The effects of Garlic Oil (*Allium sativa*), Turmeric Powder (*Curcuma longa Linn*) and Monensin on Total Apparent Digestibility of Nutrients in Baloochi Lambs

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***Abstract*—**The objective of this study was to determine the effects of garlic oil (*Allium sativa*), turmeric powder (*Curcuma longa Linn*) and Monensin on Total apparent digestibility of nutrients in Baloochi lambs. The experiment was designed as a 4 x 4 Latin square using 4 ruminally baloochi lambs with 4 treatments in four 28-d periods. Treatments were control (no additive), garlic oil (0. 4 g/d), monensin (0. 2 g/d) and turmeric powder (20 g/d). Total apparent digestibility's (% of intake) of organic matter (OM), dry matter (DM), crud protein (CP), ether extract(EE), non fiber carbohydrate (NFC), acid detergent fiber (ADF) and neutral detergent fiber (NDF) in the total tract were not influenced by addition of either additives.

***Keywords*—**apparent digestibility, essential oil, garlic oil, monensin, turmeric

I. Introduction

ESSENTIAL OILS (EO) are volatile, complex mixtures of secondary metabolites and volatile compounds characterized by a strong odor extracted from plants through distillation process and are formed by aromatic plants as secondary metabolites. They are known for their antiseptic, i. e. bactericidal, virucidal and fungicidal, and medicinal properties and their fragrance. essential oils used traditionally by man for many centuries for the pleasant odor of the essence [1]. Essential oil are classified as generally recognized as safe food additives and have been proposed as a safe alternative to antibiotics growth promoter [2]. Essential oils have been shown to modulate ruminal fermentation to improve nutrient utilization in ruminants [3]-[4]. It is accepted that the controlled administration of certain antibiotics can be useful for ruminants and non ruminants [5]. In ruminants, several types of chemicals agents and antibiotics have been developed in order to manipulate the fermentative digestion and flux of nutrients from rumen [6]. Most of the products used for ruminants are ionophores, these can increasing efficiency of energy metabolism and improve nitrogen metabolism in the rumen [7]. One of the ionophores that most commonly used feed additives in cattle is monensin [8]. There is a great awareness from public health aspects such as residues of these chemicals in the milk and meat and bacterial resistance to antibiotics [9]. In the last two decades have seen a substantial increase in the use of aromatic herbs and essential oils as feed additives in animal nutrition. One of the main reasons for this trend is to substitute antibiotic growth promoters, which have been completely banned as feed additives in the European Union since 2006 [10]. Beseem Plants and their extracts have important potential as manipulators of rumen fermentation for productivity and health benefits [1]. Only a few studies to date have investigated the effects of EO or their components on digestion in sheep. Objective of this experiment was to evaluate the effect of monensin, garlic oil (*Allium sativa*) and turmeric powder (*Curcuma longa Lin.)* on total apparent digestibility of nutrients in Baloochi lambs.

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II. Materials And Methods

A. Animals, diet and experimental design

The Four ruminally fistulated Baloochi lambs (38±1.5 kg body weight) were used in a 4×4 Latin square design with 4 periods. Each period included 21 days of adaptation. The animals were housed in individual metabolically cages (0.5× 1.2×1m) and had free access to salt and fresh water throughout the experiment. The animals were fed a diet, (2.48 Mcal kg^{-1} DM and CP 155 g kg^{-1}DM) containing of Lucerne hay and concentrate (45:55 based on DM, respectively). The treatments were basal diet (as control) or plus 0.4 g of garlic oil, 20 g turmeric powder and 0.2 g monensin (day/head).

B. Sampling and Chemical Analyses

Experimental period consisted of 28 days; the first 21 days were designated to adaptation of animals to diets and 7 days of each period for feces collection. The digestibility trial was performed between the 21 and 28 day. For each animal, Dry Matter Intake (DMI) was measured at the last seven days of each period and grab samples of feces (approximately 150 g) were collected at the last seven days of the period. All chemical analyses were performed for each

sample in duplicate. All feed and feces samples were ground through a Wiley mill with a 2 mm screen for chemical analyse. Analytical dry matter (DM) of the samples was determined by drying in air oven at 55 °C for more than 72 h until constant weight[11]. Ash content was determined by oven at 550ºC overnight, organic matter (OM) content was calculated as 100 minus the percentage of ash[11].

