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Effect of supplementation of microencapsulated essential oils on performance of growing goats

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Abstract

Eighteen Osmanabadi growing goats were randomly divided into three equal groups viz. T₀ (Control), T₁ and T₂, having six growing goats in each. Group T₀ was fed concentrate mixture routinely used on farm. Group T₁ and T₂ were fed same concentrate mixture plus supplemented with microencapsulated essential oils (EOM) @ 1 and 1.5 g/animal, respectively, for seven days with 23 days interval after every supplementation for entire experimental period of 90 days. Roughage feeding was same for all three experimental groups. The average body weights of goats and gain in weight of group T₂ were significantly ($p < 0.01$) higher followed by group T₁ and T₀. Average DMI of group T₂ was significantly ($p < 0.05$) higher than control, however, difference between group T₂ and T₁ was non significant. The average percent DMI and DMI per unit metabolic body size was comparable among all the groups. The average TDN and DCP intake was significantly ($p < 0.01$) higher in group T₂ than control. The efficiency of utilization in term of DM required (kg)/ (kg) gain in weight was significantly ($p < 0.05$) better in group T₂ than T₀, however, difference between group T₁ and T₂ was non significant. The efficiency in terms TDN and DCP required (kg)/ kg gain was comparable among various experimental groups. The economics of supplementation of EOM indicated that cost per kg gain in weight was reduced by Rs. 5.21 and 2.02 in group T₂ and T₁, respectively, over control group.

Keywords: Osmanabadi growing goats, growth performance, microencapsulated essential oils, blood biochemical parameters

Introduction

The use of essential oils in ruminant diets as an alternative to antimicrobials agents, rumen fermentation modifiers, greenhouse gas emissions reduction agent, and improved animal productivity has been documented in various studies (Zeng *et al.*, 2015; Oh *et al.*, 2017) [13, 8]. Essential oils provide beneficial effects on immune response, gut health, antioxidant status and blood cholesterol in broiler chickens (Chowdhury *et al.*, 2018) [5]. Encapsulated essential oils can reduce harmful bacteria and promote digestive enzyme activity and higher concentrations of short chain fatty acids in broiler chicken (Yang *et al.*, 2019) [11]. Some studies showed that during the post-weaning period essential oils feeding in male calves increased daily body gain, reduced feed intake and improved FCR (Soltan, 2009) [10]. It also helps in improving growth performance, nutrient digestibility, increase IgG concentration and decrease noxious gas concentration in weanling piglets (Cho and Kim., 2015) [4].

However, EOs are volatiles, heat sensitive, and susceptible to oxidation in the presence of light, air and moisture that hinder their application. Thus, microencapsulation is one strategy employed to prolong the stability of EOs during manufacturing, processing, and storage of feed. Spray drying is one of the oldest encapsulation methods that has been used since 1930s to prepare the first flavour compounds encapsulated. This method is the most used in food industry due to its cost of manufacturing, varieties of encapsulating matrices, adequate retention and stability of volatiles compounds, and large scale production in a continuous mode.

Keeping in view advantages of inclusion of essential oil in livestock ration the present study was designed to assess the effect of supplementation of microencapsulated essential oils on performance of growing goats.

Materials and Methods

The animal experimentation protocol was approved (No. IV/21) by the Institutional Animal Ethics Committee (IAEC) of College of Veterinary and Animal Sciences, Udgir. The trial was conducted at Livestock Farm Complex, College of Veterinary and Animal Sciences, Udgir, Maharashtra, having latitude 18.3942886, longitude 77.1176 and altitude 2086 ft. During the trial period, maximum 30 °C and minimum 24 °C temperature and 823 mm precipitation was recorded.

The trial involved eighteen Osmanabadi growing goats of 4-5 months age (9.80- 9.83 kg) which were randomly divided into three equal groups viz. T₀, T₁ and T₂, having six goats of either sex in each group. Group T₀ was fed concentrate mixture routinely used on farm whereas group T₁ and T₂ were fed same concentrate mixture and supplemented with microencapsulated essential oils (EOM) @ 1 and 1.5 g/animal, respectively, for seven consecutive days with 23 days interval after every supplementation for entire experimental period of 90 days. All experimental animals were fed on DHN₆ as a source of green roughage throughout experiment. The trial was conducted for a period of 90 days.

