EFFECT OF Moringa Oleifera LEAVES ON PHYSIOLOGICAL RESPONSE, HORMONAL CHANGES AND SEMEN QUALITY OF MALE RABBITS UNDER NORTH SINAI CONDITIONS

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ABSTRACT: This study was intended to evaluate the effect of Moringa Oleifera leaf meal (MOLM) on reproductive hormones and semen quality traits in male rabbits. A total number of 24 New Zealand White (NZW) rabbits at 42 weeks of age, having an average body weight $3.00 \pm 0.15$ kg, were randomly divided into four equal treatment groups of six rabbits each. The 1st group (control) was fed a basal diet. The 2nd, 3rd and 4th treatments were fed on diets at 2.5, 5 and 7.5% MOLM inclusion levels of the total diet, respectively. Blood samples were collected through the marginal ear vein from each rabbit for biochemical and hormonal assay using standard procedures. In addition to, semen samples were collected weekly for 8 weeks and were analyzed for semen quality traits. Results of this experiment showed that, the use of moringa leaves in the diets of male rabbits led to a significant ($P<0.05$) improvement in ejaculate volume, sperm concentration, live sperm, normal sperm and sperm motility compared to the control group. The results also showed a higher level of gonadotropic hormones (FSH, LH) and testosterone in rabbits fed on moringa compared to control group rabbits, a decrease in total cholesterol and LDL-cholesterol in the groups fed diets containing moringa. It was also noted that there was an increase in the levels of total protein and HDL-cholesterol in the same groups, compared to the control group. Plasma ALT and AST decreased with all treatments of MOLM and this indicates that it has a role in improving liver health.

In conclusion, this study showed that replacement of 2.5, 5 and 7.5% of MOLM inclusion levels of the total diet seems to have a positive effect on blood biochemical, physiological response, hormonal changes and semen quality on male rabbits, and it could be used as a sexual promoter.

Key words: Moringa Oleifera, blood biochemical, sex hormone, Physiological response, semen quality.
INTRODUCTION:

Semen quality is required for achieving fertility in animals (Dalton, 2011). Infertility has become a frequent problem, more than 90% of male infertility cases are linked to low sperm counts or poor quality of semen or both (Ekere et al., 2013). Mammalian reproductive physiology is primarily regulated by several hormones and the central nervous system. There are many factors that affect the hormones and gland's activities and also reproductive process either directly or indirectly such as temperature and nutrition (George et al., 2017), where inappropriate environmental signals lead to decreases in semen quality and fertility (Rasooli et al., 2010).

Heat stress is one of the most factors that lead to a disturbance in the fertility rates of males, this is evident from the decrease in the conception rate and litter size at birth after mating with males exposed to heat stress during summer season compared with winter season (Marai et al., 2008). Furthermore, Agarwal et al. (2008); Ahmad et al. (2012) explained that levels of free radicals and imbalances in the antioxidant-defense system are increased result for evoking the sympathetic system functions and that's because high ambient temperature stimulates the hypothalamo–pituitary–adrenal axis activity. As noted that the increase of accumulations of the free radicals lead to decreases in sperm motility and significant increases in abnormal sperm and defect of DNA which leads to infertility (Potts et al., 2000).

So, infertility has been associated with oxidative stress, this indicates that approximately 80% of infertile animals may be due to high oxidative stress (Wu et al., 2020). Since, maintaining semen quality characteristics of rabbit bucks through the heat stress period is important in the hot areas. Thus, the protective effect of antioxidant may be essential to improve the semen quality traits for male rabbits in the hot and semi-hot areas (Jimoh and Ewuola, 2018; Jimoh et al., 2021)

Medical plants have been used as an aphrodisiac to improve sexual performance, libido, sperm quality (Prabsattroo et al., 2012) and treat infertility (Bhatia et al., 2010; Jimoh et al., 2020) or as fertility-enhancing agents (Sumalatha et al., 2010; Bhatia et al., 2010), and improved testosterone level (Prabsattroo et al., 2015).

