Effect of Dietary Supplementation with Fenugreek, Marjoram and Their Combination on Performance and Carcass Traits of NZW Growing Rabbits

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ABSTRACT

A study was conducted to investigate the effect of two dietary herbal plants (fenugreek seeds (F), marjoram leaves (M)) and their combination (F+M) supplementation on productive performance and carcass traits of New Zealand White rabbits (NZW). The herbal plants were dietary added for 8 weeks at the following levels: T1 (0% F+0% M), T2 (0.25% F), T3 (0.25% M), T4 (0.50% F), T5 (0.50% M), T6 (0.25% F+0.25% M), T7 (0.50% F+0.25% M), T8 (0.25% F+0.50% M) and T9 (0.50% F+0.50% M). Ninety unsexed rabbits at 6 week of age (750-775g initial body weight) were divided into 9 treatment groups. Each treatment had 10 rabbits. At the end of the feeding traits, no significant differences were observed in LBW of rabbits comparing with the control group. However, group 4 which fed fenugreek (0.50%) achieved the highest final LBW at 14 weeks of age. During the whole period, means of feed consumption of rabbits were not significantly different among experimental groups. Concerning feed conversion ratio (FCR) for the whole experimental period, there were no significant differences among all groups. Herbal plants supplementation had no significant effect on relative weights of carcass yield, liver or heart. Generally, the present study concluded that the consumption of fenugreek and marjoram had positive effects on rabbit’s performance and carcass traits of growing NZW rabbits.

Keywords: Rabbit, herbal plants, fenugreek, marjoram, production, carcass yield.

INTRODUCTION

Feed additives are a group of nutrient and non-nutrient compounds which helps in improving the efficiency of feed utilization and thus reducing the high cost of food. In the past, antibiotics were the most routinely used feed additives. Nowadays, use of antibiotics has been banned in many countries due to their alteration of gut microflora and drug resistance of bacteria in humans. The global trend to go back to nature had enforced to use fenugreek seeds and marjoram leaves as natural growth promoters. Fenugreek has been used as a spice and a native medicine for many years. It has possessed antibacterial, antifungal, antiviral, and antioxidant activities. Fenugreek seeds are rich in protein, fat, total carbohydrates and minerals such as calcium, phosphorus, iron, zinc and magnesium (Gupta et al., 1996), and contains active constituents such as alkaloids, flavonoids, steroids, saponins and phenolic (Kor and Zadeh 2013) which help to enhance antioxidant capacity (Srinivasan, 2006). Fenugreek seeds in the diet significantly improve the body weight of broiler chicken (Yatoo et al., 2012 and Qureshi et al., 2015). In addition, Zeweil et al. (2015) observed that feed additives fenugreek at 0.6% to rabbit diets significantly improved final body weight, body weight gain, feed intake, feed conversion ratio and performance index as compared to the control group. While Feeding diet supplemented with 0.3% fenugreek significantly increased dressing % and the absolute and relative weight of spleen, kidneys, liver, heart and lungs of Californian rabbits (Seleem, 2008). Oregano leaves (Origanum vulgare L.) essential oil is one of many plant extracts that are used at present as supplements in animal’s diets. It contains mainly carvacrol, thymol and their precursors (terpinene and p-cymene) and it possesses intense in vitro antimicrobial (Dorman and Deans, 2000), antifungal (Daouk et al., 1995) and antioxidant (Cervato et al., 2000) properties, making it an appropriate candidate as a replacement for antibiotic growth promoters and also a promising food additive in order to prevent meat lipid oxidation. Oregano aids nutrient digestion and absorption, it displays antibacterial properties and prevents gut misbalances (De Koning et al., 1993). Untea et al. (2011) considered that oregano stabilizes the gut microflora and increases nutrient digestibility. Amount of volatile oil from the Origanum vulgare L is varying from 0.18-0.45% and 0.32-1.02% in fresh and dried plant (Robu and Milica, 2004). The present study was carried out to evaluate the beneficial effect of fenugreek seeds and marjoram leaves alone at two levels (0.25 and 0.50%) and in combination at different levels on performance and carcass traits of NZW rabbits.

MATERIALS AND METHODS

Experiments of the present study were carried out at the Rabbits Farm of Abo-Greada at Damietta Governorate that follows Faculty of Agriculture, Damietta University.

Experimental Design

Ninety unsexed NZW rabbits at 6 weeks of age were divided into 9 treatment groups, each treatment had 10 rabbits. The mean average weight of rabbits in all groups ranged from 750 to 775g.

