unblinding for the supplement groups was provided for data analysis.

Questionnaire. All participants filled out a small questionnaire in which questions were included to register the experienced levels of stress and tiredness on a visual analogue scale, which was used to measure subjective phenomena. It consisted of a line of known length (in this research, 10 cm) and it separated the extremes of the phenomenon (stress or tiredness) being measured (Miller and Ferris, 1993). All measurements were performed both before and directly after the week in which the 30 subjects were asked to take two pills per day.

Statistical analysis. Before statistical tests were run, photon emission data were corrected for outliers. For every individual and every measurement (e.g. dorsal left hand), measuring points from photon emission that were higher than 15 standard deviations were replaced by the mean value of that specific data set. Independent sample *t*-tests and a one-way ANOVA were used to compare the three different groups (ADAPT-232, *Rhodiola* and placebo), as well as to calculate the significance of supplement effects.

RESULTS

Adaptogens and photon emission

Ultraweak photon emission was measured on the dorsal side of both hands. Before supplementation, there were no significant differences in photon emission between the three groups as established with one-way ANOVA analysis. In Table 2 the different mean values measured at the dorsal side of the right and left hand are indicated as they were obtained before and after a week of supplementation. Although a tendency to a decrease of photon emission was observed, especially in the *Rhodiola* group, a significance level of 5% was not reached. However, when all measured values of both

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Table 2. Mean and SD of indicated variables in groups taking ADAPT-232 or *Rhodiola* vs placebo

Variable	Pre Mean ± SD	Post Mean ± SD	Difference Mean ± SD	Pre Mean ± SD	Post Mean ± SD	Difference Mean ± SD	Difference significance *p*
	ADAPT-232 (n = 10)			Placebo (n = 10)			
UPE hands	2.39 ± 3.06	1.82 ± 0.98	–0.56 ± 3.14	2.30 ± 1.32	2.81 ± 2.55	0.51 ± 1.93	0.199
Symmetry	–0.53 ± 0.83	–0.09 ± 0.35	0.43 ± 0.82	–0.48 ± 0.70	0.30 ± 0.61	0.18 ± 0.76	0.483
Stress	4.10 ± 2.30	4.38 ± 1.60	0.28 ± 3.00	4.71 ± 2.32	4.30 ± 2.94	–0.41 ± 3.01	0.614
Fatigue	5.50 ± 1.71	5.08 ± 2.13	–0.42 ± 1.46	4.92 ± 1.87	5.13 ± 1.51	0.21 ± 1.72	0.388
	Rhodiola (n = 10)			Placebo (n = 10)			
UPE hands	2.94 ± 2.46	1.72 ± 1.47	–1.22 ± 2.77	2.30 ± 1.32	2.81 ± 2.55	0.51 ± 1.93	0.027
Symmetry	0.05 ± 0.81	0.11 ± 0.84	0.063 ± 1.20	–0.48 ± 0.70	0.30 ± 0.61	0.18 ± 0.76	0.795
Stress	4.86 ± 1.61	3.93 ± 2.23	–0.93 ± 2.01	4.71 ± 2.32	4.30 ± 2.94	–0.41 ± 3.01	0.655
Fatigue	5.37 ± 1.86	3.25 ± 2.54	–2.12 ± 3.05	4.92 ± 1.87	5.13 ± 1.51	0.21 ± 1.72	0.049

