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Research Paper

Beneficent Effect of Ginseng on Semen Characteristics in Treated Bisphenol A Adult Rabbits

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ABSTRACT: *Bisphenol A (BPA) is a chemical material that because of its positive characteristics is using in polycarbonate plastic and epoxy resins. However, BPA is a recognized endocrine disruptor with estrogenic activity. Ginseng extracts have shown a wide array of beneficial role on the semen characteristic. This study was carried out to investigate the possible protective effects of ginseng extract on the BPA-induced effect on semen parameters of adult rabbit. Twenty male New Zealand White rabbits were randomly divided into four groups: (1): control group ;(2): rabbits were treated with ginseng alone (3): rabbits were treated with BPA and (4): rabbits were giving BPA and ginseng. An adult male exposure to BPA caused a reduction in sperm production that was accompanied by a decrease in ejaculates volume, total sperm output and sperm concentration. In addition, specific functional parameters were affected, including the motile sperm, total function of sperm and level of testosterone. Ginseng alone caused significant increase in same parameters. The presence of ginseng with BPA caused significant increase in the reduction. Overall, BPA exposure compromises sperm production and functionality and ginseng can prevent cytotoxic effect of PBA on sperm quality.*
KEYWORDS: *Ginseng, Bisphenol A (BPA), semen characters.*

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I. INTRODUCTION

BPA or 2,2 bis (4-hydroxyphenyl) propane is a high chemical production volume used in a variety of common consumer products since 1957. BPA is present in polycarbonate plastics, the epoxy resin liners of aluminium cans, and thermal receipts [1]. Polycarbonates are used in plastic containers commonly used in the food industry and at home, such as plastic bottles, lenses, and medical devices [2]. The major human exposure route to BPA is diet, including ingestion of contaminated food and water [3]. There are many uses of BPA for which related potential exposures have not been fully assessed including digital media, electrical and electronic equipment, automobiles, sports safety equipment, electrical laminates for printed circuit boards, composites, paints, and adhesives [4]. Thus, humans may be exposed to BPA through different routes, including ingestion, inhalation and dermal exposure. In developing organisms, effects can occur at concentrations of the chemical that are much lower than those that would cause harmful effects in the adult. Studies have indicated that perinatal exposure to BPA at very low concentration feminizes activity and spatial memory of male offspring [5]. Reproductive physiology involves complex biological processes that can be disrupted by environmental contaminant exposure. This exposure may be partially responsible for the increase in male reproductive pathologies classified as testicular dysgenesis syndromes, including hypospadias, cryptorchidism, testicular cancer, and low sperm production in adulthood [6]. BPA is a recognized endocrine disruptor with estrogenic activity. The estrogenic activity of BPA is weak when compared with ethinylestradiol or diethylstilbestrol because BPA has a relatively low affinity for nuclear estrogen receptors [7]. The effect of BPA on spermatogenesis remains poorly understood. It is known that BPA interferes with processes related to spermatogenesis, such as androgen production [8. 9] and Sertoli cell activity [10-12]; however, the action mechanism through which BPA alters sperm quality has not been well elucidated. Toxicants can alter the energy metabolism of the intermediate region and decrease spermatic fertility [13]. The oxidative stress induced by toxicants is the most common cause of damage to the sperm [14]. Several conditions can interfere with spermatogenesis and reduce sperm quality and production. More factors such as drug treatment, chemotherapy,

toxins, air pollutions and insufficient vitamins intake have harmful effects on spermatogenesis and sperm normal production [15]. Ginseng (Panax ginseng C.A. Meyer) roots have long been used as a traditional medicine in Asian countries for preventive and therapeutic purposes. Ginseng has immune-modulatory [16] anti-tumor [17], antioxidant, and glucose-lowering activities [18]. Most published biochemical and pharmacological studies have reported ginsenosides as the main bioactive constituents of ginseng. Polyacetylene and phenolic compounds, such as maltol, have attracted attention due to their antioxidant activities [19]. Ginseng was also reported to boost the increase of the testis and spermatogenesis in rabbits, accelerate the development of the ovary and ovulation in frogs, stimulate egg-laying in hens, and facilitate lordotic response in female rats [20-22]. Increased gonadal weight occurred in young male and female rats receiving the ginseng alcohol extract, and increased testicular nucleic acid content was also observed in treating rats [23, 24]. The purpose of the current study was to find out the effect of an extract of ginseng on semen characteristics induced experimentally by BPA in male rabbits.