Experimental diets:

Nine diets were made from different local materials. All diets were formulated to meet all the essential nutrient requirements of growing rabbits (De Blas and Mateots, 1998). The ingredients and chemical composition of experimental diets are shown in Table 1. All the diets were pelleted (3.5 mm diameter). Feed and fresh water were offered ad libitum to the experimental groups.

Animal housing:

All rabbit were housed individually in galvanized wire cages provided with feeders and automatic nipple
drinkers. Cages were kept in an open side well ventilated pen.

**Growth trial:**

A comparative feeding experiment was carried out to study the effects of adding fenugreek seeds and/or marjoram leaves at different levels to the rabbit’s diets on growth performance and carcass traits. Feed consumption was recorded weekly during the 8-week experimental period. Rabbits were individually weighed each week from weaning (at 6 week of age) to slaughter (at 14 week of age) to obtain live body weight and body weight gain.

**Slaughter test**

At the end of the feeding trial (14th week of age), three rabbits from each group were selected for slaughter test. Just prior to slaughter and again after complete bleeding, the rabbits were individually weighed, and their fur and legs were plucked and then eviscerated. Records on individual weights of eviscerated carcass and giblets (including heart, liver and kidney) were done. Carcass yield was calculated as eviscerated carcass plus giblets. All carcass traits were expressed as % of live body weight at slaughter.

### Table 1: Ingredients and chemical analysis (%) of the experimental pelleted rations

<table>
<thead>
<tr>
<th>Items</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
<th>T5</th>
<th>T6</th>
<th>T7</th>
<th>T8</th>
<th>T9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ingredients %:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Clover hay</td>
<td>38.4</td>
<td>38.15</td>
<td>38.15</td>
<td>37.9</td>
<td>37.9</td>
<td>37.9</td>
<td>37.9</td>
<td>37.65</td>
<td>37.65</td>
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<tr>
<td>Yellow maize</td>
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<td>10.1</td>
<td>10.1</td>
<td>10.1</td>
<td>10.1</td>
<td>10.1</td>
<td>10.1</td>
<td>10.1</td>
<td>10.1</td>
</tr>
<tr>
<td>Wheat bran</td>
<td>32.4</td>
<td>32.4</td>
<td>32.4</td>
<td>32.4</td>
<td>32.4</td>
<td>32.4</td>
<td>32.4</td>
<td>32.4</td>
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</tr>
<tr>
<td>Soybean meal</td>
<td>13.8</td>
<td>13.8</td>
<td>13.8</td>
<td>13.8</td>
<td>13.8</td>
<td>13.8</td>
<td>13.8</td>
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<tr>
<td>Molasses</td>
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<td>4.0</td>
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<tr>
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<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
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</tr>
<tr>
<td>Vitamins &amp; Minerals permix*</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
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<tr>
<td>DL-Methionine</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
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<tr>
<td>DL. Lysine</td>
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<tr>
<td>Choline Chloride</td>
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<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
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</tr>
<tr>
<td>Anticoccidin</td>
<td>0.1</td>
<td>0.1</td>
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<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
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</tr>
<tr>
<td>Fenugreek</td>
<td>-</td>
<td>0.25</td>
<td>-</td>
<td>0.50</td>
<td>-</td>
<td>0.25</td>
<td>0.50</td>
<td>0.25</td>
<td>0.50</td>
</tr>
<tr>
<td>Marjoram</td>
<td>-</td>
<td>-</td>
<td>0.25</td>
<td>-</td>
<td>0.50</td>
<td>0.25</td>
<td>0.25</td>
<td>0.50</td>
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</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
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<td>Chemical analysis (as fed):</td>
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<td></td>
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<tr>
<td>DM%</td>
<td>89.05</td>
<td>89.14</td>
<td>90.12</td>
<td>90.45</td>
<td>90.83</td>
<td>89.62</td>
<td>89.50</td>
<td>89.87</td>
<td>86.45</td>
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<tr>
<td>OM%</td>
<td>81.28</td>
<td>81.5</td>
<td>82.54</td>
<td>82.48</td>
<td>84.23</td>
<td>81.81</td>
<td>83.12</td>
<td>81.93</td>
<td>78.77</td>
</tr>
<tr>
<td>CP%</td>
<td>17.21</td>
<td>17.90</td>
<td>17.16</td>
<td>17.22</td>
<td>17.16</td>
<td>17.19</td>
<td>17.22</td>
<td>17.19</td>
<td>17.22</td>
</tr>
<tr>
<td>EE%</td>
<td>1.50</td>
<td>1.07</td>
<td>2.97</td>
<td>2.34</td>
<td>1.33</td>
<td>1.83</td>
<td>1.97</td>
<td>2.03</td>
<td>1.13</td>
</tr>
<tr>
<td>NFE%</td>
<td>50.97</td>
<td>53.16</td>
<td>50.72</td>
<td>50.57</td>
<td>54.84</td>
<td>52.23</td>
<td>52.67</td>
<td>52.99</td>
<td>48.99</td>
</tr>
<tr>
<td>DE/Kcal/kg</td>
<td>2877</td>
<td>2830</td>
<td>3031</td>
<td>2904</td>
<td>3062</td>
<td>2850</td>
<td>2924</td>
<td>2893</td>
<td>2820</td>
</tr>
</tbody>
</table>

