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EFFECT OF GINGER (*ZINGIBER OFFICINALE*) ON SEXUAL PERFORMANCE AND FERTILITY OF QUAIL BIRDS UNDER SEMI-ARID CONDITIONS

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ABSTRACT:A study was carried out to study the effects of Ginger (*Zingiber officinale)* on quail semen quality, sexual hormones levels and histology of testicles. A total number of 108 birds at the age of 8 weeks were divided into four groups, with three replicates per treatment and 9 birds per replicate. Birds in control group were fed basal diets and birds in treatment groups were fed on diet supplemented with 0.25, 0.50 and 0.75% Ginger. At ages of 10 till 20 weeks, blood and semen samples were collected, and analyzed. At the end of the trial. One male from each replicate was slaughtered and testes were excised for histological analyses. Result of this experiment showed that supplementing quail diets with Ginger improved sperm concentration, sperm quality factor %, livability% and reduced abnormality%. Also results showed significant ($P<0.05$) higher semen plasma glucose and total protein concentration in treated groups than in the control. In addition, serum LH, FSH and testosterone levels were higher in treated groups compared with control group. In general, diets supplemented with Ginger showed significant increases in reproductive related parameters, and it could be considered sex promoter for quail birds.

Key words: Ginger, quail birds, semen quality, fertility, sex hormone.

INTRODUCTION

Infertility is considered one of the major issues in breeding, and about 30% of this problem is male-related *(Khaki et al., 2009)*, and the reproductive potential of male birds is determined by semen quality *(Glori and Isaendoi, 2015)*. In poultry, a temperature more than 32°C has leads to decrease fertility through decreased ability of the uterus to store sperm and hindrance sperm-egg penetration *(Karaca et al., 2002).*

Ginger (*Zingiber ofcinale*) has been known as a medicinal plant in many cases *(Han et al., 2013)*. Ginger is used to treat many diseases as it possesses antibacterial, antioxidants *(Nile and park 2015)*, anti-parasitic, antimicrobial *(Kumar et al., 2014)*, anticancer *(Citronberg et al., 2013)*, anti-inflammatory *(Zhang et al., 2016)* and antiseptic materials *(Ali et al., 2008)*. In addition, Ginger contains many biologically active compounds such as phenolic and terpene compounds. The phenolic compounds are mainly gingerol, shogaols, paradols, gingerdiol and gingerdione *(Zhao et al., 2011; Stoner 2013; Liu et al., 2019).* Also, *Ginger* contains amount of iron, calcium, magnesium, selenium, Zinc, Vitamin E and vitamin C *(Shirin and Jamuna 2010)*. Generally, Ginger was used in poultry feeding as antioxidants and as a growth promoter *(Omage et al., 2007; khan et al., 2012).* Furthermore, some studies showed that Ginger has some properties of sex hormones which help to improve sexual performance *(Kamtchouing et al., 2002; Herve et al., 2018; Banihani 2019; Ogbuewu and Mbajiorgu 2020).*The present study was carried out to study the effect of different levels of Ginger on semen quality, fertility, blood serum hormones and investigation of some histological sections of quail testis.

MATERIALS AND METHOD'S

Study Area:

The study was carried out at the Animal Production Farm of the Department of Animal and Poultry Production, Faculty of Environmental Agricultural Sciences, Arish University, El Arish, North Sinai Governorate, Egypt.

Experimental Birds and design:

One hundred and eight quail birds at eight-week-old were obtained from Atomic Energy Commission at Anshas, Sharkia Governorate, and used in the study. 72 hens and 36 cocks of quail birds at nearly equal body weight were randomly divided into 4 treatments groups (9 cocks and 18 hens in each treatment). Each treatment was sub-divided into three replicates, each of (2 female and one male and were housed in one cage). The birds were subjected to similar conditions of management and sanitary conditions throughout the experiment.

Experimental Diets:

Ginger (*Zingiber officinale)* was obtained from a local herb store in North Sinai, Egypt, and was used in diets at the rate of 0, 0.25, 0.50 and 0.75 % as replacement of the diets. Feed and clean water were provided daily and ad-libitum. Artificial light source was used, giving a total of 14 hours of light per day. The diets were formulated to meet the nutrients requirements of quail as recommended by the *National Research Council (1998)* at this period. The ingredients composition of the experimental diets is shown in Table (1).