II. MATERIALS AND METHODS

Mature male New Zealand White rabbits (age of 7 months and initial weight of 2.917 ± 28.9 Kg) were used. Animals were individually housed in cages and weighed weekly throughout 3-months experimental period. Twenty mature male rabbits were randomly divided into four equal groups (each five rabbits). The first group was used as control. The second group was used to study the effect of BPA (500 mg/kg body weight) and the third group was used to study the effect of ginseng 100 mg/kg body weight which dissolved in corn oil). The fourth group was used to study the effect of BPA plus ginseng. The doses of the BPA and ginseng were calculated according to the animal's body weight on the week before dosing. The proper doses of BPA and ginseng for each animal were placed into a syringe that was inserted orally with the help of plastic tube inserted directly into the oesopharyngeal region. The tested doses of BPA and ginseng were given daily for 12 week.

Semen collection was done weekly and continued throughout the 12-week experimental period. Ejaculates were collected using an artificial vagina and a teaser doe. The volume of each ejaculate was recorded (using a graduated collection tube) after removal of the gel mass. A weak eosin solution was used for evaluation of sperm concentration by the improved Neubauer hemocytometer slide (GmbH + Co., Brandstwiete 4, 2000 Hamburg 11, and Germany) [25]. Total sperm output calculated by multiplying semen ejaculate volume and semen concentration. Determination of initial fructose concentration in seminal plasma was determined immediately after semen collection [26]. Assessments of dead and normal spermatozoa were performed using an eosin-nigrosine blue staining mixture [27]. The percentages of motile sperm were estimated by visual examination under low-power magnification (10x) using light microscope. Total number of motile sperm was calculated by multiplying the percentage of motile sperm and total sperm obtained. Reaction time was determined as the moment of subjecting a doe to the buck until the completion of erection; it was measured in seconds. Initial hydrogen ion concentration (pH) was determined immediately after collection using pH cooperative paper (Universalindikator pH 0-14 Merck, Merck KgaA, 64271 Darmstadt, Germany). Packed sperm volume (PSV) was recorded. Total functional sperm fraction (TFSF) was calculated as the product of total sperm output, motility (%), and normal morphology (%) [28].

III. RESULTS

Table 1was showed the overall means of the Data on ejaculate volume (EV), sperm concentration and total sperm output (TSO) of rabbits treated with ginseng, PBA and their combination. Rabbits treated with PBA alone resulted in significant ($P<0.05$) decrease in EV, sperm concentration and TSO compared to control group. While, ginseng alone caused significant ($P<0.05$) increase in these parameters compared to control. The presence of ginseng with PBA was caused significant ($P<0.05$) decrease the reduction of in EV, sperm concentration and TSO and reaching to control levels due to treatment with PBA. Results in Table 2 were shown an average of total motile sperm per ejaculate, total sperm function, percentage of dead and normal sperm, initial hydrogen ion concentration and level of testosterone in male rabbits treated with ginseng, PBA and/or their combination. All parameters were measured showing similarity when compared with control and combination groups.

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Table 1: An average of ejaculates volume (EV; ml), sperm concentration (x10^6/ml), total sperm output (TSO; x106) and acid sperm motility (%) in male rabbits treated with ginseng, PBA and/or their combination

Parameters	*Groups*			
	Control	Ginseng	PBA	Ginseng + PBA
Ejaculates volume (EV; ml)	0.70 ± 0.012^{b}	0.90 ± 0.019^{a}	0.59 ± 0.020^{c}	0.69 ± 0.016^{b}
Reaction time (RT; sec.)	4.0 ± 0.119^{b}	2.99 ± 0.17^{c}	5.10 ± 0.199^{a}	3.99 ± 0.119^{b}
Sperm concentration (x10^6/ml)	278 ± 3.9^{b}	319 ± 6.9^{a}	232 ± 5.0^{c}	269 ± 3.9^{b}
Total sperm output (TSO; x106)	199 ± 5.9^{b}	279 ± 11.5^{a}	150 ± 6.0^{c}	190 ± 5.0^{b}
Sperm motility (%)	68.0 ± 0.5^{b}	78.1 ± 1.1^{a}	58.2 ± 1.6^{c}	66.0 ± 0.9^{b}
Packed sperm volume (PSV; %)	15.1 ± 0.20^{b}	18.0 ± 0.39^{a}	13.1 ± 0.25^{d}	14.6 ± 0.12^{c}

^{abc} Within row overall mean with different superscript letter differ significantly (P<0.05).

