

Effects of Ginger (*Zingiber officinale*) Extract on Male Sexual Maturation, Hormonal Profile, Reproductive Organ Weights, and Sperm Parameters in Prepubertal Mice

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ABSTRACT

Objective: To investigate the impact of graded doses of ginger extract on male sexual maturation, focusing on hormonal profiles, reproductive organ weights, and sperm characteristics in prepubertal mice. **Method:** Male mice (21–28 days old) were randomly assigned to four groups receiving 0 (control), 100, 200, or 400 mg/kg ginger extract orally for 28 days. Serum testosterone, luteinizing hormone (LH), and prolactin (PRL) were measured, and reproductive organ weights and sperm parameters were evaluated. **Results:** Ginger supplementation significantly increased testosterone, LH, and PRL in a dose dependent manner. Reproductive organ weights (testes, epididymis, prostate) and sperm quality indices (count, motility, viability) also improved significantly in treated groups compared with controls. **Novelty:** Ginger extract significantly enhances male reproductive development and function in mice, likely through endocrine stimulation and improved sperm physiology, supporting its potential use as a natural reproductive enhancer

INTRODUCTION

Zingiber officinale Roscoe (Zingiberaceae) is an ancient folk medicine medicinal plant and is employed as a remedy for oxidative, inflammatory, and metabolic diseases. Bioactive 2 H Alkylphenols such as Gingerols and Shogaols that possess potent biological activities affect reproduction physiology. Recent data indicate that ginger may enhance male sexual functions and hormonal status [1, 6]. Oxidative stress and endocrine disruption are recognized causes of impaired spermatogenesis and subfertility. Anti-oxidants may attenuate this response by reducing lipid peroxidation and steroidogenesis [15]. Results of other animal studies also revealed that dietary supplementation with ginger significantly increased testosterone levels and improved sperm counts, motility and viability [15]. Another study in infertile men also observed significant reduction in the sperm DNA damage rate following ginger supplementation [2]. These findings provide a stimulus to investigate the influence of ginger on male sexual development and fertilization potential. The mechanism through which ginger brings about changes in the endocrine control and sperm parameter is not yet known although evidence is building up. In the present study we provide evidence of a dose-response effect after ginger extract treatment on organ weights, sex hormones and spermiogenesis in immature mice.

RESEARCH METHOD

Animals

Prepubertal male mice (21–28 days old) were obtained and housed under standard conditions (22 ± 2 °C, 12 h light/dark, food and water ad libitum). All experimental procedures were approved by the Institutional Animal Ethics Committee.

Ginger Extract Preparation

Fresh ginger rhizomes were washed, air dried, and powdered. The powder was extracted with 70% ethanol, filtered, concentrated under reduced pressure, and stored at 4 °C. Before administration, the extract was dissolved in distilled water.

Experimental Design

Mice were randomly divided into four groups (n=6–8):

1. Control: distilled water
2. G 100: ginger extract 100 mg/kg
3. G 200: ginger extract 200 mg/kg
4. G 400: ginger extract 400 mg/kg

Treatments were given by oral gavage once daily for 28 days. The sample size (n = 6 per group) was selected based on previous experimental studies in rodents, where this number was sufficient to detect statistically significant differences in hormonal and reproductive parameters while minimizing animal use in accordance with ethical guidelines.

Body and Organ Weights

Body weight was recorded weekly. After euthanasia, testes, epididymis, and prostate were excised and weighed. Relative organ weights were calculated.

Hormonal Analysis

Blood samples were collected by cardiac puncture. Serum testosterone, LH, and prolactin were measured using ELISA kits.

Sperm Analysis

The cauda epididymis was minced in saline. Sperm count was determined with a hemocytometer, motility was assessed microscopically, viability by eosin nigrosin staining, and morphology by stained smear evaluation.

Statistical Analysis

Data were expressed as mean \pm SD. One way ANOVA followed by Tukey's post hoc test was performed. $p < 0.05$ was considered significant.

RESULT AND DISCUSSION

Hormonal Profile

Table 1. Effect of Ginger Extract on Hormonal Profile in Male Mice.

Groups	Testosterone(ng/dL)	LH(ng/mL)	PRL (ng/mL)
Control	586.67 \pm 204.93	4.53 \pm 1.94	15.83 \pm 3.37

Groups	Testosterone(ng/dL)	LH(ng/mL)	PRL (ng/mL)
G-100 (100 mg/kg)	861.33 ± 109.94*	4.62 ± 1.79	19.12 ± 2.42*
G-200 (200 mg/kg)	894.50 ± 98.21*	8.30 ± 1.24*	19.58 ± 1.37*
G-400 (400 mg/kg)	1017.17 ± 69.85*	9.72 ± 1.86*	22.38 ± 1.17*

Values are expressed as mean ± SD (n = 6).