*Moringa oleifera* as one of those medicinal plants belonging to the *Moringaceae* family has been used as a source of plant antioxidants. It contains high levels of antioxidant vitamins such as vitamin C (Makkar and Becker 1996; Konmy et al., 2016), vitamin E and β-carotene (Kidmose et al., 2006) and polyphenols. These components make their antioxidant activity higher than that of traditional antioxidants like ascorbic acid (Yang et al., 2006). In addition, *Moringa Oleifera* leaves contain simple sugar, rhamnose, carotenoids, phytates, phenolic acids, flavonoids (Amaglo et al., 2010 and Coppin et al., 2013), alkaloids, isothiocyanates and glucosinolates
triterpenoid (Kidmose et al., 2006; Augustin et al., 2011). In addition to, it contains vitamin A (Ferreira et al., 2008), magnesium, iron, vitamin B1 and vitamin B2 (Makkar and Becker, 1996; Konmy et al., 2016) and anti-inflammatory compounds (Yang, et al., 2006).

Therefore, the present study was carried out to study the effect of different levels of Moringa Oleifera leaf meal (MOLM) on reproductive hormones, blood biochemical parameters and reproductive performance in male rabbits.

MATERIALS AND METHODS:

Experimental design:

The study was carried out in a private farm, El Arish, North Sinai Governorate, Egypt, at summer season. A total number of 24 New Zealand White (NZW) rabbit’s male 6-month age, with average body weight 3.00±0.15 kg., were used. Rabbit were randomly divided into four equal treatment groups. The rabbits were housed in a naturally ventilated building and kept in individual wire galvanized cages (60×55×40 cm). Batteries were accommodated with feeders for pelleted rations and automatic drinkers. Animals were kept under similar management conditions.

Ambient temperature and relative humidity were recorded twice (at 6:00 am and 2:00 pm) daily during the entire experimental period, the values of ambient temperature and relative humidity of each day were used to estimate the daily mean. The temperature–humidity index (THI) was estimated according to the formula by Marai et al. (2001) as follows:

$$\text{THI} = \text{db}^\circ\text{C} - \left[0.31 - 0.31 \times \text{RH} \right] \times \left(\text{db}^\circ\text{C} - 14.4\right)$$

Where:
- db°C = Bulb temperature
- RH = Relative humidity percentage/100

The THI values obtained were then classified as follows: <27.8= Absence of heat stress, 27.8 - < 28.9= Moderate heat stress, 28.9 - <30.0 = Severe heat stress and 30.0 and more = Very severe heat stress (Marai et al., 2001).

Experimental diets:

Moringa (Moringa oleifera) was obtained from Agricultural Research Center in Dokki, Egypt, and was used in diets at the rate of 0, 2.5, 5 and 7.5 % as replacement of the diets. Moringa Oleifera leaves is composed of 91.48% Dry matter, 26.5% crude protein (CP), 11% crude fiber (CF), 10.1% total ash,6.35% Either Extract (E.E), 3200 Kcal/Kg feed Digestible energy. Feed and clean water were provided daily ad libitum. Light period was maintained at 16 hr light: 8 hr dark per day. The diets were formulated to meet the nutrients requirements of rabbit as recommended by NRC (1977). The ingredients composition of the experimental diets is shown in Table (1).
Table (1): Composition and calculated analysis of the experimental diets.

| Ingredients, % | Moringa oleifera Leaves Meal % |
|----------------|---------------------------------|
|                | 0   | 2.5  | 5    | 7.5  |
| Yellow corn    | 9   | 9    | 9    | 8.5  |
| Soybean meal, 44% | 14.43 | 13.44 | 12.18 | 11.08 |
| Wheat bran     | 28.57 | 27.06 | 27.76 | 26.92 |
| Barley         | 15  | 15   | 13.06 | 13.00 |
| Alfalfa hay    | 30  | 30   | 30    | 30    |
| Limestone      | 1   | 1    | 1     | 1     |
| Dicalcium Phosphate | 1.2   | 1.2   | 1.2   | 1.2   |
| Salt           | 0.5 | 0.5  | 0.5   | 0.5   |
| Vit. + min. premix* | 0.3 | 0.3  | 0.3   | 0.3   |
| MOLM           | 0   | 2.5  | 5     | 7.5   |
| Total          | 100 | 100  | 100   | 100   |