Measurements:

Semen collection

Semen was collected at the age of 10 and 20 weeks age and the sperm samples

were analyzed to determine: ejaculate volume, sperm concentration, sperm quality factor, live in total sperm percent, live normal sperm percent, abnormal sperm percent and glucose and protein semen. The procedure adopted for semen collection from quails began by taking the male from cage and placing it on the left hand with the bird's breast in the palm of the hand, wing and legs were held up. The foam was removed from the cloacal gland by delicate squeezing of the gland with the thumb of left hand and the forefinger of right hand and collected semen by, using the abdominal massage modified method **Burrows and Quinn (1937).** Microscopic and physical semen characteristics were evaluated in fresh collected semen for the following traits:

Ejaculate volume (ML): The volume of ejaculated fresh semen from individual male birds was measured in a graduated glass pipette (100 ml) with 1ml accuracy.

Live/dead sperm percentage: Assessment of live dead spermatozoa percentage was performed using eosin-nigros in blue staining mixture (Blom, 1950) by testing 100 sperm cells.

Abnormal sperm percentage: Percentage of abnormal spermatozoa was determined in smear prepared for live/dead sperm test.

Sperm cell concentration: A weak eosin solution (Smith and Mayer, 1955) was used for evaluation of sperm cell concentration. Spermatozoa were counted microscopically by the improved Neubauer Haemocytometer slide (GmbH and co., Brand stwiete 4, 200 Hamburg 11, Germany)

Total sperm count: = sperm concentration x total volume of ejaculate ($x10^6$) (Hafez, 1985).

Sperm quality factor (SQF): were calculated according to the following pattern was used:

SQF = (sperm concentration × Ejaculate volume × live normal sperm)/100

Glucose and protein semen: were determined by using procedures mentioned by Al-Daraji (2007).

Serum FSH, LH and testosterone hormones measurements: Serum concentration of FSH and LH were determined in duplicated samples using Radioimmunoassay (RIA). Cocks FSH/LH kits obtained from Biocode Company-Belgium, according to the protocol provided with each kit. The sensitivities of hormone detected per assay tube were 0.2 ng/ml and 0.14 ng/ml for FSH and LH respectively. Serum concentration of total testosterone was measured by using a double antibody RIA kit from immunotech Beckman Coulter Company-USA. The sensitivities of hormone detected per assay tube were 0.025 ng/ml *(Haung et al., 1995; Khaki et al., 2009).*

Histological analyses

At the end of experimental one male from each replicate were slaughtered by cutting the jugular vein, testis were excised for histological analyses. The right and left testis of each bird were weighed, right testis from three birds of each treatment were cut into serial cross sections 5mm in thickness and fixed in 10% neutral buffered formalin, fixed samples were processed and stained with hematoxylin and eosin stains ***(Luna ,1968)*** then used for the measurement of The number of seminiferous tubules (STs) were counted at four different fields, and the average number was calculated. The diameter of tubules in each group was measured at high power (x40 magnification), both at periphery and at center of testicular

tissue, and the average size and the presence of Leydig cells (LC) was observed in the interstitial cells between tubules and calculated objectively as percentage from total size of testicular tissue.

Fertility and Hatchability Percentages

Eggs were collected daily and labeled using a marker to denote each treatment. Eggs were saved within the experimental house in egg crates at room temperature. After seven days of collection, eggs were sorted out to remove cracks, and odds (extra small or large) ones. Eggs with acceptable size were then transported to a hatchery machine and set-in trays for incubation at 37^{o} C and 58-60% RH until hatching. Eggs started hatching on the eighteen day of incubation. Unhatched eggs were opened to see if there are dead embryos or not.

Fertility was calculated using the expression:

Fertility (%) = ($number\ of\ fertility\ egg$ / $number\ of\ incubation\ egg$) ×100

Hatchability and embryonic mortality were obtained as follows:

Hatchability (%) = ($number\ of\ egg\ hatched$ / $number\ of\ fertility$ egg) ×100

Statistical Analysis:

The obtained data were statistically analyzed by using the general linear model procedure described in SAS User's Guide *(SAS., 2004).* Differences among means were tested using Duncan's multiple range test *(Duncan, 1955).*

RESULT AND DISCUSSION

Serum FSH, LH and total testosterone hormone measurements:

The results in table (2) showed that Ginger supplemented quail diets had significant effects ($p<0.05$) on LH, FSH and Testosterone concentrations for male in the serum than that in control group. The increase in Serum FSH, LH and testosterone hormones due to Ginger was explained by *(Sekiwa et al., 2000; Kamtchouing et al., 2002)* who reported that *Ginger* contained variety of antioxidant and androgenic activity. The major active phenolic components isolated from *Z. officinale* (Zingibrene, Zingerone, gingerols, shogaols and Gingerdiol) which have antioxidant activity *(Kamtchouing et al., 2002; Zancan et al., 2002; Jorsaraei et al., 2008 and Saeid et al., 2011).* In addition to, other studies reported that *Z. officinale* has an androgenic activity *(Amr and Hamza, 2006; Shanoon et al., 2011; Saeid et al., 2011and Banihani 2019).* Also, *Banihani 2018* reported a research linking dietary Ginger to testosterone production. The mechanisms through which Ginger promote testosterone production may be due to was mainly increasing LH production and the activity of certain antioxidant enzymes, normalizing blood glucose, increasing blood flow in Leydig cells and increasing testicular weight. This is which may lead to recycling testosterone receptors *Banihani 2018.*

Semen characteristics:

The result in table 3 showed that administration of Ginger form 10 till 20 wk in quail males significantly ($p<0.05$) increased ejaculate volume, sperm concentration, sperm quality factor, total live sperm in all experimental groups as compared with the control group, Also, abnormal sperm were significant decreased in birds fed diets content *Z. officinale than that in control.* Results obtained for semen glucose and semen protein content revealed significant differences between groups. Birds fed diet supplemented with *Ginger* had the highest ($P\leq0.05$) semen glucose and

semen protein at 10 week and 20 week than those of birds in control group. This could be due to Ginger containing antibacterial, anti-parasitic, antimicrobial, anti-inflammatory and antiseptic materials which boosts immune system. In addition, this may be attributed to the reason that Ginger contains a broad spectrum of nutrients and chemical compounds that have a positive effect on the sexual performance of birds, in addition, Ginger contains many significant compounds such as Capsaicin, Zingerone, Shagaols, gingerol, phenolic, curcumin, proteolysis, vitamin C and E *(Sekiwa, 2000; Zancan et al., 2002; Grzanna, 2005 and Belewu, 2009)*. The current results were in agreement with the studies conducted by *(shanoon et al., 2011; Zhao et al. 2011; Ezzat et al., 2017; Herve et al., 2018; Ogbuewu et al., 2018; Banihani 2019; Ogbuewu and Mbajiorgu 2020)* who showed that the use of Ginger led to improvement semen quality such as (Ejaculate volume, Live/dead sperm percentage, Abnormal sperm percentage, sperm cell concentration and total sperm count).

Fertility and Hatchability Percentages

Table (4) showed the effects of feeding different dietary levels of Ginger on quail fertility and hatchability percentages. Birds fed diet supplemented with 0.50% or 0.75% of Ginger had significantly higher ($p \leq 0.05$) fertility values (78.53%) and (76.27%), respectively than values obtained for birds fed diets 0.25% Ginger (73.84%). While, the lowest fertility value (71.52%) was obtained from birds fed control diet. The results obtained for hatchability showed that there were *(Herve et al., 2017; Herve et al., 2018 and Fouad et al., 2020).* significant ($P \leq 0.05$) differences among dietary treatments. Birds fed diet supplemented with Ginger had significantly ($P \leq 0.05$) higher value compared with control diet. The improvement in Fertility and hatchability percentages due to Ginger with explained by (*Park et al., 2004; Mahmood and Al-Daraji, 2011; Herve et al., 2017 and Herve et al., 2018*) who reported that *Z. officinale* contains Vitamin E and Zinc, which can play important role in eggs hatched. *Brown and Pentland 2007* showed that Zinc helps in protecting the DNA chromatin in the sperm nucleus and the structure of the genetic material, which an important for successful fertilization. In addition to, the *Z. officinale* contains amount of iron, calcium, magnesium, selenium and vitamin C (*Shirin and Jamuna 2010*) which play a role in fertility.

According to, *(Park et al., 2004; Mahmood and Al-Daraji, 2011*) The higher embryonic mortality and relatively poor hatchability observed in the control group might be due to a deficiency in important nutrients such as Vitamin E and Zinc, which are important for better hatchability. In addition, it was noted that organic Selenium supplementation of laying hens diets improved the environment of the Sperm nests in the oviduct, allowing the sperms to live longer, It also led to increasing the number of sperm holes in the yolk layer *(Davtyan et al., 2006; Petrosyan et al., 2006 and Hanafy et al., 2009).* So, Ginger plays an important role in increasing fertility rates due to its rich formula in minerals, vitamins and biologically active

Histology of testes.