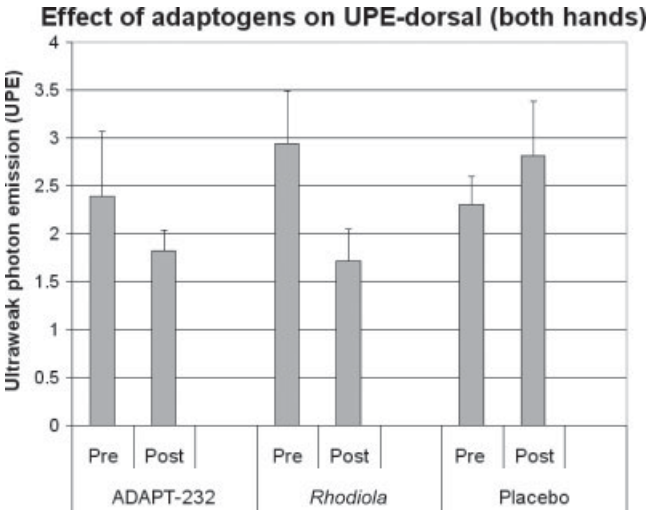

Figure 1. Effect of adaptogens on ultraweak photon emission as measured on the dorsal side of both hands before (Pre) and after (Post) a week of supplementation with ADAPT-232 (n = 10), *Rhodiola rosea* (SHR-5) (n = 10) or placebo (n = 10), A significant decrease in photon emission was observed in the *Rhodiola* group compared with the placebo group (p = 0.027), whereas the decrease observed in the ADAPT-232 group was not significant.

right and left hand were grouped together, a decrease in photon emission was observed in both the adaptogen groups after 1 week of supplementation, whereas the placebo-group showed a small (but non-significant) increase in photon emission (Fig. 1). Only in the *Rhodiola* group, a statistically significant (p = 0.027) decrease in photon emission was measured in comparison with the placebo (Table 2, Fig. 1). This comparison was carried out by subtracting the values found after supplementation from the values found before supplementation. The significance of the difference values were subsequently evaluated. A comparison between the ADAPT-232 group and the placebo group did not lead to any significant changes in photon emission (p = 0.199) (Table 2, Fig. 1). Nevertheless, a tendency in the ADAPT-232 group was observed that suggested a slight decrease in photon emission after supplementation in comparison with the measurement before supplementation.

Since differences have been reported in photon emission emitted from both hands, the study also evaluated the symmetry of photon emission and the possible effect of adaptogens on normalization of asymmetry if present. However, no significant changes in symmetry nor in the normalization of asymmetry was observed following adaptogen supplementation in comparison with placebo (Table 2).

Adaptogens and experienced levels of stress and fatigue

Initial levels of experienced stress and of fatigue between the three groups (ADAPT-232, *Rhodiola* and placebo) (Table 2) were not significantly different using ANOVA analysis. Comparison of experienced levels of 'stress' before and after supplementation did not lead to significant results in any of the adaptogen groups in comparison with placebo (Table 2, Fig. 2). However, after 1 week of supplementation, it was observed that *Rhodiola rosea* (SHR-5) significantly decreased the experienced level of 'fatigue' (tiredness), when compared with the placebo group (p = 0.049) (Table 2, Fig. 3). No significant change in experienced level of fatigue (tiredness) was observed in the ADAPT-232 group in comparison with the placebo.

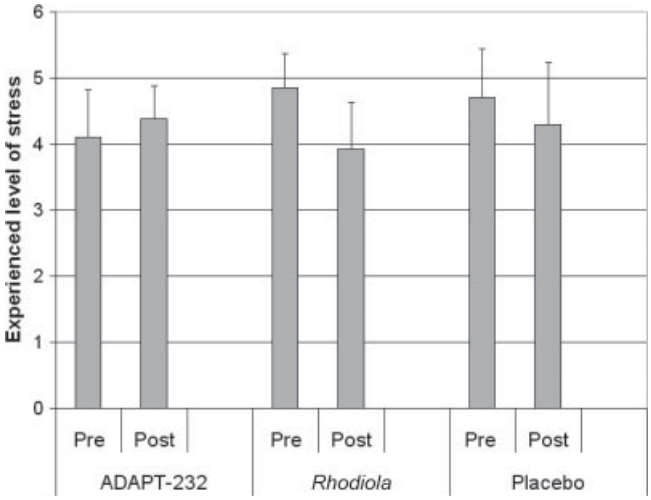

Figure 2. Effect of supplementation with the adaptogens (ADAPT-232) or *Rhodiola rosea* (SHR-5) in comparison with placebo on the experienced level of stress as measured on a visual analogue scale (values are indicated in cm).