* Each kilogram contains: Vit A 2000000 IU, Vit. D, 150000 IU, Vit. E 8.33g, Vit. K 0.33g, Vit. B6 0.33g, Vit. B12 1.7 mg, Vit. B1 8.33g, Pantothenic acid 3.33g, Zn 11.7g, Fe 12.5, Cu 0.5g, Co 1.33 mg, Se 16.6

**Statistical analysis:**

Statistical analysis for the obtained data was performed by analysis of variance using the method of least square analysis of Co-variance (SAS, 1996). Duncan's multiple range tests was used to separate significant differences among means (Duncan, 1955).

**RESULTS AND DISCUSSION**

Table 2 shows the effect of different levels of fenugreek (F), marjoram (M) and their combination (F+M) on LBW of rabbits during the whole experimental period (6-14 week of age). No significant differences were observed in LBW of rabbits throughout the whole experimental period between each treatment and the control. However, group 4 which fed fenugreek (0.5%) achieved the highest final LBW at 14th week of age. Means of final LBW at 14th week of age were 2.501, 2.492, 2.442, 2.522, 2.371, 2.464, 2.487, 2.464 and 2.477 kg for rabbit’s groups fed T1 (0% F+0% M), T2 (0.25% F), T3 (0.25% M), T4 (0.50% F), T5 (0.50% M), T6 (0.25% F + 0.25% M), T7 (0.50% F + 0.25% M), T8 (0.25% F + 0.50% M) and T9 (0.50% F+0.50%M), respectively. These results are in agreement with the findings of Abdelatif et al. (2012) who found slight gradual increase in LBW of rabbits supplemented with fenugreek. Similarly, other researchers such as Zeweil et al. (2015) indicated that different supplementation of fenugreek powder to growing rabbit's diets improved the performance of the experimental rabbits compared to un-supplemented group. Also, the results are in agreement with findings of Rayes et al. (2009) who mentioned that improvement of body weight gain of rabbits fed fenugreek diets might be attributed to increase in feed intake or to the fenugreek contents of active compounds such as antibacterial, antifungal, anti-inflammatory, carminative and antioxidant activities. Also, Hernandez et al. (2004) found that the improvement due to fenugreek diets might be due to presence of the fatty acids or due to stimulating effect on the digestive system. In addition, Botsoglou et al. (2004) observed that dietary inclusion of 100 and 200mg/kg diet with an essential oil from oregano (marjoram) exerted no growth promoting effect in rabbits. However, Ibrahim et al. (2000) found that dietary supplementation with 0.5% oregano extract significantly increased LBW compared to a control group.
Table 2: Effect of dietary supplementation with fenugreek, marjoram, and their combination on live body weight of rabbits from 6th to 14th week of age.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>X ± SE</th>
<th>X ± SE</th>
<th>X ± SE</th>
<th>X ± SE</th>
<th>X ± SE</th>
<th>X ± SE</th>
<th>X ± SE</th>
<th>X ± SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1 (Control)</td>
<td>844.5 ± 30.2</td>
<td>1171.5 ± 26.1</td>
<td>1415.2 ± 30.8</td>
<td>1693 ± 30.8</td>
<td>1822 ± 30.8</td>
<td>2015 ± 30.8</td>
<td>2208 ± 30.8</td>
<td>2372 ± 30.8</td>
</tr>
<tr>
<td>T2 (0.25% F)</td>
<td>955.4 ± 30.7</td>
<td>1241.6 ± 26.1</td>
<td>1574.5 ± 30.8</td>
<td>1865.6 ± 30.8</td>
<td>2058.7 ± 30.8</td>
<td>2251.8 ± 30.8</td>
<td>2444 ± 30.8</td>
<td></td>
</tr>
<tr>
<td>T3 (0.5% M)</td>
<td>887.5 ± 26.2</td>
<td>1264.5 ± 26.0</td>
<td>1603.5 ± 43.6</td>
<td>1904.5 ± 43.6</td>
<td>2105.5 ± 43.6</td>
<td>2306.5 ± 43.6</td>
<td>2507 ± 43.6</td>
<td></td>
</tr>
<tr>
<td>T4 (0.5% F)</td>
<td>887.0 ± 33.8</td>
<td>1311.0 ± 20.1</td>
<td>1655.6 ± 22.0</td>
<td>1928.5 ± 22.0</td>
<td>2101.5 ± 22.0</td>
<td>2274 ± 22.0</td>
<td>2447 ± 22.0</td>
<td></td>
</tr>
<tr>
<td>T5 (0.5% M)</td>
<td>885.0 ± 18.4</td>
<td>1311.5 ± 15.8</td>
<td>1565.6 ± 31.4</td>
<td>1745.5 ± 31.4</td>
<td>1926.5 ± 31.4</td>
<td>2107.5 ± 31.4</td>
<td>2288.5 ± 31.4</td>
<td></td>
</tr>
<tr>
<td>(0.5% F + 0.5% M)</td>
<td>896.0 ± 11.7</td>
<td>1225.0 ± 14.0</td>
<td>1388.0 ± 40.3</td>
<td>1672.5 ± 40.3</td>
<td>1857.0 ± 40.3</td>
<td>2042 ± 40.3</td>
<td>2227 ± 40.3</td>
<td></td>
</tr>
</tbody>
</table>

