HISTOLOGICAL AND HEMATO–BIOCHEMICAL STUDY OF FENUGREEK (*Trigonella foenum*) AND GINGER (*Zingiber officinale*) AQUEOUS EXTRACTS ON OVARY STRUCTURE IN WHITE SWISS MICE (*Mus musculus*)

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Abstract

The present study was carried out to investigate the separate and combined importance of using Fenugreek (*Trigonella foenum*) and Ginger (*Zingiber officinale*) aqueous extracts on hematological and biochemical parameters and ovary structure in white Swiss Mice females. Totally 32 Mice were assigned into following groups: Group 1 (Control group - 1 ml of distilled water); Group 2 (1 ml of Fenugreek); Group 3 (1 ml of Ginger) and Group 4 (1 ml of Fenugreek +1 ml of Ginger). The results showed significantly (P <0.05) increase in anatomical dimensions of right and left ovaries and significant superiority for Ginger on other groups when compared with control group. The Ginger, fenugreek and combined groups caused significantly (P <0.05) increase in FSH, estrogen and progesterone values but Ginger group revealed higher significant superiority on other groups when compared with control group. The hematological results revealed significantly (P<0.05) differences in values represented by significant increasing of RBC count, MCV, MCH, MCHC, ESR, Neutrophil, Eosinophil and Lymphocyte values with significant superiority for Ginger group on other groups, and significant decreasing of WBC count, HGB, PCV, PLT, Basophil and Monocyte values with significant superiority for Ginger group on other groups.

The biochemical parameters values revealed significantly (P<0.05) decreasing in values of serum and ovary tissues content of Cholesterol, Glucose, Creatinine, Urea, Triglycerides, HDL, LDL, AST and ALT with significant superiority for Fenugreek group on other groups. The Histological results were showed significant development in ovary structure and follicles maturation especially in Ginger group which recorded a significant superiority on other two groups when compared with control group. In Conclusion, the administration of Ginger extract that better than Fenugreek extract or combination with each other in significant alterations in hematological values and decreased the biochemical values in white Swiss mice and that benefit to possibility of using these medicinal plants especially in persons which suffered from some cases of infertility, obesity, renal disturbance and diabetes mellitus.

Article History

Received : 10.02.2017
Revised : 25.02.2017
Accepted : 15.03.2017

Key words: Fenugreek, Ginger, Ovary and Fertility.
1. Introduction

Medicinal plants are increasingly recognized worldwide as an alternative source of efficacious and inexpensive medications to synthetic chemotherapeutic compound and high proportion of the world’s population rely on plants for their primary healthcare (Omo et al., 2011). The most important active substances in these plants are alkaloids, tannins, terpenoids, glycosides, phenolics, saponins, flavonoids, quinines, lectins and polypeptides (Cai et al., 2003). Fenugreek is an annual herb widely grown in India, Egypt and Middle Eastern countries (Isidori et al., 2006). Its seeds are commonly used for flavoring and as a spice in curries due to their strong flavor and aroma (Al – Gubory et al., 2011).

Fenugreek is known to lower blood glucose level and partially restore the activities of key enzymes of carbohydrate and lipid metabolism close to normal values in various animal model systems (Al – Habori et al., 2002). It can increase the erythrocyte insulin receptors and peripheral glucose utilization, thus showing improved pancreatic function and the antidiabetic and hypcholesterolemic activity of fenugreek is primarily associated with defatted fraction of its seeds and can be largely attributed to their saponin and high fiber content (Esson et al., 2005). As previously identified fenugreek seeds contain about 12 % by weight steroidal saponins (including diosgenin and yamogenin) which are building blocks for various steroids including cholesterol and female sex hormones (More et al., 2005). The steroidal extract of fenugreek has been stimulating fertility and histological form of rodent female ovary and improved the follicular development (numerous mature ovarian follicles and multiple corpora lutea) and ovulation rate in female mice (Narajo et al., 2007).

