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TECOMA STANS PROTECT CENTRAL NERVOUS SYSTEM AGAINST OXIDATIVE DAMAGES OF ELECTROMAGNETIC RADIATION ON RAT

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ABSTRACT

The interaction of mobile phone radio-frequency electromagnetic radiation (RF-EMR) with the brain is a serious concern of our society. In this study, we aimed to experiment on the anti-oxidative property of methanolic extract of *Tecoma stans* (METS) to protect central nervous system against oxidative damages of mobile phone electromagnetic field (EMF). Healthy male albino wistar rats were exposed to RF-EMR by giving 5 min calling/5 min interval for 1 hour per day for 2 months, keeping a GSM (0.9/1.8 GHz) mobile phone in silent mode (no ring tone) in the cage. After 15, 30, 45, 60 days exposure, three randomly picked animals from each group were tested with using behavioural model of CNS on rats. *Tecoma stans* flowers extract could be effective in decreasing immobility ($P < 0.05$) and increased locomotor activity ($P < 0.05$). This result indicates the protective effect of *Tecoma stans* flowers against EMF induced oxidative damage of central nervous system.

INTRODUCTION

As recent increase in the use of electromagnetic field (EMF) producing equipments, such as mobile phones, both epidemiological and experimental studies have been motivated. Indisputable reports from harmful effects of these microwaves have been associated with growing concern and some alarms in our today society. In the year 1990, 12.4 million people worldwide had cellular subscriptions. By the end of 2009, only 20 years later, the number of mobile cellular subscriptions worldwide reached approximately 4.6 billion, 370 times the 1990 number, penetrating the developing economies and reaching the bottom of the economic pyramid. The interaction of mobile phone radio-frequency electromagnetic radiation (RF-EMR) with the brain is a serious concern of our society. Mobile telephones emit radiations that are intercepted in the proximity of the brain and cranial nerves. There is now an added worry if these radiations are carcinogenic or tumor promoter or have any other health implications [1]. The use of mobile phones is increasing day by day, and it is estimated that approximately 500 million people worldwide are using mobile phones currently. A large proportion of users are made up of children and teenagers. Mobile phone has negative effects on sperm motility, [2] anti-oxidant enzymes [3] and sperm concentration [4]. Exposure to EMF at even low frequencies (900-1800 Hz) causes some established pathologic consequences such as increased permeability of the blood-brain barrier, disturbed neurons function and alteration in electroencephalography (EEG) disturbed regional cerebral blood flow, oxidant and anti-oxidant balance, neurotransmitter imbalance and genomic responses [5,6]. *Penafiel et al*., have shown that the radiation from TDMA digital cellular phones can cause significant changes in ornithine decarboxylase activity (ODC), which is essential for DNA synthesis [7]. *Kolomytkin et al*., studied specific receptor binding of three neurotransmitters: Gamma-aminobutyric acid (GABA), an inhibitory transmitter and acetyl choline and

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glutamate, both excitatory to rat brain synaptosomes [8] Experimental studies have shown that the RF-EMR emitted from the mobile phones can affect the brain in various ways. These effects have been described *in vitro* and *in vivo* in a number of studies in particular, effects on cerebral blood flow,[9] blood-brain barrier permeability, [10] oxidant and anti-oxidant balance, [11] neurotransmitter balance, [12] nerve cell damage [13] and genomic responses have been reported. Anti-oxidative substances have to protect from central nervous system in front of oxidative effect of EMF. We have studied and use herbal extracts as anti-oxidative agents, because herbal-base medications are accompanied with lower imposed side effects and have more facing today society.