NS: Not significant at P≥0.05.

### Body weight gain (BWG):

Results in Table 3 show that different dietary supplementation of fenugreek, marjoram, and their combination had insignificant effect on BWG during the experimental period, except at the 9th, 10th, and 12th weeks of age. The group 5 (0.5% M) of rabbits exhibited significantly lowest BWG compared with the other groups from the 9th week of age. During the period from 9 to 10 weeks of age, body weight gains of rabbits were significantly affected by dietary supplementation with F+M, where group 6 (0.25%F+0.25%M) gained more weight than the other groups. The group 7 (0.50%F+0.25%M) of rabbits less improved BWG compared with the other groups from the 12th week of age. Means of body weight gain of NZW rabbits during the whole period were 1656, 1645, 1555, 1635, 1486, 1577.5, 1598.5, 1568 and 1592g for groups 1, 2, 3, 4, 5, 6, 7, 8, and 9, respectively.

### Table 3: Effect of dietary supplementation with fenugreek, marjoram, and their combination on weight gain of NZW rabbits from 7th to 14th and 6-14 week of age.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>X ± SE</th>
<th>X ± SE</th>
<th>X ± SE</th>
<th>X ± SE</th>
<th>X ± SE</th>
<th>X ± SE</th>
<th>X ± SE</th>
<th>X ± SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1 (Control)</td>
<td>272 ± 14</td>
<td>289 ± 14</td>
<td>278 ± 14</td>
<td>297 ± 14</td>
<td>193 ± 14</td>
<td>194 ± 14</td>
<td>164 ± 14</td>
<td>130 ± 14</td>
</tr>
<tr>
<td>T2 (0.25% F)</td>
<td>259 ± 14</td>
<td>258 ± 14</td>
<td>217 ± 14</td>
<td>209 ± 14</td>
<td>197 ± 14</td>
<td>215 ± 14</td>
<td>181 ± 14</td>
<td>112 ± 14</td>
</tr>
<tr>
<td>T3 (0.5% M)</td>
<td>236 ± 14</td>
<td>245 ± 14</td>
<td>126 ± 14</td>
<td>11.8 ± 14</td>
<td>16.7 ± 14</td>
<td>15.0 ± 14</td>
<td>11.0 ± 14</td>
<td>6.06 ± 14</td>
</tr>
<tr>
<td>T4 (0.5% F)</td>
<td>257 ± 14</td>
<td>258 ± 14</td>
<td>221 ± 14</td>
<td>191 ± 14</td>
<td>198 ± 14</td>
<td>170 ± 14</td>
<td>167 ± 14</td>
<td>114 ± 14</td>
</tr>
<tr>
<td>T5 (0.5% M)</td>
<td>18.7 ± 14</td>
<td>27.5 ± 14</td>
<td>13.9 ± 14</td>
<td>12.8 ± 14</td>
<td>20.4 ± 14</td>
<td>16.0 ± 14</td>
<td>24.0 ± 14</td>
<td>7.98 ± 14</td>
</tr>
<tr>
<td>(0.25% F + 0.25% M)</td>
<td>247 ± 14</td>
<td>265 ± 14</td>
<td>171 ± 14</td>
<td>176 ± 14</td>
<td>163 ± 14</td>
<td>150 ± 14</td>
<td>192 ± 14</td>
<td>123 ± 14</td>
</tr>
<tr>
<td>T6 (0.25% F + 0.25% M)</td>
<td>27.0 ± 14</td>
<td>24.8 ± 14</td>
<td>20.1 ± 14</td>
<td>26.7 ± 14</td>
<td>17.6 ± 14</td>
<td>16.7 ± 14</td>
<td>4.00 ± 14</td>
<td>15.8 ± 14</td>
</tr>
<tr>
<td>(0.50% M)</td>
<td>241 ± 14</td>
<td>262 ± 14</td>
<td>234 ± 14</td>
<td>227 ± 14</td>
<td>196 ± 14</td>
<td>159 ± 14</td>
