Research Article

Effect of *Saraswatarishta* on sleep deprivation induced behavioral changes in mice

R. Yuvaraj[1], R. Vijayakumar[1]*, G. Bupesh[2], S. Vasanth[2]

ABSTRACT

Objective: The study is aimed to assess the effect of *Saraswatarishta* (SA) on behavioral changes following 96 h of sleep deprivation in mice. **Materials and Methods:** The study was done in the Department of Physiology, Sri Lakshmi Narayana Medical College and Research Institute. Proper ethical clearance was obtained from the CPCSEA. Thirty-six Swiss albino mice weighing 15–30 g were used for the study. **Results:** The 36 Swiss albino mice were divided into three groups with six animals in each group: Group I – control-(6), Group II – sleep-deprived group, and Group III – SA treated sleep-deprived group. SA was administered orally in the dose of 1.8 ml/kg/day for 15 days. Following this, the animals were deprived of sleep for 96 h using flower pot technique. Behavior was assessed using open field maze and elevated plus maze. Statistical analysis was performed by one-way ANOVA using SPSS version 20 when compared to controls, mice that were deprived sleep showed behavioral changes. The immobilization time and the time spent in the closed arm were increased with a significant decrease in the ambulation. Whereas in the group treated with SA, the immobilization time and the time spent in the closed arm were decreased with an increase in the ambulation when compared with the sleep-deprived group not treated with SA. Sleep-deprived mice showed alteration in behavior when compared to controls.**Conclusions:** This study identified that SA treated group showed an improvement in such behavioral changes when compared to the sleep-deprived group not treated with SA. Hence, it proves that SA exerts antidepressant effects on its own on sleep-deprived rats.

KEY WORDS: Flower pot technique, *Saraswatarishta,* Sleep deprivation

INTRODUCTION

Sleep is a normal human function that is detrimental to sustaining life yet; individuals are affected differently by their sleep schedule. Sleep deprivation (SD) is a significant problem in humans. It is considered to be a risk factor that contributes to various diseases. It has been proposed that reactive oxygen species and the resulting oxidative stress may be responsible for some of the effects of SD.[1] The sleep occupies approximately one-third of a person's lifetime. SD seems to disturb the vital biological processes necessary for cognitive function and physical health, yet the ways in which the body is compromised are not fully understood. SD caused various behavioral disturbances involving motor activity, anxiety level, memory and metabolic functions related to anabolic hormones, body weight, and so on. There is pressure in modern society to carry out an increasing variety of complicated activities during wakefulness. The expectation that these activities which are to be achieved tends to push sleep. This result in impaired concentration, altered behavior, reduced the quality of life, inability to enjoy, and complete the routine activities.[2]

In Ayurveda, formulations containing multiple herbal and herbomineral ingredients are often used for many different conditions. One such multi-ingredient plant-based herbomineral formulation is *"Saraswatarishta* (SA)*."* It consists of 18 plants. Some of which include Ashwagandha, Brahmi, and Shatavari which are *Medhya rasayanas. Medhya rasayanas* are used to improve memory and cognitive deficits. SA is claimed to be useful to treat acute anxiety, fatigue, insomnia, partial loss of memory, low grasping power, slurred speech, etc.[3-7] In view of the central nervous system effects of SA described in Ayurveda, the present study was

Access this article online

Website: jprsolutions.info | ISSN: 0975-7619

[1]Department of Physiology, Lakshmi Narayana Medical College and Research Institute, Pondicherry, India, [2]R&D Wing, Central Research Laboratory, Sree Balaji Medical College and Hospital, Bharath Institute of Higher Education and Research, Chennai, Tamil Nadu, India

***Corresponding author:** Dr. R. Vijayakumar, Department of Physiology, Lakshmi Narayana Medical College and Research Institute, Pondicherry, India. E-mail: sivanviji@gmail.com

Received on: 14-02-2019; Revised on: 17-03-2019; Accepted on: 21-04-2019

planned to study the effect of SA on behavioral changes induced by SD.

MATERIALS AND METHODS

The study was done in the Department of Physiology, Sri Lakshmi Narayana Medical College and Research Institute. Animal Ethical Clearance was obtained from CPCSEA. The mice were adapted 7 days before the experiment with access to food and water *ad libitum*. Thirty-six male Swiss albino mice weighing 15–30 g were used for the study. The animals were divided into three groups, Group I – control-(6), Group II – sleep-deprived group, and Group III – SA *treated* sleep-deprived group.

