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ABSTRACT

The objectives of this experiment were to investigate the effects of supplementation of four types of medicinal herbs on some rumen fluid parameters, fermentation gas production, activities of rumen bacteria, blood constituents of bucks and productive performance of does. Fifteen mature healthy goat bucks averaged 44.75 ± 3.6 kg live body weight and 33 months of age were divided into five similar groups (3 animals each). Another 5 experimental groups of does (7 does each) with an average live body weight of 56.38 ± 4.3 Kg were also used. All groups were fed similar basal diet consisted of 60% concentrate feed mixture (CFM) and 40% berseem hay (BH) on DM basis. Bucks and does in the 1st group was fed on basal diet without supplementation (control), while CFM in diets of the 2nd, 3rd, 4th and 5th groups were supplemented with 1 g/10 kg LBW, of Ginger powder (Zingiber officinale, L) ZIN, Curcumin or Turmeric powder (Curcuma longa) CUR, Oregano leaves crushed (Origanum vulgare, L.) ORI or crushed (Nigella sativa, L. seeds) NSS. Results showed that all the tested feed additives, except ORI one, were significantly (P<0.01) increased pH values of rumen fluid in comparison with that of control that free from the additives. The highest values of VFA were obtained with groups received either ZIN or ORI followed by that from NSS group with insignificant differences between them and control one. Other with CUR-ration had significant lower total VFA than that of control one. The supplementation with ORI produced the highest (P<0.01) NH₃-N value compared to those of NSS, ZIN, CUR and control groups. Also, the values of ZIN, CUR and NSS regarding NH₃-N were significantly higher than that of control. The addition of CUR produced the highest value of in vitro gases with proteolytic bacteria and NSS gave the highest one with cellulolytic bacteria, while ZIN recorded the highest gas with amylolytic bacteria without significant differences for all. Differences among treatments in terms of Deoxy ribonucleic acid (DNA), Ribonucleic acid (RNA) and Olego nucleotide (ON) were not significant. The group received ZIN had the highest values for proteolytic, cellulolytic and amylolytic bacterial groups compared to the control ones or those received CUR, ORI or NSS ones. Animals received ORI gave the lowest significant (P<0.01) values of all studied blood constituents among the values of all experimental dietary treatments. Does in the experimental groups showed that supplementation improved and maintained their body weight from starting of the experiment till after kidding with superiority for CUR, ORI and NSS over that recorded for ZIN and control groups. As for average total milk production during suckling period NSS group produced the highest value followed by ORI, CUR and ZIN compared to the control ones which produced the lowest average. Meanwhile, kids average birth weight was higher in NSS group followed by those of ORI, CUR and ZIN, respectively compared to that in the control group. On the other hand, kids of the control group and ORI ones attained more weaning weight than those of the other 3 groups although the average daily body weight gain of kids in the control group during the 90 days of suckling (g/h/d) was the lowest value. It can be concluded that the use of herbs as feed additives in a descending order (NSS followed by ORI, CUR and ZIN) according to the results obtained herein can participate in enhancing animal productivity, health and reducing the energy which can be lost from other feed constituents.

Keywords: Bucks, Does, Kids, Milk, Ginger, Curcumin or Turmeric, Oregano, Nigella sativa, rumen, bacteria, blood.

INTRODUCTION

Few decades ago, with increasing populations in the world, scientists used antibiotics as feed additives in dairy cows to improve animal's productivity to meet human needs. Nowadays from one point of view, with increasing health awareness its use became banned in different countries due to the fearing of appearance for residues in animal products (Russell and Houlihan, 2003). So that, attention has recently paid to natural antimicrobial sources as a safe means of modifying ruminal fermentation. For this reason, the interest in phytogetic feed additives has considerably increased recently. Phytogetic feed additives are commonly defined as plant-derived compounds incorporated into farm animals’ diets, such as herbs, spices and essential oils (Windisch et al., 2008 and Jacela et al., 2010). From environmental point of view, herbs and essential oils of aromatic plants used as feed additives in order to reduce methane emission from livestock during last decade as discussed and reviewed by Papatsiros et al. (2012). According to this classification, Ginger (Zingiber officinale) and Oregano (Origanum vulgare L.) considered as flavouring additives, Turmeric (Curcuma longa) used as a spice, food preservative and colouring material and Black Common Seeds (Nigella sativa, L.) is classified as a mild spice. On the basis of plant organs used, ginger and curcumin are rhizomes, leaves for oregano and seeds for black common. All the four tested additives have antioxidant, antimicrobial, pharmaceutical and nutritional properties. Some plant extracts and pure forms of active compounds of plants were evaluated for their potential application as modifiers of rumen microbial fermentation. As VFA are the end products of rumen microbial fermentation and represent the main supply of metabolizable energy for the ruminant (Van Soest, 1982), a reduction in their production would be nutritionally unfavorable for the animal (Busquet et al., 2005). These additives can modify diet fermentability and energy availability for ruminants. Ginger (Zingiber officinale) "ZIN" contains compounds named gingerol, ginger-related and diarylheptanoids. The chemical group of alkaloid compounds called capsaicinoids (CAPS) is the main source of pungency in peppers which are produced in its fruit. Similarity detected in the atomic structure of CAPS and zingerone (ginger's active component, Zingiber officinale). The CAPS is the most abundant Capsaicin which through antioxidant activity triggering the brain to release natural painkillers (endorphins), producing the mouth water, responsible for neutralizing cavity-causing acids. The thermic effects of food (TEF) (the slight increase in the body’s metabolic rate after consumption of a meal) increases in foods containing CAPS. Accordingly, CAPS in a meal containing foods can increase the body’s TEF up to 25% for three hours. In vitro gas production studies by Bunglavan et al. (2010) using Zingiber
El-Deeb, M. M. and E. S. H. El-Gohary

officialne rhizomes water residue recorded a reduction in methane production by about 15.02%.

