Original Research Article

ANTI-STRESS AND NOOTROPIC ACTIVITY OF ETHANOLIC EXTRACT OF *CORIANDRUM SATIVUM* AERIAL PARTS

ABSTRACT

The swimming endurance test, anoxic tolerance test, and basal activity by actophotometer were used to assess the antistress activity of a seven-day therapy (200 and 400 mg/kg, p.o.) of the ethanolic extract of *Coriandrumsativum* (EECS) aerial parts. A method for measuring the *in vitro* antioxidant activity of hydroxyl radicals was used. In all of the examined models, *Coriandrumsativum* at both doses demonstrated antistress effects. In the anoxic tolerance test, swimming endurance test, and duration of stay on the rotarod, the EECS treated rats demonstrated enhanced swimming time, duration, and anoxic tolerance time, respectively.The *C. sativum's* potential to scavenge free radicals, which enhanced the cognitive effect, was utilized to determine the in vitro antioxidant activity.The results demonstrated clearly that the extract's *in vivo* adaptogenic performance and cognitive improvement were caused by its *in vitro* antioxidant activity.The EECS treated animals showed increase locomotor scores inbasal activity by Actophotometer. The plant secondary metabolites flavonoids, glycosides, triterpenoids, and phenolic components may be accountable for the animals' improved swimming endurance, stress tolerance, and overall performance. This study gave evidence that the ethanolic extract of *Coriandrumsativum* has antioxidant, anti-stress, and nootropic activity, and that utilizing them by humans as nutraceuticals is beneficial and scientific. By stress reduction in animals, the antioxidant effect provides the pharmacological basis for supporting a healthy memory.

Keywords: Antistress activity, Nootropic activity, *Coriandrumsativum*, anoxic tolerance test, swimming endurance test, Basal activity score.

1.INTRODUCTION:

Biological stress is a defence mechanism for the body against physical, chemical, biological, and emotional changes. It entails a series of metabolic and behavioural responses. The organism requires more energy when under stress, which leads to an increase in the production of free radicals. Proteins and nucleic acids are oxidised as a result of free radicals. Additionally, due to increased lipid peroxidation caused by free radical damage to bio-membranes, cells' integrity and functionality are compromised. Due to a decrease in antioxidants throughout this phase, the body's defensive mechanism may become less effective in combating oxidative stress. Performance declines and stress-related diseases occur when the level of stress exceeds the individual's threshold. Thus, managing exceptional stress has become extremely important in day-to-day existence[1].

Hyperactivity of the hypothalamic-pituitary-adrenal (HPA) axis is a characteristic of the temporal extension of adaptive response to discrete stressful stimuli. Various pathophysiological states, including a variety of disorders like hypertension, coronary heart disease, gastric ulcers, immunosuppression, metabolic disorders like diabetes, reproductive dysfunction, mental depression, memory loss, and a host of other diseases, are brought on by sustained hyperactivity of the stress system (HPA axis) [2].

Similar to how heightened physical and mental stress increases the likelihood of forgetting. According to mounting evidence, either beta amyloid-mediated production of free radicals or disturbed ionic calcium balance within neurons and their mitochondria, Alzheimer's disease worsens severe oxidative stress. Higher ascorbic acid and beta-carotene supplementation was linked to enhanced memory function, suggesting a possible role for antioxidants in cognitive decline and brain ageing. Additionally, research suggests that free radicals play a key part in the development of diseases including cancer, ageing, Alzheimer's, and diabetes, and that chemicals with the ability to neutralise free radicals have a significant impact on the treatment of these diseases [3].

Xenohormesis were once defined as substances that enhancethe “state of non-specific resistance” of an organism against stress. However, Panossian*et al.,* 1999 [4]referred to adaptogens as “newclass of metabolic regulators which increase the ability of anorganism to adapt to environmental factors and to avoid damage from such factors”.The hypothalamic-pituitary-adrenal (HPA) axis and other important mediators of stress responses have been connected to a number of mechanisms that are involved in the maintenance of homeostasis and the stress-protective impact of adaptogens. The positive effects of adaptogens have also been connected to their ability to influence various processes involved in the organism's

stress adaption as well as to prevent the production of free radicals. Additionally, adaptogens are often thought to increase stamina or resilience in the face of stress and to strengthen the body's defence mechanisms [4].