<td>147 ± 14</td>
<td>112 ± 14</td>
</tr>
<tr>
<td>(0.50% F + 0.25% M)</td>
<td>20.9 ± 14</td>
<td>16.3 ± 14</td>
<td>11.0 ± 14</td>
<td>15.9 ± 14</td>
<td>23.4 ± 14</td>
<td>20.6 ± 14</td>
<td>15.4 ± 14</td>
<td>9.04 ± 14</td>
</tr>
<tr>
<td>T7 (0.50% F + 0.25% M)</td>
<td>322 ± 14</td>
<td>237 ± 14</td>
<td>249 ± 14</td>
<td>170 ± 14</td>
<td>164 ± 14</td>
<td>90.0 ± 14</td>
<td>238 ± 14</td>
<td>130 ± 14</td>
</tr>
<tr>
<td>(0.50% F + 0.50% M)</td>
<td>28.2 ± 14</td>
<td>16.1 ± 14</td>
<td>18.3 ± 14</td>
<td>22.0 ± 14</td>
<td>22.5 ± 14</td>
<td>18.8 ± 14</td>
<td>14.0 ± 14</td>
<td>7.1 ± 14</td>
</tr>
<tr>
<td>T8 (0.50% M)</td>
<td>227 ± 14</td>
<td>205 ± 14</td>
<td>239 ± 14</td>
<td>221 ± 14</td>
<td>151 ± 14</td>
<td>148 ± 14</td>
<td>197 ± 14</td>
<td>122 ± 14</td>
</tr>
<tr>
<td>(0.50% F + 0.50% M)</td>
<td>14.0 ± 14</td>
<td>36.0 ± 14</td>
<td>13.3 ± 14</td>
<td>11.0 ± 14</td>
<td>18.5 ± 14</td>
<td>10.0 ± 14</td>
<td>18.6 ± 14</td>
<td>11.5 ± 14</td>
</tr>
<tr>
<td>NS</td>
<td>18.3 ± 14</td>
<td>24.4 ± 14</td>
<td>24.1 ± 14</td>
<td>190 ± 14</td>
<td>170 ± 14</td>
<td>144 ± 14</td>
<td>198 ± 14</td>
<td>142 ± 14</td>
</tr>
</tbody>
</table>

NS: Not significant at P≥0.05. NS: Not significant at P≥0.05. ** Significant at P<0.001.

### Feed intake (FI)

Data of the effect of different levels of fenugreek, marjoram and combined dietary supplantations on weekly feed intake of rabbits are presented in Table 4. During the 7th week of age, means of feed intake were significantly different among treatments, being 625.5, 596.5, 578, 580, 492, 646, 642.5, 642 and 632 g/head for groups 1, 2, 3, 4, 5, 6, 7, 8 and 9 respectively. Rabbits given 0.50% M (T5) consumed significantly less feed compared with other experimental groups. During the whole period (6 to 14
weeks of age), means of FI of rabbits were not significantly different among experimental groups in agreement with the findings of El-Kloub (2006) who indicated that fenugreek seeds at level of 0.05% revealed no significant effect on feed intake as compared to the control group. The improvements of feed conversion ratio might be related to the development of rabbit gut morphological changes of gastrointestinal tissues that can be induced by differences in gut-fluid microbial content including their metabolites; the result was in line with finding of Amal et al. (2013) and Mamoun et al. (2014). Gomez et al. (1998) indicated that the improvement in performance characteristics in broilers may be due to antibacterial related to flavonoids in fenugreek that led to maintaining normal intestine microflora by competitive exclusion and antagonism, altering metabolism and increased liver muscle glycogen.

