Effect of dietary *Zingiber officinalis* root powder and vitamin E–selenium on milk yield and its chemical composition in lactating Iraqi female goats

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Abstract. The present study was carried out in a private sector farm in Kerbala district (100 Km south of Baghdad) to investigate the effect of *Zingiber officinalis* root powder supplements and vitamin E–selenium on milk yield and chemical composition in Iraqi lactating goats. Twenty-four pregnant Iraqi goats at the 2nd month of gestation, were divided into three groups of 8 animals each. The 1st group (control group C) was fed on concentration diet and *ad libitum* of green grass. The 2nd group (T1) was fed on similar diet and supplemented with 60 g of *Zingiber officinalis* root powder / kg of concentration diet, while the 3rd group (T2) was fed on similar diet and supplemented with of vitamin E and selenium (20 IU and 2 mg per Kg. concentration diet respectively), for 5 month experimental period. The results did revealed significant increasing in milk yield for (T1 and T2) groups as compare with C group. The solid not fat %, milk protein %, lactose % percentage were significantly increased in T1 group in comparion with control group, The fat % percentage was significantly increased in T2 group as comparated with The C group.

1. Introduction
The modern studies trend to increase animals production by add some medical plants and vitamins to animal rations. In addition, in few last year's the using of medical plants were be increased due to their therapeutic effects for treated several cases [1]. *Zingiber officinalis* has several healing properties as well as its used in food [2]. From chemical analysis point of view, the plant contained 8.5% protein, 35% fat, 10% moisture, and 2.4% fiber [3]. This contents made *Zingiber officinalis* root used several medicinal purposes like antioxidant [4], hypoglycemic drug [5] as well as its healing action in different animals [6]. Some researchers showed that *Zingiber officinalis* root could increase animals appetite and nutrients palatability [7], improved digestion and absorption of fats [8] and enhancing of milk production in human [9]. When administration 2 ml *Zingiber officinalis* oil to lactating goat the milk yield were increased [10], moreover the plant was used in ewe ration leading to improved the total solid, fat percentage in milk [11], as well as increased in milk protein, solid not fat percentage in ewe milk [12].

Vitamin E and selenium were regarded as essential nutrients for animals [13], Their supplementation led to increase milk yield in ewe [14], Recently study showed favorable influence of administration of vitamin E to dairy goat on milk production, milk protein, milk fat contents its attributed to accept better use nutrients in ration [15], different studies showed increased milk yield significantly following vitamin E and selenium added to ruminant rations [16], Another study noticed increasing in milk fat percentage of cows following vitamin E-selenium added to the ration [17],
Vitamin E and selenium increased birth and weaning weight [18]. Body weight and the reproductive activity in sheep following adding vitamin E—selenium to the ration [19]. The addition of vitamin E and selenium to female goat ration increased milk yield as well as its milk fat, protein and lactose percentage [20]. The purpose of this study was to determine the effect of dietary Zingiber officinalis root powder, vitamin E and selenium on milk yield, fat, protein, solid not fat and milk lactose percentage of Iraqi goats.

2. Materials and Methods
This study was conducted in private sector farm in Kerbala district (100 Km south of Baghdad) during period from 3/12/2019 to 6/4/2019, twenty-four Iraqi lactating goats at 3-4 years old with weight average between 33 to 42 kg at the second month of gestational period were divided to three equal groups each 8 does. The 1st group (C group) fed on concentrate diet and ad libitum of green grass, the 2nd group (T1) fed on concentrate diet supplemented with 60 g of Zingiber officinalis root powder per kg of and ad libitum green grass, while the 3rd group (T2) fed on concentrate diet, green grass and supplemented with 20 IU of vitamin E and 2 mg of selenium to per Kg, for 5 month experimental period. Milk samples were collected from all animals every week during the 45 days post-kidding. Ten ml of milk from each does were taken for chemical composition analysis. The does were hand milked twice daily at 5 a.m and 5 p.m. recorded the milk yield from each does then mixed the both morning and evening milking and obtained the average of both. The milk composition of protein, solid not fat, lactose, fat percentages were determined by using Eko milk analyzer Germany according to [21]. The results analyzed using statistical analysis system (SAS) [22], with complete random design (CRD), Duncan multiple range test was performed for comparison among significant means [23].