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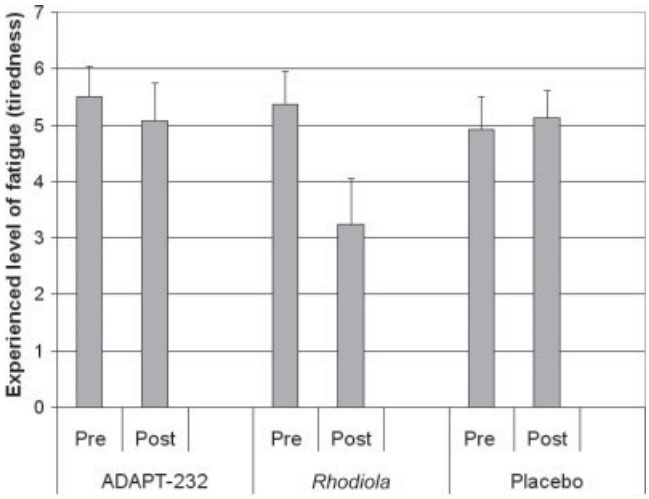

Figure 3. Changes in the experienced level of fatigue (tiredness) due to supplementation with the adaptogens (ADAPT-232) or *Rhodiola rosea* (SHR-5) in comparison with placebo, as measured on a visual analogue scale (values are indicated in cm). *Rhodiola* induced a significant decrease in the level of experienced fatigue in comparison with placebo ($p = 0.049$).

DISCUSSION

In this paper, the main aim was to determine whether adaptogens influence ultraweak photon emission in a randomized double blind placebo-controlled experiment. In addition, the effect of adaptogens on the experienced levels of stress and of fatigue (tiredness) were evaluated. Thirty participants were randomly assigned to one of the three different treatment groups (ADAPT-232, *Rhodiola* or placebo), each consisting of 10 individuals.

A decrease in overall photon emission from the dorsal side of both hands was observed in both the ADAPT-232 group as well as in the *Rhodiola* group in comparison with the placebo group. However, only in the *Rhodiola* group was this decrease significant compared with the placebo.

With respect to the external validity of the UPE measurements, the detailed mechanism that is responsible for the generation and emission of biophotons is still a matter of debate. Several researchers have suggested that photons in the visible wavelength reflect reactive oxygen Species (ROS) that are generated as a by-product of metabolism (Boveris *et al.*, 1980, 1981; Kobayashi *et al.*, 1999; Khabiri *et al.*, 2008; Laager *et al.*, 2008; Van Wijk *et al.*, 2008). Spectral analysis of human UPE has suggested that ultraweak emission is, at least in part, a reflection of the free radical reactions in a living system (Van Wijk *et al.*, 2004, 2005). Other evidence that UPE is a measure of ROS was obtained in studies using UV exposure of the skin, which is known to increase oxidative stress in the skin (Evelson *et al.*, 1997; Ou-Yang *et al.*, 2004). An increase in photon emission due to exposure to UV has been established over the years (Evelson *et al.*, 1997; Sauermann *et al.*, 1999; Ou-Yang *et al.*, 2004; Hagens *et al.*, 2008). In this respect, Ou-Yang *et al.* (2004) observed an increase in photon emission rates following UV exposure of the skin, but after applying the powerful antioxidant vitamin C topically, the photon signal reduced significantly.

What can be concluded when a lower level of photon emission is observed due to supplementation with adaptogens? Assuming that UPE reflect ROS, one might conclude that adaptogens raise antioxidative defence and thereby aid in the quenching of free radicals. This conclusion is in line with previous observations and suggestions in which extracts of adaptogens, such as *Rhodiola* (SHR-5), were able to enhance cellular levels of antioxidative defence (Brown *et al.*, 2002; DeSanctis *et al.*, 2004; Wiegant *et al.*, 2008a).

In an alternative explanation, it is assumed that the amount of emitted photons as well as the degree of asymmetry in photon emission from different body parts, reflects the degree of disorder/disease of an organism (Cohen and Popp, 2003; Jung *et al.*, 2003). In this respect, it can be concluded that adaptogens support a recovery towards a more organized/healthy condition as reflected in a decrease of emitted photons. However, with respect to the level of symmetry between emission of left and right hands in the population of students measured in this research, hardly any asymmetry was noticed before supplementation and therefore no clear effect could be obtained following supplementation. This can be explained by the fact that the participating subjects in our study consisted of a relatively healthy population of students.