Tecoma stans (common name yellow bell) also known as yellow trumpet bush belongs o the family bignoniaceae. It is an ornamental plant. It is an erect, branched, sparingly hairy or nearly smooth shrub two to four meters in height. The flowers are opposite, odd-pinnate, Up to 20 centimeters in length with 5 to 7 leaflets. The leaflets are lanceolate to oblong- lanceolate, 6 to 13 centimeters long, pointed at both ends and toothed on the margins. Trumpet shaped flowers are yellow faintly scented and borne in short, dense, terminal clusters. The calys is green. 5 to 7 millimeters long and 5 toothed. Flowering can begin as early as April and continue in to fall. The flowers are followed by 6 inch long, tan pods that are filled with small, papery winged seeds [14].

Flowers of *Tecoma stans* contain the alkaloids tecomin and tecostamine are potent hypoglycaemic agent when given intravenously. Anthranilic acid is responsible for the anti diabetic activity. Roots are powerful diuretic and vermifuge [15]. *Tecoma* is not a toxic because this plant is used in latine America as a remedy for diabetes and moreover for feeding cattle and goats in mexico [16]. The preliminary phytochemical screening of methanolic extract of flower extract of *Tecoma stans* showed the presence of flavaniods, phenol, alkaloids, tannins, steroids, triterpenes, anthraqunones and saponins etc.The objective of this research was to see the effect of methanolic extract of flowers *Tecoma stans* on central nervous system that is induced by EMF.

MATERIALS AND METHOD

Plant Material

The flowers of *Tecoma stans* were collected in the month of May 2011 from Rasipuram (Namakkal District) Tamil Nadu. A herbarium specimen of the plant was deposited in the Department of Pharmacognosy. The plant was identified by Dr.G.V.S.Murthy, Joint Director of the Botanical Survey of India, Southern circle, TNAU Campus, Coimbatore, who authenticated the plant from information available in the literature. The flower petals were dried in the shade for 10–12 days. After complete drying, the flower petals were pulverized to a coarse powder of 40 mesh size in a mechanical grinder. The powdered material was subjected to sohxlet extraction for 18 h at 50–55oC. The extract was thereafter concentrated under vacuum and air-dried. The phytochemical study of EETS showed the presence of flavaniods, phenol, alkaloids, tannins, steroids, triterpenes, anthraqunones and saponins etc.

Animals

Wistar albino rats weighing between 200 and 300g of either sex were used. All animals were housed in well ventilated polypropylene cages at 12/12 h light/dark schedule at 25 ± 2°C and 55-65 RH with free access of food (standard laboratory rodent's chow) and water.

Electromagnetic Radiation Exposure Setup

Keeping a GSM (0.9/1.8 GHz) mobile phone in silent mode (no ring tone) in the cage (36 × 23 × 21 cm). Animals were exposed to RF-EMR by giving 5 min calling/5 min interval for 1 hour per day for 2 months. Each call was of the duration of 5 min. Animals were free to move in the cage. The phone was kept in a small wood bottomed cage sized 12 × 7 × 7 cm. The wire mesh on top of the wood bottom cage prevented the animals from contact with the phone. After 15, 30, 45, 60 days exposure, three randomly picked animals from both groups were tested for using behavioural screening model of central nervous system [17].

Experimental Design

The animals were allocated into four experimental groups. Each group consisted of six animals.

- Group I (control) - Animals treated by vehicle, orally (p.o) applicated every day
- Group II - Everyday exposed rats with mobile phone radiation
- Group III - Mobile phone radiation exposed rats treated with methanolic extract of *Tecoma stans* flowers (700 mg/kg, p.o.).

Pharmacological Studies

Tail-suspension Test

A cord of about 50 cm in length was stretched between two metal tripods at a height of 70 cm, to which the rats were attached by the tail with sticky tape. Measurement was carried out for 6 min. After the initial period of vigorous motor activity, the rats became still and the immobility time was measured with a stopwatch, for a total duration of last 4 min. Rats were considered immobile when they hung passively and completely motionless[18].