SD Technique (Flower Pot Technique)

The mice were deprived sleep for 96 h using a small platform (3 cm) by flower pot technique.[8] They were placed on top of an upside-down flower pot which was placed in a bucket filled with water up to 1 cm. When the mouse entered into sleep, it lost its muscle tone and fall off the flowerpot into the water, then climb back up and awake from sleep. Control group mice were kept on a large platform (6 cms) in the same environment where SD was performed. The animals were provided with food and water throughout the experiment.

Drug

SA was purchased (IMCOPS) and stored at room temperature throughout the experiment. SA was administered orally in the dose of 1.8 mL/kg/day for 15 days. Ingredients of SA are *Bacopa monnier*i, *Asparagus racemosus*, *Pueraria tuberose*, *Terminalia chebula*, Zingiber *officinal*e, *Anethum sowa*, *Operculina ipomoea*, *Piper longum*, *Syzygium aromaticum*, *Acorus calamus*, *Saussurea luppa*, *Withania somnifera*, *Terminalia belerica*, *Tinospora cordifolia*, *Elettaria cardmomum*, *Embelia ribes*, *Cinamomum zelonica*, and pure gold.[9]

Behavioral Analysis

Behavioral analysis was performed using open field test and elevated plus maze, according to Brown *et al*.[10] and Espejo.[11]

Open Field Test

Mice were placed into the center or one of the four corners of the open field apparatus and allowed to explore the apparatus for 3 min. The behaviors scored using an open field test are: (1) Peripheral square entries, (2) center square entries, (3) rearing, (4) grooming, and (5) immobilization time of the animal.[12]

Elevated Plus Maze Test

The animal was left in the open arm and the time is taken for it to enter the closed arm 1. Transfer latency was measured first. Then, the time spent in the open arm (2), time spent in the closed arm (3), and the number of crossings (4) were also measured. The test duration in elevated plus maze is 5 min.[13]

RESULTS

In the behavioral assessment using elevated plus maze, there was a significant increase in closed arm time with a significant increase in transfer latency and the time in open arm and number of crossings were significantly decreased in sleep-deprived mice, when compared to control group [Table 1]. Whereas in SA treated SD group, there was a significant decrease in closed arm time with a significant decrease in transfer latency and the time in open arm and number of crossings were significantly increased when compared to sleep-deprived group [Table 2]. While assessing behavior using open field test, there was a significant increase

Table 1: Assessment of behavioral parameters using elevated plus maze test between controls and sleep-deprived mice

Groups	Transfer latency		Time in open arm		Time in closed arm		Number of crossings	
	Mean±SD	*P* value	Mean±SD	*P* value	Mean±SD	*P* value	Mean±SD	*P* value
Control	23.17±5.516	0.000	100.17±14.209	0.001	70.00±13.239	0.031	15.33±2.654	0.006
Sleep deprived	97.17±12.690	0.001	26.33±6.216	0.002	134.17±21.815	0.035	5.33±1.116	0.011

Table 2: Assessment of behavioral parameters using elevated plus maze test between sleep-deprived mice and sleep-deprived mice treated with *Saraswatarishta*

Groups	Transfer latency		Time in open arm		Time in closed arm		Number of crossings	
	Mean±SD	*P* value	Mean±SD	*P* value	Mean±SD	*P* value	Mean±SD	*P* value
Sleep deprivation	97.17±12.690	0.002	26.33±6.216	0.016	134.17±21.815	0.154	5.33±1.116	0.033
Sleep deprivation treated with SA	33.18±6.412	0.000	82.11±11.540	0.001	90.00±14.106	0.001	12.23±1.156	0.05

Table 3: Assessment of behavioral parameters using an open field test between control and sleep-deprived mice

Groups	Grooming (nos)		Rearing (nos)		Ambulation (number of peripheral squares)		Ambulation (number of central squares)		Immobilization time (s)	
	Mean±SD	*P* value	Mean±SD	*P* value	Mean±SD	*P* value	Mean±SD	*P* value	Mean±SD	*P* value
Control	30.83±3.525	0.000	22.83±1.641	0.000	89.17±4.549	0.000	21.67±1.726	0.000	17.83±1.815	0.000
Sleep deprived	6.33±0.919	0.001	3.17±0.749	0.000	12.17±2.548	0.000	3.67±0.667	0.000	91.17±9.551	0.000

Table 4: Assessment of behavioral parameters using an open field test between sleep-deprived mice and the SD mice treated with *Saraswatarishta*

Groups	Grooming (nos)		Rearing (nos)		Ambulation (number of peripheral squares)		Ambulation (number of central squares)		Immobilization time (s)	
	Mean±SD	*P* value	Mean±SD	*P* value	Mean±SD	*P* value	Mean±SD	*P* value	Mean±SD	*P* value
Sleep deprived	6.33±0.919	0.005	3.17±0.749	0.000	12.17±2.548	0.000	3.67±0.667	0.000	91.17±9.551	0.000
Sleep deprivation treated with SA	24.6±2.134	0.000	20.46±1.054	0.000	88.23±3.115	0.000	19.5±2.112	0.000	15.9±1.089	0.000

SD: Sleep deprivation, SA: *Saraswatarishta*

in immobilization time and a significant decrease in grooming, rearing, and ambulation in sleep-deprived mice when compared to the control group [Table 3]. Whereas in SA treated SD group, while assessing behavior using open field test, there was a significant decrease in immobilization time and a significant increase in grooming, rearing, and ambulation when compared to sleep-deprived mice [Table 4].

