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Effects of medicinal plants on haematological indices, colostrum, and milk composition of ewes

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Abstract

Objective: This study investigated the effect of dietary supplementation of black seed or ginger fine powder on haematological parameters, colostrum composition, milk yield and composition of lactating ewes.

Methods: Fifteen pregnant crossbred ewes (aged 3 to 5 years old and weighing an average of 48.5 ± 2.03 Kg) 8 weeks before expected calving date were randomly divided into three feeding treatments, five animals each. Medicinal plants were added to the basic diet at a level of 5 g/ewe/day for 3 months after parturition. Milk yield and composition were determined every week, while blood samples were withdrawn biweekly until weaning.

Results: Counts of red blood cells and white blood cells were higher ($p < 0.05$) in ewes fed ginger fine powder compared with the other groups. Colostrum dry matter percentage tended to be higher ($p = 0.077$) in ewes fed black seed than in ewes fed on basal diet only. The percentage of milk fat and total solids increased significantly in ewes that received herbal plants compared with the control ewes.

Conclusion: Data from the present study indicate that dietary supplementation of medicinal plants to ewes' diet during pregnancy period may enhance red blood cells and white blood cells as well as milk composition of ewes.

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Introduction

Loss of energy takes place during ruminal fermentation because a considerable portion of consumed energy and protein is not utilized by microflora or host animal and thus is excreted as methane and ammonia nitrogen [1]. Such wastes cause environmental pollution. In addition, the constantly increasing productive cost of milk and meat is related to the cost of feed stuff which constitutes the vast majority of the total productive cost [2]. Thus, the least cost ration formula is considered a target for animal nutrition to achieve the best efficiency of utilization and lower cost in animal health and production [2].

Feed additives such as antibiotics "monensin and lasalocid" are used to optimize diet formulation and diminish losses of energy [1]. Despite their economic benefits, growth-promoting antibiotics have been prohibited in most countries of the world because milk and meat residue are associated with many health hazards, particularly development of multi-drug resistance [3-5]. For breeders, it is important to produce milk and meat at low cost without using the banned chemicals. The sheep industry, especially in Egypt, needs new non-traditional protein sources that are cheap and sufficient in the amount to overcome the high cost of traditional protein sources [6]. Aiming to enhance immunity, milk and meat production, as well as fertility at a low cost, researchers are forced to explore natural alternative growth promoters such as medicinal plants and their extracts [5]. The last few decades witnessed an increasing attention to use of herbal plants as potential alternatives to growth promoters for animal production. Their selective antibacterial activity may inhibit degradation of protein in the rumen, and thereby potentially increase the intestinal supply of amino acids to the animal host [7].

Black seed (*Nigella sativa*) and Ginger (*Zingiber officinale*) are examples of medicinal plants alternatives that are commonly used as additives to animal feed. Availability, improved animal health, and comparable cost to commercial preparations are cited as attributes that make herbal plants attractive to producers [8]. The objective of the present study was to examine the effect of dietary supplementation of black seed and ginger fine powder on blood parameters, colostrum composition, milk yield, and composition of lactating ewes. We hypothesized that ewes supplemented by herbal plants will exhibit improved haematological parameters, colostrum composition, milk yield, and composition compared with the control counterparts.

Materials and methods

Animals and managements

The Ethics of Animal Experiments Committee of the Damanhour University approved all procedures. The present study was carried out at the experimental farm of the Faculty of Agriculture, Damanhour University situated in Al-Bostan and lasted for 5 months. The sample comprised 15 pregnant crossbred ewes (Rahmany X Balady), aged 3 to 5 years old and weighing an average of 48.5 ± 2.03 Kg. Eight weeks before parturition, ewes were randomly assigned to three treatments: a control and 2 experimental groups. Ewes in all treatments were fed a basal diet that contained wheat straw and concentrate feed mixture of 55% yellow corn, 20% wheat peel, 12.5% cotton seed, 10% Soya bean, 1% NaCl, 1.4% $CaCO_3$, and 0.1% avimix mineral mixture. A kilogram of avimix mineral mixture (AGRI-VET) is composed of manganese sulphate (16.66 g), iron sulphate (10 g), zinc sulphate (20 g), potassium iodide (0.83 g), cobalt chloride (0.17 g), sodium selenite (0.066 g), and calcium carbonate (952.27 g). While the control group received only basal diet, the 2 experimental groups received 5 g/h/d of either black seed or ginger fine powder. Concentrate feed mixture was offered twice a day at a rate of 2.5% of animal weight while wheat straw and water were offered ad lib. Wheat straw, concentrate feed mixture, black seed and ginger fine powder were analyzed for moisture, ash, crude protein, ether extract, crude fiber, and nitrogen free extract according to the official methods of analysis [9]. The resulting data are presented in (Table 1).