Forced-swimming Test

Measurement of immobility time was carried out by observing the motoric activity of the rats, which were placed in a pool of water. A glass cylinder, 25 cm in

diameter and height of 23 cm, was filled with water to a height of 12 cm. The temperature of water was 23 ± 1°C. Measurement was carried out for 6 min. The first 2 min the animal was allowed to adjust to the new conditions, after these 2 min, the immobility time that alternated with conditions of enhanced motor activity was measured. Immobility time was measured with a stopwatch for the next 4 min. Each time animals were removed from the water, dried with a soft towel and placed in separate cage. Immobility time is the time during which the animal floated on the surface with front paws together and made only those movements which were necessary to keep afloat [19].

Actophotometer

The locomotors activity was studied using actophotometer. The movement of the animal interrupts the beam of light falling on a photocell at which the count was recorded and displayed digitally. Each rat was placed individually in the actophotometer for 10 min and the basal activity was obtained. The rats were observed in a square open field arena (68 × 68 × 45 cm) equipped with two rows of eight photocells, sensitive to infrared light, placed 40 and 125 mm above the floor, respectively. The photocells were spaced 90 mm apart and the last photocell in a row was spaced 25 mm from the wall. Measurements were made in the dark in a ventilated, sound-attenuating box [20].

Statistical Analysis

All the data were given as means ± S.E.M (n = 10). Data were analysed by one-way analysis of variance (ANOVA). Whenever ANOVA was significant, further comparisons between vehicle- and drug-treatment groups were performed using the Dunnett's test. The level of statistical significance adopted was $P < 0.05$.

Figure 1. Effect of 700 mg/kg body weight *Tecoma stans* flowers extract and Mobile phone Electromagnetic radiation on forced swimming test

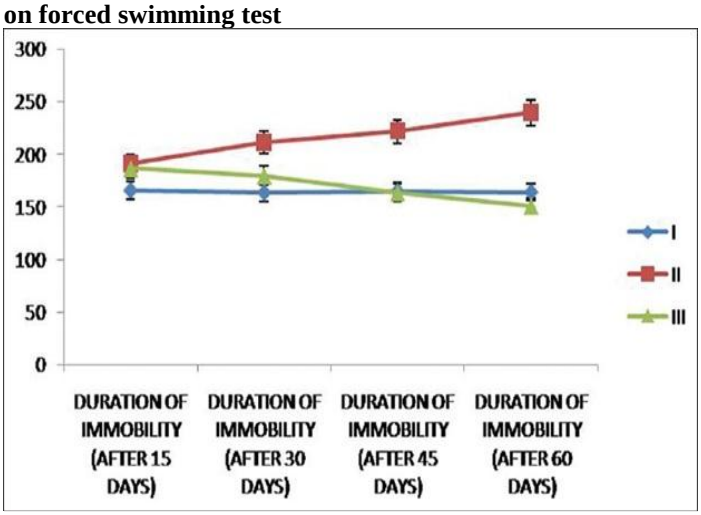


Figure 2. Effect of 700 mg/kg body weight *Tecoma stans* flowers extract and Mobile phone Electromagnetic radiation on Tail suspension test