Curcumin (Curcuma longa) is rich in carbohydrates (69.4%) and steam distillation of rhizomes produce about 5.8% essential oil contains mainly 25% zingiberene and 53% sesquiterpines. Curcumin antioxidant activity was due to it works as a scavenger of oxygen free radicals and protects hemoglobin from oxidation. Masuda et al. (2001) and Chattopadhyay et al. (2004) said that this effect occurred by maintaining the activities of antioxidant enzymes like superoxide dismutase, catalase and glutathione peroxidase. The last authors added also that a wide spectrum of biological actions noticed, e.g. antioxidant, anticancerous, antifertility, antibacterial, antifungal, antiprotozoal, antiviral and hypocholesteremic activities for curcumin (diferuloylmethane), the main bioactive yellow component of turmeric. The curcumin's yellow pigment and demethoxylated curcumins found in both turmeric and ginger known to possess their potent antioxidant activity (Kikuzaki et al., 1994; Kikuzaki and Nakatani 1993). Rios et al., 1988 stated that tests of antimicrobial activity can be classified as diffusion, dilution or bioautographic methods.

Another one of the various herbal spices is Oregano (Origanum vulgare L.) "ORI" shows the highest antioxidant activity. Oregano's essential oils named Carvacrol has been proved to be the most important fungitoxic compound. According to Holland et al. (1991) the dietary value of oregano is quite high, since it contains significant amounts of vitamins E, B6, riboflavin, niacin, folate, pantethenate and biotin. Lagouri and Boskou (1996) detected α-, β-, γ- and δ-tocopherol in a non-polar fraction of oregano extracts, with the α-tocopherol content being significantly higher than other tocopherol homologues. Oregano also has a relatively modest energy and fat content "66 kcal/100 g and 2 g fat/100 g, respectively" (USDA, NRCS, 2007). In a study of natural herbs as alternatives to antimicrobials, a decrease in sow and litter mortality occurred in an experiment in which sows were fed oregano leaf, flower, and essential oil.Benriched food fed oregano leaf, flower, and essential oil.Benriched food Californian goats and proved to have positive influence on improvement in milk production and feed efficiency and kids weights as discussed and managerial conditions.

Moreover, to achieve the second goal of this study, thirty-five mature healthy does averaged 56.38 ± 4.3 kg live body weight in the second parity were divided into five similar groups, 3 animals each. The trial lasted for 4 weeks, where the first three weeks were considered as preliminary period and the fourth one was employed for rumen fluid sampling and measurements. Blood samples were also collected from all experimental animals once at the last day of the experiment. Bucks within all experimental groups were housed under semi-open sheds and kept under the same feeding and managerial conditions.

MATERIALS AND METHODS

This study was carried out at El-Serw Experimental Station, at Domiat Governate, belonging to the Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture, Egypt.

Animals:

To achieve the goals of the present investigation two separate trials carried out using bucks and does. In the first trial fifteen mature healthy goat bucks averaged 44.75 ± 3.6 kg live body weight and 33 months of age were divided into five similar groups, 3 animals each. The trial lasted for 4 weeks, where the first three weeks were considered as preliminary period and the fourth one was employed for rumen fluid sampling and measurements. Blood samples were also collected from all experimental animals once at the last day of the experiment. Bucks within all experimental groups were housed under semi-open sheds and kept under the same feeding and managerial conditions.

Moreover, to achieve the second goal of this study, thirty-five mature healthy does averaged 56.38 ± 4.3 kg live body weight in the second parity were divided into five similar groups (7 dams each) according to LBW, parity and milk production. Does were housed under a semi-roofed yard and kept under the same managerial conditions. Does were fed the supplementation from the last third of pregnancy period till weaning their kids after 90 days from kidding.

Feeding system and treatments:

Bucks in all groups in the first trial as well as does in the second one fed a basal ration consisted of 60% concentrate feed mixture (CFM) plus 40% beseem hay (BH) on DM basis according to allowances of NRC (1981). All animals received the experimental feed additives "at the rate of 1g/10 kg live body weight" from Ginger powder, Zingiber officinalis (ZIN), Turmeric powder, Curcuma longa (CUR), Oregano leaves, Origanum vulgare (ORI) or Black Common (Nigella sativa, L) seeds (NSS) in the 2nd, 3rd, 4th and 5th groups, respectively while the 1st group fed the basal ration without feed additives. Such additives were mixed manually with some fine CFM and then supplemented with the whole amount of daily diets according to Chevallier (1996). Approximate chemical analysis for both CFM and BH according to the methods of A.O.A.C. (1995) was carried out. The bucks were kept at separated pens for about 28 days, in which the dry matter intake of the tested BH and CFM was adjusted and the tested additives were given once with every morning meal.

Diet were offered in two equal parts at 900 a.m. and 1600 p.m. along the experimental periods to all experimental animals. Fresh water was available for the animals at all times a day. Chemical composition of the experimental ingredients and calculated composition of the control and tested diets are presented in Table (1).
Table 1. Chemical composition of feedstuffs, calculated composition of experimental rations and its calculated feeding values (% DM).

| Ingredient       | DM (%) | OM (%) | CP (%) | EE (%) | CF (%) | NFE (%) | Ash (%)
|------------------|--------|--------|--------|--------|--------|---------|-------
| CFM*             | 91.20  | 87.50  | 16.10  | 4.29   | 14.01  | 53.10   | 12.50 |
| BH               | 89.00  | 89.19  | 13.05  | 1.94   | 25.51  | 48.69   | 10.81 |
| Zingiber officinale, L. (ZIN) | 89.90  | 92.65  | 9.40   | 21.80  | 8.35   | 53.10   | 5.60  |
| Curcuma longa (CUR) | 90.14  | 62.99  | 7.01   | 8.51   | 7.60   | 39.87   | 7.81  |
| Origanum vulgare, L. (ORI) | 88.18  | 56.36  | 13.93  | 3.30   | 3.15   | 39.13   | 21.58 |
| Nigella sativa, L. (NSS) | 93.50  | 91.20  | 21.00  | 35.50  | 8.41   | 34.70   | 3.70  |

Calculated composition of the experimental diets (%)

- Group 1, Control (CR), 90.32
- Group 2, (+ ZIN), 90.25
- Group 3, (+ CUR), 90.32
- Group 4, (+ ORI), 90.30
- Group 5, (+ NSS), 90.35

Calculated feeding values of the experimental diets on DM basis

- Feeding values %
  - TDN
  - DCP
  - DE
  - ME
  - NE
  - GE
- Group 1, Control (CR): 90.32
- Group 2, (+ ZIN): 90.25
- Group 3, (+ CUR): 90.32
- Group 4, (+ ORI): 90.30
- Group 5, (+ NSS): 90.35