Testicular tissue were stained with H&E and viewed at low power (×10 magnification). The numbers of

seminiferous tubules (STs) were counted at four different fields, and the average number was counted. The diameter of tubules in each group was measured at high power (x40 magnification), both at periphery and at center of testicular tissue, and the average size was measured. The presence of Leydig cells (LC) was observed in the interstitium between tubules and calculated objectively as percentage from total size of testicular tissue as showed in table (5).

Table (1): Composition and calculated analysis of the experimental diets during the egg production period

Ingredients %	***Zingiber officinale* %**			
	0	**0.25**	**0.50**	**0.75**
Yellow corn	62.69	62.69	62.67	62.68
Soybean meal (44%)	25.05	24.68	24.33	23.95
Corn gluten meal (60%)	6.05	6.21	6.37	6.53
Di-calcium phosphate	2.65	2.63	2.61	2.59
Salt	0.30	0.30	0.30	0.30
Limestone	2.84	2.82	2.8	2.78
L. Lysine	0.11	0.11	0.11	0.11
DL. Methionine	0.11	0.11	0.11	0.11
(V&M.)Premix*	0.20	0.20	0.20	0.20
Zingiber officinale	0.00	0.25	0.50	0.75
Total	100	100	100	100
	Calculated analysis (%)			
Crude protein	20	20	20	20
ME Kcal/Kg	2900	2900	2900	2900
Calcium	2.5	2.5	2.5	2.5
AV. Phosphorus	0.57	0.57	0.57	0.57
L. Lysine	1.10	1.09	1.09	1.10
DL. Methionine	0.45	0.45	0.45	0.45

* Each kg of vitamin mineral premix: contains: vitamin A, 1200000; vitamin D3, 300000IU; vitamin E, 700 mg; vitamin K3, 500 mg; vitamin B1, 500 mg; vitamin B2, 200 mg; vitamin B6, 600 mg; vitamin B12, 3 mg; folic acid, 300mg; choline chloride, 1000 mg; Niacin, 3000 mg; Biotin, 6 mg; panathonic acid, 670 mg; manganese sulphate, 3000 mg; iron sulphate, 10000 mg; zinc sulphate, 1800 mg; copper sulphate, 3000 mg; iodine, 1.868 mg; cobalt sulphate, 300 mg; selenium, 108 mg.

Table (2): Effect of dietary supplementation of *Zingiber officinale* to quail diets on serum LH, FSH, testosterone hormones of quail males at 10 and 20 weeks of age (mean ±S.E)

Traits (g)	Control	*Zingiber officinale* %		
		0.25	0.50	0.75
At 10 old-week				
LH (ng/ml)	$9.45^{d} \pm 1.14$	$10.58^{c} \pm 1.14$	$11.73^{b} \pm 1.27$	$12.88^{a} \pm 1.07$
FSH (ng/ml)	$9.85^{c} \pm 1.06$	$11.07^{b} \pm 1.36$	$11.94^{ab} \pm 1.24$	$12.79^{a} \pm 1.39$
Testosterone (ngr/ml)	$1.08^{d} \pm 1.04$	$1.61^{c} \pm 1.11$	$2.02^{b} \pm 1.04$	$2.54^{a} \pm 1.06$
At 20 old-week				
LH (ng/ml)	$9.51^{d} \pm 1.29$	$10.65^{c} \pm 1.14$	$11.82^{b} \pm 1.17$	$12.79^{a} \pm 1.22$
FSH (ng/ml)	$10.02^{c} \pm 1.07$	$11.10^{b} \pm 1.16$	$11.87^{ab} \pm 1.41$	$12.82^{a} \pm 1.25$
Testosterone (ng/ml)	$1.11^{d} \pm 1.16$	$1.67^{c} \pm 1.12$	$2.15^{b} \pm 1.19$	$2.76^{a} \pm 1.16$

a,b,c Means in the same row with different superscripts are significantly different ($p \leq 0.05$).