Coriander, also known as *Coriandrumsativum* Linn is a spice that is widely grown around the world and is a member of the *Apiaceae/Umbelliferae* family. One of the world's oldest spice crops, coriander has been consumed since approximately 1550 BC. Convulsions, sleeplessness, anxiety, and digestive, respiratory, and urinary diseases are all treated with *C. sativum* traditionally. In terms of pharmacology, *C. sativum* has been shown to have anti-diabetic, hepatoprotective, anti-mutagenic, antihypertensive, antioxidant, anxiolytic, antibacterial, and heavy metal detoxifying properties. This plant is aptly referred to as the "herb of happiness" due to its multifunctional uses and protective and preventative effect against numerous chronic conditions. Flavonoids, polyphenols, and carotenoids have been shown to be the plant's main chemical constituents [5, 6].

2. MATERIALS AND METHODS

2.1 Collection and preparation of plant extract

Aerial parts (leaves, stems, twigs and flowers) of *Coriandrumsativum* were collected from garden during the month of December 2021. This material was identified and authenticated by botanist Government Degree College, Kukatpally.

2.2 Preparation of ethanolic aerial part extract of *Coriandrumsativum*:

The aerial parts were shade dried for a week and coarsely powdered in a mixer grinder. The powdered material was stored taken up for concurrentextraction through maceration with 99.9 % ethanol for 7 days and filtrate was collected and evaporates to dryness to obtain thick extract [7].

2.3 Phytochemical evaluation

The Aerial parts of ethanolic extract of *Coriandrumsativum* were subjected to various preliminary phytochemical tests to detect the phytoconstituents present in plant extract [8, 9, 10, 11, and 12].

2.4Experimental animals

Swiss albino mice (approx. 20to 25 gms) were procured from Albino research, Hyderabad. Present studies were carried out in CPCSEA approved animal house of GokarajuRangaraju College of pharmacy, Bachupally, Hyderabad, India (Reg. No. 1175/PO/Re/S/08/CPCSEA).The animals were housed in poly acrylic cages with not more than six animals per cage, with 12 hour-light /12 hour dark cycle. Mice have free access to standard diet and drinking water ad libitum. The mice were allowed to acclimatize the

laboratory environment for a week before the start of the experiment. The care and maintenance of the animals were carried out as per the approved guidelines of the committee for the purpose of control and supervision of experiments on animals.

2.5Acute Toxicity Study

Acute toxicity studies were carried out in order to check the toxic effects for ethanolic extract of *Coriandrumsativum* aerial parts. The studies were performed as per Organization for economic cooperation and Development (OECD). The method is used to evaluate the acute oral toxicity is up and down procedure (OECD guideline-425). Up and down procedure (OECD guideline-425) acute toxicity studies were carried out as per the OECD 425 guidelines.Animals are observed with a special attention given during the first 4 hours and daily thereafter, for a total of 14 days generally.

2.6*In vivo* Methods for Evaluation of Adaptogenic and Cognitive enhancement activity

In vivo evaluation of Anticonvulsant activity of the ethanolic aerial parts extract of *Coriandrumsativum*was carried out using the following models.

2.6.1 *In-vivo*Methods for Evaluation Adaptogenic Activity

2.6.1.1Swimming endurance and post-swimming motor function test:

Swiss Albino mice were divided into four groups, Group I normal control that received saline water, Group II & Group III received ethanolic extract of *Coriandrumsativum*(EECS) 200 & 400 mg/kg, bd.wt. *p.o* and Group IV received standard Geriforte tablets (Himalaya drugs) 50 mg/kg,bd.wt., *p.o* used as a standard adaptogenic drug for seven days continuously. All the drugs were administered orally to all the animals. Stress was induced in mice by carrying out forced swimming endurance test. All the animals in different groups were subjected to stress on last day after 1hr drug administration by placing them in polypropylene tank filled with water to a height of 25cm at a room temperature of (30±2ºC). Mice were allowed to swim until complete exhaustion and end point was taken when animal starts drowning. The mean swimming time for each group was calculated and allowed to recover for about 5min. All the animals were subsequently tested for post swimming muscle coordination on rota rod rotating at 15rpm and the duration of stay on the rod was recorded [13].