Rumen fluid parameters:

Some rumen fluid parameters, i.e. pH, ammonia-nitrogen (NH$_3$N) and total volatile fatty acids (VFA) concentrations were determined in rumen liquor (RL) samples taken via the stomach tube of the three experimental bucks in each group. On each of the two sampling days about 50 ml of rumen fluid was collected just before offering the morning meal (0 time) and at 2, 4 and 8 hours after offering morning feed for determining the above-mentioned parameters. Rumen liquor pH was immediately measured and the rest of samples of rumen liquor were filtered through two layers of surgical gauze. Sub-samples of known volumes were used for the determinations of VFA and NH$_3$N concentrations. The remaining filtered rumen liquor was kept frozen at -20°C for microbiological studies. Rumen pH was read-off immediately using battery operated pH meter (CG 728 SCHOTT). The concentration of NH$_3$N was determined according to the method of Conway and O'Malley (1957). According to Abou Akkada and El-Shazly (1964) a known volume of RL sample was acidified by concentrated orthophosphoric acid and 0.1 N HCl and kept frozen at -20°C until their analysis for the VFA concentration using the Markham apparatus for steam-distillation for about 10-15 minutes.

Microbial growth measurements:

Microscopic examination was used for direct counting of the bacterial cells in rumen fluid. Breed slide techniques was used as described by Collins and Lyne (1985). Approximate count of rumen bacterial population in appropriate dilution of rumen fluid was measured offline at 600 nm in 1 cm cell using PYE Unicam SP6-400 UV spectrophotometer. Appropriate volume of rumen fluid was inoculated in a three different culture media under anaerobic conditions using vaspar broth method as described by West and Wilkins (1980). After the time of incubation at 39°C, the produced gas was measured using a ruler.

Determination of microbial enzymes produced in the rumen liquor:

About 10 ml portion of rumen fluid “liquid phase” was taken as interval samples. Centrifugation was carried out at 4000 rpm for 15 min to remove bacterial cells, cell debris and residues of rumen components. The supernatant obtained was used as a crude enzyme solution after appropriate dilutions. Cellulase activity was measured by using filter paper following the method described by Gadgil et al. (1995). Amylase activity in rumen fluid was measured by the method described by Kochhar and Dua (1990). Quantitative assay of proteinase activity was carried out using the modified casein digestion method described by Lupin et al. (1982). The determination of Deoxyribonucleic acid (DNA), Ribonucleic acid (RNA) and Oligo nucleotide (ON) carried out according to the technique of Maniatis et al. (1982) and Levine and Cooney (1973). The absorbency was measured at 260 and 280 nm using Milton Roy Spectronic 1201 spectrophotometer using distilled water as blank and the DNA and RNA calibration curve were setup and the following equations were adopted:

For DNA:  
\[ Y = ax + b \]

Where:  
\[ a = 0.021 \text{ and } b = 0.007 \text{ and } r=1.0 \]

For RNA:  
\[ Y = ax + b \]

Where:  
\[ a = 0.018 \text{ and } b = 0.033 \text{ and } r=0.999 \]

Blood samples:

Blood sampling were taken once at the last day of the experimental period from the jugular vein of the three bucks in each group with anticoagulant. Each sample was divided into two parts, the first to determine some haematological parameters including hematocrite (Ht%), hemoglobin (Hb), Red Blood Corpuscles (RBCs) and White Blood Corpuscles (WBCs) immediately after blood samples collection. The 2nd sample was centrifuged at 3000 rpm for 20 minutes to obtain plasma which was stored at -20°C till the biochemical analysis. Concentrations of total protein, albumin and globulin (calculated by difference), creatinine, urea-N, energy glucose, total lipids, cholesterol,
triglycerides and cholesterol were estimated. In addition, activity of aspartate (AST), alanine amino-transferase (ALT) and alkaline phosphatase (Alk-P) enzyme activities was determine calorimetrically using commercial chemical reagent kits (Bio-diagnostic product Kit, Egypt).

**Does and kids performance parameters:**

Does were weighed biweekly starting from the last third of pregnancy period (at the start of experiment) until kidding to evaluate changes of live body weight of does.

Daily milk yield for each ewe was determined weekly using weight suckling-weight technique. During suckling period (90 days), milk yield measurements were commenced after the kids were allowed to suckle the dams for the first 7 days postpartum. The kids were separated from their dams for 12 h overnight and only reintroduced to their dams after hand milking and milk was collected and weighed thereafter. The daily milk yield was calculated by summing the weight of suckled milk, differences between kid’s weight before and after suckling, and the weight of striped milk in both morning and evening milking.

After 7 days from kidding suckling milk were determined weekly and average daily milk yield during suckling period (Kg/doe) was calculated. Kid’s average birth weight (Kg/h), average weaning weight (Kg/h) as well as calculated average daily body weight gain of kids during the 90 days of suckling (g/h/d) were also recorded.

**Statistical analysis:**

Data were subjected to factorial statistical analysis by the computer program of SAS (1996) using the General Linear Model (GLM). The data of rumen liquor, rumen liquor’s bacteria activities, single cell protein concentration, dams’ weight, milk yield and kids’ parameters were subjected to analysis of variance for examining the effects of treatments, time of sampling and their interaction. Means were compared according to Duncan’s Multiple Range Test at 0.05 level (Duncan, 1955).

**RESULTS AND DISCUSSION**

Herbs are medicinal plants valued for their medicinal and aromatic properties and are often grown and harvested for these unique properties. Ravindran et al. (2002) classified the herbs and spices according to its basic uses to flavouring, deodorizing/masking, pungency and colouring. Accordingly, the four tested herbs in the present study are of different properties that distribute them under different categories of their potent effects.