3. Results and discussion
3.1. Milk Yield
The results showed significant (p<0.01) increasing in milk yield in T1 and T2 groups as compared with C group (Table 1).

| Treatment                  | 1st week | 2nd week | 3rd week | 4th week | 5th week | 6th week |
|---------------------------|----------|----------|----------|----------|----------|----------|
| Control C                 | 3.17±0.12| 3.17±0.12| 3.20±0.12| 3.35±0.20| 3.00±0.11| 2.90±0.15|
| Zingiber officinalis (T1) | 4.25±0.48| 4.75±0.31| 5.23±0.44| 6.21±0.49| 5.45±0.59| 4.73±0.48|
| VitE+selenium (T2)        | 4.12±0.46| 4.51±0.38| 4.52±0.33| 5.12±0.48| 4.88±0.33| 4.00±0.45|

Mean with different superscripts within similar column differ significantly (P<0.01).

The significant increasing in milk yield of T1 group (Zingiber officinalis) may be due to the role of plant root powder that could improve the appetite and feeding and increased ruminal activity and reduce the gas production and its lead to improve digestion of animals [24]. The other research showed significant increase in milk yield in cow fed on ration supplemented with 50-100 g of zingiber officinalis root for per head/day [10]. The zingiber officinalis have high protein percentage about 8.5% and vitamins that lead to increase milk yield [25]. The current results agreed with [26], who recorded increasing in milk yield in dairy cow fed on zingiber officinalis root powder [27]. The increasing milk yield in T2 group (vitamin E-Se) may due the effect of vitamin E and selenium to decrease the somatic cells in milk and decrease inflammation of udder and that referred to improvement of health and lead to increased amount of milk yield [28], or may be due to the antioxidant action of selenium its protection mammary cells and family improved udder health.

Table 1. Milk yield (kg) of Iraqi does as affected by dietary Zingiber officinalis and vitamin E + selenium supplementation during six weeks experimental period (Mean ± SE).
some reported show relationship between increase in milk production and increase concentration of selenium in blood [29], AAlso this may return to the role of vitamin E in increasing feed intake of animals [30]. Current results agreed with [20] who found increasing in milk yield from meriz does when treated with vitamin E- Selenium and [31] when administrated vitamin E _selenium to dairy buffaloes, and [32] showed increasing in milk yield in dairy cattle following supplemented with vitamin E-Se in last pregnancy and lactation period, whereas [33] showed no significant effect of vitamin E and selenium on milk yield.

3.2. Milk fat percentage
The results recorded significant (p<0.01) increasing in milk fat percentage in T1 and T2 groups as compared with the C group while there was no significant effect of zingiber officinalis root on fat percentage (Table 2)

### Table 2. Milk fat percentage of Iraqi does as affected by dietary Zingiber officinalis and vitamin E + selenium supplementation during six weeks experimental period (Mean ± SE).

| Week | Treatment          | 1\(^{st}\) week | 2\(^{nd}\) week | 3\(^{rd}\) week | 4\(^{th}\) week | 5\(^{th}\) week | 6\(^{th}\) week |
|------|--------------------|-----------------|----------------|----------------|----------------|----------------|----------------|
|      | Control C          | 3.91±0.11       | 3.37±0.05      | 2.73±0.18      | 2.77±0.14      | 2.80±0.08      | 2.83±0.11      |
|      | Zingiber officinalis (T1) | 4.25±0.48       | 3.41±0.05      | 3.13±0.18      | 2.86±0.15      | 2.97±0.13      | 2.87±0.18      |
|      | VitE+selenium. (T2) | 3.73±0.13       | 3.43±0.09      | 3.43±0.09      | 3.38±0.10      | 3.06±0.16      | 3.12±0.14      |

Mean with different superscripts within similar column differ significantly (P<0.01).

The significant increase in fat percentage of T2 group may be due to vitamin E-Se role for increasing fatty acid production like C10:0 and C6:0 level [33]. The fat percentage increased significantly when ration supplemented with vitamin E-Se [17]. Other studies showed increasing in fat percentage following dietary vitamin E supplementation [34]. The current finding were in line with [35] who showed increasing in fat percentage of cow's milk following supplemented with vitamin E, and [20] who recorded increase in fat percentage in Meriz does after treated with vitamin E and selenium selenite.

3.3. Milk protein percentage
Current results showed significant (p<0.05) increase in milk protein percentage of T2 group as compared with C group, however non significant effect of vitamin E – Selenium on protein percentage (Table 3).