Table 1: Experimental study design for scheduled drug treatment in Swimming endurance and post-swimming motor function test

GROUPS	**TREATMENT**
Group-I	Control received vehicle

Group-II	EECS 200 mg/kg,bd.wt., *p.o*for 7days +Stress
Group-III	EECS 400 mg/kg, bd.wt.,*p.o*for 7days + Stress
Group-IV	Geriforte 50 mg/kg, bd.wt.,*p.o*for 7days + Stress

2.6.1.2 Anoxia stress tolerance test:

Healthy swiss Albino mice of either sex weighing 20-25gm. The animals were divided into four groups, Group I normal control that received saline, Group II & Group III received EECS 200 & 400 mg/kg, bd.wt., *p.o* and Group IV received Geriforte tablets (Himalaya drugs) 50 mg/kg, bd.wt., *p.o* used as a standard adaptogenic drug for 3 weeks continuously. All the drugs were administered orally to the animals. Every week after 1hr of drug administration each animal was placed in the conical flask (hermetic vessel) of 250 ml were used to induce stress. There flasks made airtight by using rubber cork before the conduct of experiment. Each animal kept in airtight vessel and time was recorded. The moment at which the animal shows first convulsion immediately it was removed from conical flask. The time duration from the entry of animal in the hermetic vessel to the appearance of first convulsion was taken as the time of "anoxic stress tolerance". The mean time of convulsion was recorded, and animal was removed from flask and taken as end point. Mean duration of anoxia tolerance time in mice (min) was recorded for three weeks [13, 14].

Table 2: Experimental study design for scheduled drug treatment in Anoxia stress tolerance test

GROUPS	**TREATMENT**
Group-I	Control received vehicle
Group-II	EECS 200 mg/kg,bd.wt., *p.o* for 3 weeks + Anoxic Stress for every week
Group-III	EECS 400 mg/kg,bd.wt.,*p.o* for 3 weeks + Anoxic Stress for every week
Group-IV	Geriforte 50 mg/kg, bd.wt.,*p.o* for 3 weeks + Anoxic Stress for every week

2.6.2*In vivo* Methods for evaluation of cognitive enhancement activity:

2.6.2.1Basal activity by Actophotometer:

This study will be carried out by taking healthy 30 Albino mice of either sex weighing having 20-25 gm. Group I normal control group that received saline. Group II served as disease control received Midazolam (2 mg/kg, bd.wt., *i.p*), Group III & Group IV received ethanolic extract of *Coriandrumsativum* (200&400 mg/kg, bd.wt, *p.o*) and Group V received Standard drug Donepazil (1mg/kg, bd.wt., *i.p*) will be injected followed by Midazolam (2 mg/kg, bd.wt., *i.p*) after 30 min. Each animal will be placed individually in the actophotometer and the basal activity score of all the animals will be recorded after 30, 60 and 120 min of drug treatment. The activity of each animal will be tested for 10 min. The difference in the activity will be recorded considering standard drug treatment score and extract treatment score [15,16].

Table 3: Experimental study design for scheduled drug treatment in Basal activity by actophotometer

GROUPS	**TREATMENT**
Group-I	Control received Normal saline
Group-II	Disease control received Midazolam 2 mg/kg, bd.wt., *i.p*
Group-III	EECS 200 mg/kg, bd.wt.,*p.o* + Midazolam 2 mg/kg, bd.wt., *i.p*
Group-IV	EECS 400 mg/kg,bd.wt., *p.o* + Midazolam 2 mg/kg, bd.wt., *i.p*
Group-V	Donepezil 1 mg/kg,bd.wt., *i.p*+ Midazolam 2 mg/kg, bd.wt., *i.p*

2.6.3 *In-vitro*Determination of hydroxyl radical scavenging activity:

A free radical is an atom or molecule that has an unpaired electron and is therefore unstable. This unstable radical has the tendency to become stable through electron pairing with biological macromolecules such as proteins, lipids, and DNA in healthy human cells, thus causing protein and DNA damage.All biological systems have innate antioxidant defense mechanisms that remove damaged molecules, but these mechanisms can be inefficient. Therefore dietary intake of antioxidants is imperative to protect cells from damage caused by free radicals.Antioxidants also turn free radicals into waste by-products, which are eliminated from the body.