**Effect of feed additives on some rumen liquor parameters:**

From the chemical composition of the tested additives (Table 1) it could be noticed that tested rations with all tested feed additives, except that of ORI one, were significant higher respecting ruminal pH values than that of control ration, while ORI-ration was insignificant higher than the control and in the meantime the differences among all tested rations did not significant in respect of pH values (Table 2). Regarding sampling time effect, pH values followed the normal pattern since it started to decrease significantly (P<0.01) after 2 and 4 hours of feeding and back to increase after 8 hours. The obtained trend for the tested additives can be explained by its capability because its content of pungent compounds that initialize making the mouth water (more saliva), which helps to neutralize cavity-causing acids (Purseglove et al., 1981). Moreover, Bensky and Gamble (1993) documented that Ginger (ZIN) is a diaphoretic (causes much sweat) and effective as a digestive aid by increasing the production of digestive fluids and saliva.

The highest (P<0.01) value of VFA (Table 2) obtained with the group received either ZIN or ORI followed by those from the control and NSS groups, respectively. At the same time CUR group recorded the lowest VFA value. Such differences between each value of control, ZIN and ORI rations and that of CUR one were highly (P<0.01) significant, but the CUR-tested ration did not significantly differ than that for NSS group. As sampling time advanced, total VFA concentration increased significantly (P<0.01) compared to that recorded for 0 time (before feeding). In this concern, Busquet et al. (2005) reported that some plant extracts and pure forms of active compounds of plants were evaluated for their potential application as modifiers of rumen microbial fermentation. They added also that, as VFA are the end products of rumen microbial fermentation and represent the main supply of metabolizable energy for the ruminant, a reduction in their production would be nutritionally unfavorable for the animal.

Andoa et al. (2003) reported that adding herbs to rations of dairy cattle had no adverse effects upon ruminal fermentation and nutrient digestibilities. On the other hand, Busquet et al. (2005) found that plant extracts including ZIN and some active compounds of herbs and plants affected total volatile fatty acids (VFAs) concentrations and individual VFA’s proportions as well as N fraction concentrations in high milk yielding cows.

Regarding NH$_3$-N concentration in the rumen fluid (Table 2), ORI supplement produced the highest (P<0.01) value among all the experimental dietary treatments, being the values of all tested rations were significant higher than that of control one. It is of worth mentioning that CUR recorded the lowest NH$_3$-N among the other tested additives. Sampling time showed significant (P<0.01) differences among the four tested intervals, but such difference was not significant between 2 and 4 hours of sampling. The obtained results showed that ZIN, CUR and NSS have the ability to reduce NH$_3$-N production more than that obtained in the ORI group. Such effect for the three tested feed additives (ZIN, CUR and NSS) could be referred to its antioxidant and nutritional prosperities. Since, regarding ZIN, the chemical group of alkaloid compounds called capsaicinoids (CAPS), which are produced in the fruit of pepper have the same atomic structure of zingerone (the active component of ginger, Zingiber officinale). Foods containing CAPS, e.g. ZIN, increases the thermic effects of food (TEF). The TEF is slight increase in the body’s metabolic rate after consumption of a meal. A meal containing foods with CAPS can increase the body’s TEF up to 25% for three hours. Regarding Nigella sativa seeds, it contains high nutritional compounds e.g. mono-saccharides in the form of glucose, rhamnose, xylose, and arabinose, non-starch polysaccharide components which is a useful source of dietary fiber and is rich in unsaturated and essential fatty acids (El-Saadany et al., 2008). These results are on line with those recorded and discussed by Chaturvedi et al. (2015).

It is worthy to note that improvement in nitrogen digestion can take place with adding CUR to diets of goats, since less NH$_3$ is produced in the rumen and less urea is eliminated in urine (Rochfort et al., 2008 and Santos et al., 2004).
Table 2. Effect of feed additives on some rumen liquor parameters of Zaraibi bucks.

<table>
<thead>
<tr>
<th>Item</th>
<th>Treatment effect</th>
<th>Experimental rations</th>
<th>Time effect</th>
<th>CR</th>
<th>ZIN</th>
<th>CUR</th>
<th>ORI</th>
<th>NSS</th>
</tr>
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<tbody>
<tr>
<td>pH</td>
<td></td>
<td></td>
<td>Time (hr)</td>
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<td></td>
<td>LSD = 0.19</td>
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<td></td>
<td>5.79b</td>
<td>6.00a</td>
<td>6.06a</td>
<td>5.96b</td>
<td>6.14a</td>
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<td>Total VFA (meq./100 ml RL)</td>
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<td></td>
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<td>LSD = 1.18</td>
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<td>7.67a</td>
<td>7.79a</td>
<td>5.49b</td>
<td>6.93a</td>
<td>6.60ab</td>
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<td>NH₃-N (mg/100 ml RL)</td>
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<td>25.48b</td>
<td>23.85b</td>
<td>34.37a</td>
<td>26.51b</td>
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</table>

A, B, C Means within the same row or column with different superscripts are significantly different at P<0.01.

Effect of medicinal herbs on some bacterial growth measurements and activities:

In a previous report, Hegde (2010) mentioned that out of the total methane emitted, livestock contributes about 37% that amounting to 80 million tons per year globally. When the feed reaches the rumen, it is converted into short chain fatty acids, microbial biomass and fermentative gases, mainly carbon dioxide and methane, through microbial degradation that known as enteric fermentation. The proportion of these components produced in rumen varies to a great extent with the type of intake, retention time in rumen and type of present microbes. Moreover, the variability of end outcomes of ruminal fermentative processes was attributed to adaptation of the bacterial population, or to the use of low doses of essential oils (Horton, 1980). Moreover, the antibacterial properties of essential oils and their components are broken down to its diverse commercial products as feed supplements and thereby the performance of lactating sows and weaned piglets could be adjusted favorably (Van Krimpen and Binnendijk, 2001; Ilsley et al., 2002).

Depending on different species of microbes, nutrients and other chemical substances present in the feed, the degree of fermentation will vary and the volume of gases released will also change. Therefore, there is scope for reducing the production of gases by proper manipulation of these factors. Among these efforts, the efficiency of different species and strains of rumen microorganisms that likely to vary widely and therefore attempts carried out to identify different species and their strains present in the rumen which are considered as an efficient converter of feed into amino acids and microbial biomass. In pertinent, Burt (2004) concluded that the action of EOs improved with low pH, low temperature and low oxygen levels.

