SUMMARY

- In the present study the effects of *Camellia sinensis* (Indian origin), on the overall morphology and functional status of male gonad and adrenal have been investigated in detail on adult albino rats (Sprague Dawley strain). *Camellia sinensis*, widely used as a common beverage, is a rich source of flavonoids. Based on processing tea leaves can be grouped into green tea (non-fermented) and black tea (fermented). The information regarding the morphological and functional aspects of male reproduction and adrenal after the short and prolonged exposure of green and black tea extracts (GTE & BTE) at different doses for different durations is not available and thus the present investigation has been undertaken. Morphological parameters were body weight, weight of testis, adrenal and accessory sex organs and histology of testis, and accessory sex organs in control and experimental groups of animals. On the other hand functional parameters were testicular steroidogenic enzymes $\Delta^3\beta$ HSD and $17\beta$ HSD activities in testis and serum testosterone level. Serum LH and FSH levels were measured to evaluate the pituitary control on testicular steroidogenesis and spermatogenesis, followed by testicular gametogenesis, quantitative evaluation of spermatogenesis by counting the relative number of germ cells at stage VII of the seminiferous cycle which represents the condition of spermatogenesis as a whole. As the hypothalamo-pituitary-gondal (HPG) axis is in close association with hypothalamo-pituitary-adrenal (HPA) axis therefore along with the gonadal status, adrenocortical system as evidenced by adrenal gland weight, adrenal $\Delta^3\beta$ HSD activity and serum corticosterone level that assess the stressful condition (if develops) in the experimental animals have also been examined. For this study, green tea was collected from Institute of Himalayan Bioresource Technology (IHBT), Palampur, Himachal Pradesh. A) The composition of green tea is EC (Epicatechin) - 1.55%, EGCG (Epigallo catechin gallate) - 9.00%, ECG (Epicatechin gallate) - 4.8%, EGC (Epigallo catechin) - 5.0%, Caffeine- 2.38%, as mentioned by manufacturer. B) Black tea was collected from Toklai Tea Research Centre, Johrat, Assam. The composition of black tea is as theaflavins (TF) - 1.56%, thearubigins (TR) - 11.95%, as mentioned by manufacturer.
The significant findings based on the present investigation are as follows

- The weight of testes and accessory sex organs (except prostate) were altered significantly resulting the possible alterations of morphological as well as histological organization of testis and accessory sex organs under prolonged GTE and BTE exposure at relatively moderate and high doses as used in this study.

- Degenerative changes of sperms at their different stages of development, decreased diameter of the seminiferous tubules, tubular shrinkage have been observed in the moderate and high doses of GTE and BTE treated groups respectively for 26 days as compared with control. There was significant difference between GTE and BTE in effective degeneration of 7Sd (round spermatid of stage VII). BTE was found more potent to degenerate round spermatids than GTE. These changes as mentioned were associated with lower level of serum testosterone.

- Prostate weight and prostate acinar diameter were significantly increased after exposure of GTE at moderate and high doses for 26 days. Moreover there was no significant difference between the dry weight and wet weight of prostate in moderate and high doses of GTE for 26 days exposure compared to that of control group. Literature suggested that EGCG of GTE increases 5α reductase activity by chelating zinc and thus increases the production of dihydrotestosterone (DHT) from testosterone. DHT is more active androgen than testosterone. In contrast prostate weight and prostate acinar diameter were significantly decreased after exposure of BTE at moderate and high doses for 26 days. Further, theaflavin of BTE do not have any chelating activity on zinc and thus 5α reductase activity do not increases. Decreased weight of prostate may be due to decreased level of testosterone.

- No significant changes were found in the activities of the testicular Δ5-3β HSD and 17β HSD enzymes for 13 days treatment with mild and moderate doses of both GTE and BTE. However, the activities of the testicular enzymes Δ5-3β HSD and 17β HSD were decreased significantly in the moderate and high doses of both GTE and BTE for 26 days exposure in comparison to that of the control group. All these indicate that both GTE and BTE inhibit the activities of the regulatory enzymes in the
steroidogenic pathway of testosterone biosynthesis. Prolonged (26 days treatment) treatment with both GTE and BTE exert more potent effect on the testicular enzyme activities.

- In consistent with the decreased enzymatic activities serum testosterone level was reduced significantly after moderate and high doses of both GTE and BTE in 26 days exposed animals. Decreased testosterone level may be for less biosynthesis of testosterone as evidenced by the decreased activities of testicular $\Delta^5$-3$\beta$ HSD and 17$\beta$ - HSD enzymes. Further, excessive levels of both LH and FSH indicate disruption in germ cells development.

- Epididymal sperm count decreased markedly in both the moderate and high doses of GTE and BTE exposed groups in comparison to that of their respective control group. In case of 13 days treatment, significant reduction was observed only in high dose of both GTE and BTE exposure. Low testosterone level is perhaps responsible for the reduction in sperm count.

- Adrenal weight, adrenal $\Delta^5$-3$\beta$ HSD activity, serum corticosterone level in both GTE and BTE exposed groups showed no significant changes possibly for catechin, the major constituent of tea having antioxidant properties and thus no stress developed.

- To explore the possibilities of direct effect of both GTE and BTE on gonadal and adrenocortical systems, in vitro experiments were performed. The results of in vitro study demonstrated the same deleterious effects as observed in vivo studies on male gonads by the alteration of the activities of steroidogenic enzymes. Results of MTT assay demonstrates that inhibitory activity of testicular $\Delta^5$3$\beta$ HSD and 17$\beta$ HSD were not due to toxicity at high doses either of GTE or BTE. Thus it may be concluded that both GTE and BTE may have direct effect on testicular enzymes; on the contrary, no direct inhibitory effect on adrenal $\Delta^5$3$\beta$ HSD activity was found.
• The study as conducted, explores the effects of short (13 days) as well as prolonged (26 days) GTE and BTE exposure in the morphological and functional changes of adult male reproductive as well as adrenocortical systems. It can be inferred that flavonoids, the major constituents of tea extracts, have potent inhibitory role on male gonadal morphology and functions without any development of stress respectively at high concentrations and 26 days exposure.