Calculated analysis (%)

|                | 0  | 2.5 | 5   | 7.5 |
|----------------|----|-----|-----|-----|
| Crude protein  | 18 | 18  | 18  | 18  |
| Digestible energy (DE) | 2628.58 | 2636.39 | 2629.97 | 2631.23 |
| Crude fiber    | 12.2 | 12.28 | 12.22 | 12.36 |
| Either extract | 3  | 2.9  | 2.9  | 2.8  |
| Lysine         | 0.83 | 0.79 | 0.79 | 0.78 |
| Methionine     | 0.3 | 0.3  | 0.3  | 0.3  |
| Calcium        | 1.05 | 1.12 | 1.19 | 1.27 |
| Phosphorus     | 0.5 | 0.55 | 0.61 | 0.64 |

* Each 3 kg of vitamin mineral premix: contains: Vitamin A, 12000000; 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, 15 mg; Folic acid, 10 mg; Choline chloride, 1000 mg; Niacin, 3000 mg; Biotin, 6 mg; Panathonic acid, 670 mg; manganese sulphate, 80 g; iron sulphate, 1 g; zinc sulphate, 70 g; Copper sulphate, 0.2 g; Iodine, 1 g; Cobalt sulphate, 300 mg; Selenium, 0.3 g.

Measurements:

Blood analysis:

At the end of the experimental period (after 2 month), blood samples (5ml) were withdrawn in the morning from marginal ear veins for each treatment before feeding. Samples were collected in test tubes with heparin to obtain plasma, and in test tubes without heparin to obtain serum. Blood samples were centrifuged at 3000 rpm for 15 min and samples were stored until analysis.

Serum concentration of FSH and LH were determined in duplicated samples using Radioimmunoassay (RIA). FSH/LH kits obtained from Bio-code 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 levels of testosterone hormones were measured by using enzyme-linked immune sorbent assay (ELISA) kits (Diagnostics Test Canada, Inc., Ontario, Canada). The sensitivities of hormone detected per assay tube were 0.025 ng/ml.

Moreover, collected serum samples were subjected to biochemical analysis to each parameter according to the same steps of its kit as described by the manufacturers. Total protein was analyzed by Sonnenwirth and Jarett, (1980), albumin (Doumas, 1971), total cholesterol was measured using the method of Stein (1986).

**Semen collection:**

Semen samples were collected once weekly for 8 weeks between 8.00 am and 9.00 am by means of an artificial vagina using a female teaser rabbit. A different artificial vagina was used for each collection. Semen volume was read off the collection tube and recorded in milliliters. Each ejaculate was taken to measure physical sperm characteristics such as:

- **Live/dead sperm percentage:** Assessment of live dead spermatozoa percentage was performed using eosin-nigrosin staining mixture (Blom, 1959) 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 output:** It was estimated by Hafez, (1985) by the following equation

\[
\text{Total sperm output} = \text{Sperm concentration} \times \text{Total volume of ejaculate} (\times10^6)
\]

- **Sperm quality factor (SQF):** Calculated according to the following pattern was used:

\[
\text{SQF} = \frac{\text{sperm concentration} \times \text{Ejaculate volume} \times \text{live normal sperm}}{100}
\]

**Statistical analysis:**

The obtained data were statistically analyzed using Analysis of Variance (ANOVA), applying the General Liner Model (GLM) Procedure, described in SAS User’s Guide (SAS, 2004).

Differences among means were tested using Duncan’s multiple range test (Duncan, 1955).
RESULTS AND DISCUSSION:

Temperature-humidity index (THI):

The temperature-humidity index (THI) estimated in Table (2) indicated exposure of the rabbits to severe heat stress, during the experimental period.