### Table 4: Effect of dietary supplementation with fenugreek, marjoram, and their combination on feed intake of NZW rabbits from 6th to 14th and 6-14 week of age.

<table>
<thead>
<tr>
<th>Age (wk.)</th>
<th>7th</th>
<th>8th</th>
<th>9th</th>
<th>10th</th>
<th>11th</th>
<th>12th</th>
<th>13th</th>
<th>14th</th>
<th>6-14 wk.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatments</td>
<td>$X \pm SE$</td>
<td>$X \pm SE$</td>
<td>$X \pm SE$</td>
<td>$X \pm SE$</td>
<td>$X \pm SE$</td>
<td>$X \pm SE$</td>
<td>$X \pm SE$</td>
<td>$X \pm SE$</td>
<td>$X \pm SE$</td>
</tr>
<tr>
<td>$T_1$ (Control)</td>
<td>626±</td>
<td>669±</td>
<td>947±</td>
<td>766±</td>
<td>829±</td>
<td>794±</td>
<td>764±</td>
<td>726±</td>
<td>619±</td>
</tr>
<tr>
<td>$T_2$ (0.25% F)</td>
<td>597±</td>
<td>668±</td>
<td>870±</td>
<td>818±</td>
<td>933±</td>
<td>905±</td>
<td>813±</td>
<td>725±</td>
<td>6327±</td>
</tr>
<tr>
<td>$T_3$ (0.25% M)</td>
<td>578±</td>
<td>699±</td>
<td>869±</td>
<td>812±</td>
<td>839±</td>
<td>792±</td>
<td>751±</td>
<td>644±</td>
<td>598±</td>
</tr>
<tr>
<td>$T_4$ (0.50% F)</td>
<td>581±</td>
<td>688±</td>
<td>845±</td>
<td>790±</td>
<td>937±</td>
<td>918±</td>
<td>819±</td>
<td>712±</td>
<td>628±</td>
</tr>
<tr>
<td>$T_5$ (0.50% M)</td>
<td>492±</td>
<td>715±</td>
<td>823±</td>
<td>719±</td>
<td>887±</td>
<td>832±</td>
<td>710±</td>
<td>688±</td>
<td>586±</td>
</tr>
<tr>
<td>$T_6$ (0.25%F+0.25 %M)</td>
<td>646±</td>
<td>704±</td>
<td>864±</td>
<td>882±</td>
<td>896±</td>
<td>646±</td>
<td>699±</td>
<td>690±</td>
<td>699±</td>
</tr>
<tr>
<td>$T_7$ (0.50%F+0.50 %M)</td>
<td>643±</td>
<td>726±</td>
<td>883±</td>
<td>789±</td>
<td>785±</td>
<td>532±</td>
<td>824±</td>
<td>742±</td>
<td>592±</td>
</tr>
<tr>
<td>$T_8$ (0.50%F+0.50 %M)</td>
<td>642±</td>
<td>748±</td>
<td>935±</td>
<td>952±</td>
<td>812±</td>
<td>671±</td>
<td>808±</td>
<td>707±</td>
<td>627±</td>
</tr>
<tr>
<td>$T_9$ (0.50%F+0.50 %M)</td>
<td>632±</td>
<td>726±</td>
<td>836±</td>
<td>836±</td>
<td>855±</td>
<td>677±</td>
<td>849±</td>
<td>762±</td>
<td>617±</td>
</tr>
<tr>
<td>$T_{10}$ (0.50%F+0.50 %M)</td>
<td>17±</td>
<td>22±</td>
<td>48±</td>
<td>21±</td>
<td>46±</td>
<td>15±</td>
<td>18±</td>
<td>129±</td>
<td>208±</td>
</tr>
</tbody>
</table>

**Means in the same column with different superscripts differ significantly (P≤0.05), NS: Not significant at P≥0.05, **: Significant at P≤0.01.**