* $p < 0.05$ vs. Control

** $p < 0.01$ vs. Control

Serum hormonal analysis revealed a significant dose-dependent increase in testosterone levels in ginger-treated groups compared with the control group ($p < 0.05$). The highest testosterone concentration was observed in the G-400 group. Similarly, LH levels showed a significant elevation in the G-200 and G-400 groups, indicating stimulation of the hypothalamic-pituitary-gonadal axis. Prolactin levels also increased significantly following ginger administration, particularly at higher doses, while remaining within physiological limits.

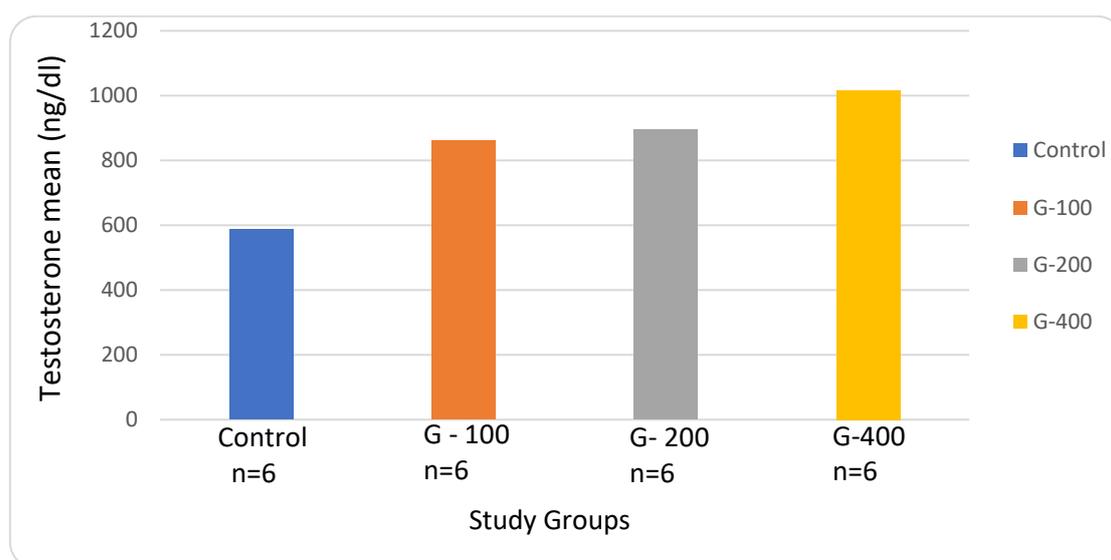


Figure 1. Mean serum testosterone levels in control and ginger-treated groups.

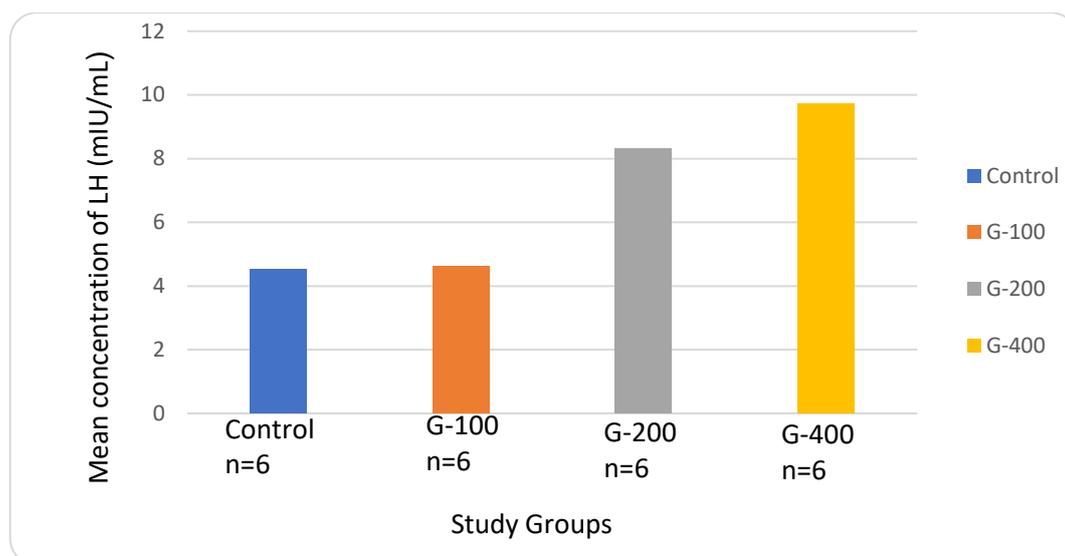


Figure 2. Mean serum LH levels in control and ginger-treated groups.