Table 2: An average of total motile sperm per ejaculate, total sperm function, percentage of dead and normal sperm, Initial hydrogen ion concentration and level of testosterone in male rabbits treated with ginseng, PBA and/or their combination

Parameters	*Groups*			
	Control	Ginseng	PBA	Ginseng + PBA
Total motile sperm per ejaculate (TMS; x10^6)	140 ± 3.9^{b}	222 ± 12.6^{a}	90 ± 4.4^{d}	123 ± 3.9^{c}
Total function sperm fraction (TFSF; x10^6)	110 ± 3.6^{b}	189 ± 11.5^{a}	70 ± 3.9^{d}	100 ± 2.8^{c}
Normal sperm (%)	79.1 ± 0.5^{b}	84.1 ± 0.3^{a}	74.9 ± 0.3^{d}	78.9 ± 0.2^{c}
Dead sperm (%)	27.0 ± 0.68^{c}	18.9 ± 1.20^{d}	38.5 ± 1.20^{a}	29.0 ± 0.68^{b}
Initial hydrogen ion concentration (pH)	7.80 ± 0.020^{c}	7.46 ± 0.029^{d}	8.61 ± 0.059^{a}	7.99 ± 0.029^{b}
Testosterone (nmol/ml)	6.29 ± 0.257^{b}	8.01 ± 0.369^{a}	5.0 ± 0.229^{c}	6.10 ± 0.159^{b}

^{abc} Within row overall mean with different superscript letter differ significantly (P<0.05).

IV. DISCUSSION

BPA is an endocrine disorderly chemical released into the environment, so many studies focus on its effect on reproductive organs [2]. In males, it interferes with processes related to spermatogenesis, such as and rogenproduction [8. 9], and Sertoli cell activity [10, 11]. BPA treated rabbits for 12 weeks cause numerous histopathological changes in testes of adult rabbits [29]. Herbal therapy is increasingly popular worldwide as a way to treat infertility such as ginseng which it is used to treat sexual dysfunction as well as to enhance sexual behavior in traditional Chinese medical practices [30]. In this study protective effect of ginseng on BPA-induced effect on semen characteristic was investigated using adult male rabbits as an experimental model. Results showed that BPA exposure in adulthood significant decrease in EV, sperm concentration and TSO compared to

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control group. That results were agreeing with different studies, Chitra et al., showed that 45 day-old male rats submitted to BPA treatment at dosages from 0.0002- 0.02mg/kg presented a dose-dependent reduction in sperm motility and epididymis sperm count [31]. Liu et al., also reported a decreased sperm count after long-term exposure to 0.2mg/kg BPA in rats [32], and another study observed a reduction in epididymal sperm motility and count in a dose dependent manner for the 10 and 50mg/kg treatment groups [33]. The presence of ginseng with PBA was caused decrease the reduction of in EV, sperm concentration and TSO and reaching to control levels due to treatment with PBA. Studies in both rodents and humans have shown that ginseng can increase sperm count. Ginseng-treated rats have demonstrated an increased rate of spermatogenesis via glial cell-derived neurotrophic factor expression elevation in Sertoli cells [17, 34]. Ginseng is also found to help preserve the ejaculated sperms. It has been proven that the sperm count of ejaculated sperms that were incubated with ginseng extract was significantly higher than those treated with vehicle [35]. From our results, an average of total motile sperm per ejaculate, total sperm function, percentage of normal sperm, and level of testosterone were significantly decreased in PBA treated group. These result agreeing with study found that serum concentrations of testosterone were reduced by for BPA-treated rats [36], in same study exposure to BPA in adult rats reduces sperm production, sperm reserves and sperm transit time [36]. Our results were found that reduction back to nearly normal value in combination group. These actions are mostly attributed to ginsenosides, the major pharmacological active components of ginseng. Treatment with ginsenoside Rg1 (50 μg/ml) significantly increases sperm motility and membrane integrity of post-thawed sperms [37].

Although the exact mechanism of ginseng against PBA is unknown the present data strongly suggest that it decreases the toxicity of PBA and might be beneficial in tests in which PBA is toxic. Overall we summarized that ginseng has shown a wide array of pharmacological activities including beneficial role in the evaluate semen characteristic.

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