Results in Table (3) indicated that gas production (GL) was not affected by herbs addition as well as Deoxy ribonucleic acid (DNA), Ribonucleic acid (RNA) and Olego nucleotide (ON) did not affected by the experimental herbal supplements. Gas length recorded during amylolytic bacterial activity was the highest among all bacterial activities’ tests. Moreover, CUR produced the highest value of gases with proteolytic bacteria and NSS gave the highest one with cellulolytic bacteria, while ZIN recorded the highest gas with amylolytic bacteria without significant differences among dietary treatments in respect of the gas production by different bacterial activities as shown in Table (3). In the meantime, the different types of bacterial activities showed that group received ZIN had significantly the highest values for proteolytic, cellulolytic and amylolytic bacterial groups compared to the control one or those received CUR, ORI or NSS ones. Although CUR group recorded the highest (P<0.05) total bacterial count (TBC), it gave the lowest (P<0.05) optical density (OD) of the tested groups (Figure 1). Sampling time seemed to have no effect on TBC, gas production for the three bacterial activities as well as OD, proteolytic, cellulolytic and amylolytic bacterial activities compared to these values recorded for the control group.

![Figure 1. Bacteria growth measurements (OD, 600 nm and TBC, CFU x 10^7/ml) in the rumen fluid of bucks supplemented with feed additives.](image-url)
Table 3. Effect of feed additives on some bacterial activities and single cell protein synthesis in the rumen liquor of Zaraibi bucks.

<table>
<thead>
<tr>
<th>Item</th>
<th>Time</th>
<th>Experimental group</th>
<th>Time effect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>CR</td>
<td>ZIN</td>
</tr>
<tr>
<td>Proteolytic activity (mg tyrosine/ml RL)</td>
<td>8</td>
<td>4.06</td>
<td>6.60</td>
</tr>
<tr>
<td>Treatment effect LSD = 1.24</td>
<td>4.44&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6.04&lt;sup&gt;A&lt;/sup&gt;</td>
<td>3.63&lt;sup&gt;B&lt;/sup&gt;</td>
</tr>
<tr>
<td>Gas length from Proteolytic bacteria (Cm)</td>
<td>8</td>
<td>0.69</td>
<td>0.50</td>
</tr>
<tr>
<td>Treatment effect LSD = 1.55&lt;sup&gt;C&lt;/sup&gt;</td>
<td>0.87</td>
<td>0.76</td>
<td>1.19</td>
</tr>
<tr>
<td>Cellulase activity (mg glucose/ml RL)</td>
<td>8</td>
<td>173.92</td>
<td>287.32</td>
</tr>
<tr>
<td>Treatment effect LSD = 55.27</td>
<td>190.63&lt;sup&gt;B&lt;/sup&gt;</td>
<td>262.08&lt;sup&gt;A&lt;/sup&gt;</td>
<td>154.53&lt;sup&gt;B&lt;/sup&gt;</td>
</tr>
<tr>
<td>Gas length from Cellulolytic bacteria (Cm)</td>
<td>8</td>
<td>0.64</td>
<td>1.13</td>
</tr>
<tr>
<td>Treatment effect LSD = 1.53&lt;sup&gt;C&lt;/sup&gt;</td>
<td>0.88</td>
<td>0.99</td>
<td>0.94</td>
</tr>
<tr>
<td>Amylolytic activity (mg glucose/ml RL)</td>
<td>8</td>
<td>2.73</td>
<td>4.42</td>
</tr>
<tr>
<td>Treatment effect LSD = 0.823</td>
<td>2.97&lt;sup&gt;b&lt;/sup&gt;</td>
<td>4.04&lt;sup&gt;A&lt;/sup&gt;</td>
<td>2.44&lt;sup&gt;B&lt;/sup&gt;</td>
</tr>
<tr>
<td>Gas length from Amylolytic bacteria (Cm)</td>
<td>8</td>
<td>1.74</td>
<td>1.63</td>
</tr>
<tr>
<td>Treatment effect LSD = 1.97&lt;sup&gt;C&lt;/sup&gt;</td>
<td>1.43</td>
<td>1.58</td>
<td>1.39</td>
</tr>
<tr>
<td>Deoxy ribonucleic acid, DNA (µg/ml)</td>
<td>8</td>
<td>44.86</td>
<td>45.57</td>
</tr>
<tr>
<td>Treatment effect LSD = 0.97</td>
<td>45.06</td>
<td>46.74</td>
<td>43.94</td>
</tr>
<tr>
<td>Ribonucleic acid, RNA (µg/ml)</td>
<td>8</td>
<td>35.88</td>
<td>36.45</td>
</tr>
<tr>
<td>Treatment effect LSD = 7.98&lt;sup&gt;C&lt;/sup&gt;</td>
<td>36.04</td>
<td>37.39</td>
<td>35.15</td>
</tr>
<tr>
<td>Olego nucleotide, ON (µg/ml)</td>
<td>8</td>
<td>17.95</td>
<td>18.23</td>
</tr>
<tr>
<td>Treatment effect LSD = 3.98</td>
<td>18.02</td>
<td>18.69</td>
<td>17.57</td>
</tr>
</tbody>
</table>

A, B, C Means within the same row or column with different superscripts are significantly different at P<0.01.

The variable findings in TBC and OD can be explained by the findings of Burt (2004) who stated that essential oils (EOs) comprise a large number of components and it is likely that their mode of action involves several targets in the bacterial cell. The hydrophobicity of EOs enables them to partition in the lipids of the cell membrane and mitochondria, rendering them permeable and leading to leakage of cell contents.

The essential oils stimulate the intestinal endogenous enzymes. Essential oils from oregano are showing the greatest potential as an alternative to antibiotic growth promoters. Oregano contains phenolic compounds (e.g. carvacrol) that have antimicrobial activity (Akagul and Kivanc, 1988).

Oregano essential oils can modify the gut microflora and reduce microbial load by suppressing bacteria proliferation. This mode of action would increase the animal’s maintenance energy requirement because enterocyte turnover is a major proportion of the basal metabolic rate. Bitter substances are found in herbs and stimulate the secretion of gastric juices. The pungent substances are found in plants such as paprika, garlic, and onion and are purported to function by increasing blood circulation, leading to faster detoxification of the whole metabolism (Papastis et al., 2012).

