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Cell Phone Radiations: Influence on Haemolymph and Semen of Drone Honey Bee *Apis mellifera* L.

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Abstract—*The increasing level of electromagnetic frequency radiations in the atmosphere is giving rise to a new type of environmental pollution referred to as 'Electrosmog'. The honey bees are susceptible to environmental changes, diseases and are attacked by natural enemies. Recently a sharp decline in the population of honey bees has been observed all over the world. This decline in population is not necessarily due to the natural enemies but is often caused by the activities of man such as deforestation, habitat alterations and now unscientific proliferation of cell phones and use of electronic gadgets. Therefore in the present study the impact of cell phone radiations on various biochemical and physiochemical aspects of haemolymph and semen of drone honey bee Apis mellifera L. was observed. The drones were exposed to radiations for 30 minutes, using live cell phones kept in working mode with tape recorder at the speaker end, and positive response at the receiver's end. The parameters were analyzed and compared with that of control drones. The concentration of various biomolecules- viz. carbohydrates, proteins and lipids were found to be increased whereas, the activities of seminal enzymes decreased leading to reduced utilization of the biomolecules, and hence increase in their concentration.*

Keywords*: Apis mellifera, haemolymph, semen, drone, cell phone radiations, Apiculture*

1. INTRODUCTION

A honey bee colony is a waxen city where there lives a monarch, the queen, with hundreds and thousands of selfless workers, an army of guards to defend the fortress and majestic drones to help continue the race. The honey bees are not only important for satisfying the taste buds of honey loving humans, these tiny insects are responsible for 80% of the food we consume every day since a multitude of flowering plants rely on these small creatures for pollination and for the agricultural production (Kumar and Kadian., 2015). Massive and sudden declines have occurred in bee population across the world during the last decades. The primary reasons include parasitic mites, viruses, pesticides, genetically modified crops and climate changes. More recently however the electromagnetic environment has been suggested to be crucially influential on honey bee behavior and physiology as reported by Greenberg *et al.* (1981); Eskov *et al.* (1982); Cartensen (1987); Sharma and Kumar. (2009); Kumar *et al* (2009). The honey bees are a good model as bio indicator to study the influence of cell phone radiations. They are good biological indicators for electromagnetic pollution as they have tiny magnets glued to their head, thorax and abdomen in the anterior dorsal region, helping in their navigation flight. The integument of bees has semiconductor functions. These characteristics make it directly susceptible to the influence of EMR. Further, Menzel and Muller (1996); Zhang *et al.* (1999); Schwarzel and Muller (2006) reported that the brain anatomy of honey bee's concerning associative learning was comparable to that of vertebrates. Lean and Shawcross (2007) asserted in a media report that mobile phones were a possible cause of honey bee colony collapse disorder. Therefore the present studies were planned to study the effect of cell phone radiations on the haemolymph and the semen of drones of *Apis mellifera* honey bee.

2. MATERIAL METHOD

2.1 Study area

The haemolymph and semen samples of adult drones were drawn from the colonies of *Apis mellifera* maintained by Department of Zoology, Panjab University, Chandigarh.

2.2 Experimental design

In order to carry out the experimental studies a specially designed box called the observation hive was used for the experiments. The front and back of the box were made up of glass. The sides had wire gauze for proper ventilation. A comb frame without bees was put in the observation hive. 20-30 drone bees were segregated from the healthy colony and released in the observation hive. The observation hive had 2 mobile phones placed against the sides having wire gauze. An exposure of 30 minutes was given to the drones kept in observation hive by keeping cell phones in listen and talk mode for 30 minutes using a tape recorder. After 30 minutes 10 drones were collected at random, put in test tubes and labeled as exposed. A similar set was installed for control which did not have cell phones. Random sample of 10 drones was likewise collected and labeled control. The experiment was run in triplicate.

2.3 Sample preparation

For collection of haemolymph the tip of a micropipette was inserted into the intersegmental region of the drone's abdomen. By applying mild pressure at one end of the abdomen the haemolymph was sucked in to the tip of the micropipette. Equal volume of haemolymph from all drones was dissolved in 0.5ml of normal saline. For collection of semen, drones were activated by allowing them to move freely on a glass pane. Drones were then caused to evert by gently pressing the thorax dorsoventrally. Squeezing the thorax made the abdomen turgid and the genetalia were exposed at its best. A drop of semen oozed out at the tip of genitalia and was immediately collected with the help of auto pipette and dispersed in 0.5 ml of saline or PBS as the experiment demanded. Biochemical tests and enzyme assays were performed and the results were analyzed

3. RESULTS AND DISCUSSION

Table I: Cell phone radiations: Influence on biomolecules of haemolymph and semen of Drone Honey Bee *Apis mellifera* L.