**Feed conversion ratio (FC):**

Effects of dietary supplementation of fenugreek and/or marjoram on weekly feed conversion ratio of rabbits are presented in Table 5. During the period from 6th to 8th weeks of age, the ratio of fenugreek was not significantly affected. However, during the 9th week of age, significantly worst mean of FCR was achieved by the group 5 fed the 0.50% marjoram as compared with other groups. Also, during the 10th week of age, significantly better mean of FCR was achieved by the group 7 fed 0.50% fenugreek plus 0.25% marjoram as compared with other groups. However, during the 11th, 13th and 14th weeks of age, there were no significant effects on FCR among all groups, except during the 12th week of age, since there was significantly worst mean of FCR achieved by group 7 fed 0.50%F plus 0.25%M as compared with other groups. The FCR of rabbits for the whole experimental period had no significant differences among groups.

### Table 5: Effect of dietary supplementation with fenugreek, marjoram, and their combination on feed conversion ratio of NZW rabbits from 7th to 14th and 6-14 week of age.

<table>
<thead>
<tr>
<th>Age (wk.)</th>
<th>7th</th>
<th>8th</th>
<th>9th</th>
<th>10th</th>
<th>11th</th>
<th>12th</th>
<th>13th</th>
<th>14th</th>
<th>6-14 wk.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatments</td>
<td>$X \pm SE$</td>
<td>$X \pm SE$</td>
<td>$X \pm SE$</td>
<td>$X \pm SE$</td>
<td>$X \pm SE$</td>
<td>$X \pm SE$</td>
<td>$X \pm SE$</td>
<td>$X \pm SE$</td>
<td>$X \pm SE$</td>
</tr>
<tr>
<td>$T_1$ (Control)</td>
<td>2.55±0.27</td>
<td>2.46±0.26</td>
<td>3.55±0.24</td>
<td>6.12±0.34</td>
<td>4.52±0.32</td>
<td>4.67±0.51</td>
<td>5.24±0.58</td>
<td>5.97±0.53</td>
<td>3.74±0.10</td>
</tr>
<tr>
<td>$T_2$ (0.25% F)</td>
<td>2.51±0.28</td>
<td>2.82±0.33</td>
<td>4.11±0.20</td>
<td>4.07±0.36</td>
<td>5.01±0.35</td>
<td>4.41±0.32</td>
<td>4.68±0.35</td>
<td>6.61±0.28</td>
<td>3.89±0.14</td>
</tr>
<tr>
<td>$T_3$ (0.25% M)</td>
<td>2.52±0.19</td>
<td>2.88±0.21</td>
<td>4.04±0.24</td>
<td>4.39±0.37</td>
<td>4.71±0.62</td>
<td>4.92±0.42</td>
<td>5.09±0.41</td>
<td>5.79±0.27</td>
<td>3.88±0.10</td>
</tr>
<tr>
<td>$T_4$ (0.50% F)</td>
<td>2.75±0.22</td>
<td>3.24±0.16</td>
<td>3.83±0.25</td>
<td>4.13±0.31</td>
<td>4.04±0.24</td>
<td>4.57±0.35</td>
<td>4.57±0.41</td>
<td>5.89±0.23</td>
<td>3.86±0.09</td>
</tr>
<tr>
<td>$T_5$ (0.50% M)</td>
<td>2.11±0.27</td>
<td>2.87±0.25</td>
<td>5.66±0.58</td>
<td>4.63±0.35</td>
<td>6.14±0.77</td>
<td>5.95±0.45</td>
<td>4.92±0.71</td>
<td>5.93±0.42</td>
<td>3.98±0.13</td>
</tr>
<tr>
<td>$T_6$ (0.25%F+0.25 %M)</td>
<td>2.87±0.26</td>
<td>2.77±0.18</td>
<td>3.73±0.12</td>
<td>3.99±0.19</td>
<td>4.96±0.38</td>
<td>4.88±0.64</td>
<td>5.65±0.49</td>
<td>6.54±0.46</td>
<td>3.87±0.05</td>
</tr>
<tr>
<td>$T_7$ (0.50%F+0.50 %M)</td>
<td>2.20±0.27</td>
<td>3.16±0.17</td>
<td>3.62±0.15</td>
<td>4.93±0.26</td>
<td>5.27±0.43</td>
<td>6.92±0.58</td>
<td>3.57±0.24</td>
<td>5.89±0.31</td>
<td>3.73±0.09</td>
</tr>
<tr>
<td>$T_8$ (0.50%F+0.50 %M)</td>
<td>2.90±0.20</td>
<td>3.08±0.24</td>
<td>3.99±0.16</td>
<td>4.41±0.20</td>
<td>5.69±0.30</td>
<td>4.84±0.48</td>
<td>4.52±0.53</td>
<td>6.09±0.43</td>
<td>4.02±0.09</td>
</tr>
<tr>
<td>$T_9$ (0.50%F+0.50 %M)</td>
<td>2.49±0.15</td>
<td>3.09±0.17</td>
<td>3.63±0.24</td>
<td>4.45±0.16</td>
<td>5.35±0.34</td>
<td>5.14±0.46</td>
<td>4.73±0.49</td>
<td>5.52±0.33</td>
<td>3.91±0.10</td>
</tr>
</tbody>
</table>

