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EVALUATION OF FERTILITY POTENTIAL OF BALANITES AEGYPTIACA SAPOGENIN EXTRACT IN MALE RATS

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Abstract

Purpose: The aim of the present study was to evaluate the effect of *Balanites aegyptiaca* sapogenin extract (BASE) on the fertility of male rats.

Design/methodology/approach: The fertility experiment was done on four groups of male rats. One group was kept as a normal control (NC) and the others were treated with BASE at levels 25, 50 and 100 mg/kg b.w. for 70 days. Serum chemistry (total cholesterol, glucose, sALT, sAST, urea and creatinine), and serum hormones (LH, FSH, oestradiol and testosterone) were then determined. Sperm parameters (sperm motility, sperm count [testicular and epididymal], daily sperm production and sperm transit rate [day]), fructose in semen and semen quality were also determined.

Findings: The results showed no significant ($P< 0.05$) effect on serum cholesterol, sALT, urea, semen quality, sperm motility, sperm count (testicular and epididymal), daily sperm production and sperm transit rate (day) in animals treated with BASE at levels 25, 50 and 100 mg/kg b.w. compared to NC. Serum creatinine decreased significantly in rats treated with BASE at levels 50 and 100 mg/kg b.w. compared to NC, while fructose in semen significantly increased in rats treated with BASE at levels 50 and 100 mg/

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kg b.w. Serum LH, oestradiol and testosterone showed significant increases and serum FSH concentration showed no significant effect in rats treated with BASE at levels 25, 50 and 100 mg/kg b.w. compared to NC.

Originality/value: From the present study, we can conclude that BASE at levels 25 and 50mg/kg b.w. is safer for inducing fertility in male rats.

Key words: Balanites aegyptiaca, Sapogenin extract, Fertility, Sperm motility, Semen quality, Testicular, Epididymal, oestradiol, Testosterone, Luteinizing hormone (LH), Follicle-stimulating hormone (FSH)

Paper type: Research paper

INTRODUCTION

Balanites aegyptiaca (L.) Del. is an economical medicinal plant commonly used in many regions of Africa (Iwu, 1993). It grows in most arid to sub-humid areas north of Zimbabwe and throughout the Sahel (El Ghazali, 1986; El Amin Hamza, 1990). *B. aegyptiaca* is widespread in northern Kordofan and throughout northern and central Sudan it is called desert date. In Arabic, the tree is known as Heglig and the fruits as Labob (Von Maydell, 1986; Wickens, 1963). All parts of the tree have medicinal properties. The fruit is used to treat stomach pain, as an anthelmintic, and as an oral antidiabetic, while the seed extract is used to treat bilharzia (Iwu, 1993; Mohamed *et al.*, 1999; Kamel *et al.*, 1991). The tree has many folk uses in various African countries and it is largely used as component of many popular preparations for its abortive, antiseptic, anti-malarial, anti-syphilitic and anti-viral *(Herpes zoster)* activity (Duke, 1983; Kokwano, 1976). The fruits are commonly used to purge, to remove intestinal parasites and sometimes to treat *Schistosomum japonicum* (Koko *et al.*, 2000). The bark aqueous extract is traditionally used as an anti-jaundice aid, while one of the fruit mesocarps is administered as an oral hypoglycemic (Kamel, 1991) and seems to be effective against *Fasciola gigantica* (Koko *et al.*, 2000).

Phytochemical investigations on *Balanites aegyptiaca* yielded the isolation of several classes of secondary metabolites, many of which expressed biological activities such as cumarins, flavonoids and steroidal saponins (Sarker *et al.*, 2000). Earlier studies have shown that kernel and root extracts of *B. aegyptiaca* contain steroidal saponins (Pettit *et al.*, 1991; Farid *et al.*, 2002). Saponins possess cytotoxic, antifungal, antimicrobial and anti-inflammatory properties (Iorizzi *et al.*, 2002)

and play a vital role in metabolism and biosynthesis. They are also considered to be the major effective components in many traditional medicines (Liu *et al.*, 2005).