Table (3): Effect of dietary supplementation of *Zingiber officinale* to quail diets on semen characteristics of quail males at 10 and 20 weeks of age (mean ±S.E)

Traits	Control	*Zingiber officinale* %		
		0.25	0.50	0.75
At 10 old-week				
Ejaculate volume (ml)	$0.024^{d} \pm 0.00$	$0.029^{c} \pm 0.00$	$0.036^{b} \pm 0.00$	$0.044^{a} \pm 0.00$
Sperm concentration ($x10^{9}$/ml)	$531.25^{d} \pm 6.87$	$595.18^{c} \pm 8.81$	$776.85^{b} \pm 7.95$	$853.74^{a} \pm 8.00$
Sperm quality factor	$8.98^{d} \pm 0.74$	$13.22^{c} \pm 1.13$	$22.42^{b} \pm 0.98$	$31.09^{a} \pm 1.88$
Total live sperm (%)	$85.73^{c} \pm 1.53$	$87.19^{b} \pm 1.77$	$89.57^{ab} \pm 2.86$	$91.27^{a} \pm 2.95$
Live normal sperm (%)	$70.43^{c} \pm 2.28$	$76.58^{b} \pm 1.84$	$80.15^{ab} \pm 1.54$	$82.77^{a} \pm 1.56$
Abnormal sperm (%)	$15.30^{a} \pm 1.53$	$10.61^{b} \pm 1.77$	$9.24^{b} \pm 1.33$	$8.50^{c} \pm 1.51$
Semen glucose (mg/100ml)	$12.52^{c} \pm 1.75$	$15.85^{b} \pm 1.77$	$17.37^{b} \pm 1.88$	$20.64^{a} \pm 1.24$
Semen protein (g/100ml)	$21.18^{d} \pm 1.68$	$24.27^{c} \pm 1.52$	$27.82^{b} \pm 1.38$	$30.08^{a} \pm 1.36$
At 20 old-week				
Ejaculate volume (ml)	$0.025^{d} \pm 0.00$	$0.030^{c} \pm 0.00$	$0.035^{b} \pm 0.00$	$0.041^{a} \pm 0.00$
Sperm concentration ($x10^{9}$/ml)	$552.25^{c} \pm 4.89$	$618.74^{b} \pm 8.46$	$798.85^{ab} \pm 5.38$	$857.18^{a} \pm 3.00$
Sperm quality factor	$9.77^{d} \pm 0.47$	$13.97^{c} \pm 0.87$	$22.53^{b} \pm 0.28$	$29.15^{a} \pm 0.54$
Total live sperm (%)	$84.76^{c} \pm 4.40$	$88.48^{b} \pm 3.56$	$90.05^{ab} \pm 1.90$	$91.83^{a} \pm 1.43$
Live normal sperm (%)	$70.77^{c} \pm 2.03$	$76.28^{b} \pm 1.57$	$80.57^{ab} \pm 1.31$	$82.93^{a} \pm 1.36$
Abnormal sperm (%)	$13.99^{a} \pm 1.48$	$12.20^{b} \pm 1.55$	$9.48^{c} \pm 1.30$	$8.90^{d} \pm 1.43$
Semen glucose (mg/100ml)	$12.17^{c} \pm 1.10$	$15.57^{b} \pm 1.07$	$18.74^{ab} \pm 1.45$	$20.11^{a} \pm 1.02$
Semen protein (g/100ml)	$20.57^{b} \pm 1.09$	$23.66^{b} \pm 1.79$	$27.67^{a} \pm 1.41$	$29.73^{a} \pm 1.19$

a,b,c Means in the same row with different superscripts are significantly different ($p \leq 0.05$).

Table (4): Effect of dietary supplementation of *Zingiber officinale* to quail diets on fertility and hatchability rate of quail birds (mean ±S.E)

Traits (g)	Control	*Zingiber officinale* %		
		0.25	0.50	0.75
Fertility (%)	$71.52^{c} \pm 3.13$	$73.84^{b} \pm 2.45$	$76.27^{a} \pm 4.42$	$78.53^{a} \pm 3.28$
Hatchability (%)	$67.88^{c} \pm 4.18$	$70.87^{b} \pm 3.48$	$72.45^{ab} \pm 3.27$	$74.48^{a} \pm 2.97$

a,b,c Means in the same row with different superscripts are significantly different ($p \leq 0.05$).**Table (5):** Effect of dietary supplementation of *Zingiber officinale* to quail diets on histology of right and left testes of quail males