Table (2): Mean (±SEM) ambient temperature (°C), relative humidity (%), and temperature–humidity index (THI) during the experimental period

| Summer months | Average temp. (°C) | Averages RH (%) | Averages (THI) |
|---------------|-------------------|-----------------|----------------|
|               | Min       | Max       | Min       | Max       | Min       | Max       |
| Mid-June      | 25.51 ±0.15 | 37.04 ±0.38 | 32.34 ±1.43 | 82.81 ±1.88 | 23.44      | 35.48     |
| July          | 25.80 ±0.24 | 36.01 ±0.26 | 33.46 ±1.36 | 83.61 ±1.13 | 23.93      | 34.99     |
| August        | 26.91 ±0.33 | 37.91 ±0.52 | 35.92 ±1.52 | 83.66 ±1.36 | 24.81      | 36.82     |
| Mid-September| 26.05 ±0.26 | 36.96 ±0.32 | 33.94 ±1.47 | 83.36 ±1.27 | 24.06      | 35.75     |
| Average       | 26.07 ±0.18 | 36.98 ±0.31 | 33.91 ±1.07 | 83.36 ±0.98 | 24.06      | 35.76     |

Blood analysis:

The results in Table (3) showed a significant (P≤0.05) increase in total protein, albumin, globulin and HDL-cholesterol for rabbits fed diets containing MOLM compared to control group. On the contrary, the result showed using MOLM in rabbit diets had a significant (P≤0.05) decrease in total cholesterol, LDL-cholesterol, ALT and AST compared to control group. These results agree with Samar et al., (2016) who showed a significant (P≤0.05) diminishing in total cholesterol and LDL. Same result obtained by Idemudia et al., (2013) who found that HDL level increased in rats. In the same side, Ezzat et al., (2014) and El-Speiy et al., (2021) they got the same results when they used oils and extracts moringa in feeding rabbits. Also, Mehta et al., (2003) showed that decreased the total cholesterol, triglyceride, VLDL, LDL-cholesterol, and an increase in the HDL-cholesterol when using of moringa fruit. Also, Voemesse et al., (2018) showed significantly (P≤0.05) increase in total protein and albumin levels when using Moringa Oleifera leaf in chicken’s diet.
Table (3): Effect of used *Moringa oleifera* leaves meal of male rabbit on some blood biochemical parameters (Mean ±S.E)

| Traits                        | Control       | Moringa oleifera leave meal % |
|-------------------------------|---------------|-------------------------------|
|                               |               | 2.5                          | 5               | 7.5                          |
| T. protein (g/dl)             | 5.01d ±0.13   | 5.90c ±0.28                  | 6.39b ±0.24     | 6.77a ±0.37                  |
| Albumin (A) (g/dl)            | 2.67d ±0.14   | 3.17c ±0.12                  | 3.49b ±0.14     | 3.75a ±0.15                  |
| Globulin (G) (g/dl)           | 2.34c ±0.16   | 2.73b ±0.19                  | 2.91a ±0.17     | 3.02a ±0.21                  |
| T. Cholesterol (mg/dl)        | 90.96a ±2.71  | 86.40b ±2.82                 | 84.82bc ±2.40   | 82.69c ±2.55                 |
| HDL-Cholesterol (mg/dl)       | 39.01d ±1.42  | 49.74c ±1.45                 | 53.54b ±1.35    | 54.92a ±2.22                 |
| LDL-Cholesterol (mg/dl)       | 50.83a ±2.68  | 35.59b ±1.69                 | 30.23c ±1.49    | 26.75d ±1.48                 |
| ALT (U/L)                     | 32.50a ±0.83  | 25.38b ±0.90                 | 23.65c ±0.65    | 22.83d ±0.60                 |
| AST (U/L)                     | 37.41a ±0.85  | 31.03b ±0.67                 | 28.59c ±0.88    | 27.19d ±0.76                 |

a,b,c Means in the same row with different superscripts are significantly different (P<0.05).

These results may be due to that moringa is a rich source of protein, β-carotene, calcium, potassium, vitamin C and other active substances. These components work as a good source of natural antioxidant in addition the presence of phenolics, flavonoids and carotenoids (Shahidi *et al.*, 1992). In addition, moringa may have a role in promoting cholesterol secretion in the digestive system.

On another side, the results of the experiment showed that the use of moringa leaves had an effect on the liver function where the use of moringa led to a significant decrease in ALT and AST activities. In addition, Moringa leaves led to an increase in total protein and albumin which reflects the ability of this plant to protein metabolism and stimulate the regeneration of hepatic tissue in rabbits which increases protein synthesis in the liver and improvement of the functional status in liver cells. This shows the role it plays in maintaining the health and safety of liver tissues.