Since saponins show anti-hypercholesteremic, hypoglycemic and anti-carcinogenic action (Pettit *et al.*, 1991; Oakenfull and Sidhu, 1990; Abdel-Rahim *et al.*, 1986**;** Sidhu and Oakenfull 1986), great attention has been paid to saponin-containing plants in order to recover saponins as additives for food products, as pharmaceuticals and as chemical ingredients (Mohamed *et al.*, 2000). Chapagain and Wiesman (2007) chromatographically separated nine compounds and determined their masses in the negative ion mode; subsequent fragmentation of each component was then carried out. From the nine components, six saponins with molecular masses of 1196, 1064, 1210, 1224, 1078 and 1210 Da were identified, with the compound of mass 1210 Da being the main saponin (ca. 36%) (Chapagain and Wiesman, 2007).

Studies have shown that *B. aegyptiaca* plant tissues contain steroidal saponins primarily with diosgenin or its isomer yamogenin as a sapogenin (Neuwinger, 1996). Ognyanov *et al.* (1977) have reported 3% sapogenin in the fruit mesocarp and 2% in seed kernels from the East African sample. The total sapogenin in the *B. aegyptiaca* seed kernel in the analyzed samples would be higher because *B. aegyptiaca* also contains yamogenin, an epimer of diosgenin, and of equal utility (Fazil and Hardman, 1971). Diosgenin is a steroidal sapogenin compound of great value to pharmaceutical industries as a natural source of steroidal hormones. Diosgenin is found in a few higher plant species and interest in its medicinal properties has increased recently (Liu *et al.*, 2005).

Recent studies have found that diosgenin can be absorbed through the gut and plays an important role in the control of cholesterol metabolism (Roman *et al.*, 1995). Other authors have reported that it has estrogenic effects (Aradhana *et al.*, 1992) and antitumour activity (Moalic *et al.*, 2001; Corbiere *et al.*, 2003). Studies have also revealed that diosgenin produces changes in the lipoxygenase activity of human erythroleukemia cells and is responsible for morphological and biochemical changes in megakaryocyte cells (Beneytout *et al.*, 1995; Nappez *et al.*, 1995). Furthermore, diosgenin was found to be the most effective cell death inducer when compared to the other two plant steroids (hecogenin and tigogenin) in the human osteosarcoma 1547

cell line (Corbiere *et al.*, 2003). Diosgenin is generally used as a starting material for partial synthesis of oral contraceptives, sex hormones and other steroids (Zenk, 1978). The partial synthesis of steroids from plant-based precursors has been a boon because of the increasing demand for corticosteroids, contraceptives, sex hormones and anabolic steroids since about 1960 (Hall and Walker, 1991). Therefore, the present study was designed to examine the effect of *Balanites aegyptiaca* sapogenin extract on fertility in male rats.

MATERIALS AND METHODS

Materials

Balanites aegyptiaca was obtained from the Agriculture Research Center, Egypt. Kits of TC, TG, ALT, AST, urea, creatinine, LH, FSH, oestradiol and testosterone were obtained from Biodiagnostic Co., 29 El-Tahreer St., Dokki-Giza, Egypt (email: Biodiagonsticeka@Lycos.com)

METHODS

Isolation of the major sapogenin from dry fruit

The powdered dry fruit was extracted (170g) for 24hr in a soxhlet with light petroleum (b.p. 40-60). The "defatted" powder was dried in a hot-air oven (80°C) to remove excess solvent. It was then extracted to exhaustion with MeOH in a soxhlet apparatus to afford 40g of a dark brown, hygroscopic crude saponin, which was hydrolysed by refluxing with 2N HCl (600ml) for 2hr. The mixture was cooled, filtered and the acid-insoluble portion washed with H_2O before neutralizing with 20 ml of 10% NH_4OH. After draining, the acid-insoluble portion was dried in a hot-air oven (80°C) for 4hr. The dried residue was crushed in a mortar and extracted with light petroleum in a soxhlet for 2 days. The solvent was removed *in vucuo* (Hardman and Sofowora, 1970).