Procedure:

In hydroxyl radical scavenging assay, the reaction mixture was prepared by adding 100 ml of 2-deoxy- D ribose (28mM in 20 mM KH_2PO_4-KOH buffer, pH 7.4), 500 ml of EECS at different concentrations (10, 20, 30, 40, 50 mg/mL), 200 ml EDTA (1.04 mM) and 200

mM$FeCl_3$, 100 mL of H_2O_2 (1 mM) and 100 mL ascorbic acid (1mM), and incubated at 37 C for 1 h. 1mL thiobarbituric acid (1%) and 1mL of trichloroacetic acid (2.8%) was added to resultant mixture and again incubated at 100 C for 20 min. After cooling, absorbance of resultant solution was measured at 532 nm, against a blank sample [17].

Hydroxyl radical scavenging activity (%) = $Abs_{sample} - Abs_{control}/Abs_{sample} \times 100$

Where, Abs_{sample} = Absorbance of the test sample

$Abs_{control}$ = Absorbance of control.

2.7 Statistical analysis:

All the values were expressed as arithmetic mean ± SEM & were analysed by one-way analysis of variance (ANOVA), followed by Dunnett's multiple comparison test$p<0.05$ way the criterion for statistical significance.

3. Results

3.1Preliminary phytochemical screening

Preliminary analysis of the ethanolic extract's phytochemical Alkaloids, glycosides, steroids, flavonoids, phenols, terpenoids, anthocyanins, coumarins, and volatile oils were found in *Coriandrumsativum* aerial parts.

3.2 Acute toxicity study

In our investigations on acute toxicity, the injection of EECS at a dose of 2000 mg/kg did not result in any fatalities or evidence of negative effects, indicating that *Coriandrumsativum's* aerial portion is not poisonous. There were no alterations in the mice's behaviour, clinical symptoms, or body weight throughout the observation period of 14 days. This demonstrates that up to 2000 mg/kg of *Coriandrumsativum*was safe.

3.3 Dose Selection

From poisonousness studies, a portion of 2000 mg/kg bd. wt. was distinguished to be protected, and the functioning portion was considered as $1/10^{th}$ i.e. 200 mg/kg, bd. wt. In the current review pharmacological assessments were finished utilizing 200 mg/kg. bd. wt. further 100 mg/kg, bd. wt.

4.4Swimming endurance and post-swimming motor function test:

The swimming capabilities of mice treated withEECS at 200 & 400 mg/kg and geriforte over control group of miceshown in table 4. The controlgroup of mice swam for133.5±1.257s, EECS treated mice at adose of 200 and 400 mg/kg/day swam for 218.83±1.45and342.83±0.94 s whereas gerifortetreated mice swam for425.16±1.42 at a dose of 50 mg/kg. Table 5 shows that theduration of stay on rota rod which was significantly increased from8.66±0.494s in control group to 16.66±0.66s and 22.5±0.763s inthe group

treated with EEFCC at dose of 200 and 400 mg/kg/day compared togerifortetreated group at 50 mg/kg/day that is 28±0.577s.

Table 4: Effect of EECS on swimming endurance test in mice

GROUPS	Treatment	Mean±SEM
I	**Control Vehicle**	133.5±1.257
II	**EECS 200 mg/kg bd.wt, *p.o***	218.83±1.45^{*A}
III	**EECS 400 mg/kg bd.wt, *p.o***	342.83±0.94^{*A}
IV	**Geriforte 50mg/kg bd.wt, *p.o***	425.16±1.42*

The values are expressed as mean±SEM, n=6. Statistical analysis was performed by using one-way (ANOVA) followed by Dunnett's multiple comparison test by comparing with control (*=p<0.0001), and standard (^{A}=p<0.0001) were considered as statistically significant.