**Serum FSH, LH and testosterone hormone measurements:**

The results in Table (4) showed that using MOLM in rabbit diets had significant (P≤0.05) effects on LH, FSH and testosterone concentrations for
males fed different MOLM diets compared with that in control group. The results archived that the treatments in which moringa leaves were used in feeding male rabbits achieved the highest rate in the LH, FSH and testosterone hormones in the blood compared to the control group, these results agree with Khalifa et al., (2016) who showed that use of *Moringa oleifera* led to increase in LH, FSH and testosterone level in blood. In same side, Gouda et al., (2020) they found that the use of moringa led to a significant (P≤0.05) increase in the proportion of the testosterone hormone into the blood bucks rabbits.

**Table (4):** Effect of used *Moringa oleifera* leaves meal of male rabbit on serum LH, FSH, and testosterone hormones (Mean ±S.E)

| Traits (g)       | Control | Moringa oleifera leave meal, % |
|------------------|---------|--------------------------------|
|                  |         | 2.5  | 5    | 7.5  |
| LH (ng/ml)       | 44.48d  | 55.25c| 59.85b| 63.63a|
|                  | ±1.28   | ±1.97| ±1.25| ±1.60|
| FSH (ng /ml)     | 47.28d  | 57.47c| 63.53b| 69.38a|
|                  | ±1.44   | ±2.22| ±1.41| ±1.36|
| Testosterone (ng/ml) | 2.18c | 2.89b | 3.37a | 3.75a |
|                  | ±0.68   | ±0.58| ±0.57| ±0.73|

a,b,c Means in the same row with different superscripts are significantly different (P≤0.05).

These results may be due to the moringa can have an effect on the hypothalamus releasing hormone (GnRH) which stimulate the anterior pituitary to produce the gonadotropins hormones release into the blood and thus increase the level of LH, FSH and testosterone (Ekaluo et al., 2013). In addition to the above, the presence of flavonoids, alkaloids and other phytochemical content are well known for their ability to increase testosterone hormone concentration (Alabi et al., 2017). All of this affects sexual performance in male rabbits. This is related to an increase in FSH secretion since FSH plays a role to facilitate spermatogenesis (Ojeda and Skinner, 2006). Addition to increase in serum testosterone levels acts in the improvement of sexual behavior and erection (Türk et al., 2008). This could be due to the bioactive component like flavonoids that may stimulate the testis or through a hypothalamus-pituitary-testis-axis (Türk et al., 2008; Jimoh et al., 2021).

In addition, the reason for the increase in these hormones may be due to that the MOLM possessed potent antioxidant properties due to its high contents of phenolic compounds and isothiocyanate (Verma et al., 2009; Coppin et al., 2013 and Tumer et al., 2015). Also, maybe because of bioactive content such
as tocopherol, carotene and beta-sitosterol in moringa (Rajanandh and Kavitha, 2010), which might have affected hormone synthesis.

Semen characteristics:
The result in Table (5) showed that administration of MOLM in males’ rabbits 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 sperms were significantly (P≤0.05) decreased in birds fed diets content MOLM than that in control. These results agree with (El-Harairy et al., 2016; George et al., 2017; Ojo and Abdurahman 2017; El-Desoky et al., 2017; Ajuogu et al., 2018 and Gouda et al., 2020) were they found a significant (P≤0.05) increase and improvement of semen quality on male rabbits fed diets contain Moringa Oleifera compared with control groups. On other side, Abu Ahemen and Ikpechukwu (2013) and Ezzat et al., (2014) found the use of Moringa Oleifera had no adverse effect on the sperm quality of rabbit bucks.

