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Role of Seabuckthorn (*Hippophae rhamnoides*) in the maintenance of cardiovascular homeostasis following cold stress

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Abstract

Objective: To study the beneficial role of Seabuckthorn (*Hippophae rhamnoides*) in the maintenance of cardiovascular homeostasis following cold stress. Materials and Methods: The effect of the alcoholic extract of Seabuckthorn in the daily oral dose of 500 mg was studied on various electrophysiological and neurochemical parameters following cold stress among the positive cold stress responders (human subjects) continuously for 3 months. Results: The average differences in cardiovascular responses like systolic and diastolic blood pressure, and pulse rate that were found to be raised following cold pressor test, minimized following three months oral administration of Seabuckthorn. Further, the psychophysiological parameters like occipito frontalis EMG and galvanic skin resistance also regulated under drug treatment. The serotonin and plasma cortisol levels were also modified following oral administration of Seabuckthorn. Conclusion: Seabuckthorn exhibited beneficial effects to reduce the cardiovascular reactivity following cold stress and thus it enhances the stress tolerance capacity as well as better adaptation towards stress.

Key words: Homeostasis, Seabuckthorn, Cold pressor test, Cardiovascular reactivity, Serotonin.

1. Introduction

Humans have evolved a complex set of physiological controls to maintain homeostasis. These controls compensate for physical changes in the composition of the external or internal environment. Apart from physical threat to homeostasis, it can often be experienced that threats and emotional upsets are associated with psychological distress. Psychological stressors also affect the state of body. The significance of psychological stress responses is that they are internally generated and affect the body in a top-down fashion. Such responses are generally associated with undesirable reactions which may occur frequently in social setting without being

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acted out behaviourally. Repetition of these responses have definite adverse health consequences. [1, 2]

Studies have suggested that long term exposure to stress and presumably prolonged, frequent sympathetic activation may lead to increased rates of disease [3]. There are evidences that in such cases the cardiovascular disease risk and an altered immune system function are the common manifestations. A basic assumption of the theory relating stress to disease risk is the sympathetic nervous system and accompanying endocrine reactions can exert damaging effects on the body, when responses are frequent and of large magnitude. [4]

According to Selye [5] the exposure to a stressor can increase the body's ability to cope with the stressor in the future by a physiological adaptation. The adverse reaction management requires some adaptive mechanism intervention to ensure that harmful effects are avoided or limited. In traditional medicine several herbal plants are advocated which have been used for their medicinal properties. Seabuckthorn (*Hippophae rhamnoides*) has been recognised as a pickle plant and is a wild shrub commonly found in western Himalayas particularly in Himalchal Pradesh.

When this plant reached to China from Tibet, Chinese could detect its medicinal values and they included this plant in their official pharmacopoeia. The fruit of plant is rich in vitamins and protein. In the western Himalaya the tribal population are using Seabuckthorn to protect themselves from cold stress, pneumonia and to enhance the body resistance against various infectious disease.

Keeping the above facts in mind it was decided to evaluate the beneficial role of Seabuckthorn on reaction to stress and adaptation pattern among the human adults by following various neuropsychophysiological parameters. Before conducting the clinical trial, the acute and chronic toxicity studies on Seabuckthorn were carried out in rats and was found to be safe.

Further, the effect of the Seabuckthorn in high doses were studied on different organ systems like renal function, liver function including the Gastro-intestinal tract and no debilitating effect of the drug could be noticed among the experimental rabbits.

2. Materials and methods

2.1 Extraction procedure

Fresh ripe fruits of Seabuckthorn was dried in the shade. The dried fruits of the plant were crushed. The coarse fruits were taken for extraction. Extraction was done by soxhlet apparatus using ethanol. Extraction was carried out for 90 h at 70°C. The extract was concentrated and dried. The yield was found to be 50% w/w.

2.2 Method of study

75 adults between the age range of 35-50 years of both sex were selected for clinical evaluation of the alcoholic extract of Seabuckthorn (*Hippophae rhamnoides L.*). To assess the anti-stress and adaptogenic property of the drug, cold pressor test was applied as stress stimulus. In order to determine the efficacy of the test drug 32 adults were kept on placebo treatment and 43 subjects under investigation were administered the alcoholic extract of Seabuckthorn in an effective dose (i.e. 250 mg twice daily). Cold pressor test was applied to all the subjects by putting the palm of left hand in the ice water (having ice cubs) for 2.5 minutes maximum.

The subjects showing rise of systolic blood pressure more than 15 mmHg and diastolic blood pressure more than 8 mmHg following cold pressor test were designated as positive responder to cold stress [6]. Various neuropsychological and biochemical assessment were carried out to validate the role of

Seabuckthorn. The Occipito-frontalis muscle action potential and Galvanic skin resistance (GSR) were measured by electronic devices EMG and GSR biofeedback apparatuses.

The biochemical assessment like Plasma Cortisol levels were determined by adopting method of Mattingly J. [7] and 5HT (serotonin) were measured by following method developed by Soloman *et al.* [8]

After basal recordings the subjects of treated group were given the alcoholic extract of the fruits of Seabuckthorn in the dose of 500 mg per day in divided doses (i.e. 250 mg morning, 250 mg evening) and was administered for three months. Follow up studies were conducted at the end of every one-month except the blood examination which was measured at initial level and after three months of therapy only. After three months the initial values were compared with final obtained values of the parameters. The data obtained were statistically analyzed.

2.3 Statistical Analysis

The obtained data were statistically analyzed. The values of before therapy were compared with three months therapy in both placebo as well as test drug treated groups with the help of paired *t* - test. The results were regarded as significant at $p<0.05$.

