

Effect of Ginseng Herbal Tea on Whole Brain Serotonin Level and its Metabolites 5-HTP and 5-Hydroxyindole Acetic Acid (5-HIAA) with the Change in Feeding Behavior and Body Weight in Albino Westar Rats

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Abstract: Obesity is becoming a major worldwide health problem associated with a number of diseases. Serotonin (5-HT) is a biogenic neurotransmitter with a well-defined network in the central and peripheral nervous system and plays an important role in the regulation of feeding behavior. Studies revealed that high levels of serotonin are associated with reduced energy intake and its level and function is dependent on the availability of its precursor, tryptophan. Several synthetic serotonin agonists are available in the market to reduce body weight but many of these synthetic drugs were found to have certain side effects. Therefore, there is a great need to search for more economical natural serotonin agonists. Ginseng is a traditional Chinese medicinal herb known for many of its beneficial effects. Present work was designed to evaluate the effect of three week's oral administration of aqueous extract of *herbal tea*, made from a Chinese herb Ginseng and *Malva Verticillata* (GMV) on overweight Albino Wistar rats. We found inverse relationship between body weight and serotonin level in whole brain and also found increased levels of tryptophan and serotonin metabolite 5-hydroxyindoleacetic Acid (5-HIAA) in both plasma and whole brain of test animals.

Keywords: Obesity, Serotonin, Tryptophan, Ginseng tea, *Malva Verticillata*, 5-hydroxyindoleacetic Acid.

INTRODUCTION

Obesity is a major risk factor responsible for a variety of diseases such as diabetes [1], hypertension [2] and cardiovascular diseases [3]. Serotonin (5-HT) is a biogenic neurotransmitter that participates in a variety of functions in nervous system such as sleep, body temperature, mood control etc. and plays an important role in satiety and weight control. Synthesis and level of serotonin in periphery and central nervous system depends on the availability of its precursor tryptophan.(Trp), food and carbohydrate intake [4,5]. Number of studies demonstrated that acute depletion of tryptophan decreases 5-HT level in cerebrospinal fluid and also decreases its major metabolite 5-hydroxyindoleacetic acid (5-HIAA) concentration [6], whereas tryptophan injection or ingestion elevates brain 5-HT level and turnover [7]. It was found that out of three of the 5-HT receptors, 5-HT_{2C} receptor appear to be the most important one involved in the control of appetite and weight control [8, 9]. Hypothalamus plays an important role in the regulation of energy balance in

which 5-HT act as a satiety factor [10], supported by the evidence that increased 5-HT levels decrease the desire of eating which in turn reduces hunger and body weight [11].

Ginseng is an old traditional Chinese medicinal herb used over the past two centuries for many of its beneficial effects. Ginseng leaves and stem contains many bioactive constituents including ginsenosides, polysaccharides, triterpenoids, flavonoids [12], fatty acids, oligopolysaccharides and polyacetylenic alcohols [13]. Main pharmacological effects of ginseng root, leaf and stem is due to its important constituent, ginsenosides. Asian ginseng (panax ginseng) is used for years to improve memory [14], prevent coronary dysfunction [15], as an antidiabetic agent [16], in hypoglycemia [17], as an antiobesity herb [18], as an antioxidant [19], antiallergic [20], anti-amnesic and antiaging agent [21]

The aim of present research is to investigate the effect of GMV (Ginseng & Malva Verticillata herbal tea on whole brain serotonin level and its metabolites with the change in body weight and feeding behavior in over weight rats.

EXPERIMENTAL PROTOCOLS

Preparation of extract

Fresh Ginseng tea was prepared by boiling one tea bag in 100 ml of water for five minutes.

Animal models

The research was carried out on 24 Pakistani breed male Albino Wister rats purchased from Hussain Ebrahim Jamal institute (HEJ), University of Karachi with the initial body weight of 280-290 gm. All animals were placed in single cages for 12 hours under light – dark cycle, and under controlled room temperature of $23 \pm 2^{\circ}\text{C}$. free access to specially prepared diet and normal water was given for one week, prior the experiment for the rats to adopt themselves to new conditions.