Table 5: Effect of EECS on Post motor function test in mice

GROUPS	Treatment	Mean±SEM
I	**Control Vehicle**	8.66±0.494
II	**EECS 200 mg/kg bd.wt, *p.o***	16.66±0.66^{*A}
III	**EECS 400 mg/kg bd.wt, *p.o***	22.5±0.763^{*A}
IV	**Geriforte 50mg/kg bd.wt, *p.o***	28±0.577*

The values are expressed as mean±SEM, n=6. Statistical analysis was performed by using one-way (ANOVA) followed by Dunnett's multiple comparison test by comparing with control (*=p<0.0001), and standard (^{A}=p<0.0001) were considered as statistically significant.

4.5Anoxia stress tolerancetest:

It was observed that EECS 200& 400 mg/kg and standard drug Gerifortesignificantly enhanced the anoxia tolerance time (p< 0.05). The anoxia tolerance effect was increased with dose and duration of treatment as it is depicted in table 6. Pre-treatment with EECS (200 & 400 mg/kg) observed that increase in anoxia stress tolerance time indicating the significant adaptogenic activity.

Table 6: Effect of EECS on Anoxia stress tolerance time in mice

GROUPS	Treatment	Mean duration of anoxia tolerance time in mice (min)			
		0 Week	**1st Week**	**2nd Week**	**3rd Week**
I	**Control**	14.83±0.401	16.33±0.49	17±0.447	18.16±0.600
II	**EECS 200 mg/kg bd.wt, *p.o***	16.66±0.477	23.16±0.40^{*A}	25.33±0.494^{*A}	26.5±0.562^{*A}
III	**EECS 400 mg/kg bd.wt,*p.o***	15.5±0.670	26.83±0.60^{*A}	31.5±0.444^{*B}	32±0.447^{*A}
IV	**Geriforte 50mg/kg bd.wt, *p.o***	16.33±0.666	32.16±0.40*	34±0.365*	36.5±0.427*

The values are expressed as mean±SEM, n=6. Statistical analysis was performed by using one-way (ANOVA) followed by Dunnett's multiple comparison test by comparing with control (*=p<0.0001), and standard (^{A}=p<0.0001, ^{B}=p<0.005) were considered as statistically significant.

4.6 Basal activity by Actophotometer:

The locomotor or basal activity scores were measured at 0,30,60,120 min to evaluate the effect of EECS on memory loss in SwissAlbino mice. EECS at 200 & 400 mg/kg, standard group mice showed significant increase in BAS at 30, 60, and 120 min when compared to disease control that showed decreased BAS which is shown in below table 7.

Table7: Effect of EECS on basal activity scores in mice

GROUPS	Treatment	Locomotor Activity scores in 5 min			
		0 min	**30 min**	**60 min**	**120 min**
I	**Control**	332.33±1.053	340.5±1.0877	374.5±1.6885	386.5±1.543
II	**Disease control**	352.5±0.957	217.83±1.166*	183.16±1.6414*	173.33±1.453*
III	**EECS 200 mg/kg bd.wt,**	343.33±1.085	346.83±1.077* $^{*@A}$	355.33±1.115* $^{@A}$	366.33±1.837$^{*@B}$

	p.o				
IV	**EECS 400 mg/kg bd.wt, *p.o***	363.66±1.115	383.5±1.335$^{*@A}$	391.66±1.475$^{*@A}$	406.66±2.347$^{*@ns}$
V	**Donepazil 1 mg/kg bd.wt, *i.p***	372.16±0.945	407.66±1.475$^{*@}$	421.83±0.869$^{*@}$	437.83±1.249$^{*@}$

The values are expressed as mean±SEM, n=6. Statistical analysis was performed by using one-way (ANOVA) followed by Dunnett's multiple comparison test by comparing with control (*=p<0.0001, **=p<0.001), Disease control ($^{@}$=p<0.0001) and standard (^{A}=p<0.0001, ^{B}=p<0.05) ns =non-significant were considered as statistically significant.