BIOLOGICAL METHODS

Male albino adult rats (40 animals weighing 180 g ± 2) were obtained from the animal house at Dammam University. Rats were housed in individual cages with screen bottoms and fed on a basal diet (corn starch 70%, casein 10%, corn seed oil 10%, cellulose 5%, salt mixture

4% and vitamins mixture 1%) for two weeks. After equilibration, rats were weighed and divided into four groups (ten animals per group) and each was assigned to one of the four diet groups: Negative Control (NC) and three groups treated with BASE (25, 50 and 100 mg/kg b.w.). Total feed consumption was weighed, fresh feed was provided every day and total body weight of the animals was recorded at the beginning and during the experimental period. Blood samples were collected from the orbital plexus by means of heparinized capillary glass tubes according to Schermer's method (1967). Each sample was placed into a dry clean centrifuge tube and centrifuged at 1500xg for 30 min at 4°C to obtain serum.

SERUM CHEMISTRY

Total Cholesterol (TC) was determined according to the method described by Allain *et al.* (1974). Serum transaminases sAST and sALT (Aspartate transferase and Alanine transferase) were measured colorimetrically according to the method described by Reitaman and Frankel (1957). Serum urea was determined according to Fawcett and Scott's method (1960) and creatinine was determined according to the method of Barthes *et al.* (1972).

SERUM HORMONAL ASSAY

The concentrations of serum testosterone were measured according to standard methods (Ekins, 1998); LH and FSH were measured by the method of Uotila *et al.* (1981), and serum levels of oestradiol were measured by the method of Tietz (1995).

SPERM PARAMETERS

Sperm motility

Sperm motility was recorded and evaluated immediately after tissue isolation. Cauda epididimis was cut into small pieces and transferred to Petri dishes containing pre-warmed nutrition medium (RPMI). Sperm were allowed to swim out within five min at 37°C. The analysis was carried out under light microscope magnification of 400 fold. The percentage of sperm motility was calculated using the number of live sperm cells over the total number of sperm cells, both motile and nonmotile. The sperm cells that were not moving at all were considered to be nonmotile, while

the rest, which displayed some movement, were considered to be motile by the method of Akdag *et al.* (1999).

SPERM COUNT

Testicular sperm count

One testis of each rat was placed in 1ml of phosphate buffer saline immediately after dissection. The tunica albuginea was cut by surgical blades and removed, and the remaining seminiferous tubules were mechanically minced by surgical blades in 1ml of phosphate buffer saline. The testicular cell suspension was pipetted several times to form a homogenous cell suspension. One drop of the suspension was placed on a Makler Counting Chamber and the testicular sperm concentration was determined under a phase contrast microscope at 200x magnification and expressed as million sperm cells per ml of suspension by the method of Fatma *et al.* (2009).

EPIDIDYMAL SPERM COUNT

The left testis was decapsulated and the left epididymis was divided into two portions (head and body plus tail). Each part was homogenized in saline Triton merthiolate solution (STM solution: 17.5g NaCl, 1ml Triton X-100, and 0.2g sodium ethylmercurithiosalicylate were dissolved in distilled water for 1 litre of STM solution) with a Waring blender (Polytron, Kinematica, Littau/Lucerne, Switzerland). Homogenization-resistant spermatids or sperm were then counted using a hemocytometer by the method of Omura *et al.* (1996).

DAILY SPERM PRODUCTION

After removing the tunica albuginea, both testes were minced and homogenized in 10ml of 0.9% NaCl containing 0.5% Triton X-100 at medium speed in a POTTER'S® tissuemizer for 1min. After dilution, the number of homogenization-resistant spermatids was counted in a hemocytometer (Bürker, Germany). The number of homogenization-resistant spermatids obtained by summing the scores of the right and left testes, was divided by 6.1, the number of days these spermatids were present in the seminiferous epithelium, to convert them to daily sperm production per testis (Robb *et al.*, 1978).

SPERM TRANSIT RATE

The epididymal sperm transit rate was estimated for each male rat by dividing the epididymal sperm number by the daily sperm production (Amann, 1982).

DETERMINATION OF FRUCTOSE IN SEMEN AND SEMEN QUALITY

Fructose concentration in the seminal vesicle was determined by the method of Foreman *et al.* (1973); semen quality was determined by the method of Reddy and Bordekar (1999).

STATISTICAL ANALYSIS OF DATA

Data collected from biological evaluation were statistically analysed using one-way ANOVA with post hoc Newman Keuls test. $P<0.05$ was considered significant. All data are expressed as mean ± S.D. LSD was used to compare the significant differences between means of treatment (Waller and Duncan, 1969).