**Means in the same column with different superscripts differ significantly (P≤0.05).**
Carcass traits:
Results given in Table 6 show the effect of fenugreek and/or marjoram on carcass traits of NZW rabbits at the 14th week of age. The results showed that dietary supplementation of fenugreek, marjoram and their combination had no significant effect on relative weights of carcass yield, liver or heart. Results of carcass weight were in harmony with final live body weight. This result was in line with finding of Zeweil et al. (2015) indicate that diets containing 0.6% fenugreek seeds had no significant effect on carcass weight percent and organs relative weights as compared with the control group.

Table 6: Effect of dietary supplementation with fenugreek, marjoram, and their combination on carcass traits (% of live body weight at slaughter) of NZW rabbits.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Age (wk.)</th>
<th>LBW (g)</th>
<th>carcass wt. (%)</th>
<th>Heart wt. (%)</th>
<th>Liver wt. (%)</th>
<th>Dressed carcass wt. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>X ± SE</td>
<td>X ± SE</td>
<td>X ± SE</td>
<td>X ± SE</td>
<td>X ± SE</td>
</tr>
<tr>
<td>T1 (Control)</td>
<td></td>
<td>2519.3±51.2</td>
<td>59.78±2.75</td>
<td>0.32±0.05</td>
<td>2.72±0.12</td>
<td>62.81±2.86</td>
</tr>
<tr>
<td>T2 (0.25% F)</td>
<td></td>
<td>2521.5±26.3</td>
<td>60.03±0.29</td>
<td>0.34±0.02</td>
<td>2.85±0.17</td>
<td>63.21±0.30</td>
</tr>
<tr>
<td>T3 (0.5% F)</td>
<td></td>
<td>2501.5±33.6</td>
<td>59.26±0.45</td>
<td>0.33±0.02</td>
<td>3.05±0.26</td>
<td>62.64±0.41</td>
</tr>
<tr>
<td>T4 (0.5% F)</td>
<td></td>
<td>2506.8±32.7</td>
<td>58.77±0.82</td>
<td>0.35±0.02</td>
<td>3.23±0.24</td>
<td>62.36±0.70</td>
</tr>
<tr>
<td>T5 (0.5% F)</td>
<td></td>
<td>2609.8±71.4</td>
<td>59.19±0.77</td>
<td>0.34±0.02</td>
<td>3.16±0.18</td>
<td>62.71±0.80</td>
</tr>
<tr>
<td>T6 (0.25% F+0.25% M)</td>
<td></td>
<td>2499.5±34.3</td>
<td>59.87±1.07</td>
<td>0.33±0.02</td>
<td>2.71±0.23</td>
<td>62.91±1.21</td>
</tr>
<tr>
<td>T7 (0.5% F+0.25% M)</td>
<td></td>
<td>2569.0±73.5</td>
<td>59.12±0.43</td>
<td>0.29±0.02</td>
<td>2.81±0.28</td>
<td>62.22±0.36</td>
</tr>
<tr>
<td>T8 (0.25% F+0.5% M)</td>
<td></td>
<td>2473.0±19.6</td>
<td>58.28±1.05</td>
<td>0.31±0.03</td>
<td>2.99±0.31</td>
<td>61.57±0.88</td>
</tr>
<tr>
<td>T9 (0.5% F+0.5% M)</td>
<td></td>
<td>2559.8±62.6</td>
<td>58.77±0.72</td>
<td>0.34±0.01</td>
<td>3.66±0.27</td>
<td>62.78±0.53</td>
</tr>
<tr>
<td>Significant</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>

NS: Not significant at P≥0.05.

CONCLUSION
The consumption of fenugreek and marjoram had positive effects on rabbit’s performance and carcass traits of growing NZW rabbits.

REFERENCES