3.6*In-vitro*Hydroxyl radical Scavenging assay:

Table 8: Effect of EECS on Hydroxyl radical Scavenging assay

S.No	Compounds	Concentration (µg/mL)	% Inhibition (Mean±SEM)	IC_{50} Value (µg/mL)
1.	**EECS**	10	21.27±1.76	25.60
		20	41.93±1.45	
		30	69.45±1.07	
		40	75.56±2.10	
		50	81.67±0.19	
2.	**Ascorbic acid**	10	21.62±1.40	19.51
		20	51.25±0.47	
		30	62.56±2.15	
		40	74.80±0.78	
		50	79.27±2.07	

Fig 1: Effect of EECS on *In-vitro* hydroxyl radical scavenging assay

The anti-oxidant activity of ethanolic aerial parts extract of *Coriandrumsativum*was carried out by hydroxyl radical scavenging assay. EECS has shown increase in percentage inhibition of hydroxyl radicals with increase in dose and its IC_{50}value was found tobe25.60 µg/mlwhich is represented in table 8. The potential of the extract was comparable to that standard Ascorbic acid and IC_{50} value was found to be 19.51 µg/ml.

4.DISCUSSION:

The Xenohormesis potential of traditionally employed *Coriandrumsativum* aerial components was attempted in the current investigation. For adaptogenic, cognitive enhancement, and *in vitro* anti-antioxidant activity, anoxia stress, swimming endurance test and post-swimming motor function test, basal activity, and hydroxyl radical scavenging assay were done. Because of modern lifestyles, people are exposed to more stressful situations, which can lead to physical and psychological disorders. The ability of humans to adapt to stressful situations must therefore be improved. An extremely serious type of stress is anoxia. The oxygen supply to all bodily processes, including cellular respiration, is essential.Any deficiency in this essential component (as in anoxia) will have a detrimental effect on all physiological functions, and a drug's main anti-stress benefit may be an increase in adaptability under such stress. Pre-treatment with EECS revealed a dose-related increase in the amount of time that animals could tolerate anoxia stress, showing that the plant used in this study had strong adaptogenic activity. Additionally, it has been hypothesised that adaptogenic substances aid in adaptation by facilitating the conversion of energy in an organism's biological system. As a result, during the experiment, we discovered that EECS facilitated energy conversion in organisms' cellular systems, which may have aided adaptation processes under anoxia tolerance stress [13].

The findings of the swimming endurance test and the post-swimming motor function tests clearly show that the EECS pre-treatment has the ability to boost the physical swimming endurance time and keep mice on the rota rod. Flavonoids, glycosides, triterpenoids, and phenolic compounds are plant secondary metabolites that may contribute to the animals' improved swimming endurance, stress tolerance, and overall performance when compared to normal animals the treated mice [6, 18].

The cholinergic system is negatively impacted by stressful situations and suffers as a result, which impairs learning. However, the cholinergic system's response to stressful stimuli varies depending on the nature and length of the stressor. Behavioural inhibition, working (short-term) memory, retrieval from reference (long-term memory), attention and decision-making processes, movement and strategy selection, and altered sensory processing are all affected when muscarinic receptors are blocked by drugs like scopolamine, according to a large body of clinical research [2]. The memory loss by Midazolam is one of the side effects of benzodiazepine anti–anxiety agents which is still controversial but it can use acutely postoperatively to forget the pain and which can cause amnesia or memory loss at the dose of 2 mg/kg due to long term potentiation of GABA. In humans, Benzodiazepine induced Anterograde amnesia have been emphasized [15].Previous research has shown that the body's important organs are damaged by excess corticosterone released during a chronic stress reaction, and the immune system's capabilities are also compromised. The harmful effects of cortisol are more pronounced on the brain, and it has also been connected to the symptoms of a number of neurological illnesses. According to studies, cortisol harms the brain by producing more free radicals, which set off a chain reaction leading to neuronal degeneration [19]. Additionally, damaged brain cells emit inflammatory mediators that promote the creation of free radicals and continue the neuronal degeneration that impairs memory.When the body's natural antioxidant defence mechanisms are overwhelmed by reactive oxygen species generation, oxidative stress results in lipid peroxidative tissue damage. It has also been demonstrated that stress on a physical and psychological level accelerates lipid peroxidation, causes oxidative damage, and increases free radical production. Our study's findings supported earlier findings that prolonged stress reduces memory by causing more oxidative stress in the brain [20]. The anti-inflammatory properties of substances found in *Coriandrumsativum* leaves, such as ascorbic acid, cineole, berneol, α-pinene, and β-pinene, may also be contributing to the observed memory-enhancing activity [21].Free radicals are produced spontaneously in biological systems as byproducts of metabolic processes, and they can significantly harm tissues and biomolecules, leading to a number of serious clinical