Ginger (Zingiber officinale) belong to the family Zingiberaceae is widely used as a digestive aid for mild stomach upset and is commonly recommended by health care professionals to help prevent or treat nausea and vomiting associated with motion sickness pregnancy (Kamtcn et al., 2002). Also ginger has effective antioxidant and anticancer activity and known to significantly increase activity of ovary tissue, maturation of ovary follicles and Rat female hormones (Khaki et al., 2009). The important active components of the ginger are thought to be volatile oils and pungent phenol compounds such as gingerols, shogaols, zingerone, gingerols, zingiberene, turmerone, methyl chavicol, and γ-terpinene (Morakino et al., 2008). Ginger rhizome (Zingiber officinale; Family: Zingiberaceae) used worldwide as a spice and both anti oxidative and hormonal activity of Ginger were reported in animal models (Nathan et al., 2006). Other researchers showed that medicinal plants (ginger oil) has dominative protective effect on DNA damage induced by H2O2 and might act as scavenger of oxygen radical and might be used as antioxidant (Putheti et al., 2008).

2. Materials and Methods
The Experimental Animals
The current study was carried out in animal house of Agriculture college, Al-Muthanaa University to investigate the separate and combined importance of using Fenugreek (Trigonella foenum) and Ginger (Zingiber officinale) aqueous extracts on hematocrit – biochemical parameters and ovary Structure in Females of White Swiss Mice, 32 adult female mice used in this study were brought from laboratory of drug control, Bagdad. The experimental mice were housed in animals house in large plastic cages (11 × 12 × 30 cm) with metal covers in healthy conditions represented by typical ration and healthy water source drinking and typical temperature (20 – 32 °C) for daytime and night and natural light circle (12 hrs light and 12 hrs dark) (Reves et al., 2006).

The preparation of Medicinal Plants Extracts:
The Fenugreek or Ginger Extraction methods to preparation of aqueous extracts of each plant which described by Aizam et al. (2006). In case of Fenugreek extract was obtained from the drying Fenugreek seeds which purchased from local markets which examined and cleaned, then dried in the shade at room temperature and powdered. While Ginger rhizome extract was purchased from local
market. Fresh ginger rhizome was cleaned, washed under running tap water and cut into small pieces, then air dried and powdered. The specimens of Fenugreek or Ginger were boiled for 30 min and the extract was filtered and concentrated with a rotary evaporator apparatus by strainer. The pure liquid was located in warm bath and its aqueous extract with high viscosity was collected just before using it, the extract was diluted in distilled water.

**Experimental Design**

The 32 adult female mice used in study are divided into two groups are:

- Control group included 8 adult female mice which drenched by distilled water for 45 days of experiment.
- Treated groups included 24 adult female mice which subdivided into three sub groups were: (i) Group A included 8 female mice which drenched orally by Fenugreek extract dose 1 ml for 30 days, (ii) Group B included 8 female mice which drenched orally by Ginger extract in dose 1 ml for 30 days and (iii) Group C included 8 adult female mice which drenched orally by (1 ml of Fenugreek extract + 1 ml of Ginger extract) for 30 days and all three sub- groups were drenched daily through the mouth.

**The scarification of mice and samples collection**

After the 24 hours of the last drenching dose (in 30 days and 60 days), the mice were weighted and then the blood samples were collected. Blood samples (4 - 8 ml) were collected from the heart directly for each animal. The (4 ml) of blood that collected to hormones estimation and 4 ml to blood analysis parameters, samples of hormones estimation were placed in plastic special tubes and directly centrifuged in Janetzki centrifuge at 3000 rpm for 15 min. To getting serum which aspirated by micropipette and placed in microtube special for saving until hormones analysis, while residual (4 ml) of blood were placed in plastic test-tube had Ethylene Diamine Tetra Acetic acid (EDTA) anticoagulant for hematology studies (Hendrix et al., 2007). Then, mice were anesthetized by local anesthesia (intra peritoneal dose of 0.2 ml of ketamine + 0.2 ml of xylazine) (Hall et al., 2001), then mice were sacrificed and the abdominal cavity and peritoneum were opened by surgical incision and ovaries were removed and placed in physiological solution. Then fixed by the formalin solution 10 % for 24 hours then saved in Ethyl alcohol for used in histological technique.

**The Anatomical technique**

Anatomical study of ovaries including physical examination (shape and color) and calculation of dimensions which including ovarian weight (OW), ovarian length (OL), ovarian width (OW), ovarian thickness (OT) and ovarian volume (OV) and ovaries length was taken from cranial to caudal pole of ovary, while width was taken at ovary middle. The volume of ovaries was calculated from ellipsoid equation by water displacement methods. The measurements were carried out by electronic caliper vernier which described by Maier et al. (1990).