Sampling and measurements

Blood samples were collected biweekly from parturition until weaning from each group (in the morning before feeding). Samples were obtained from the jugular vein in clean tubes containing EDTA disodium salt as an anticoagulant for haematological parameters. Samples were transported to the laboratory and analyzed within 2 h after collection. Using an automatic blood analyzer (EXIGO VET, Boul Medical AB, Spanga, Sweden), we analyzed fresh blood samples to determine haematological parameters such as Red Blood Cells (RBCs), Hemoglobin (Hb), Packed Cell Volume (PCV), Mean Cell Volume (MCV), Mean Cell Hemoglobin (MCH), Mean Cell Hemoglobin Concentration (MCHC), platelets, and White Blood Cells (WBCs).

Ewes colostrum was sampled from each ewe within 12 h post-parturition and stored at −20°C for analysis of fat, protein, lactose, and ash. Milk yield was measured using lambs suckling technique [10]. Daily milk yield was multiplied by 7 to obtain the weekly milk yield of each ewe till the end of the lactation period. The lambs suckling technique involved separating lambs away from their mothers at 16:00 of the previous day of measurement and in the following day, lambs were weighed at 07:00, then lambs were left to suckle their mothers till satisfaction, lambs were weighed again after suckling and then were kept in closed pins while their mothers were hand milked to estimate surplus milk. The same procedure was followed again at 16:00 in the same day. The milk consumed by lambs and surplus milk (summing those at 07:00 and at 16:00) was taken as average daily milk yield. Milk samples were collected weekly from the 4^{th} day postpartum till weaning. Each ewe was fully hand milked and an amount of that milk was taken as a milk sample. Milk samples from each ewe were chemically analyzed for fat, protein, lactose, and total solids not fat by a milk analyzer (Milko tester Insturment Inc. Bulgaria). Total solids were calculated by summing solids not fat and fat.

Statistical Analysis

Mean differences among the experimental groups were tested using the One-Way Analysis Of Variance (ANOVA) test 'Duncan's Multiple Range Test' with alpha at the significance level of 0.05. The collected data were performed using PASW statistic 18.0 (SPSS, Inc., Chicago, IL, USA) [11].

Results and discussion

Haematological parameters

We found that RBCs and WBCs increased significantly in ewes fed ginger powder compared with the control ewes and ewes fed black seed. In contrast, MCH was higher in both the black seed and control groups than the ginger group ($p < 0.05$). Meanwhile, there were no significant differences in the percentages of Hb, PCV, MCV, MCHC, and platelets (Table 2). Findings from former studies are mixed. Consistent with our results, Abd El-Halim et al. [12] reported a transient decrease in RBCs count in growing lambs fed *Nigella sativa* oil (NSO) at 2 wk, but it significantly improved ($p \leq 0.05$) after 6 wk. That study also indicated significantly ($p \leq 0.05$) lower WBCs total means in the NSO treated group than the control; while PCV, MCV, MCH, and MCHC weren't affected by NSO throughout the experiment. On the other hand, Habeeb and El-Tarabany [13] recorded that *Nigella sativa* significantly increased RBCs count in Zaraibi kids; while WBCs and PCV were not affected. In line, dairy cows that were fed ginger fine powder recorded increase in RBCs, Hb, PCV, platelets, and WBCs than those fed basal diet only [4]. Meanwhile, EL-Ghousein [14] reported no difference in RBCs, Hb, and WBCs in ewes fed 10 g/h/d *Nigella sativa* seed. The positive haematological impact of medicinal plants is related to their ingredients of folic acid, iron, and vitamin C; which are blood forming factors that stimulate blood production in the bone marrow [15]. Still the observed variation in these parameters can be attributed to the variation of preparation, species, and factors that affect their absorption from the gut and their bioavailability.

Colostrum composition

The effect of black seed and ginger fine powder supplementation on colostrum composition is shown in (Table 3). Supplementation of medicinal plants during gestation did not affect colostrum composition ($p < 0.05$). However, black seed supplementation tended to increase ($p = 0.077$) dry matter percentage in colostrum compared with dry matter percentage in colostrum of ewes that received basal diet only. Results on the effect of medicinal plants supplementation on colostrum composition are conflicting among studies. Mohammadi et al. [16] reported no effect of extruded linseed (500 g/kg DM) on parameters of colostrum in cows. This study is consistent with the results in the current study.

Unlike the current study, administration of the essential oil of rosemary (0.6 g/kg) in pregnant ewes resulted in increased solids not fat and fat contents of colostrum [17]. It is well known that colostrum composition is affected by many factors such as individuality, breed, age, calving season, parity, nutrition, regimen of rearing, energy balance during dry period, length of dry period, and health status of udder [18-20].