The neutral detergent fiber (NDF) and acid detergent fiber (ADF) contents were determined using the methods described by Van Soest et al., (1991) [12]. Crude protein (CP) was determined by the Kjeldahl method[11]. Non fiber carbohydrate (NFC) concentration in diet and feces was calculated as NFC= 100-(CP+ ash+ EE+ NDF). Total tract apparent digestibility of nutrients was calculated as suggested with Church (1988) [13].

C. Statistical Analyses

Data were analyzed using the same mixed model procedure of SAS[14] as a Latin square design with treatment, period, and their interaction as fixed effects and lambs within treatment as random effects.

III. Results And Discussion

Results of the present study indicated that Total apparent digestibility's of DM, OM, CP, NDF, NFC, EE and ADF were not influenced by garlic oil, monensin and turmeric powder supplementation compared with control (Table 1).

TABLE I
APPARENT DIGESTIBILITY (%) OF NUTRIENTS IN BALOOCHI LAMBS FED DIFFERENT ADDETIVES

Nutrients	Treatments				SEM[1]	P-value
	Control	Garlic oil	Monensin	Turmeric		
DM	68. 53	69. 90	72. 92	68. 75	1.61	NS
OM	72. 83	73. 19	75. 85	72. 22	1.42	NS
NDF	48. 88	47. 86	54. 39	46. 23	2.66	NS
ADF	48. 34	47. 67	51. 59	46. 33	2.82	NS
NFC	90. 95	94. 40	93. 71	95. 67	1.04	NS
EE	64. 56	64. 26	66. 95	64. 32	2.14	NS
CP	76. 84	77. 82	80. 02	77. 02	1.18	NS

1: Standard error of mean

These results agree with the results of Benchaar et al, (2006), They were supplemented diets of lactating Holstein cows with essential oils (0 vs. 2 g/d; EO) and monensin (0 vs. 350 mg/d; MO). They show that apparent digestibility's of dry matter, organic matter and neutral detergent fiber were similar among treatments, but apparent digestibility of acid detergent fiber was increased when diets were supplemented with EO (48. 9 vs. 46. 0%) and Apparent digestibility of crude protein was higher for cows fed MO compared with than fed other diets (65.0 vs. 63.6%) [15]. Meyer et al., (2009) conducted experiment with 300 mg monensin (day/steer), and 1 mg essential oil mixture (EOM) (day/steer). They found the treatments did not significant effect on total tract digestibility [16].

In similar study, Gonzalez et al., (2009) showed that diet containing 30 parts per million (ppm) monensin in lambs did not effect on digestibility of DM, NDF and NFC [17]. yang et al., (2007) reported that total digestibility's of DM, Om, NDF and ADF were not influence in Holstein cows fed diets with 5 mg/d of garlic oil but ruminal digestibility's of dry matter, organic matter increased [18]. Bergen and Bates., (1984) reported similar finding for monensin, They observed that monensin, despite frequently decreased protein degradation in rumen, caused variable impact on DM or CP digestibility [7].

The effect of monensin on fiber digestibility could be observed positive or negative effects. The effects of ionophores on fiber digestibility are explained in part by an increase in DM retention time in rumen [20], lower voluntary feed intake [21], improvement in ruminal conditions [22] or by increase in rumination stimulus [23]. Although ionophores cause low to moderate improvement in feed digestibility [24], these conditions are not defined at the present moment and may suffer influence of several factors such as feed intake, rumen filling, passage rate and others. It is possible that these experimental conditions help to explain the lack of results observed in this study.

IV. Conclusion

These results suggest that supplementation of garlic oil, monensin and turmeric powder in the lamb diets had minimal beneficial effects on total digestibility tract of lambs, it did not alter feed digestion under the experimental conditions of the current study. However, evaluation their effects on ruminal fermentation and animal immunity needs to investigation.

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