**The Histological technique**

In the histological methods we take the samples (1 cm) from the fixative organs in formalin 10 % to washing for 5 minutes in tap water to remove the fixative effect, then making the steps of routine histological technique which include the dehydration by serial of progressive concentrations of ethanol (50 % - 100 %), the clearing by using the zylene or chloroform, infiltration by using paraffin wax path, embedding by paraffin wax blocks, sectioning by using Rotary Microtome to thin 6 -7 micrometer plates which placed in water path and then placed in glass slides to become ready to staining by using the (Hematoxline - Eosine stain, PAS stain and Van geizen stain), then the slides become ready to examined by microscope by making the Calibration curve for each focus by using Ocular micrometer and Stag micrometer and photographed by digital camera Genex (Bancroft and Gamble, 2008) and (Luna, 1968).

**Hormonal Analysis**

The hormones level in serum of adult female mice were estimated by using Time Resolved Fluoroimmino Assay (TRFA) (Perkin Eimer life and the Analytical Sciences, Finland) to analyzed the Estrogen, FSH and Progesterone hormones in the same method which represented by preparation of standard curve concentration

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in 6 vials containing 0.5, 2.5, 25, 125, 250 ng/ml and using special antibiotic for each hormones and add 200 µl from anti hormone dilution to tube to measure Anti-ICSH –T tracer solution and adding 25 µl from ICSH – Testosterone standards and blood serum which calculated the hormones in which to special 6 vials as a real 2 vials for each concentration, all vials were placed to 90 minutes in the room temperature with slowly moving and all vials washed carefully by special solution from manufactured company for system, then directly adding 200 µl from Enhancement solution directly to prepared bottle and the vial moved for five minutes and the solution became ready for measured (Katsumi, 2010).

Hematological and Biochemical analysis

The hematological analysis which including the parameters of Red Blood Cell Count (RBCs) Cell/mm³, Hemoglobin Concentration (Hb) g/dl, Packed Cell Volume (PCV) %, Mean Corpuscle Volume MCV fl, Mean Corpuscular Hemoglobin (MCH) Pg, Mean Corpuscle HB Concentration (MCHC) %, Erythrocyte Sedimentation Rate (ESR) mm/hr, White Blood Cell Count (WBC), Cell/mm³ and Differential WBC Count) and the biochemical analysis of serum and ovary tissues content of cholesterol, glucose, creatinine, urea, triglycerides, HDL, LDL, AST and ALT) were measured in college labs by routine hematological techniques and biochemical parameters which described by Thomas (1992), Petersen et al. (2002), Sandgruber et al. (2012), Verma et al. (2012) and Shariati et al. (2015).

Statistical Analysis

All data were analyzed using SPSS version 17 (SPSS Inc., Chicago, IL, USA). A computerized program Statistical Package for the Social Science for windows. One way analysis of variance was used to detect age and effect of castration - related variations, the results were expressed as mean ± SE. The results were regarded as significant when P ≤ 0.05. To compare between means used Duncan Multiple test (Joda, 2008).

3. Results and Discussion

Anatomical Results

The anatomical results described in (Table - 1) for right ovary and (Table - 2) for left ovary and revealed significantly (P <0.05) increase in anatomical dimensions of right and left ovaries , the values of anatomical dimensions of right and left ovaries in Ginger group were greater than (significant superiority) from Fenugreek and Combined groups when compared with control group. The reason of the significant differences in result belong to the effect of medicinal plants on hormonal and elements equilibration in tissues and increasing levels of estrogen, FSH and progesterone hormone in Mice which lead to increasing the weight and dimensions of ovary. These results were agreed with results of Kaisser et al. (2006) in female Rabbit and Bancroft and Gamble (2008) and Mori et al. (2005) in female Hamster which revealed similar results in effect of medicinal plant in improving anatomical dimensions in experimented animals. While our results disagreed with Nassem et al. (2009) in Albino Rat and Verma et al. (2012) which showed different results and considered these medicinal plant not affecting on ovary and that belong to the difference in lab animal species used in experiments and different methods of plant extract preparation and the origin of medicinal plant used and for environmental and physiological condition in the experiments.