The picture noticed from data of Table (2) and Table (3) clearly indicates that the tested additives does not alter the rumen environment and kept it in optimal state for...
bacterial activities with tendency to increase microbial protein synthesis in forms of DNA, RNA and ON. Such positive action for the tested additives can be referred to their antioxidant, antimicrobial, pharmaceutical and nutritional properties. In this concern, however, Burt and Reinders (2003) and Chorianopoulos et al. (2004) stated that the volatile oils of Oregano in vitro have antibacterial activity against a wide range of gram-positive and gram-negative microorganisms including Listeria, Pseudomonas, Proteus, Salmonella, Clostridium species and some methicillin-resistant staphylococci. On the other hand, Busquet et al. (2005) reported that Ginger and some active compounds of herbs and plants did not modify ration fermentability and energy availability and do not have an impact on rumen bacteria with low extractions doses.

Organic acids could be established their antimicrobial effect in the intestines by suppressing fungal activity and maintaining an acidic environment (Dibner and Buttin, 2002). In addition, Castillo et al. (2004) stated that acidifiers might increase energy-efficiency and digestibility of crude protein, Ca, and P by lowering methane production and decreasing the numbers of harmful bacteria attached to the intestinal wall. The reduction in TBC that recorded with NSS group can be attributed to its richness content of oils which have lipophilic nature and possess its action through interact with the cell membrane of bacteria, thus acquiring their toxic and antimicrobial effects, especially against Gram-positive bacteria. In the meantime, the external capsule of Gram-negative bacteria can protect them against essential oils (Griffin et al., 1999 and Chao et al., 2000), but some are small enough to enter the inner membrane and damage it. Burt (2004) reported that these oils can also cause coagulation of cytoplasmic material and Chao et al. (2000), Davidson and Naidu (2000) and Farag et al. (2004) added that these substances impair fungal, protozoal and viral growth. From practical point of view, McIntosh et al. (2003) and Newbold et al. (2004) reported generally that the effectiveness of commercial blends of essential oils depends on the protein source.

**Effect of feed additives on some blood parameters:**

Data in Table (4) clearly indicated that animals received ORI gave significant lower (P<0.01) values of all studied blood constituents than that of control one. While the animals received ZIN recorded almost by the highest significant (P<0.01) values among the tested treatments but not significant differed with those of control one. The animals received CUR came in the second order after ORI one in reducing values of all blood constituents, except for Ht%, Albumin, total lipids and its fractions and liver functions which were not significant compared to those from the control group.