3. Results

In the present series of investigation, the role of Seabuckthorn was evaluated on cardiovascular and neuroendocrine response pattern following cold stress. The cardiovascular response like systolic and diastolic blood pressure, pulse rate and respiration rate were found greatly affected by cold stress. Following three months of alcoholic extract of Seabuckthorn, the cardiovascular reaction to stress minimized to a significant extent where as placebo treatment did not exert any such change (Table 1).

Table 1
Effect of Seabuckthorn on blood pressure and pulse rate following cold stress.

Groups	Parameters	Before therapy		After 3 months therapy	
		Basal values	After cold stress	Basal values	After cold stress
Placebo treatment (N = 32)	Systolic B.P. (mmHg)	128.68 ±7.92	152.43 ± 8.41	125.04 ± 7.85	154.51 ±9.06
	diastolic B.P. (mmHg)	83.35 ± 4.28	91.67 ±5.06	83.65 ±4.72	91.85 ±6.11
	Pulse rate (per min.)	85.29 ± 4.72	102.89 ±7.38	87.37 ±4.11	105.80 ±5.02
Test drug treatment (N = 43)	Systolic B.P. (mmHg)	130.14 ± 6.21	154.90 ±8.02	124.85* ±5.36	135.42* ±7.85
	diastolic B.P. (mmHg)	82.24 ± 4.35	93.24 ±5.01	80.65* ±3.97	87.04* ± 4.22
	Pulse rate (per min.)	54.63 ±4.72	108.44 ±5.11	82.28* ±4.06	92.33* ±3.97

Comparision between before therapy *vs.* after 3 months therapy; *$P<0.01$ (paired *t* - test)

Table 2
Changes in electrophysiological parameters following cold stress and effect of Seabuckthorn.

Groups	Parameters	Before therapy		After 3 months therapy	
		Before cold stress	**After cold stress**	**Before cold stress**	**After cold stress**
Placebo treatment (N = 32)	EMG (μv/sec)	24.95 ±3.65	55.78 ±8.35	28.65* ±4.72	59.34 ±7.88
Test drug treatment (N = 43)	EMG (μv/sec)	26.72 ±3.95	58.97 ±7.62	21.25* ±4.16	39.85* ±6.72
Placebo treatment (N = 32)	GSR (Kohms)	205.35 ±14.13	162.41 ±9.85	212.90 ±16.35	158.60 ±11.22
Test drug treatment (N = 43)	GSR (Kohms)	202.68 ±16.28	163.53 ±11.42	228.75* ±14.80	192.62* ±12.97

Comparision between before therapy *vs.* after 3 months therapy. * $P< 0.001$ (paired *t* - test)

The electophysiological assessment like occipito frontalis muscle action potential and galvanic skin resistance were also found to be significantly influenced by cold stress at the initial level. A drastic modification in the values following test drug therapy confirms the reduced autonomic over reactivity even after cold stress (Table 2).

At the basal stage increased levels of Serotonin and Plasma cortisol under influence of cold stress suggests the autonomic imbalance, which were decreased significantly following three months Seabuckthorn treatment. The average differences in Serotonin and plasma cortisol levels following cold stress reduced significantly under three months drug treatment (Table 3).

The results clearly revealed that Seabuckthorn has definite effect in minimising the reactivity to stress either cardiovascular reactivity or neuroendocrine response towards stress.

4. Discussion

Substantial changes can occur in peripheral physiology because of mental activity. Any physical stimulation or performing a psychomotor task in the laboratory can invoke activational changes in cardiovascular function. These changes can cause positive or negative reaction to various biological systems [9].

The cardiovascular response pattern towards a specific stress as documented by several workers are not similar as the pattern observed with other mental stressors. Allen *et al.* [10] demonstrated that difficult mental task produces increased heart rate and cardiac output elevations and does not result the reduction in peripheral resistance.

It has been pointed out that the emotional component of a task can determine the pattern of endocrine changes particularly the cortisol response. Cortisol level may increase in bloodstream, considerably following the aversive stimulus. It was observed that the level of cortisol rises definitely with a negative stimulus to which the subject is being tested. Several studies have suggested that social

Table 3
Effect of Seabuckthorn on Plasma cortisol and Serotonin levels following cold stress.

Groups	**Parameters**	**Before therapy**		**After 3 months therapy**	
		Before cold stress	**After cold stress**	**Before cold stress**	**After cold stress**
Placebo treatment (N = 32)	Plasma cortisol (μg/100ml)	13.95 ±2.63	27.88 ± 3.14	14.06 ±1.96	29.05 ±2.88
Test drug treatment (N = 43)	Plasma cortisol (μg/100ml)	14.32 ± 2.78	30.28 ±3.11	13.20* ± 1.84	18.32* ±2.64
Placebo treatment (N = 32)	Serotonin (μg/ml)	0.14 ±0.06	0.28 ±0.08	0.13 ±0.05	0.31 ±0.04
Test drug treatment (N = 43)	Serotonin (μg/ml)	0.15 ±0.07	0.32 ±0.06	0.13* ±0.08	0.23* ±0.04

Comparision between before therapy *vs.* after 3 months therapy; *P<0.001 (paired *t* - test)

stress can alter the serotonergic system associated with the brain stem raphe nuclei. Stress may produce long-standing alterations in serotonin with consequent changes in behaviour and emotions [11].

In the present experiment, Seabuckthorn was effective in normalising the cardiovascular, muscular and biochemical changes induced by stress. These results support the traditional use of this plant as an adaptogen.

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