implications, including diabetes mellitus, chronic inflammation, neurodegenerative disorders, and cancer. An imbalance between the production and neutralisation of prooxidants leads to oxidative stress, a major factor in a number of diseases, including cancer, diabetes mellitus, atherosclerosis, cardiovascular disorders, ageing, and inflammatory diseases. Free radicals, which seek stability by electron pairing with biological macromolecules including proteins, lipids, and DNA in healthy human cells, are the cause of oxidative stress. These molecules also destroy proteins, DNA, and lipids.In order to protect human cells from damage caused by free radicals, enzymes, particularly superoxide dismutase (SOD) and catalase, as well as substances like tocopherol, ascorbic acid, and glutathione, are essential. When the capacity of antioxidant defence mechanisms is exceeded, there is significant tissue damage as a result of free radical generation. Antioxidant components from medicinally significant plants have great promise for treating oxidative stress-induced imbalances and numerous degenerative illnesses.Furthermore, it has been established that phenolic chemicals such flavonoids, polyphenols, tannins, phenolic, and terpenes are primarily responsible for the antioxidant activity of plant products.In this study also, the ethanolic aerial part extract of *Coriandrum sativum* exhibited a dose dependent inhibition of oxidation. Hence it may also be inferred that the ethanolic aerial parts extract of *C.sativum* possess scavenging activity against oxidizing agents like hydroxyl ions. In this context, *C.sativum*can prove to be effective as a potent antioxidant agent since it is found to exhibit considerable *in vitro* antioxidant activity[22].

5.CONCLUSION

According to the results of the current investigation, *Coriandrumsativum* aerial parts' ethanolic extract shown notable adaptogenic, cognitive-improving, and *in vitro* anti-antioxidant activity. Further isolation of active constituents, identification and confirmation of the particular mechanism, additional research is needed.

ETHICAL APPROVAL

The Institutional Animal Ethics Committee of GRCP approved the research entitled “Anti-Stress and Nootropicactivity of Ethanolic extract of *CoriandrumSativum*aerial parts” with Regd number. 1175/PO/Re/S/08/CPCSEA. All animal experiments were carried out in accordance with CPCSEA guidelines.

REFERENCES

1. Vanita G, Asheesh G, ShaliniS, Harish MD, Grover SK, Ratan K.Anti-stress and Adaptogenic Activity of L-Arginine Supplementation.Evid Based Complement Alternate Med.2005;2(1):93–97.