The animals were divided into two groups; 12 test and 12 control groups. The test group received 2ml *Ginseng Malva Verticillata tea* (GMV) tea whereas the control group received normal water equivalent to that of tea. Weighed amount of food was placed in the hopper of all cages. Body weight and food intake was monitored weekly for both groups. When 15-19% body weight reduction was observed in treated animals, they were decapitated after one day using guillotine. Blood and brain samples were collected and preserved at -70°C for neurochemical and biochemical estimations. Untreated rats were also decapitated at the same time to observe the difference.

RESULTS

Three week repeated oral administration of GMV tea revealed a significant increase ($p < 0.01$) in brain & plasma tryptophan as given in figures 1 & 2 respectively. Effect of GMV tea on rat's brain 5-HT and 5- HIAA is shown in figures 3 & 4 respectively.

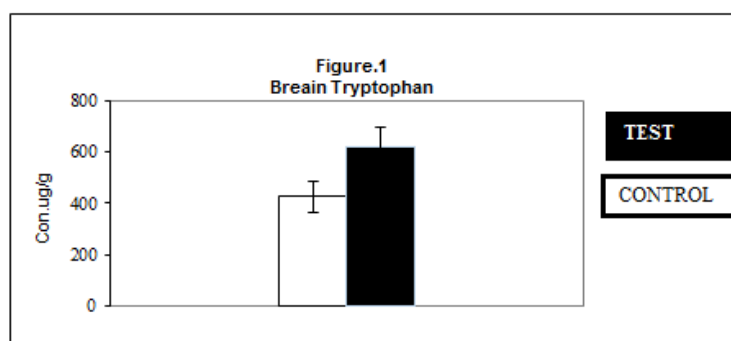


Fig-1: Effect of repeated administration of GMV tea on brain Trp in rats

Values are mean \pm SD (n=12) significant difference by Student t- $p < 0.01$ from respective controls

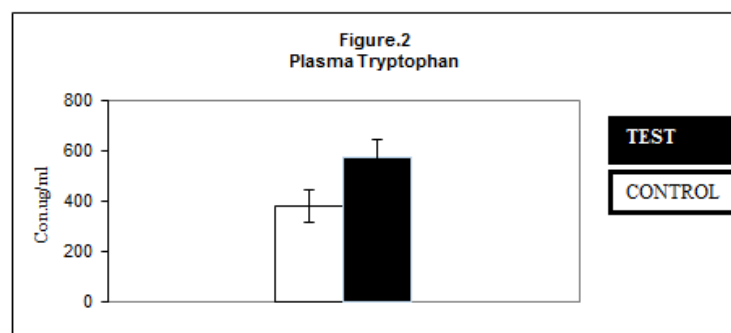


Fig-2: Effect of repeated administration of GMV tea on plasma Trp in rats. Values are mean \pm SD (n=12) significant difference by Student t- $p < 0.01$ from respective controls.

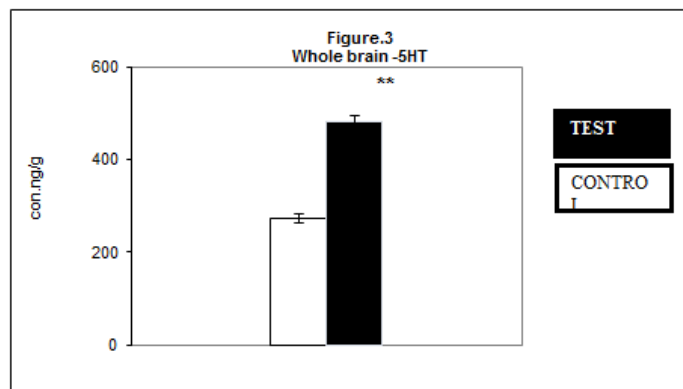


Fig-3: Effect of repeated administration of GMV tea on 5-HT level in rat's brain. Values are mean ± SD (n=12) significant difference by Student t- $p < 0.01$ from respective controls