Table 2. Effect of Ginger Extract on Body and Reproductive Organ Weights

Groups	Body weight (g)	Testes weight (mg)	Epididymis weight(mg)	Prostate weight (mg)
Control	21.5 ± 1.2	80 ± 5	55 ± 4	40 ± 3
G-100 (100 mg/kg)	22.3 ± 1.3	90 ± 6*	60 ± 4*	45 ± 3*
G-200 (200 mg/kg)	23.0 ± 1.2	98 ± 5**	65 ± 5**	50 ± 4**
G-400 (400 mg/kg)	23.5 ± 1.1	105 ± 6**	70 ± 5**	55 ± 4**

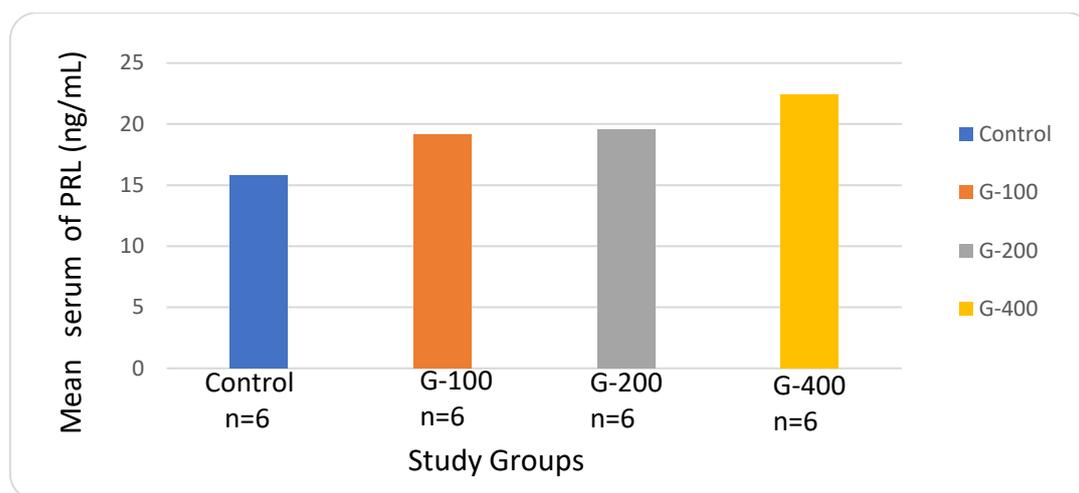


Figure 3. Mean serum prolactin levels in control and ginger-treated groups

Values are expressed as mean \pm SD (n = 6).

* $p < 0.05$ vs. Control

** $p < 0.01$ vs. Control

As shown in Table 2, oral administration of ginger extract significantly affected body and reproductive organ weights. Treated groups, particularly G-200 and G-400, exhibited significant increases in testes, epididymis, and prostate weights compared with the control group ($p < 0.05$), while body weight changes were moderate and non-significant.

Table 3. Effect of Ginger Extract on Sperm Parameters

Groups	Sperm count ($\times 10^6$ /mL)	Motility (%)	Viability (%)	Abnormal morphology (%)
Control	45 \pm 5	60 \pm 7	70 \pm 6	25 \pm 3
G-100 (100 mg/kg)	55 \pm 6*	68 \pm 5*	78 \pm 5*	18 \pm 2*
G-200 (200 mg/kg)	62 \pm 5**	75 \pm 4**	83 \pm 4**	15 \pm 2**
G-400 (400 mg/kg)	68 \pm 6**	80 \pm 3**	88 \pm 3**	12 \pm 1**

Values are expressed as mean \pm SD (n = 6).

* $p < 0.05$ vs. Control

** $p < 0.01$ vs. Control

Table 3 demonstrates the effects of ginger extract on sperm parameters. Ginger-treated groups showed significant improvements in sperm count, motility, and viability

compared with the control group ($p < 0.05$). Additionally, the percentage of abnormal sperm morphology decreased markedly in the G-200 and G-400 groups.