Microencapsulated Essential oils

The essential oil containing monoterpene and diterpene compounds, microencapsulated with palmitic acid by using air dry methods was utilized for supplementing growing goats from treatments groups. The essential oil was present in free flowing granular powder form having yellow colour, easy to mix homogenously in concentrate mixture.

Experimental growing goats were fed under stall feeding system with commonly routine managemental practices. The amount of concentrate mixture and roughage feeding was adjusted according to change in body weight and growth rate of growing goats. Animals were offered a diet consisting of concentrate mixture and green fodder to meet their nutrient requirements (ICAR, 1998) [7]. The growing goats were fed allowance of concentrate mixture at 8:00 am and 3.00 pm while green roughage (DHN₆) was made available throughout day. Feed leftover was weighed the next day morning to calculate total dry matter intake.

All the growing goats were treated with standard anthelmintic protocol before starting of the experiment to ensure that growing goats were free of parasites. All the experimental growing goats were reared in intensive housing system-zero grazing stall feeding with in a well-ventilated house with common routine managemental practices and environmental conditions. The experimental growing goats were housed in three separate compartments. *Ad-libitum* fresh, clean, and cool drinking water was provided to growing goats throughout experimental periods.

All the experimental animals were weighed at the start of experiment before feeding and watering and thereafter weighing was done every fortnightly at the same time. The digital weighing balance of 200 kg capacity was used for weighing the experimental animals.

The representative samples of concentrate mixtures and green fodder (DHN₆) used for feeding of experimental growing goats were collected at fortnight interval throughout the experimental period, oven dried and the pooled samples were analyzed. The analysis for proximate principles was

undertaken as per AOAC (2005) [2] in the laboratory of Department of Animal Nutrition, College of Veterinary and Animal Sciences, Udgir.

Observations of various parameters recorded during experimental period were tabulated and data were statistically analyzed as per Snedecor and Cochran (1994) [9], by using Randomized block design and Completely Randomized Design.

Results and Discussion

The percent ingredient composition of concentrate mixture used in present experiment is presented in Table 1. The chemical composition (% DMB) experimental of concentrate mixture and DHN₆ is presented in Table 2.

Table 1: Percentage composition of concentrate mixture of growing goats

Ingredients	% Composition
Maize chuni	40
Groundnut cake	22
Udid chuni	35
Mineral mixture	2
Salt	1
Total	100

Table 2: Average chemical composition of concentrate mixture and DHN₆ (%DMB)

Nutrient%	Concentrate mixture	DHN ₆
Organic matter	92.88	89.88
Crude protein	18.28	8.45
Ether extract	3.67	2.80
Crude fibre	9.68	27.56
Nitrogen free extract	61.25	51.07
Total ash	7.12	10.12

The overall performance of growing goats from various experimental groups is presented in Table 3. The average body weights and gain in weight of goats from group T₂ was significantly ($p < 0.01$) higher than group T₁ and control. Further, it is also revealed that average body weights of group T₁ were significantly ($p < 0.01$) higher than control group. The higher gain in weight observed in microencapsulated essential oil supplemented groups might be due to improvement in rumen fermentation pattern and reduction in greenhouse gas emissions. These results are in accordance with Soltan (2009) [10] who observed improved final body weight in calves fed EOM at 94 and 281 mg/calf/day as compared with control. Similarly, Chaves *et al.* (2008) [3] also observed significantly higher average daily gain in lambs supplemented with of cinnamaldehyde (CDH) and juniper berry (JUN) essential oils than control. Yatoo *et al.*, (2018) [12] found improved average daily gain in growing buffaloes by the supplementing of blend essential oils at 0.15 and 0.30 ml/kg of dry matter intake.

However, contrary to present findings, Cruz *et al.* (2014) [6] reported that addition of essential oils to the diet of bulls did not affect final live weights of bulls. Similarly, no difference in final body weight was also observed when crossbred bulls were supplemented with mixture of essential oils @ 500 and 1000 mg/kg of DM/animal/day (Rivaroli *et al.*, 2017). Soltan (2009) [10] also observed no significant effect on daily gain in weight in HF calves supplemented with 94, 187, and 281 mg EOM/calf/day. Vakili *et al.* revealed no change in average daily gain in Holstein calves supplemented with thyme (5 g/day/calf) and cinnamon (5 g/day/calf). Cruz *et al.* (2014) [6]

reported that addition of essential oils to the diet of bulls did not affect average daily gain.