Hormonal Results

The hormonal results described in Table - 3 which showed significant difference (P <0.05) between control and treated groups, the study revealed significant superiority for Ginger group on Fenugreek, Combined and control groups represented by significantly (P <0.05) increasing in the blood level values of estrogen, FSH and progesterone hormones and the Ginger group recorded higher increasing range than others groups when compared with control group (the smallest value).The reason of significant differences in this result belong to effect of medicinal plants especially (Ginger extract) on pituitary gland or brain in hypothalamus to increased receptors of Gn-RH to secreted high levels of hormones which lead to stimulating effect to producing a higher secretion of (FSH) hormone which stimulated pituitary gland to increasing development and maturation of follicles and ovulation and also
stimulate to production of higher corpus luteum numbers and secretion of progesterone and estrogen from active ovary of experimental mice or these medicinal plants contain steroidal saponins which considered as a starter for medical steroids manufactured such as hencogenin to corticosteroids and yhamogenin for progesterone synthesis and dhaosegnin for sex hormones synthesis in female. These results were agreed with Guyton and Hall (2006) and Shariati et al. (2015) in female Rabbit and Nassem et al. (2009) in Albino Rat and with Parta et al. (2008) in Mice which observed that Fenugreek and Ginger administration lead to changing in hormonal values of estradiol, progesterone and FSH hormones by elevation and improving the activity of these hormones, while our results disagreed with Kaisser et al. (2006) in female Rabbit and Sakamato et al. (2003) in female Mice and Morakino et al. (2008) in female Rat which showed different results and considered these medicinal plant as anti-fertility and caused dropping or not effecting in values of sex hormones and these differences in results may belong to the difference in lab animal species used and different between methods of extract preparation and origin of medicinal plant used or the physiological and environmental and hygienic conditions of experiments.

**Hemato-Biochemical Analysis Results**

The Hematological analysis results was described in Table - 4, 5 and 6 which revealed the significantly (P<0.05) differences between control and treated groups, Ginger group recorded higher values in increasing or decreasing affecting of blood parameters on the Fenugreek and combined groups when compared with control group. The result showed significant (P <0.05) increasing of RBC count, MCV, MCH, MCHC, ESR, Neutrophil, Eosinophil and Lymphocyte values with significant superiority for Ginger group on other groups, and significant decreasing of WBC count, HGB, PCV, PLT, Basophil and Monocyte values with significant superiority for the Ginger group on other groups. The biochemical parameters values revealed significantly (P<0.05) decreasing in values of serum and ovary tissues content of Cholesterol, Glucose, Creatinine, Urea, Triglycerides, HDL, LDL, AST and ALT with significant superiority for Fenugreek group on other groups. The reason of these differences in result belong to that medicinal plants (Fenugreek and Ginger) contain the alkaloids materials such as Trigonellin, Choline, Tannin, Coumarin and Flavonoids which enter and affected on metabolism and elements balance in body. These plants contain large amount of steroidal Saponins and organic types of lead, phosphorus and other elements and vitamins which become as a foreign bodies which disturbance the blood values of hematological parameters. These results were agreed with Esson et al. (2005) and Tohamy et al. (2012) and Sekiwa et al. (2009) in female Mice which observed similar result represented by that Fenugreek and Ginger administration lead to changing in hematological values in experimental Mice while our results disagreed with results of Kamal et al. (1993) in Albino Rat and Al-Gubory et al. (2011) in female New Zealand Rabbit and Al-Habiri et al. (2002) in female Albino Rat which revealed that Ginger and Fenugreek extracts not affecting on hematological parameters and considered anti-fertility and these differences may belong to differences between experimental animals or design and place and environmental, physiological and nutritional conditions of experiments. While in dropping of biochemical values that belong to that medicinal plants especially Fenugreek which caused blood glucose dropping due to containing the Glactomannan which enlarged the time of food transmission in intestinal canal which produced slowly in saccharides absorption with food and decreased blood sugar level, or the Fenugreek contain 4-HIL amino acid which stimulate the Glucose induced insulin release and improving the Peripheral Utilization of Glucose which lead to dropping all biochemical values in female mice, or Fenugreek contain antioxidant effect or antimutagen and anticancer effect which stimulate apoptosis, cell multiplication and cell division. These results were agreed with Isidori et al. (2006) and Nathan et al. (2006) in Wister Rat and Okibo et al. (2007) in female Albino Mice which revealed that medicinal plants (Ginger and Fenugreek) decrease biochemical values especially in some cases as diabetes mellitus and with Petersen et al. (2002) who explained that supplementation of these medicinal plants caused dropped the values of...
LDL, HDL AST, ALT in Hamster. While our results disagreed with Norajo et al. (2007) and Mahmud et al. (2015) in female Guinea Pig and Al-Habori et al. (2002) in female Albino rat which revealed that Ginger and Fenugreek extracts not affecting on biochemical parameters and anti-fertility, these differences may belong to differences between experimental design and animals or some environmental, physiological and nutritional conditions of these experiments.