Discussion

The current study demonstrated that ginger extract significantly enhanced several reproductive outcomes in prepubertal mice, including increases in testosterone, luteinizing hormone (LH), and prolactin, along with improvements in reproductive organ weights and key sperm parameters. These findings align with broader evidence that *Zingiber officinale* positively modulates male reproductive function via endocrine and antioxidant mechanisms [1, 7].

Several animal studies also showed comparable impact of ginger on reproductive hormones and seminal parameters. For instance, ginger powder has been shown to increase serum testosterone, LH and FSH levels along with sperm count and motility in broiler breeder males [3]. and male mice [4]. In male albino rats, ginger intake improved sperm quality and reproductive organ development, indicating strong pro fertility effects [5]. Furthermore, enhancements in ejaculate volume and sperm motility from Japanese quails also provide evidence that reproductive benefits of ginger are pronounced among species [6]. Elevation in prolactin levels occurred following ingestion of ginger, but this increase was within the physiological limit, which indicated its effect to be at the level of pituitary response rather than direct endocrine activity. This control may have a synergistic effect on fertility (211, 356).

These results agree with systematic reviews, they have reported the antioxidant and androgenic effects mediated by ginger enhance semen quality probably due to its antioxidant effect and steroid support actions [1, 7]. In addition, from a mechanistic point of view it has been known that gingerol and analogs could initiate the release of gonadotropins and subsequently increase testosterone production by testis which support for improving spermatogenesis [12, 15]. It has been demonstrated that ginger and its related bioactive extracts can ameliorate oxidative stress and hormonal imbalance in diabetic animal models, indicating its medicinal potential for the treatment of physiological disorders [8, 10]. (The present findings reveal that ginger can reduce the oxidative stress and hormonal disbalance in diabetic animal models suffering from some diseases of the body. Some experimental data are supported by human research. In an RCT, ginger administration decreased sperm DNA fragmentation in infertile men, but it did not result in any significant changes in routine semen analysis. This suggests that there is a genomic protective effect of ginger [2]. Furthermore, ginger in combination with other herbal supplements (e.g., cinnamon and turmeric) synergistically improved reproductive parameters and sperm characteristics in animal models of hypertension and diabetes [10,11].

Taken together, the evidence indicates that ginger not only enhances hormone levels and functional reproductive outcomes in animal models but may also exert beneficial effects on sperm DNA integrity in humans. While this study did not include histological analysis, the functional outcomes—hormonal and semen based—provide

compelling evidence for ginger's reproductive benefits. Future research should examine molecular pathways and long term fertility outcomes to fully elucidate these mechanisms.

Study Limitations

Despite the promising findings, this study has several limitations that should be acknowledged. First, histological evaluation of testicular tissue was not performed; therefore, structural changes in seminiferous tubules and Leydig cells could not be directly assessed. Second, the study was limited to a relatively short experimental duration and a single animal model, which may not fully reflect long-term reproductive outcomes or translational relevance to humans. Additionally, oxidative stress markers and molecular signaling pathways related to steroidogenesis and spermatogenesis were not examined, which limits mechanistic interpretation. Hormonal and sperm parameters were assessed at a single time point, and fertility outcomes such as mating success or offspring production were not evaluated. Future studies should incorporate histopathological and molecular analyses, extend the treatment duration, and include functional fertility assessments to provide a more comprehensive understanding of ginger's effects on male reproductive health.

CONCLUSION

Fundamental Finding: The present study demonstrates that oral administration of ginger (*Zingiber officinale*) extract significantly enhances male reproductive maturation in prepubertal mice. Ginger supplementation resulted in a dose-dependent increase in serum testosterone, luteinizing hormone (LH), and prolactin levels, accompanied by marked improvements in sperm count, motility, viability, and a reduction in abnormal sperm morphology. These hormonal and functional changes suggest stimulation of the hypothalamic-pituitary-gonadal axis and enhancement of spermatogenic activity. **Implication:** Overall, the findings support the potential role of ginger as a natural reproductive enhancer with androgenic and fertility-promoting properties. Ginger extract may represent a promising, low-cost, and accessible therapeutic or nutritional strategy for improving male reproductive health. **Limitation:** However, further investigations are required to confirm these effects and elucidate the underlying molecular mechanisms. **Future Research:** Further investigations are required to confirm these effects and elucidate the underlying molecular mechanisms.

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