Table (5): Effect of used Moringa oleifera leaves meal of male rabbit on semen characteristics (Mean ±S.E)

| Traits                        | Control                  | Moringa oleifera leave meal % |
|-------------------------------|--------------------------|-------------------------------|
|                               |                          | 2.5  | 5            | 7.5            |
| Semen Appearance              | Milky Normal             | Milky Normal                  | Milky Normal   | Milky Normal   |
| Semen Viscosity               | Milky Normal             | Milky Normal                  | Milky Normal   | Milky Normal   |
| Ejaculate volume (ml)         | 0.43d ±0.02              | 0.52c ±0.02                   | 0.61b ±0.03    | 0.69a ±0.04    |
| Sperm concentration (x10⁶/ml) | 181.7d ±5.55             | 245.3c ±7.91                  | 267.6b ±8.26   | 295.2a ±8.41   |
| Total live sperm (%)          | 71.8d ±1.36              | 79.5c ±1.23                   | 83.6b ±1.28    | 88.7a ±1.94    |
| Normal sperm (%)              | 83.3d ±1.40              | 90.6c ±1.17                   | 91.8b ±2.20    | 94.2a ±2.16    |
| Abnormal sperm (%)            | 16.7a ±0.91              | 9.4b ±0.67                    | 8.2c ±0.70     | 5.8d ±0.56     |
| Dead Sperm (%)                | 28.2a ±1.36              | 20.5b ±0.73                   | 16.4c ±0.78    | 11.3d ±0.94    |
| Sperm quality factor          | 65.1d ±2.85              | 115.5c ±3.88                  | 149.8b ±3.30   | 191.9a ±4.56   |
| Total sperm output (10⁶/ejaculate) | 78.1d ±1.93           | 127.5c ±2.04                  | 163.2b ±2.29   | 203.7a ±2.60   |

a,b,c Means in the same row with different superscripts are significantly different (P<0.05).
This could be due to MOLM containing natural nutrients and active components such as protein, a simple sugar, rhamnose, carotenoids, phytates, phenolic acids, flavonoids, magnesium, iron, vitamin A, vitamin B1 and vitamin B2 and anti-inflammatory compounds. In addition, this could be due to MOLM containing some active substances that work as an aphrodisiac to improve sexual performance, libido and sperm quality (Prabsattroo et al., 2012) and treat infertility or as fertility-enhancing agents and improved testosterone level (Prabsattroo et al., 2015). Or it may be because moringa contains vitamin C, vitamin E, β-carotene and polyphenols and other substances that act as powerful natural antioxidants that reduce the levels of free radicals that lead to high oxidative stress that leads to a decrease in sperm motility and a noticeable increase in abnormal sperm and DNA defects leading to infertility (Potts et al., 2000).

**Conclusion:**
It could be concluded that use *Moringa oleifera* leaves meal in diet of male rabbits improved semen quality, in addition blood constituents especially serum FSH, LH and testosterone hormone, also helped to maintain the health and integrity of liver tissues.

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EFFECT OF Moringa oleifera LEAVES ON MALE RABBITS

Tأثير استخدام أوراق المورينجا أوليفيرا على الاستجابة الفسيولوجية والتغيرات الهرمونية والسائل المنوي لدى الأرانب تحت ظروف منطقة شمال سيناء

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تهدف هذه الدراسة إلى تقييم تأثير استخدام أوراق المورينجا أوليفيرا في علاج ذكور الأرانب على تقييم السائل المنوي وبعض مكونات الدم البيوكيميائية. تم تقييم عدد 24 ذكر من الأرانب البالغين بعدة شموع منطقة شرق سيناء. شمل المشروع 3 مجموعات متساوية. لم يتم تغيير تركيز بعض الهرمونات وبعض مكونات الدم الأخرى. بالإضافة إلى ذلك، تم تقييم فترات من السائل المنوي. الاختبارات الهامة للذكور تتألف من دراسة التأثير المعرفي لانثولوجية وتكيف الهرمونات في الدم مثل (FSH) والأنثراكترون والانخفاض في الكولسترول الكلي والكولسترول الدهني منخفض (LDL). زائد في مستوى البروتينات الكلي وكولسترول الدهني على مدار 5 أيام، ومعالجة كفاءة الهرمونات المنوية مقارنة بنتائج المجموعة الضابطة. كما أن الفئات من ذكور الأرانب، والذي تحتوي على أوراق المورينجا وذكور الأرانب، وذكور الأرانب، والذي تحتوي على أوراق المورينجا وذكور الأرانب، والذي تحتوي على أوراق المورينجا وذكور الأرانب. على لون من سيناء.

الكلمات المعرشفة: المورينجا، مكونات الدم، الاستجابة الفسيولوجية، الهرمونات الجنسية، جودة السائل المنوي.