In comparison with placebo, *Rhodiola* (SHR-5) was able to decrease the experienced level of fatigue (tiredness) significantly and also showed a tendency to decrease experienced levels of stress in comparison with the effect of placebo. These observations are in line with clinical data in the literature, where it has been shown that *Rhodiola* (SHR-5) has antifatigue, antistress, antioxidant and immune-enhancing effects (Darbinyan *et al.*, 2000, 2007; Spasov *et al.*, 2000; Shevtsov *et al.*, 2003; Bystritsky *et al.*, 2008). In the present experiment, no effect of ADAPT-232 on experienced levels of stress and of fatigue was observed.

It is quite intriguing why only *Rhodiola* was effective of the two adaptogen preparations. In the first instance, it could be argued that if the groups had been larger, the ADAPT-232 group could have shown a significant decrease in photon emission and level of experienced fatigue. Another possibility is that if the dose had been higher and/or the time duration that the subjects had taken supplements had been longer, the effect might have been more pronounced and/or more significant. Further, the study focused on the question of whether the difference in the antifatigue effect of *Rhodiola rosea* (SHR-5) and of ADAPT-232 could be explained by a difference in its constituents. In this respect, it should be noted that ADAPT-232 contains the same standardized extract of *Rhodiola* (SHR-5) as was used in the *Rhodiola* pills, but at a lower concentration. The fact that ADAPT-232 did not significantly reduce the feelings of antifatigue, might thus be explained by the lower concentration of *Rhodiola* and/or the inactivity in ameliorating fatigue by the other extracts (*Eleutherococcus senticosus* and *Schisandra chinensis*) that are present in ADAPT-232. It is of interest to note that these latter extracts are known for their ability to improve resistance to stressors and to enhance physical performance. Although these aspects have been described in many different studies (reviewed by Panossian and Wagner, 2005), a significant modulation of fatigue by *Eleutherococcus* (Siberian ginseng) (Hartz *et al.*, 2004) or by *Schisandra*

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has not yet been reported. In the study of Hartz *et al.* (2004), it was suggested that despite a lack in overall efficacy of Siberian ginseng in patients suffering from chronic fatigue, that the findings indicated a possible effect in a subgroup of patients with moderate 'fatigue'. Based on the results from our pilot-study, it could be suggested that the *Eleutherococcus* and *Schisandra* within ADAPT-232 did not add to the effect of *Rhodiola*, nor that there was a possible synergistic action between the mentioned adaptogens, as far as the antifatigue effect was concerned.

In case specific compounds present in the *Rhodiola* extract are (partly) responsible for the observed effect, especially salidroside and rosavin which were present in both adaptogen preparations, it could be argued that in *Rhodiola* pills the concentration of salidroside and rosavin are about 5× as high in comparison with their concentrations in the ADAPT-232 preparation (see also Materials and Methods).

Recently, a paper by Olson (2007) addressed the issue of identifying sub-categories in the concept of 'fatigue', corresponding to an increase in severity (tiredness, fatigue and exhaustion) and related to the different phases in Selye's definition of the stress response. Each category was identified with a set of symptoms. According to the symptoms indicated by Olson (2007), the level of experienced 'fatigue' that was evaluated in our study, would obviously fall within the sub-category of 'tiredness' rather than in the 'fatigue' sub-category. In addition, since 'tiredness' was suggested to be the condition in which interference might be most successful, it is of interest to include this indication in future studies in order to identify the sub-category in which adaptogen extracts are most successful.

Finally, it would be interesting to substantiate the effect of *Rhodiola* observed in this pilot experiment in a larger randomized double blind placebo-controlled experiment.

CONCLUSION

In our research, some interesting effects of adaptogens were observed in a randomized double blind placebo-controlled trial. *Rhodiola rosea* (SHR-5) reduced the experienced level of fatigue (tiredness) in comparison with the placebo group significantly ($p = 0.049$). With respect to ultraweak photon emission, it was observed that both adaptogens (ADAPT-232 as well as *Rhodiola rosea* (SHR-5)) were able to reduce photon emission from the dorsal side of both hands. However, only *Rhodiola rosea* (SHR-5) reduced photon emission significantly in comparison with the placebo group ($p = 0.027$).

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