### Table 3. Milk protein percentage of Iraqi does as affected by dietary Zingiber officinalis and vitamin E + selenium supplementation during six weeks experimental period (Mean ± SE).

| Week | Treatment          | 1\(^{st}\) week | 2\(^{nd}\) week | 3\(^{rd}\) week | 4\(^{th}\) week | 5\(^{th}\) week | 6\(^{th}\) week |
|------|--------------------|-----------------|----------------|----------------|----------------|----------------|----------------|
|      | Control C          | 3.48±0.10       | 3.25±0.05      | 3.28±0.05      | 3.36±0.07      | 3.25±0.06      | 3.21±0.05      |
|      | Zingiber officinalis (T1) | 3.70±0.07       | 3.40±0.08      | 3.31±0.04      | 3.35±0.04      | 3.43±0.02      | 3.43±0.05      |
|      | VitE+selenium. (T2) | 3.46±0.03       | 3.26±0.03      | 3.31±0.05      | 3.24±0.05      | 3.32±0.05      | 3.28±0.04      |

Mean with different superscripts within similar column differ significantly (P<0.05).

This increase in protein percentage of T1 may be attributed to role of Zingiber officinalis root to increase the activity of normal micro flora in rumen that lead to improve rumenal microbial protein and increase milk protein % occurred [36], and the role of Zingiber officinalis to increase total
protein in body by improving the protein digestion and metabolism and inhi-

cent shorten time of feed to pass through the digestive system [37].

3.4. Milk lactose percentage

Current results showed increasing (p<0.01) in lactose percentage of T1 group in comparison with C group, however non significant effect of vitamin E-Selenium on lactose percentage was noticed. (Table 4)

| Week treatment | 1st week   | 2nd week   | 3rd week   | 4th week   | 5th week   | 6th week   |
|----------------|------------|------------|------------|------------|------------|------------|
| Control C      | 4.01±0.20  | 4.27±0.14  | 4.27±0.16  | 4.20±0.08  | 4.01±0.01  | 4.05±0.03  |
| Zingiber officinalis (T1) | 4.43±0.14  | 4.61±0.11  | 4.55±0.14  | 4.62±0.09  | 4.38±0.06  | 4.30±0.07  |
| VitE+selenium. (T2) | 4.32±0.05  | 4.33±0.13  | 4.47±0.09  | 4.43±0.10  | 4.23±0.09  | 4.20±0.06  |

Mean with different superscripts within similar column differ significantly (P<0.01).

The increasing in milk lactose percentage of T1 group may return to the effect of Zingiber officinale root that decrease blood glucose level [38], In this way [27] noticed increasing in milk lactose percentage in dairy cows fed rations supplemented with Zingiber officinalis root. The current results were agreed with [26] who found increasing in lactose percentage in dairy cows fed on rations supplemented with Zingiber officinalis root powder.

3.5. Milk solid not fat percentage

The percentage in solid not fat in milk increased significantly (p<0.01) in T1 group as compared with the C group (Table 5).

| Week treatment | 1st week   | 2nd week   | 3rd week   | 4th week   | 5th week   | 6th week   |
|----------------|------------|------------|------------|------------|------------|------------|
| Control C      | 9.01±0.20  | 9.08±0.22  | 9.16±0.19  | 8.66±0.13  | 8.51±0.11  | 8.31±0.13  |
| Zingiber officinalis (T1) | 9.35±0.26  | 9.56±0.16  | 9.07±0.18  | 9.58±0.18  | 9.71±0.18  | 9.35±0.06  |
| VitE+selenium. (T2) | 8.92±0.23  | 9.11±0.21  | 9.24±0.18  | 9.25±0.18  | 8.99±0.17  | 9.11±0.22  |

Mean with different superscripts within similar column differ significantly (P<0.01).

The increasing in SNF percentage in T1 group in comparison with the C group, was the role of Zingiber officinalis root supplementation that lead to increase of non-protein nitrogen and lactoses percentage in milk its was finally lead to increased solid not fat SNF percentage in milk [10], this results same the results of [12] who referred to increased of SNF percentage in milk ewe supplemented with zingiber officinale extract.

4. Conclusion
The effect of zingiber officinalis on milk and its chemical composition better than the effect of vitamin E-selenium.

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