RESULTS AND DISCUSSION

The results in Table 1 show no significant ($P<0.05$) effects of gain in body weight, daily gain in body weight and food efficiency in various groups of animals treated with BASE at levels 25, 50 and 100 mg/kg b.w. compared to NC. In contrast, food efficiency ratio significantly decreased in rats treated with BASE at levels 25 and 50 mg/kg b.w. compared to NC.

The results shown in Table 2 indicate that the presence of BASE at levels 25, 50 and 100 mg/kg b.w. showed no significant ($P< 0.05$) effects on serum cholesterol level. Treatment with 25, 50 and 100 mg/kg b.w. BASE showed a significant ($P< 0.05$) increase in serum glucose at levels 50 and 100 mg/kg b.w. (110.6 mg/dl and 115.1 mg/dl), respectively compared to NC (101.3 mg/dl), but these results are within the safe limit for the level of glucose in blood.

Morsy *et al.* (2010) suggested that the possible mechanism of hypoglycaemic action in *B. aegyptiaca* may be through either potentiation of pancreatic secretion of insulin from the β-cell of islets, or due to enhanced transport of blood glucose to the peripheral tissue.

Treatments	Initial body weight (g)	Final body weight (g)	Gain in body weight (g)	Daily gain in body weight (g)	Food intake (g)	Daily food intake (g)	Food efficiency	Food efficiency ratio (%)
G1	180.16$^{(a)}$ ±15.97	345.94$^{(a)}$ ±59.71	165.78$^{(ab)}$ ±50.46	2.37$^{(ab)}$ ±0.721	716.1$^{(a)}$ ±98.193	10.23$^{(a)}$ ±1.566	0.2317$^{(a)}$ ±0.035	23.17$^{(a)}$ ±3.469
G2	179.38$^{(a)}$ ±15.88	349.83$^{(a)}$ ±60.87	170.45$^{(ab)}$ ±51.52	2.44$^{(ab)}$ ±0.736	707.7$^{(a)}$ ±107.773	10.11$^{(a)}$ ±1.540	0.2413$^{(a)}$ ±0.0361	24.13$^{(bc)}$ ±1.488
G3	182.45$^{(a)}$ ±16.14	372.5$^{(a)}$ ±66.65	190.05$^{(a)}$ ±57.41	2.72$^{(a)}$ ±0.820	746.9$^{(a)}$ ±114.084	10.67$^{(a)}$ ±1.630	0.2549$^{(a)}$ ±0.0381	25.49$^{(cd)}$ ±1.914
G4	181.11$^{(a)}$ ±16.03	370.46$^{(a)}$ ±66.57	189.35$^{(a)}$ ±57.41	2.71$^{(a)}$ ±0.820	705.6$^{(a)}$ ±107.993	10.08$^{(a)}$ ±1.543	0.2688$^{(a)}$ ±0.0403	26.88$^{(ad)}$ ±2.114
L.S.D. at 5%	19.04	72.04	60.55	0.8650	116.909	1.8726	0.0416	2.801

G1: Negative Control (NC) G2: treated with BASE (25 mg/kg b.w)
G3: treated with BASE (50 mg/kg b.w.)
G4: treated with BASE (100 mg/kg b.w.)
Significantly different from controls ($p < 0.05$) by ANOVA multiple rage test

Table 1. Relative weights of initial body weight, final body weight, gain in body weight, food efficiency and food efficiency ratio of normal male rats and rats treated with BASE (25, 50 and 100 mg/kg b.w.) for 70 days

Table 2. Serum cholesterol (mg/dl) and glucose (mg/dl) of normal male rats and rats treated with BASE (25, 50 and 100 mg/kg b.w.) for 70 days

Treatments	Cholesterol (mg/dl)	Glucose (mg/dl)
G1	161.7[a] ±7.41	101.3[a] ±5.64
G2	182.3[a] ±33.33	108.4[ac] ±5.59
G3	±178.3[a] 42.20	110.6[c] ±7.15
G4	166.7[a] ±9.45	115.1[c] ±12.91
L.S.D. at 5%	37.28	9.11