### Histological Results

The Histological results explained fine structure of ovary in control (Figures 1 and 2) and treated groups in Figures - 3, 4, 5, 6, 7 and 8 which showed the developed histological structure of ovary in treated groups more than control group. The reason of this differences in result belong to the effect of medicinal plants on hormonal and elements equilibration in tissues and increasing levels of estrogen, FSH and progesterone hormone in Mice. These results were agreed with Esson et al. (2005) and Patra et al. (2008) in female Mice and Khaki et al. (2009) in female Albino Rats which revealed that Ginger and Fenugreek extracts lead to development of ovary structure and presence of different stages of follicles while our results disagreed with Verma et al. (2012) in female Rats and Omo et al. (2011) which observed that medicinal plants caused the damage in ovary tissue with presence forms of congestion and inflammatory cells and undeveloped follicles in ovary tissue and that may belong to several cases as dose of extract or animal age, species, breed and environmental, physiological and nutritional conditions of these experiments.

#### Table 1: Anatomical analysis values of right ovary in studied groups (n = 8)

<table>
<thead>
<tr>
<th>Groups</th>
<th>Traits</th>
<th>Ovary Weight (gm)</th>
<th>Ovary Length (mm)</th>
<th>Ovary Width (mm)</th>
<th>Ovary Thick (mm)</th>
<th>Ovary Volume (mm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Group</td>
<td></td>
<td>1.68±0.02</td>
<td>17.23±0.01</td>
<td>6.89±0.02</td>
<td>6.21±0.02</td>
<td>2.27±0.02</td>
</tr>
<tr>
<td>Fenugreek Group</td>
<td></td>
<td>1.89±0.03</td>
<td>17.92±0.02</td>
<td>7.22±0.03</td>
<td>6.95±0.01</td>
<td>2.89±0.03</td>
</tr>
<tr>
<td>Ginger Group</td>
<td></td>
<td>2.17±0.04</td>
<td>18.73±0.04</td>
<td>8.43±0.02</td>
<td>7.88±0.03</td>
<td>3.41±0.01</td>
</tr>
<tr>
<td>Combined Group</td>
<td></td>
<td>1.90±0.03</td>
<td>17.89±0.02</td>
<td>7.32±0.01</td>
<td>7.08±0.02</td>
<td>2.98±0.02</td>
</tr>
</tbody>
</table>

The different small letters refer to significant differences at (p≤0.05) among groups in vertical column. The similar small letters refer to Non-significant differences at (p≥0.05) between groups in vertical column. n = refers to the number of the animals in each group. Values represent mean ± S.E.

#### Table 2: Anatomical analysis values of Left Ovary in studied groups (n = 8)

<table>
<thead>
<tr>
<th>Groups</th>
<th>Traits</th>
<th>Ovary Weight (gm)</th>
<th>Ovary Length (mm)</th>
<th>Ovary Width (mm)</th>
<th>Ovary Thick (mm)</th>
<th>Ovary Volume (mm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Group</td>
<td></td>
<td>1.46±0.02</td>
<td>16.16±0.03</td>
<td>6.18±0.02</td>
<td>5.88±0.03</td>
<td>2.22±0.03</td>
</tr>
<tr>
<td>Fenugreek Group</td>
<td></td>
<td>1.77±0.03</td>
<td>16.91±0.03</td>
<td>6.99±0.03</td>
<td>6.12±0.03</td>
<td>2.96±0.04</td>
</tr>
<tr>
<td>Ginger Group</td>
<td></td>
<td>2.22±0.04</td>
<td>17.65±0.04</td>
<td>7.99±0.02</td>
<td>6.88±0.03</td>
<td>3.22±0.02</td>
</tr>
<tr>
<td>Combined Group</td>
<td></td>
<td>1.86±0.03</td>
<td>16.97±0.03</td>
<td>6.91±0.03</td>
<td>6.18±0.03</td>
<td>2.87±0.04</td>
</tr>
</tbody>
</table>

The different small letters refer to significant differences at (p≤0.05) among groups in vertical column. The similar small letters refer to Non-significant differences at (p≥0.05) between groups in vertical column. n= refers to the number of the animals in each group. Values represent mean ± S.E.
The similar small letters refer to significant differences at (p≤0.05) among groups in vertical column.