Traits (g)	Control	*Zingiber officinale* %		
		0.25	0.50	0.75
At right tests				
Testes weight (g)	1.77	2.11	2.34	2.68
Average ST	35.25	24.5	20.5	19.25
LC (%)	20	5	10	10
Diameter (micro) µm	13.83	25.00	40.00	50.00
At left tests				
Testes weight (g)	1.85	2.15	2.28	2.71
Average ST	42.5	28.25	26.75	22.25
LC (%)	20	10	10	10
Diameter (micro) µm	15.50	36.67	50.00	50.00

Histology picture for testes

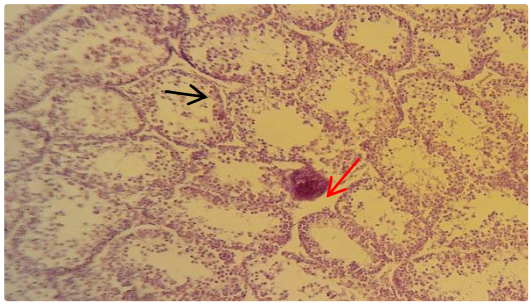

Fig A: Variable size and shaped uniform ST, Large sized irregular shaped STs (Black arrows) (H&E, 10x) (Black arrows). Leydig cells are seen in the interstitium (Red arrow). (H&E, 10x) for control group.

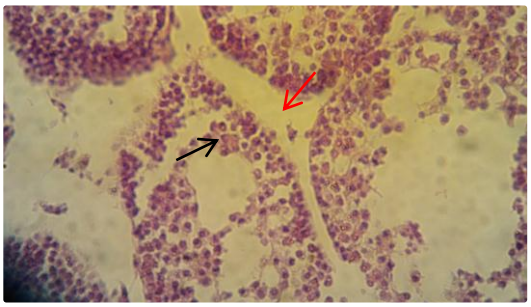

Fig B: Decreased number of spermatogenic cells, with degenerative changes (Black arrow). Marked reduction in Leydig cells (Red arrow). (H&E, 40x) for control group.

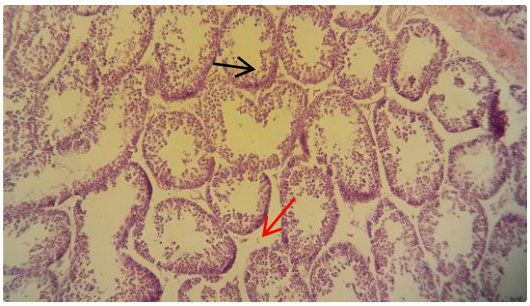

Fig C: Large sized irregular shaped STs (Black arrows) (H&E, 10x) (Black arrows). Leydig cells are seen in the interstitium (Red arrow). (H&E, 10x) for birds fed 0.25% of ginger.

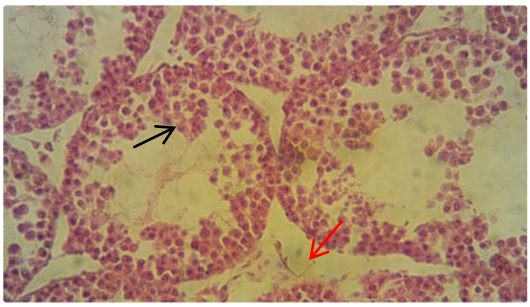

Fig D: Degenerated irregularly arranged spermatogenic cells in STs (Black arrows) (H&E, 40x) Leydig cells are seen (Red arrow). (H&E, 40x) for birds fed 0.25% of ginger.

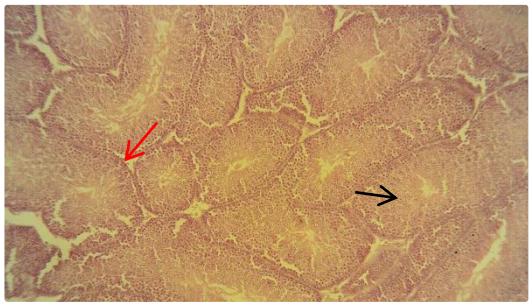

Fig E: Large sized densely packed STs (Black arrows) (H&E, 10x) (Black arrows). Interstitum is compressed (Red arrow). (H&E, 10x) for birds fed 0.50% of ginger.