Biochemical Estimation	Protocol	Control Drone (Haemolymph)	Exposed Drone (Haemolymph)	Control Drone (Semen)	Exposed Drone (Semen)
Total Carbohydrates	Sawhney and Singh (2000)	1.65±0.015mg/ml	2.75±0.015mg/ml	0.63+0.032 mg/ml	1.40+0.017 mg/ml
Glycogen	Seifter et al. (1950)	0.50± 0.081mg/ml	1.16± 0.030mg/ml	0.04+0.00 mg/ml	0.114+0.00 mg/ml
Glucose	Somogyi and Nelson (1945)	0.023±0.002mg/ml	0.302±0.002mg/ml	0.17+0.002 mg/ml	0.28+0.002 mg/ml
Total lipids	Fringes and Dunn (1970)	0.325±0.005mg/ml	1.33±0.014mg/ml	0.176+0.001 mg/ml	1.03+0.015 mg/ml
Cholesterol	Zalatki et al. (1953)	0.25±0.041mg/ml	0.24±0.026mg/ml	0.136+0.01 mg/ml	0.130+0.01 mg/ml
Protein	Lowry et al. (1951)	3.74±0.047mg/ml	4.85±0.020mg/ml	0.076+0.008 mg/ml	0.207+0.072 mg/ml
SDS-PAGE	Laemmli, (1971)	7 protein types mol. Weights (27-216) KDa	13 protein types mol. weights (20.5- 217) KDa	12 protein types mol. weights (21- 217) KDa	6 protein types mol. weights (33.2- 217) KDa
Free amino acid assay	Swarup et al. (1981)	5 amino acids	3 amino acids	4 amino acids	3 amino acids

Table II: Cell phone radiations: Influence on activities of different enzymes of haemolymph and semen of Drone Honey Bee *Apis mellifera* L.

Acid phosphatase	Bergmyer (1963)	0.54±0.018 units/mg of protein	0.42±0.018 units/mg of proteins	25.9+0.616 units/mg of proteins	7.922+0.695 units/mg of proteins
Alkaline phosphatase	Bergmyer (1963)	1.04±0.018 units/mg of protein	0.82±0.015 units/mg of protein	1.04+0.018 units/mg of proteins	0.187+0.005 units/mg of protein
Glucose-6-phosphatase	Freeland and Harper (1959)	0.126±0.00units/mg of protein	0.047±0.011 units/mg of protein	26.25+0.443 units/mg of protein	8.09+0.799 units/mg of protein
Hexokinase	Crane and Sols (1995)	0.537±0.009 units /mg of protein	0.422±0.018 units/mg of protein	26.25+0.173 units/mg of protein	8.54+0.365 units/mg of protein

Mobile phone towers emit microwave radiations which fall in the radio frequency waves of the electromagnetic spectrum and are an immense source of thermal energy, responsible for heating effects on living being. Mobile phones, Wi- Fi systems, electric power lines and similar sources of "electro smog" are disrupting nature on a massive scale, causing small creatures like honey bees and birds to lose their lives by affecting their reproductive system, egg laying capacity and changes in their behavior and physiology. The flying animals are totally dependent upon natural electrical, magnetic and

electromagnetic fields for their orientation and navigation. These animals are confused by these much stronger and constantly changing artificial fields. The role of these radiations is causing colony collapse disorder in honey bees was reported by Carlo (2007). So for testing the authenticity of these assumptions honey bees were used as biological indicators because their anatomy and physiology are well known and they contain magnetic granules in their head, thorax and abdomen which guide them in their navigation flights and these magnetic granules are affected by cell phone radiations. Therefore in the present study the effects of Cell Phone Radiations and its influence on Haemolymph and Semen's biochemical and physiological aspects of drone honey bee *Apis mellifera* L were undertaken. The studies on the biology, behavior and biochemical make up of the worker honey bee (*Apis mellifera*) have previously been undertaken in this laboratory (Sharma, 2008; Sangwan, 2009; Kumar *et al*., 2010).

The results of the methods employed to study the changes in biochemical parameter of the drone haemolymph and Semen upon exposure to electromagnetic radiations (EMR) from live cell phones are presented in Table 1&II. The p values are less than 0.05 therefore all the results are statistically significant. After exposure the results for both haemolymph and semen showed an increase in concentration of primary macromolecules. The survival ability of an animal depends on its protein synthetic potential therefore any stress on animal invokes compensatory metabolic adjustments in its tissues through changes in protein profile (Bano *et al*., 1981; Aseem and Hanke, 1983). Hence, the total protein profile of a tissue may be considered as a diagnostic tool in assessing physiological status of an animal. The total proteins were found to be increased during this study and the results of SDS-PAGE showed increase in number of protein bands in case of exposed drones whereas the number of free amino acids decreased in case of exposed drones. These results were supported by the observations of Sangwan (2009) and Kumar *et al*. (2010). The increase in carbohydrates in the haemolymph as well as semen of cell phone radiation exposed drones was also supported by Sangwan (2009). Total lipids (main source of energy to insects) of the haemolymph and semen of EMR exposed drones also showed increased concentration as compared to the unexposed drones. The electromagnetic radiations also lead decrease in the activity of different enzymes (acid phosphatase, alkaline phosphatase, hexokinase and glucose 6 phosphatase) in the EMR exposed drones as compared to the unexposed drones.

4. CONCLUSION

The influence of cell phone radiations influences the normal metabolic and physiological processes of honey bees. It leads to increase in concentration of primary macromolecules, types of proteins and availability of fewer free amino acids which indicate the synthesis of newer functional proteins to fight stress conditions. The activity of enzymes decreased which led to corresponding increase in concentration of the specific metabolites. The normal constitution and physiology of haemolymph and semen were therefore disrupted. Hence it is clear that the massive amount of radiations produced by towers and cell phones are probably responsible for colony collapse disorder by disturbing the navigational skills of flying animals, preventing them from returning back to their hives.

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