Milk yield and composition

The percentage of milk fat and total solids improved ($p < 0.05$) in animals fed black seed and ginger powder compared with the control animals. However, there were no differences ($p < 0.05$) among treatments in milk yield, milk protein, solids not fat, lactose, and ash content (Table 4). Consistent with our findings, addition of herbs mixture to the feed of dairy cows at levels of 100 g and 200 g had no effect on milk production [21]. Similarly, Benchaar et al. [7] reported no difference in milk yield in dairy cows fed plant extracts. In accordance with our results, a former study indicated that ewes fed black seed recorded higher percentage of fat ($p < 0.05$) than those received control diet [22]. Whereas there were no significant changes in solids not fat and ash percentage. In line, Abo EI-Nor et al. [23] recorded a higher milk fat yield in *Nigella sativa* seed fed buffalo compared with control ones. The improvement in fat content may be due to the increase of ruminal activity and production of high amounts of acetic acid and acetate propionate ratio in the rumen, which are precursors of fatty acid. Despite the fact that the current study depicted no effect of herbal plants on milk yield, several other studies, in contrast, reported that milk yield increased in animals treated with black seed and ginger [4,14,23]. Kholif et al. [24] reported an increase of milk protein with ginger additives whereas milk total solids and ash percentages were not significantly affected. Similarly, EL-Ghousein [14] confirmed that total solids, fat, and lactose percentage were not affected by treatment. Interestingly, all studies that reported an increase of milk yield in response to herbal supplementation also indicated lower fat yield which indicates presence of an adverse relationship between both parameters [4,24].

Conclusion

Supplementation of black seed and ginger fine powder to ewes' diet may have a positive effect on milk fat and blood haematology. Thus, they can be used to enhance the immune response of farm animals and improve milk quality. It is not clear which ingredients of herbs used have the most effect either from the current study as well as from former ones; therefore, it is recommended that several large sample size studies using certain extracts from ginger and black seed would be performed on different farm animals to check the effect of herbal plants supplementation.

Tables

Table 1: Chemical composition and cell wall constituents of concentrate feed mixture, wheat straw, black seed and ginger fine powder (on dry matter basic).

Item	Concentrate Feed Mixture	Wheat Straw	Black Seed	Ginger Fine Powder
Dry matter	88.97	91.36	93.72	89.57
Organic matter	93.73	92.31	95.81	92.26
Crude protein	15.27	2.68	25.58	7.81
Crude fiber	9.27	39.95	4.4	7.42
Ether extract	2.37	1.77	10.52	6.12
Nitrogen free extract	66.82	47.91	55.31	70.91
Ash	6.27	7.69	4.19	7.74

Table 2: Effect of black seed and ginger fine powder supplementation on haematological constituents.

Item	Control	Black Seed	Ginger	SEM	p-value
Red blood cells ($\times 10^6/\mu L$)	10.17[b]	10.32[b]	11.01[a]	0.14	0.035
Hemoglobin (g/dl)	10.67	10.62	10.39	0.17	0.793
Packed cell volume (%)	30.53	30.61	30.67	0.35	0.988
Mean cell volume (fL)	30.17	29.7	28.09	0.38	0.066
Mean cell hemoglobin (pg)	10.51[a]	10.29[a]	9.51[b]	0.16	0.021
Mean cell hemoglobin concentration (g/dL)	34.92	34.68	33.79	0.29	0.262
Platelets ($\times 10^3/\mu L$)	224.28	224.6	227	5.81	0.979
White blood cells ($\times 10^3/\mu L$)	7.48[b]	8.12[b]	9.98[a]	0.33	0.004

SEM, standard error of the mean.

[a,b] Means in the same raw with different superscript are significantly different ($p < 0.05$).

Table 3: Effect of black seed and ginger fine powder supplementation on colostrum composition.

Item	Control	Black Seed	Ginger	SEM	p-value
Dry matter (%)	22.06	23.91	23.08	0.35	0.077
Fat (%)	3.5	4.07	3.77	0.14	0.305
Total protein (%)	13.29	14.22	13.64	0.21	0.199
Solids not fat (%)	18.56	19.84	19.31	0.27	0.151
Lactose (%)	4.2	4.51	4.3	0.07	0.153
Ash (%)	1.07	1.11	1.36	0.07	0.141

SEM, standard error of the mean.

Table 4: Effect of black seed and ginger fine powder supplementation on milk yield and composition.

Item	Control	Black Seed	Ginger	SEM	p-value
Milk yield (g/d)	458	530	570	70.9	0.824
Fat (%)	4.39[b]	5.24[a]	5.04[a]	0.12	0.007
Total protein (%)	3.61	3.78	3.72	0.04	0.281
Solids not fat (%)	10.02	10.38	10.3	0.1	0.317
Total solids (%)	14.42[b]	15.61[a]	15.37[a]	0.16	0.006
Lactose (%)	5.44	5.59	5.56	0.05	0.459
Ash (%)	0.78	0.8	0.78	0.01	0.717

SEM, standard error of the mean.

[a,b] Means in the same raw with different superscript are significantly different ($p < 0.05$).

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