DISCUSSION

In the present study, while assessing behavior using elevated plus maze, the time spent in closed arm and transfer latency was significantly increased and the time spent in open arm and number of crossings were significantly decreased in sleep-deprived animals when compared to the controls. This concurs with a study of Silva where he explained that the animals remained stationary for a longer duration during behavioral analysis was due to high anxiety level following SD.[8] Whereas in SA treated group, a significant decrease in closed arm time with a significant decrease in transfer latency and the time in open arm and number of crossings were significantly increased when compared to sleep deprived group. This might be due to interaction of two mechanisms such as monoamine levels in the brain (neurochemical mechanism) and monoamine oxidase activity (biochemical mechanism) by which "SA" acts and then its effects can be better interpreted.

The open field test provides simultaneous measures of locomotion, exploration, and anxiety.[8] In our study, a significant increase in the immobilization time and significant decrease in the ambulation (peripheral and central square entry), grooming, and rearing in sleep-deprived mice could be due to a higher level of anxiety. Improvement in the state of immobility by SA indicates its antidepressant potential. SA although is used as *Medhya rasayana,* in Ayurveda clinical practice for many years, no studies have been done to evaluate its antidepressant activity on SD until recently.

CONCLUSIONS

In our present study, it is evidenced that the deprivation of sleep alters behavior, which shows that SD is a potent stressor. Moreover, the alterations in the behavioral parameters were reverted in SA treated group. Thus, the present study proved that SA exerts antidepressant effects on its own on sleep-deprived rats.

REFERENCES

1. Onen SH, Alloui A, Gross A, Eschallier A, Dubray C. The effects of acute sleep deprivation, selective sleep interruption and sleep recovery on pain tolerance thresholds in healthy

subjects. J Sleep Res 2001;10:35-42.
2. Tufik S, Andersen ML, Bittencourt LR, Mello MT. Paradoxical sleep deprivation: Neurochemical, hormonal and behavioral alterations. Evidence from 30 years of research. An Acad Bras Cienc 2009;81:521-38.
3. Kaneria MS, Naik SR, Kohli RK. Anti inflammatory, antiarthritic and analgesic activity of an herbal formulation. Indian J Exp Biol 2007;45:279.
4. Kundermann B, Krieg JC, Schreiber W, Lautenbacher S. The effect of sleep deprivation on pain. Pain Res Manag 2004;9:25-32.
5. Marrassini C, Acevedo C, Miño J, Ferraro G, Gorzalczany S. Evaluation of antinociceptive, anti inflammatory activities and phytochemical analysis of aerial parts of *Urtica urens* L. Phytother Res 2010;24:1807-12.
6. Moldofsky H, Scarisbrick P, England R, Smythe H. Musculoskeletal symptoms and non-REM sleep disturbance in patients with "fibrositis syndrome" and healthy subjects. Psychosom Med 1975;37:341-51.
7. Vogel GH. Drug Discovery and Evaluation of Pharmacological Assay. New York: Springer-Verlag and Berlin; 2002.
8. Silva RH, Kameda SR, Carvalho RC. Anxiogenic effect of sleep deprivation in the elevated pluz maze test in mice. Psychopharmacology 2004;176:115.
9. Gupta K, Ashok BK, Ravishankar B, Thakar AB. Anti-anxiety and anti-depressant activities of Sarasvata Choorna in experimental animals. Ayu 2011;32:590-3.
10. Brown RE, Corey SC, Moore AK. Differences in measures of exploration and fear in MHC-congenic C57BL/6J and B6-H-2K mice. Behav Genet 1999;26:263-71.
11. Espejo EF. Effects of weekly or daily exposure to the elevated plus-maze in male mice. Behav Brain Res 1997;87:233-8.
12. Walsh RN, Cummins RA. The open-field test: A critical review. Psychol Bull 1976;83:482-504.
13. Roehrs T, Hyde M, Blaisdell B, Greenwald M, Roth T. Sleep loss and REM sleep loss are hyperalgesic. Sleep 2006;29:145-51.

Source of support: Nil; Conflict of interest: None Declared