2. KiranBS, PrasoonG, GitikaB, RakeshM,ChandishwarN, GautamP.Adaptogenic and anti-amnesic properties of *Evolvulusalsinoides* in rodents, Pharmacology, Biochemistry and Behavior, 2005, 424 – 432.
3. SushrutaKS, RajendraK, SatyanarayanaS. Adaptogenic and nootropic activities of aqueousextracts of *Carumcarvi* Linn (caraway) fruit: an experimental study in Wistar rats, Australian Journal of Medical Herbalism, 2009;21(3).
4. Panossian A, Wikman G,Wagner H.Plant adaptogensIII. Earlier and more recent aspects and concepts on theirmodeof action.Phytomedicine. 1999;64:287–300.
5. Bhat S, KaushalP, Kaur M,Sharma HK. Coriander (*Coriandrum sativum* L.): Processing, nutritional and functional aspects, African Journal of Plant Science,2014;8(1):25-33.
6. Sushruta K, Dong KC. Anti-Stress and Anti-Amnesic Effects of *Coriandrum sativum* Linn (Umbelliferae) Extract – an Experimental study in Rats.Tropical Journal of Pharmaceutical Research, 2021;11(1):36-42.
7. Kadek SA, Elisabeth A, Kadek NBP, Fiorenza JT, Gusti NJAP. Antibacterial activity testing of hand sanitizer gel extract of coriander *Coriandrum sativum* seeds against *Staphylococcus aureus*,Journal of Pharmaceutical Science and Application,2021;3(2):98-107.
8. Dharmalingam R and NazniP.Phytochemical evaluation of *coriandrum l* flowers, International journal of food and nutritional science. 2013;2(4):34-39.
9. Raghad ZS, Yaseen MA. Detection some active Compounds in the Leaves and Stems of Local Coriander Plant - *Coriandrumsativum* L., Tikrit Journal of Pure Science. 2018;23(3): 7-15.
10. Shobna T, Anbu JS, Anita VGK, AnandarajagopaK. Preliminary phytochemical analysis and diuretic activity of the extracts of *Coriandrum Sativum* Leaves in Wistar Albino Rats, International Research Journal of Pharmacy and Medical Sciences.2019;3(1):1-3.
11. OganesyanET, NersesyanZM, and Parkhomenko AYu. Chemical composition of the above-ground part of *Coriandrum sativum*, Pharmaceutical Chemistry Journal,2007;41(3):30 – 34.
12. Shyamapada M, ManishaM. Coriander (*Coriandrumsativum L.*) essential oil: Chemistry and biological activity, Asian Pacific Journal of Tropical Biomedicine, 2015;5(6):421–428.
13. Ganga Raju M, M. Srivani, K. Gowthami, N V L Suvarchala Reddy V.Adaptogenic and anti-oxidant defence of methanolic extract of *Tecomastans*in rodents. JASR. 2020;11:71-77.
14. Prafulla PA, Pranita PJ, Shirishkumar DA, Bhaskar VH, Tushar S. Adaptogenic Activity of Lyophilized Hydroethanol Extract of *Pandanusodoratissimus* in Swiss Albino Mice. International Scholarly Research Notices. 2014;Article ID 429828.

15. Suvarchala Reddy VNVL, Ganga Raju M, Rahul Goud M, ShabnamkumariT. Neuroprotective Activity of Methanolic extract of *Terminalabellerica* Fruit against Aluminium Chloride and Haloperidol Induced Amnesia in Mice. J Young Pharm, 2020; 12(2) Suppl: s87-s90.
16. Ganga Raju M, Gouthami K, N V L Suvarchala Reddy V, Michaela Nicholas.Anti-Amnesic Effect of Methanolic Leaf Extract of Tecomastans: AnExperimental Study in Rodents. J Young Pharm, 2020; 12(2) Suppl: s91-s96.
17. SnehaNawale, Priyanka N, Sujit Das, Ganga Raju M. Data of *in vivo* screening of antiulcer activity for methanolic extract of *Vernoniaelaeagnifolia* DC. Data in brief, 2019;23(103753):1-13.
18. Singh SK, PatraA. Evaluation of adaptogenic potential of *Polygonatumcirrhifolium* (Wall.) Royle: *In vitro*, *in vivo* and *in silico* studies. South African Journal of Botany. 2019;121:159-177.
19. Dong H, Csernansky JG. Effects of stress and stress hormones on amyloid-beta protein and plaque deposition. J Alzheimers Dis. 2009;18(2):459-469.
20. Solomon U, Oritoke MA, Anthony TE, Olatunde O.Evaluation of adaptogenic-like property of methyl jasmonate in mice exposed to unpredictable chronic mild stress.Brain Research Bulletin. 2016;121:105–114.
21. Vasu DV, Milind P. Memory-enhancing activity of *Coriandrumsativum* in rats.Pharmacology online. 2009;2:827-839.
22. Sougata G, Abhishek D, Mehul, Piyush M, Soham J, Suvarna DP, Ajay BP, Amit MJ, Geeta KS, Vaishali SS, Karishma P, Dilip DD, Balu AC.Phytochemical Analysis and Free Radical Scavenging Activity of Medicinal Plants *Gnidiaglauca* and *Dioscoreabulbifera*,PLoS ONE,2013;8(12):e82529.