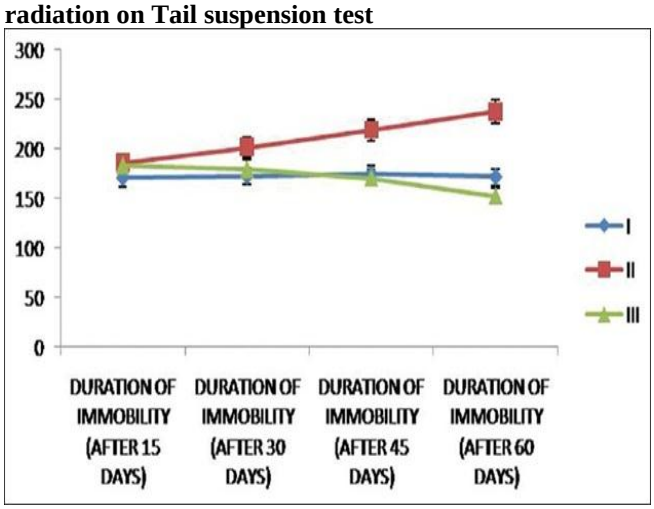
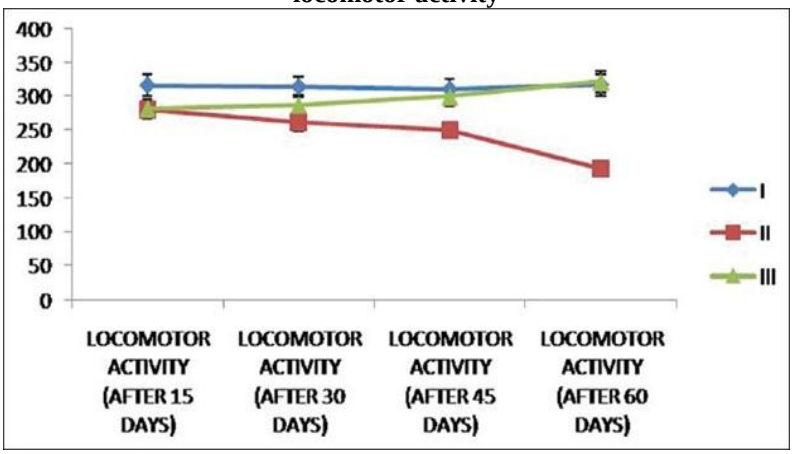


Figure 3. Effect of 700 mg/kg body weight *Tecoma stans* flowers extract and Mobile phone Electromagnetic radiation on locomotor activity



RESULTS AND DISCUSSION

Our experimental results revealed that EMF exposure affected behavioural model of depression like forced swim test, tail suspension test and locomotor activity. It significantly increases immobility and decreases the locomotor activity in comparison with control group ($P < 0.05$). *Tecoma stans* flowers extract feeding was not significantly effective to be protective in front of radiation after 15 days evaluation. After 45 and 60 days *Tecoma stans* flowers extract could be effective in decreasing immobility ($P < 0.05$) and increased locomotor activity ($P < 0.05$). This result indicates the protective effect of *Tecoma stans* flowers against EMF induced oxidative damage of central nervous system and are showed in [Figure 1],[Figure 2], [Figure 3].

Plants and natural products are extensively used in several traditional systems of medicine, so screening of these products for radio-protective compounds has several advantages, because they are usually considered non-toxic and widely accepted by humans. Many natural anti-oxidants consumed before or after radiation exposure indicated some level of radio-protection. The RF-EMR emitted from the mobile phones can affect the brain in various ways. A previous study showed that EMF exposure immediately altered the metabolism of free radicals, decreased SOD activity in plasma [21]. EMF is able to generate destructive reactive oxygen species (ROS) including superoxide, hydrogen peroxide and hydroxyl radical and frequently used to produce oxidative and narcotic damages [22]. Formation of ROS and increased oxidative stress may be involved in the action of microwave radiation on the biological system. ROS also causes injury by reacting with biomolecules, such as lipids, proteins and nucleic acid as well as by depleting enzymatic and non-enzymatic anti-oxidants in the brain. Anti-oxidant treatments in animals and humans could be beneficial in preventing or reducing some complications of microwave radiation. Anti-oxidants play an important protective role against the ROS [23]. The anti-oxidant effect is mainly due to phenolic components, such as flavonoids, phenolic acid and phenolic diterpenes because of their redox properties, which can play an important role in absorbing and neutralising free radicals, quenching singlet and triplet oxygen or decomposing peroxides [24].

CONCLUSION

The present study shows that *Tecoma stans* flowers extract have protective effect in exposed animals to EMF-induced depression, which is referred to its anti-oxidative potency and free radical scavenging activity. We cannot stop technology that emitted EMF, but we can protect ourselves, especially teen agers and young persons, against hazardous effects of radiations.

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