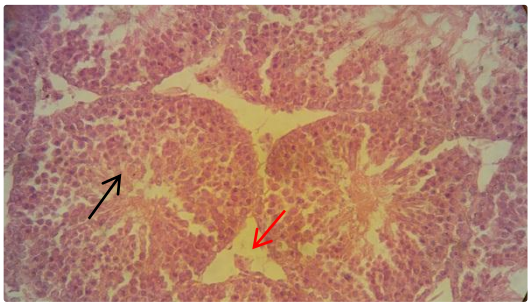

Fig F: increase number of spermatogenic cells (Black arrows), Marked reduction in Leydig cells (Red arrow). (H&E, 40x) for birds fed 0.50% of ginger.

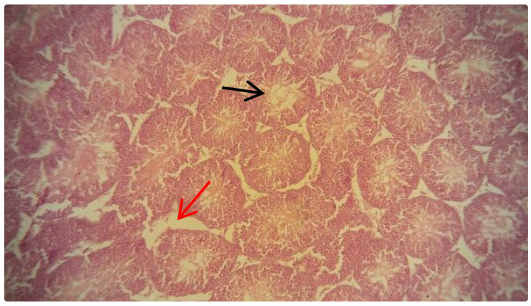

Fig G: Large sized densely packed ST and shape STs with thickened basement membrane (Black arrows). Interstitumis compressed (Red arrow). (H&E, 10x) for birds fed 0.75% of ginger.

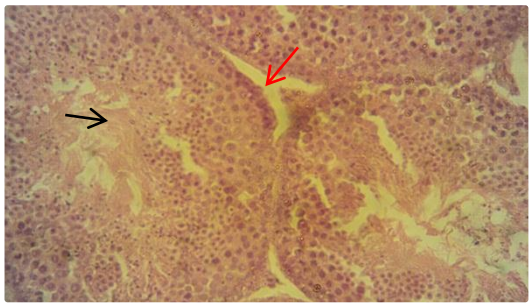

Fig H: STs are enlarged and densely packed with spermatogenic cells (Black arrows). Interstitum is markedly narrowed (Red arrow). Few Leydig cells could be identified (H&E, 40x) for birds fed 0.75% of ginger.

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الملخص العربي
تأثير الجنزبيل على الاداء الجنسي والخصوبة للسمان تحت ظروف المناطق شبه الجافة

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أجريت هذه التجربة لتقييم تأثير استخدام الجنزبيل عل جودة السائل المنوي وتركيز الهرمونات الجنسية في الدم والتغيرات الهستولوجية للخصية. تم استخدام ١٠٨ طائر سمان عمر ٨ اسابيع وتم تقسيمهم إلى أربع مجموعات، داخل كل مجموعه ثلاث مكررات (٩ كتاكيت فى كل مكررة). تم تغذية الطيور في المجموعات على علائق تحتوي على ٠، ٠.٢٥، ٠.٥٠ و٠.٧٥% من الجنزبيل. عند عمر ١٠ و ٢٠ اسبوع تم أخذ عينات من السائل المنوي لتقييم جودة السائل المنوي بها بالاضافة الى عينات من الدم لحساب تركيز بعض الهرمونات الجنسية مثل هرمون LH و FSH و هرمون التستيرون وفي نهاية التجربة تم ذبح ذكر سمان من كل مكررة واخذ الخصية اليمنى واليسرى لمعرفة التغيرات الهستولوجية بهما. وأظهرت نتائج هذه التجربة أن استخدام الجنزبيل أدى إلى تحسن في تركيز الحيوانات المنوية وعدد الحيوانات المنوية الحية ونسبة الحيوانات المنوية الشاذه وغيرها من قياسات جودة السائل المنوي بالاضافه الى ذلك ادى استخدام الجنزبيل الى تحسن في جلوكوز وبروتين البلازما في عينه السائل المنوي، كما ادي الى زياده تركيز الهرمونات الجنسية مثل هرمون LH و FSH و هرمون التستيرون في الدم مقارنه بمجموعه الكنترول، وعلى الجانب الاخر أدى استخدام الجنزبيل في علائق الطيور الى زيادة معنوية في معدلات الخصوبة وتحسن ملحوظ في البنية النسيجية للخصية مقارنة بالطيور المغذاه على بمجموعه الكنترول.

من خلال نتائج هذه الدراسة يمكن استنتاج أن استخدام الجنزبيل يبدو أن لها تأثيرًا إيجابيًا على الاداء الجنسي والخصوبة، ويمكن اعتبارها محفزًا جنسياً لطيور السمان.

الكلمات المرشدة:

الجنزبيل ، طائر السمان ، جودة السائل المنوي ، الخصوبة ، الهرمونات الجنسية.