Green Tea and Black Tea Extracts (GTE & BTE) induced changes on serum testosterone, corticosterone, LH and FSH Levels.

Introduction

Testosterone is the important male steroid hormone that regulates metabolism in many organs including male sex organs. It is synthesized in Leydig cells in testis. This is the main androgen present in the circulation. Testosterone plays an important role in sexual differentiation and development of secondary sex characteristics (Bunzo et al., 2005). Dynamics of androgen has correlation with the occurrence of benign prostatic hypertrophy (BPH) and prostate cancer (Gray et al., 1991). Along with testosterone, gonadotropins (FSH, LH) are also the prime regulators of germ cell development. The successful and complete male germ cell development is dependent on the balanced endocrine interplay of hypothalamus, pituitary and the testis. Gonadotropin releasing hormone (GnRH) secreted by the hypothalamus elicits the release of FSH and LH from the pituitary gland (De Krester, 1979). FSH binds with receptors in the Sertoli cells and stimulates spermatogenesis (O'Donnel et al., 1994). Testosterone, estradiol and inhibin control the secretion of gonadotropins (Weinbauer et al., 1995). Corticosterone, another steroid hormone, secretes from adrenal cortex and regulates adrenal steroidogenesis. The influences of GTE and BTE on those hormones were not evaluated in vivo, thus the present study has been undertaken to evaluate the BTE and GTE-induced effect on serum testosterone, corticosterone, LH and FSH level in the control and treated animals.

Results

The serum testosterone level was significantly decreased in a dose- and time-dependent manner in both GTE and BTE treated animals (for 13 days and 26 days) as compared to control rats. However, there was no significant difference in serum corticosterone level after GTE and BTE administration (for 13 days and 26 days) when compared with control group of rats. Serum LH level was significantly increased in a dose- and time-dependent manner in both GTE and BTE animals (for 13 days and 26 days) as compared to respective control
rats. Serum FSH level was also significantly increased after high dose administration of both GTE and BTE (for 26 days), in comparison to control group. On the contrary there were no significant changes observed in FSH level after administration of both GTE and BTE for 13 days.

Data is presented as the mean ± SD, n=8. One-way analysis of variance (ANOVA) test followed by a multiple comparison t-test was performed. Values bearing asterisk and # are significantly different by ANOVA at P<0.05 when compared to controls 13 days treatment and 26 days treatment respectively.
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Discussion

The decreased serum testosterone level in both GTE and BTE-treated rats may be due to impaired synthesis or enhanced metabolism of this androgen. The production of testosterone in Leydig cells involves several enzymatic steps (Yu et al., 2010). First, the side chain of cholesterol is cleaved to yield pregnenolone by mitochondrial P450scc, the rate-limiting enzyme. A series of steroidogenic enzymes that are located in the smooth endoplasmic reticulum then convert pregnenolone to testosterone, the principal secreted hormone. Pregnenolone is oxidized to progesterone by Δ^3-3β-hydroxysteroid dehydrogenase (Δ^3β-HSD), progesterone is then hydroxylated to 17α-hydroxyprogesterone by 17α-hydroxylase and 17α-hydroxyprogesterone is converted to androstenedione by C17-20 lyase. Androstenedione is then reduced to testosterone by 17β-HSD (Marina et al., 2009).

Prolonged exposure of green tea polyphenols has chelating activity with zinc ion in prostate (Yang et al., 2009). Chelation of zinc increases the activity 5α-reductase enzyme and thus facilitated conversion of testosterone into dihydrotestosterone (DHT). DHT is a more active androgen than testosterone and accumulates into prostate gland (Pasupuleti & Horton, 1990). Accumulation of DHT into prostate may be the possible cause of the increased weight of prostate after GTE treatment for 26 days. Due to structural similarity with isoflavons, polyphenols of green and black tea mimic the estrogen like activity (Setchel, 1985) and thus it reduces the activity of Δ^3β-HSD and 17β-HSD (Ohno et al., 2002; Suzuki et al., 2000). The impairment of steroidogenic pathway may be the possible cause of alteration in testosterone biosynthesis in the present study. Further stimulation DHT formation through chelation of zinc (Pasupuleti & Horton, 1990) may be the other possible reason of decreased level of testosterone as observed in the present study.

FSH, LH and testosterone evaluation is useful in the management of male infertility (Zabul et al., 1994). Gonadotropin (FH and LH) levels were significantly elevated in high dose of green and black tea treated group (for 26 days), when compared with the respective control groups. These results are in accordance with the studies of Sulthan et al. (Sulthan et al., 1985), Zabul et al. (1994), Weinbauer and Nieschlag (1995) and Subhan et al (1995). They showed elevated levels of both FSH and LH in infertile males. Elevated levels of LH were also reported (Hopkinson et al., 1977; Marino et al., 1980) in oligozoospermic and azoospermic males when compared to normal fertile men. FSH is necessary for initiation of spermatogenesis and maturation of spermatozoa. In the fertile men, higher concentration of
FSH is considered to be a reliable indicator of germinal damage, and was shown to be associated with azoospermia and severe oligospermia (Bargmann et al., 1994). LH stimulates spermatogenesis indirectly via testosterone. Therefore reduced level of testosterone ultimately increases the level of LH. In our study it was observed that green and black tea treatments were more effective in 26 days duration. One spermatogenic cycle in rat needs 13 days duration (Leblond & Clermont, 1952). It was observed that 13 days duration does not show any significant changes after treatment, thus two spermatogenic cycles for considering the time has been followed for experimentation.

Tea polyphenols added to a broiler diet protects liver and muscle tissues from the oxidative stress induced by corticosterone (Eid et al., 2003). In case of our study, corticosterone level remains unaltered after 13 days as well as 26 days treatment. This observation reveals that no changes develop after tea extract administration.

In conclusion, this chapter reveals that no significant changes have been observed in LH, FSH, testosterone, corticosterone levels after administration of mild and moderate dose and in LH and testosterone levels after administration of high dose of both GTE and BTE for 13 days. Significant alterations have been observed in LH and testosterone level after administration of mild and moderate dose and in FSH level after administration of high dose of both GTE and BTE (for 26 days). No changes developed in corticosterone level after tea extracts administration for 26 days.