G1: Negative Control (NC) G2: treated with BASE (25 mg/kg b.w.)
G3: treated with BASE (50 mg/kg b.w.)
G4: treated with BASE (100 mg/kg b.w.)
Significantly different from controls ($p < 0.05$) by ANOVA multiple rage test

The *B. aegyptiaca* had an effect on decreasing cholesterol levels in the blood compared to that of the control group and the recommended dose was G3 (5.4 g/week/rat). Kameswara *et al.* (1997) found that the fruit part of *B. aegyptiaca* lowered blood glucose with a simultaneous decrease in triglyceride and total blood cholesterol. The incorporation of the studied aqueous *Balanites aegyptiaca* extract (ABAE) and *Balanites aegyptiaca* cake (BAC) at 5, 15 and 25% as components of rats diets resulted in a decrease in total cholesterol, total lipid and triglyceride values (128.31, 120.71, 123.32 and 121.33, 119.03, 120.01 mg/ dl for total cholesterol, 299.30, 301.71, 298.21 and 295.82, 289.30, 288.71 mg/ dl for total lipid and 98.10, 99.11, 97.81 and 92.31, 90.35, 90.71 for triglyceride), respectively as compared to AD (262.31 mg/ dl for total cholesterol, 475.32 mg/ dl for total lipid and 201.00 for triglyceride) (Soheir *et al.*, 2008). *B. aegyptiaca* species are able to lower the blood sugar content and can be considered as high potential anti-diabetic plants, which may be attributed at least in part to increased glucose metabolism and an increase in serum insulin (Samir *et al.*, 2000). This mechanism belongs to first line therapies in diabetes treatment. The demonstrated results might be a base for further studies with plants. In addition, the plant fruit can be used to decrease the level of total cholesterol (HDL and LDL-cholesterol) and triglycerides, where the suitable dose for oral intake was 5.4 g/week/rat (Morsy *et al.*, 2010).

The results presented in Table 3 show the level of sALT, sAST, urea and creatinine in the male rats treated with BASE at levels 25, 50 and 100 mg/kg b.w. It was observed that there was no significant effect of serum ALT and urea in rats treated with BASE at levels 25, 50 and 100 mg/kg b.w. Serum AST significantly ($P< 0.05$) increased (24.8 mg/dl) in rats treated with BASE at level 25mg/kg b.w. compared to NC (22.1 mg/dl). Thus, serum creatinine significantly ($P< 0.05$) decreased (0.98 mg/dl and 0.95 mg/dl) in rats treated with BASE at levels 50 and 100 mg/kg b.w. compared to NC (1.09 mg/dl). These results concur with those of Soheir *et al.* (2008), who observed that urea and creatinine significantly decreased in rats given ABAE and rats fed a diet containing BAC at 5, 15 and 25% (24.31,23.13, 22.31 mg/dl and 23.31,22.71, 21.73 mg/dl for urea and 1.31,1.21, 1.01 mg/dl and 1.11,1.01, 0.99 mg/dl for creatinine), respectively in comparison with alloxan diabetic rats (67.22 mg/ dl for urea and 4.51 mg/ dl for creatinine). The activities of AST and ALT ranged from 32.01 to 30.07 IU/ l and from 28.88 to 26.09 IU/ l in the group given ABAE and the group fed on BAC 5, 15 and 25% relative to their control (82.72 and 62.33 IU/ l), respectively. Ali *et al.* (2001) found that treatment of mice with the plant extract (*Balanites aegyptiaca* extract) followed by the vehicle of paracetamol did not affect the liver adversely, as the liver weight, appearance and histology, AST, ALT and GGT (γ-glutamyl transferase) activities, and pentobarbitone sleeping time were all unaffected. Samir *et al.* (2000)

Treatments	sAST mg/dl	sALT mg/dl	Urea mg/dl	Creatinine mg/dl
G1	22.1^{a} ±1.04	24.7^{a} ±1.62	35.4^{a} ±3.65	1.09^{a} ±0.10
G2	24.8^{c} ±1.15	25.9^{a} ±0.81	36.7^{a} ±4.55	1.02^{ac} ±0.05
G3	23.1^{a} ±1.16	25.1^{a} ±0.91	33.8^{a} ±3.6	0.98^{c} ±0.05
G4	22.5^{a} ±1.40	24.9^{a} ±0.94	32.1^{a} ±3.83	0.95^{c} ±0.04
L.S.D. at 5%	1.55	1.58	4.53	0.08