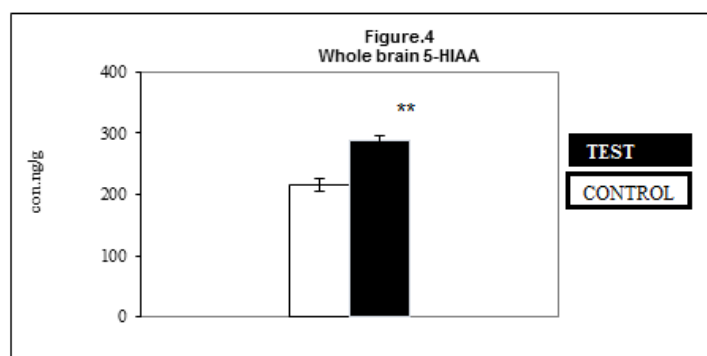


Fig-4: Effect of repeated administration of GMV tea on 5-HIAA level in rat's brain. Values are mean ± SD (n=12) significant difference by Student t- $p < 0.01$ from respective controls

Significant decrease ($p < 0.01$) in weekly food intake and body weight in Albino Wistar rats as

compared to control is clearly visible and shown in figures 5 and 6 respectively.

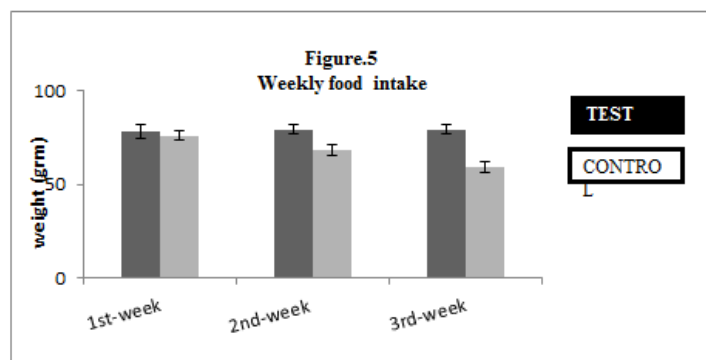


Fig-5: Effect of repeated administration of GMV tea on food intake of rats. Values are mean ± SD (n=12) significant difference by Student t- $p < 0.01$ from respective controls

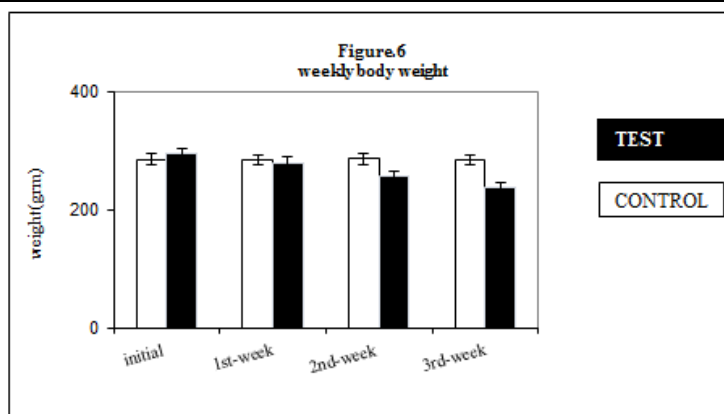


Fig-6: Effect of repeated administration of GMV tea on body weight of rats. Values are mean \pm SD (n=12) significant difference by Student t- $p < 0.01$ from respective controls

STATISTICAL ANALYSIS

The significance of difference between the mean of the treated and untreated groups were analyzed by student's t-test. Values of $p < 0.05$ was considered as significant. Data shown in figures as mean \pm standard deviation (SD).

DISCUSSIONS

Obesity is the major health problem worldwide. It is known that a well-organized neurobiological network is involved in feeding behavior and energy balance. Anti-obesity drugs produce negative energy balance during the weight loss. This must be managed either by reduction of energy intake or an increase in energy expenditure.

The present study was designed to observe the effect of GMV tea on serotonin, 5-HTP and 5-HIAA levels in whole brain and its correlation with food intake and body weight in over weight Albino Westar rats. The hypophagic effects of GMV tea observed in this study is possibly related to the high concentration of tryptophan in the plasma that crosses the blood brain barrier (BBB) where it increased the brain 5-HT levels. Under ordinary circumstances, the brain enzyme *tryptophan hydroxylase* is only 50% saturated therefore raise in Trp level will automatically increases brain 5-HT synthesis [22, 23]

CONCLUSION

GMV tea exhibited the significant weight reducing effect by increasing satiety through increasing synthesis of serotonin in brain. It may open doors for the detailed study on Ginseng to find out its role in regulating appetite and controlling body weight. Such studies may facilitate the wider use of ginseng tea for its pharmacological activities.

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