Table - 3: Hormones and cholesterol values in serum and ovarian tissue of studied groups (n=8)

<table>
<thead>
<tr>
<th>Groups</th>
<th>Traits</th>
<th>Estradiol (ng/ml)</th>
<th>FSH (pg/dl)</th>
<th>Progesterone (mIU/ml)</th>
<th>Serum Cholesterol (mg/dl)</th>
<th>Ovarian Cholesterol Tissue (mg/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Group</td>
<td></td>
<td>20.73±0.18</td>
<td>2.82±0.21</td>
<td>2.91±0.32</td>
<td>1.68±0.02</td>
<td>0.94±0.63</td>
</tr>
<tr>
<td>Fenugreek Group</td>
<td></td>
<td>21.97±0.24</td>
<td>3.96±0.65</td>
<td>3.44±0.13</td>
<td>0.89±0.03</td>
<td>0.55±0.22</td>
</tr>
<tr>
<td>Ginger Group</td>
<td></td>
<td>24.22±0.31</td>
<td>4.94±0.71</td>
<td>4.97±0.61</td>
<td>1.08±0.02</td>
<td>0.90±0.61</td>
</tr>
<tr>
<td>Combined Group</td>
<td></td>
<td>22.43±0.21</td>
<td>3.83±0.32</td>
<td>3.71±0.18</td>
<td>1.12±0.01</td>
<td>0.88±0.38</td>
</tr>
</tbody>
</table>

The different small letters refer to significant differences at (p≤0.05) among groups in vertical column.
The similar small letters refer to Non- significant differences at (p>0.05) between groups in vertical column.
n = refers to the number of the animals in each group. Values represent mean ± S.E.

Table - 4: Hematological analysis values of studied groups (n = 8)

<table>
<thead>
<tr>
<th>Groups</th>
<th>Traits</th>
<th>RBC count (× 10⁵/µl)</th>
<th>WBC count (× 10⁵/µl)</th>
<th>HGB (g/dL)</th>
<th>PCV (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Group</td>
<td></td>
<td>6.55±0.03</td>
<td>4.43±0.02</td>
<td>8.64±0.02</td>
<td>32.73±0.31</td>
</tr>
<tr>
<td>Fenugreek Group</td>
<td></td>
<td>7.43±0.02</td>
<td>3.89±0.01</td>
<td>7.34±0.05</td>
<td>30.89±0.44</td>
</tr>
<tr>
<td>Ginger Group</td>
<td></td>
<td>8.76±0.01</td>
<td>2.91±0.03</td>
<td>6.97±0.03</td>
<td>28.67±0.57</td>
</tr>
<tr>
<td>Combined Group</td>
<td></td>
<td>7.47±0.03</td>
<td>3.93±0.01</td>
<td>7.44±0.04</td>
<td>30.91±0.36</td>
</tr>
</tbody>
</table>

The different small letters refer to significant differences at (p≤0.05) among groups in vertical column.
The similar small letters refer to Non- significant differences at (p>0.05) between groups in vertical column.
n = refers to the number of the animals in each group. Values represent mean ± S.E.

Table - 5: Hematological analysis values of studied groups (n = 8)

<table>
<thead>
<tr>
<th>Groups</th>
<th>Traits</th>
<th>MCV (Fl)</th>
<th>MCH (pg)</th>
<th>MCHC (g/dl)</th>
<th>ESR (mm/hr)</th>
<th>PLT (× 10⁹/µl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Group</td>
<td></td>
<td>4.96±0.67</td>
<td>21.78±0.19</td>
<td>32.88±0.28</td>
<td>6.17±0.05</td>
<td>7.62±0.05</td>
</tr>
<tr>
<td>Fenugreek Group</td>
<td></td>
<td>6.55±0.41</td>
<td>22.94±0.23</td>
<td>33.95±0.76</td>
<td>7.66±0.02</td>
<td>6.28±0.02</td>
</tr>
<tr>
<td>Ginger Group</td>
<td></td>
<td>8.67±0.48</td>
<td>24.68±0.78</td>
<td>35.90±0.22</td>
<td>8.29±0.01</td>
<td>5.31±0.01</td>
</tr>
<tr>
<td>Combined Group</td>
<td></td>
<td>6.65±0.22</td>
<td>22.89±0.33</td>
<td>34.18±0.66</td>
<td>7.56±0.03</td>
<td>6.22±0.02</td>
</tr>
</tbody>
</table>