G1: Negative Control (NC) G2: treated with BASE (25 mg/kg b.w.)
G3: treated with BASE (50 mg/kg b.w.)
G4: treated with BASE (100 mg/kg b.w.)
Significantly different from controls ($p< 0.05$) by ANOVA multiple rage test

Table 3. Serum AST, ALT, urea and creatinine of normal male rats and rats treated with BASE (25, 50, 100 mg/kg b.w.) for 70 days

stated that *B. aegyptiaca* extract induced a significant reduction in serum glucose, glucagons, total lipids, total cholesterol, triglycerides level and transaminases (AST, ALT and □GT) activities.

Results in Table 4 show significant ($P< 0.05$) increases in serum LH, oestradiol and testosterone concentration in rats treated with BASE at levels 25, 50 and 100 mg/kg b.w. compared to NC. In contrast, there were no significant effects on serum FSH concentration ($P< 0.05$) in rats treated with BASE at levels 25, 50 and 100 mg/kg b.w. compared to NC BASE at level 100mg/kg b.w. given in high concentrations for serum LH and oestradiol (8.51 IU/L) and (58.00 pg/ml) respectively compared to NC (6.61 IU/L and 58 pg/ml respectively). However, BASE at levels 25 and 50 mg/kg b.w. is safer than 100 mg/kg b.w. Yakubu and Afolayan (2009) found that the aqueous extract of *Bulbine natalensis* stem at doses of 25 and 50 mg/kg body weight enhanced the success rate of mating and fertility due to increased libido as well as the levels of reproductive hormones in male rats. The absence of alterations in the reproductive parameters of female rats at doses of 25 and 50 mg/kg body weight of *Bulbine natalensis* stem extract suggest that the extract is safe for use at these doses by females during the organogenic period of pregnancy, whereas the extract dose of 100 mg/kg body weight portends a negative effect on some reproductive functions of male and female rats.

Treatments	LH (IU/ L)	FSH (IU/ L)	Oestradiol (pg/ml)	Testosterone (ng/dl)
G1	$6.61^{(a)}$ ±0.536	$7.93^{(a)}$ ±0.889	$38^{(a)}$ ±4.243	$450^{(a)}$ ±50.339
G2	$7.24^{(ac)}$ ±0.587	$7.79^{(a)}$ ±0.874	$45^{(c)}$ ±4.690	$537^{(c)}$ ±60.45
G3	$7.75^{(c)}$ ±0.630	$7.65^{(a)}$ ±0.990	$53^{(d)}$ ±6.033	$644^{(d)}$ ±72.16
G4	$8.51^{(d)}$ ±0.693	$6.88^{(a)}$ ±0.773	$58^{(d)}$ ±6.450	$791^{(e)}$ ±88.85
L.S.D. at 5%	0.654	1.291	5.797	74.82

Table 4. Serum LH (IU/L), FSH (IU/L), oestradiol (pg/ml) and testosterone (ng/dl) of normal male rats and rats treated with BASE (25, 50, 100 mg/kg b.w.) for 70 days

G1: Negative Control (NC) G2: treated with BASE (25 mg/kg b.w.)
G3: treated with BASE (50 mg/kg b.w.)
G4: treated with BASE (100 mg/kg b.w.)
Significantly different from controls ($p< 0.05$) by ANOVA multiple rage test.