<table>
<thead>
<tr>
<th>Item</th>
<th>CR</th>
<th>ZIN</th>
<th>CUR</th>
<th>ORI</th>
<th>NSS</th>
<th>LSD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood picture</td>
<td>5.44&lt;sup&gt;A&lt;/sup&gt;</td>
<td>5.56&lt;sup&gt;A&lt;/sup&gt;</td>
<td>4.70&lt;sup&gt;C&lt;/sup&gt;</td>
<td>4.61&lt;sup&gt;C&lt;/sup&gt;</td>
<td>5.11&lt;sup&gt;H&lt;/sup&gt;</td>
<td>0.36</td>
</tr>
<tr>
<td>WBC, x10&lt;sup&gt;3&lt;/sup&gt;/mm&lt;sup&gt;3&lt;/sup&gt;</td>
<td>13.65&lt;sup&gt;B&lt;/sup&gt;</td>
<td>14.40&lt;sup&gt;A&lt;/sup&gt;</td>
<td>12.16&lt;sup&gt;C&lt;/sup&gt;</td>
<td>11.31&lt;sup&gt;B&lt;/sup&gt;</td>
<td>13.23&lt;sup&gt;B&lt;/sup&gt;</td>
<td>0.61</td>
</tr>
<tr>
<td>RBC, x10&lt;sup&gt;6&lt;/sup&gt;/mm&lt;sup&gt;3&lt;/sup&gt;</td>
<td>42.67&lt;sup&gt;H&lt;/sup&gt;</td>
<td>45.00&lt;sup&gt;H&lt;/sup&gt;</td>
<td>40.33&lt;sup&gt;BC&lt;/sup&gt;</td>
<td>37.33&lt;sup&gt;C&lt;/sup&gt;</td>
<td>41.33&lt;sup&gt;ABC&lt;/sup&gt;</td>
<td>3.89</td>
</tr>
<tr>
<td>Ht, %</td>
<td>13.30&lt;sup&gt;A&lt;/sup&gt;</td>
<td>13.60&lt;sup&gt;A&lt;/sup&gt;</td>
<td>11.50&lt;sup&gt;B&lt;/sup&gt;</td>
<td>10.70&lt;sup&gt;B&lt;/sup&gt;</td>
<td>12.30&lt;sup&gt;HI&lt;/sup&gt;</td>
<td>0.58</td>
</tr>
<tr>
<td>Total protein, g/dl</td>
<td>6.75&lt;sup&gt;H&lt;/sup&gt;</td>
<td>6.91&lt;sup&gt;H&lt;/sup&gt;</td>
<td>5.71&lt;sup&gt;C&lt;/sup&gt;</td>
<td>5.33&lt;sup&gt;D&lt;/sup&gt;</td>
<td>6.27&lt;sup&gt;III&lt;/sup&gt;</td>
<td>0.47</td>
</tr>
<tr>
<td>Albumin, g/dl</td>
<td>3.80&lt;sup&gt;HI&lt;/sup&gt;</td>
<td>3.89&lt;sup&gt;HI&lt;/sup&gt;</td>
<td>3.54&lt;sup&gt;D&lt;/sup&gt;</td>
<td>3.28&lt;sup&gt;D&lt;/sup&gt;</td>
<td>3.63&lt;sup&gt;H&lt;/sup&gt;</td>
<td>0.32</td>
</tr>
<tr>
<td>Globulin, g/dl</td>
<td>25.1%</td>
<td>25.4%</td>
<td>24.8%</td>
<td>24.2%</td>
<td>24.6%</td>
<td>0.30</td>
</tr>
<tr>
<td>Protein fractions</td>
<td>10.55&lt;sup&gt;A&lt;/sup&gt;</td>
<td>10.79&lt;sup&gt;A&lt;/sup&gt;</td>
<td>9.25&lt;sup&gt;C&lt;/sup&gt;</td>
<td>8.60&lt;sup&gt;D&lt;/sup&gt;</td>
<td>9.90&lt;sup&gt;H&lt;/sup&gt;</td>
<td>0.38</td>
</tr>
<tr>
<td>Total lipids, mg/dl</td>
<td>3.08&lt;sup&gt;HI&lt;/sup&gt;</td>
<td>3.89&lt;sup&gt;HI&lt;/sup&gt;</td>
<td>3.54&lt;sup&gt;D&lt;/sup&gt;</td>
<td>3.28&lt;sup&gt;D&lt;/sup&gt;</td>
<td>3.63&lt;sup&gt;H&lt;/sup&gt;</td>
<td>0.32</td>
</tr>
<tr>
<td>Triglyceride, mg/dl</td>
<td>6.75&lt;sup&gt;H&lt;/sup&gt;</td>
<td>6.91&lt;sup&gt;H&lt;/sup&gt;</td>
<td>5.71&lt;sup&gt;C&lt;/sup&gt;</td>
<td>5.33&lt;sup&gt;D&lt;/sup&gt;</td>
<td>6.27&lt;sup&gt;III&lt;/sup&gt;</td>
<td>0.47</td>
</tr>
<tr>
<td>Lipid fractions</td>
<td>6.91&lt;sup&gt;HI&lt;/sup&gt;</td>
<td>7.14&lt;sup&gt;J&lt;/sup&gt;</td>
<td>6.09&lt;sup&gt;BC&lt;/sup&gt;</td>
<td>5.42&lt;sup&gt;C&lt;/sup&gt;</td>
<td>6.32&lt;sup&gt;ABC&lt;/sup&gt;</td>
<td>0.92</td>
</tr>
<tr>
<td>Total cholesterol, mg/dl</td>
<td>140.59&lt;sup&gt;HI&lt;/sup&gt;</td>
<td>143.79&lt;sup&gt;HI&lt;/sup&gt;</td>
<td>128.87&lt;sup&gt;BC&lt;/sup&gt;</td>
<td>119.33&lt;sup&gt;C&lt;/sup&gt;</td>
<td>132.06&lt;sup&gt;ABC&lt;/sup&gt;</td>
<td>13.05</td>
</tr>
<tr>
<td>AST, u/l</td>
<td>102.28&lt;sup&gt;HI&lt;/sup&gt;</td>
<td>111.36&lt;sup&gt;A&lt;/sup&gt;</td>
<td>99.80&lt;sup&gt;BC&lt;/sup&gt;</td>
<td>92.42&lt;sup&gt;C&lt;/sup&gt;</td>
<td>102.28&lt;sup&gt;HI&lt;/sup&gt;</td>
<td>9.39</td>
</tr>
<tr>
<td>ALT, u/l</td>
<td>108.88&lt;sup&gt;HI&lt;/sup&gt;</td>
<td>111.36&lt;sup&gt;A&lt;/sup&gt;</td>
<td>99.80&lt;sup&gt;BC&lt;/sup&gt;</td>
<td>92.42&lt;sup&gt;C&lt;/sup&gt;</td>
<td>102.28&lt;sup&gt;HI&lt;/sup&gt;</td>
<td>9.39</td>
</tr>
<tr>
<td>ALK-P, u/l</td>
<td>58.47&lt;sup&gt;HI&lt;/sup&gt;</td>
<td>59.80&lt;sup&gt;HI&lt;/sup&gt;</td>
<td>53.59&lt;sup&gt;HI&lt;/sup&gt;</td>
<td>49.63&lt;sup&gt;C&lt;/sup&gt;</td>
<td>54.92&lt;sup&gt;HI&lt;/sup&gt;</td>
<td>5.05</td>
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<tr>
<td>Kidney functions</td>
<td>108.88&lt;sup&gt;HI&lt;/sup&gt;</td>
<td>111.36&lt;sup&gt;A&lt;/sup&gt;</td>
<td>99.80&lt;sup&gt;BC&lt;/sup&gt;</td>
<td>92.42&lt;sup&gt;C&lt;/sup&gt;</td>
<td>102.28&lt;sup&gt;HI&lt;/sup&gt;</td>
<td>9.39</td>
</tr>
<tr>
<td>Creatinine, mg/dl</td>
<td>0.98&lt;sup&gt;H&lt;/sup&gt;</td>
<td>1.03&lt;sup&gt;H&lt;/sup&gt;</td>
<td>0.75&lt;sup&gt;C&lt;/sup&gt;</td>
<td>0.64&lt;sup&gt;D&lt;/sup&gt;</td>
<td>0.88&lt;sup&gt;HI&lt;/sup&gt;</td>
<td>0.09</td>
</tr>
<tr>
<td>Urea-N, mg/dl</td>
<td>94.94&lt;sup&gt;HI&lt;/sup&gt;</td>
<td>97.10&lt;sup&gt;HI&lt;/sup&gt;</td>
<td>81.97&lt;sup&gt;BC&lt;/sup&gt;</td>
<td>76.24&lt;sup&gt;D&lt;/sup&gt;</td>
<td>87.77&lt;sup&gt;HI&lt;/sup&gt;</td>
<td>5.03</td>
</tr>
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<td>Glucose</td>
<td>106.83&lt;sup&gt;HI&lt;/sup&gt;</td>
<td>110.95&lt;sup&gt;HI&lt;/sup&gt;</td>
<td>93.66&lt;sup&gt;C&lt;/sup&gt;</td>
<td>87.11&lt;sup&gt;D&lt;/sup&gt;</td>
<td>101.89&lt;sup&gt;HI&lt;/sup&gt;</td>
<td>4.58</td>
</tr>
</tbody>
</table>

A, B, C Means in the same raw with different superscript differ significantly at P< 0.01.

Results related to ZIN supplementation which developing the tonic of intestinal muscles, stimulates bile secretion from the liver, helping in fats digestion and promotes cardiovascular health by minimizing platelets aggregation and keep blood flowing on arteries (Bensky and Gamble, 1993). From another point of view the NSS oils could be used as antioxidant agent as it inhibits the non-enzymatic peroxidation (Saad, 2001) which may increase the immunity and help the animals to tolerate the heat stress (Azub Awa-Allah, 2002).