The average DMI of group T₂ was significantly ($p < 0.05$) higher than control, however, difference between group T₂ and T₁ was non-significant. The average percent DMI and DMI per unit metabolic body size was comparable among all the experimental groups. This also indicated that supplementation of microencapsulated essential oil had no adverse effect on palatability of feed. These results corroborated with the findings of Yatoo *et al.* (2018) ^[12] who observed increase in DM intake of growing buffaloes by the supplementing blend essential oils at 0.15 and 0.30 ml/kg of dry matter intake.

However, contrary to the present findings, Chaves *et al.* (2008) ^[3] found that supplementation of cinnamaldehyde (CDH), garlic (GAR) and juniper berry (JUN) essential oils to lambs did not affect dry matter intake. Ahmed *et al.* (2014) ^[1] also observed that supplementation of EOB did not affect dry

matter intake in goats.

The efficiency of feed utilization by growing goats from different experimental groups was calculated in terms of DM, TDN and DCP required per kg gain in weight during the experimental period of 90 days. The efficiency of utilization in term of DM required (kg)/ (kg) gain in weight was significantly ($p < 0.05$) better in group T₂ than T₀, however, difference between group T₁ and T₂ was non-significant. Further, it is also seen that efficiency of utilization of DM required (kg)/ kg gain in weight between T₀ and T₁ group was comparable. These results corroborated with Chaves *et al.* (2008) ^[3] who found that supplementation of cinnamaldehyde (CDH) and juniper berry (JUN) essential oils to lambs improved efficiency in terms of DM intake/g gain compared to garlic (GAR) and control. The efficiency in terms TDN and DCP required (kg)/ kg gain was comparable among various groups.

Table 3: Overall performance of growing goats from different experimental groups

Parameters	Groups			Stat Sig.
	T ₀	T ₁	T ₂	
Initial average body wt.(kg)	9.80	9.81	9.84	-
Final average body wt.(kg)	13.24 ^c ± 0.95	13.63 ^b ± 1.05	13.96 ^a ± 1.13	**
Total gain in weight (kg)	6.99	7.75	8.32	-
Avg. fortnight wisegain in body wt.(kg)	1.16 ^c ± 0.02	1.29 ^b ± 0.02	1.39 ^a ± 0.02	**
Avg. daily gain in weight (g)	83.20	92.22	99.08	-
Avg. daily DM intake (kg)	0.56 ^b ± 0.03	0.59 ^{ab} ± 0.04	0.61 ^a ± 0.04	*
DM intake (%)	4.10 ± 0.09	4.17 ± 0.03	4.19 ± 0.07	NS
DMI/metabolic body size(W ^{0.75} kg)	84.26 ± 1.80	86.89 ± 0.82	88.13 ± 1.26	NS
Feed Efficiency				
DM required (kg)/ kg gain in wt.	6.77 ^a ± 0.34	6.42 ^{ab} ± 0.35	6.16 ^b ± 0.36	*
TDN required (kg)/ kg gain in wt.	4.29 ± 0.22	4.29 ± 0.23	4.14 ± 0.24	NS
DCP required (kg)/ kg gain in wt.	0.565 ± 0.029	0.548 ± 0.030	0.546 ± 0.032	NS

* Significant at 5% level ** Significant at 1% level NS-Non significant

The economics of supplementation of EOM indicated that the feeding cost per kg weight gain was Rs. 129.72, 127.70 and 124.51 for groups T₀, T₁ and T₂, respectively. Thus, it was revealed that the cost per kg gain in weight was reduced by Rs. 5.21 and 2.02 in group T₂ and T₁, respectively, over control group, by supplementing microencapsulated essential oils @ 1.5 and 1 g/growing goat for 21 days in three months period (each supplementation of 7 days at 23days interval).

Conclusion

From the result obtained under the present study, it is concluded that supplementation of microencapsulated essential oils @ 1.5 g/growing goat for seven consecutive days in a month for 3 months period is beneficial for improving overall performance of growing goats in terms of weight gain and efficiency of utilization. Such supplementation is also cost effective. The supplementation of microencapsulated essential oils @ 1 g/growing goat is also beneficial in growing goats.

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Conflict of Interest

Not available.

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Not available.

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