The results presented in Table 5 show the fructose in semen and semen quality in male rats treated with BASE at levels 25, 50 and 100 mg/kg b.w. BASE did not induce significant effects on semen quality at

Treatments	Fructose in semen (mg/dl)	Semen quality
G1	310[(a)] ±25.67	1.81[(a)] ±0.20
G2	341[(ac)] ±28.47	1.86[(a)] ±0.21
G3	358[(c)] ±29.89	1.9[(a)] ±0.21
G4	370[(c)] ±30.90	1.94[(a)] ±0.22
L.S.D. at 5%	31.191	0.233

G1: Negative Control (NC) G2: treated with BASE (25 mg/kg b.w.)
G3: treated with BASE (50 mg/kg b.w.)
G4: treated with BASE (100 mg/kg b.w.)
Significantly different from controls ($p < 0.05$) by ANOVA multiple rage test

Table 5. Changes in fructose in semen and semen quality of normal male rats and rats treated with BASE (25, 50 and 100 mg/kg b.w.) for 70 days

Treatments	Sperm motility (%)	Sperm count (x10⁶/ml)		Daily sperm production[(*)]	Sperm transit rate (day)
		testicular	Epididymal		
G1	79.6[(a)] ±6.647	169.8[(a)] ±19.06	254.7[(a)] ±28.59	21.4[(a)] ±2.402	6.4[(a)] ±0.718
G2	80.1[(a)] ±6.688	167.6[(a)] ±18.81	259.6[(a)] ±29.14	20.8[(a)] ±2.335	6.3[(a)] ±0.707
G3	80.4[(a)] ±6.713	171.8[(a)] ±19.29	262.8[(a)] ±29.50	21.3[(a)] ±2.391	6.2[(a)] ±0.696
G4	81[(a)] ±6.764	172.3[(a)] ±19.34	264.1[(a)] ±29.65	21.7[(a)] ±2.436	6.1[(a)] ±0.685
L.S.D. at 5%	7.383	21.275	32.644	2.732	1.119

(*) the count is calculated per gram of testicular parenchyma
G1: Negative Control (NC) G2: treated with BASE (25 mg/kg b.w.)
G3: treated with BASE (50 mg/kg b.w.)
G4: treated with BASE (100 mg/kg b.w.)
Significantly different from controls ($p < 0.05$) by ANOVA multiple rage test

Table 6. Change in sperm motility (%), sperm count (x10⁶/ml) (testicular and epididymal), daily sperm production and sperm transit rate (day) of normal male rats and rats treated with BASE (25, 50 and 100 mg/kg b.w.) for 70 days

levels 25, 50 and 100 mg/kg b.w. or on the fructose in semen at level 25mg/kg. However, treatment with BASE at levels 50 and 100 mg/kg b.w. significantly ($P< 0.05$) increased (358 and 370 mg/dl respectively) fructose in semen compared to NC (310 mg/dl).

Results presented in Table 6 show no significant ($P< 0.05$) effects on sperm motility, sperm count (testicular and epididymal), daily sperm production and sperm transit rate (day) in animals treated with sapogenin extracts at levels 25, 50 and 100 mg/kg b.w. (80.1, 80.04, 81%), (167.6, 171.8, 172.3 [x10^6/ml]), (259.6, 262.8, 264.1 [x10^6/ml]), (20.8, 21.3, 21.7[*]) and (6.3, 6.2, 6.1 [day]), respectively compared to NC (79.6%), 169.8(10^6/ml), 254.7(10^6/ml), 21.4(*), 6.4 (day).

CONCLUSION

The results of the present study indicated that there were no significant ($P< 0.05$) effects on serum cholesterol, sALT and urea in animals treated with BASE at levels 25, 50 and 100 mg/kg b.w. compared to NC. Serum creatinine significantly decreased in rats treated with BASE at levels 50 and 100 mg/kg b.w. compared to NC. Treatment with 25, 50 and 100 mg/kg b.w. BASE induced a significant ($P< 0.05$) increase in serum glucose at levels 50 and 100 mg/kg b.w. (110.6 mg/dl and 115.1 mg/dl), respectively compared to NC (101.3 mg/dl), but within the safe limits for blood glucose levels. BASE at level 100mg/kg b.w. was given in high concentrations for serum LH and oestradiol compared to NC. However, BASE at levels 25 and 50 mg/kg b.w. is safer compared with 100 mg/kg b.w. Treatment with BASE at levels 50 and 100 mg/kg b.w. significantly ($P< 0.05$) increased fructose in semen compared to NC. In contrast, the results showed that there were no significant ($P< 0.05$) effects on semen quality, sperm motility, sperm count (testicular and epididymal), daily sperm production and sperm transit rate (day) in animals treated with sapogenin extracts at levels 25, 50 and 100 mg/kg b.w. compared to NC.

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