The obtained results in the present trial are in harmony with those recorded by El-Saadany et al. (2008) who reported that lactating goats supplemented Origanum (OV) and Nigella sativa seeds (NSS) increased (P<0.05) significantly the Hg values and RBC’s count by 21.3% and 25.1% for OV and 34.4 and 25.3% for NSS. They
concluded also that liver and kidney functions were not negatively affected by either OV or NSS and supplementation improved the immunity function and decreased total cholesterol as well as glucose level of tested animals. Moreover, Habeeb et al. (2009) reported that Ht ratios and Hb values as well as RBCs count increased significantly in Zaraibi goats supplemented with ZIN and CUR. They added that liver and kidney functions were not affected with these supplementations. In the meantime, CUR decreased total cholesterol and improved animal immunity.

Papatsiros et al. (2012) documented that ration composition may modulate the response of rumen microbes to essential oil addition, so the simplest and most economically efficient method of delivering bioactive plant secondary metabolites to farm animals would be to feed them with either fresh or dried plant.

**Effect of medicinal herbs on some productive performance parameters of does and their kids:**

Data in figure (2) indicate that the starting weight as well as the weight of does after kidding were improved with adding herbs to their diets compared to those in the control group. The does in ORI and NSS groups were heavier than those in the other two groups and the control ones and they recorded the lowest values for weight loss after kidding. These results can be explained by the fact that herbs supplementation modify diet fermentability and energy availability for ruminants and might increase energy-efficiency to be utilized in forms of live body weight of does. The superiority of ORI group does in keeping weight after birth from loss may be due to the relatively modest energy and fat content of oregano (66 kcal/100 g and 2 g fat/100 g, respectively, USDA, NRCS, 2007). Similar trend was recorded by El-Saadany et al. (2008) reported that dams’ weights were higher in the lactating Zaraibi goats supplemented with oregano or NSS in their diet than that of the control ones during experimental period. Moreover, Habeeb et al. (2009) found that adding Turmeric and Ginger to diets of Zaraibi goats gave higher body weights than that in the control group.

The results obtained herein regarding average milk yield goes on line with that reported by El-Saadany et al. (2008) who showed that supplementing diets of lactating Zaraibi goats during the summer season with oregano and NSS improved (P<0.05) significantly milk yield by 32.1% and 42.0 %, respectively. Moreover, Habeeb et al. (2009) reported similar significant (P<0.05) increase in milk yield by 29.4 and 16.4% with supplying ration of lactating Zaraibi goats during the hot season with Ginger or Turmeric, respectively.

As for kids’ average birth and weaning weights, the attained enhancement in supplementation groups compared to the control one can be attributed to the positive change in their dams’ body weights and the improvement in average total milk yield during suckling period. This explanation can be supported by Castillo et al. (2004) who stated that acidifiers might increase energy-efficiency and digestibility of crude protein, Ca, and P by lowering methane production and decreasing the numbers of harmful bacteria attached to the intestinal wall which can be reflected on animal performance.

It can be concluded that the use of such four tested additives (preferably ZIN followed by NSS, ORI and CUR) is permissible in ruminant feeds to reduce gas production and enhance feed energy utilization to improve animal productivity and health. Because of synergism and antagonism which can take place; the extent to which bacteria can adapt to the presence of active ingredients in herbs as feed additives considerably further research work is recommended. Moreover, before usage of herbs as feed additives for farm animals on a commercial scale, it is of importance to select the additives that have no negative interaction with feed constituents in order to achieve an access of positive associative effect and optimal doses from herbs to improve the efficiency of nutrient utilization and cost effective use.
REFERENCES


Bensky, D. and Gamble, A. (1993). Fresh ginger has a warming effect on the exterior of body, while the dried ginger is APT to be recommended for warming the middle of the body. Chinese Herbal Medicine, Materia Medica, Revised ed. Seattle, W.A.: Eastland Press, pp. 300-301.


El-Deeb, H. A. M., ElBGohary, E. S. and ELBSaadany, S. A.


تأثر إضافة بعض الأعشاب الطبية في علائق الماعز الزراعي على بعض أنشطة التخمر في سائل الكرش، كونيات الدم، والمظهر الإنتاجي
محمد محمد نجيب، عبد صلاح حسن الجوهري
قسم بحوث الأغذية والمواد، معهد بحوث الإنتاج الحيواني، مركز البحوث الزراعية، وزارة الزراعة، الدقي، الجيزة، مصر.

كانت أهداف الدراسة الحالية لاستكشاف تأثيرات إضافة 4 أنواع من الأعشاب الطبية على بعض مراحل نمو سائل الكرش، الغازات الناجمة عن التخمر، بعض أنواع الكرك، مكونات الدم في النبض، وكذلك بعض المظهر الإنتاجي للأنثى. تم استخدام 150 نموذجًا معناويًا مثاثًا لكل مجموعة 3 حيوانات، بالإضافة إلى عد 35 غزيرة زراعية في 5 مجموعات إضافية (480 نموذجًا) لكل مجموعة بمتوسط 38.6 ± 4.3 كجم وزن حي، لاستكشاف تأثير إضافة مسحوق الزنجبيل (Zingiber officinale) أو بذور النبات الزنجبيل (Curcuma longa) أو بذور النبات زنجبيل (Nigella sativa) على المقطعات في القلعة. تم تنفيذ الدراسات في المجموعة الأولى للكوك والإناث على إضافة مسحوق الزنجبيلLEXE من الأعشاب الطبية (Ginger officinale) أو بذور النبات الزنجبيل (Curcuma longa) أو بذور النبات زنجبيل (Nigella sativa) في نموذج مأكولات مكملة للبروتين، وفعالية النبات الزنجبيل وذات التأثير على نموذج مأكولات مكملة للبروتين، وفعالية النبات الزنجبيل وذات التأثير على نموذج مأكولات مكملة للبروتين، وفعالية النبات الزنجبيل وذات التأثير على نموذج مأكولات مكملة للبروتين، وفعالية النبات الزنجبيل وذات التأثير على نموذج مأكولات مكملة للبروتين، وفعالية النبات الزنجبيل وذات التأثير على نموذج مأكولات مكملة للبروتين، وفعالية النبات الزنجبيل وذات التأثير على نموذج مأكولات مكملة للبروتين، وفعالية النبات الزنجبيل وذات التأثير على