The different small letters refer to significant differences at (p≤0.05) among groups in vertical column.
The similar small letters refer to Non- significant differences at (p>0.05) between groups in vertical column.
n = refers to the number of the animals in each group. Values represent mean ± S.E.
Table – 6: Differential diagnosis of WBC values of studied groups (n = 8)

<table>
<thead>
<tr>
<th>Groups</th>
<th>Traits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Neutrophils (%)</td>
</tr>
<tr>
<td>Control Group</td>
<td>38.41 ± 0.63 c</td>
</tr>
<tr>
<td>Fenugreek Group</td>
<td>40.21 ± 0.63 b</td>
</tr>
<tr>
<td>Ginger Group</td>
<td>42.68 ± 0.22 a</td>
</tr>
<tr>
<td>Combined Group</td>
<td>40.33 ± 0.58 b</td>
</tr>
</tbody>
</table>

The different small letters refer to significant differences at (p≤0.05) among groups in vertical column
The similar small letters refer to Non- significant differences at (p>0.05) between groups in vertical column
n = refers to the number of the animals in each group. Values represent mean ± S.E

Table - 7: Biochemical analysis values of studied groups (n = 8)

<table>
<thead>
<tr>
<th>Groups</th>
<th>Traits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Glucose (mg/dl)</td>
</tr>
<tr>
<td>Control Group</td>
<td>9.73 ± 0.56 a</td>
</tr>
<tr>
<td>Fenugreek Group</td>
<td>6.87 ± 0.37 c</td>
</tr>
<tr>
<td>Ginger Group</td>
<td>7.31 ± 0.55 b</td>
</tr>
<tr>
<td>Combined Group</td>
<td>7.73 ± 0.42 b</td>
</tr>
</tbody>
</table>

The different small letters refer to significant differences at (p≤0.05) among groups in vertical column
The similar small letters refer to Non- significant differences at (p>0.05) between groups in vertical column
n = refers to the number of the animals in each group. Values represent mean ± S.E

Table - 8: Biochemical analysis values of studied groups (n = 10)

<table>
<thead>
<tr>
<th>Groups</th>
<th>Traits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HDL (mg/dl)</td>
</tr>
<tr>
<td>Control Group</td>
<td>27.73 ± 0.63 a</td>
</tr>
<tr>
<td>Fenugreek Group</td>
<td>25.79 ± 0.51 c</td>
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<tr>
<td>Ginger Group</td>
<td>26.96 ± 0.35 b</td>
</tr>
<tr>
<td>Combined Group</td>
<td>26.82 ± 0.22 b</td>
</tr>
</tbody>
</table>

The different small letters refer to significant differences at (p≤0.05) among groups in vertical column
The similar small letters refer to Non- significant differences at (p>0.05) between groups in vertical column
n = refers to the number of the animals in each group. Values represent mean ± S.E
Figure 1: Normal ovary structure of mice in control group showed: epithelium (black arrow), cortex (red arrow) and corpus luteum (yellow arrow). H and E stain (x 200)

Figure 2: Normal ovary structure of mice in Control group showed follicles in different stages, cortex and medulla with ovary blood supply. H and E stain (x 100)

Figure 3: Ovary structure of female mice in Fenugreek extract group showed primary follicles (1) and cortex of ovary (2) with developed structure of ovary. H and E stain (x 100)

Figure 4: Ovary structure of mice in Fenugreek extract group showed epithelial surface (1), primordial germ cells (yellow arrow), mature follicle (black arrow) and theca interna and externa (red arrow). H and E stain (x 100)

Figure 5: Ovary structure of female mice in Ginger extract group showed secondary follicles (black arrow) and medulla (red arrow) with developed structure of ovary. H and E stain (x 100)

Figure 6: Ovary structure of female mice in Ginger extract group showed mature follicles (black arrow) and medulla (red arrow) with developed structure of ovary. Van Gieson stain (x 200)

Figure 7: Ovary structure of female mice in Combined Fenugreek and Ginger extract group showed Primary follicle (P), Mature follicle (M) with developed structure of ovary. PAS stain (x 100)

Figure 8: Ovary structure of mice in Combined Fenugreek and Ginger extract group showed Primary and Mature follicle with developed structure of ovary. H and E stain (x 100)
4. References


DOI: 10.22192/lsa.2017.3.2.2