

# Effect of Dietary Supplementation of Nutmeg Seed Essential Oil on Nutrient Consumption and Digestibility of Ettawa Crossbreed Goat

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## ABSTRACT

This research aimed to determine the effect of nutmeg seed essential oil (NSEO) dietary supplementation on nutrient consumption and digestibility of Ettawa Crossbreed Goats. Eleven Ettawa Crossbreed Goats, 1 to 1.5 years of age, with initial body weight ranged from 19 to 22.5 kg, were divided into control and two treatment groups, those are 1 and 2 mL of NSEO/kg dry matter of total concentrate. The goats were reared on a metabolic cage and fed with king grass and concentrate (rice bran, wheat pollard, and molasses) for 60 d. Variables observed were nutrient consumption, digested nutrient and coefficient of digestibility of dry matter (DM), organic matter (OM), crude protein (CP), crude fiber (CF), ether extract (EE), nitrogen-free extract (NFE), and total digestible nutrient (TDN). Data were analyzed using one-way analysis of variance and continued by Duncan's Multiple Range Test (DMRT). The result showed that supplementation of NSEO up to 2 mL/kg DM of total concentrate did not affect nutrient consumption and digested nutrients of DM, OM, CP, EE, and NFE. However, supplementation of NSEO started from 1 mL/kg DM of total concentrate reduced the digested CF and its coefficient of digestibility. Based on this study, it could be concluded that the supplementation of nutmeg seed essential oil up to 1 mL/kg decreases CF digestibility in Ettawa Crossbreed Goats without affecting other parameters.

**Keywords:** Nutmeg Seed Essential Oil (NSEO), Nutrient Consumption, Nutrient Digestibility, Goat.

## 1. INTRODUCTION

Small ruminants, including goats, are the important protein sources in developing countries, where those animals are commonly owned by smallholder farmers [1]. Smallholder farmers are characterized by small numbers of animal ownership and low quality of feeding [2]. Therefore the feed efficiency is a crucial factor for animal production. Ruminants loss 7% of energy through methane and ammonia emission due to the activity of rumen microbes [3]. Improving feed efficiency can be performed by modifying rumen microbes diversity [4].

Essential oils (EO) from plants are reported to have anti-microbial properties against rumen microbes [5]. Dietary EO supplementation improved the efficiency of rumen fermentation [6], reduced methane emission [7] and ammonia production [8]. Indonesia is known for its crops and spices production, and Nutmeg (*Myristica Fragrans Houtt*) is one of those spices. Nutmeg Seed Essential Oil (NSEO) contained abundant amounts of

secondary metabolites. Those are 60-80% of terpene hydrocarbon, 5-15% of terpene derivatives (terpienol, geraniol, linaliol), and 15-20% of phenylpropanoid (myristicin, elemicin, safrol, and eugenol) [9]. Those secondary metabolites are reported as antimicrobial substances [10, 11] due to its ability to bind, disrupt, and inhibit the binding of N-acetyl muramic acid into the mucopeptide structure causes imperfect membrane formation [12].

The study reported NSEO dietary supplementation for small ruminants is limited. This research was conducted to evaluate the effect of NSEO dietary supplementation on feed consumption and nutrient digestibility of Ettawa Crossbreed Goats.

**Table 1.** Nutrient composition (% DM bases) of diet.

Nutrients	Diet Groups		
	Control	1 mL NSEO	2 mL NSEO
DM	83.87	84.72	83.89
OM	88.32	88.77	88.50
CP	13.61	13.71	12.70
CF	19.28	18.10	17.91
EE	1.34	1.53	1.58
NFE	54.09	55.43	56.30
TDN	89.99	90.68	90.47

## 2. MATERIALS AND METHOD

*In-vivo* study was conducted on October-November 2016 in Bantul Regency, and Universitas Gadjah Mada Yogyakarta, Indonesia.

Briefly, 11 goats (1-1.5 years old; 19.5-22 kg) were grouped into control (4 head), and 1 (3 head) or 2 mL (4 head) of NSEO/kg dry matter of total concentrate. The goats were raised on a metabolic cage (2 x 0.5 m) for 60 d. The goats were fed with *Pennisetum purpureum* (40%), wheat pollard (30%), rice bran (24%), molasses (6%), and free access to water. The nutrient compositions of the diets are presented in Table 1. Diet was formulated according to NRC [13] for goats with the requirements of 100 g/d average daily gain. The goats were fed twice per day in the morning (approx. 7 AM) and the noon (approx. 3 PM). The NSEO was diluted on EtOH (1:1). The Diluted NSEO was then sprayed well on concentrate and was left at room temperature until the majority of EtOH was evaporated. The NSEO was obtained from a private EO producer in Ungaran, Central Java, Indonesia.

The amount of feed offered and refusal were recorded, and the sample were collected on a daily basis. Faeces were collected in the morning before morning feeding. Feed refusal and faeces samples were subjected to proximate analysis according to [14] for the determination of dry matter (DM), organic matter (OM), crude protein (CP), crude fiber (CF), ether extract (EE), nitrogen-free extract (NFE), and total digestible nutrient (TDN). The digested nutrient was measured as the difference between the amount of ingested nutrient and nutrient excreted in faeces, while the coefficient of digestibility represents the digested nutrient in percentage.

The data of nutrient consumption, digested nutrient, and coefficient of digestibility were analysed by the one-way analyses of variance (ANOVA) of SPSS 20 (2011) followed by Duncan's New Multiple Range Test for the mean differentiation at 5% ( $P < 0.05$ ).

## 3. RESULTS AND DISCUSSIONS

Table 2 presents the effects of dietary supplementation of NSEO on nutrient consumption, digestible nutrients, and coefficient digestibility. The

dietary supplementation of NSEO up to 2 mL/kg DM of total concentrate did not affect consumption (g/head/d) of DM, OM, CP, CF, EE, NFE, and TDN ( $P > 0.05$ ). The author suggested that these findings were due to the similarity of animals used in this study. The factors affecting nutrient consumption in ruminants are species, body weight, feed nutrient, and energy requirements [15]. In this study, the averages of body weight among groups are similar resulting in relatively similar energy requirements. Moreover, the goats were kept on a metabolic cage which minimized their activity. Thus, the energy may be effectively used for body maintenance and production rather than for physical activity. Feed and nutrient intake is correlated with the energy requirements [16].

The digestible DM, OM, CP, EE, NFE, and TDN were not affected by the dietary supplementation of NSEO ( $P > 0.05$ ). Although, 1 mL NSEO/kg DM of concentrate slightly reduce the digestible DM, OM, and CP ( $P = 0.14$ ;  $P = 0.14$ ,  $P = 0.08$ ), only digestible CF was significantly decreased ( $P < 0.05$ ). The decrease in digestible CF might be due to the phenolic compounds of NSEO. Phenols bind to cellulose and hemicellulose in rumen digesta, leading to decrease starch degradability and digestibility in rumen. Phenols also might interact with protein, including enzymes responsible for nutrient digestion [15].

Dietary supplementation of NSEO up to 2 mL/kg DM of total concentrate did not affect ( $P > 0.05$ ) the digested DM, OM, CP, EE, NFE, and TDN. NSEO supplementation at 1 mL/kg DM of total concentrate significantly reduced the digested CF ( $P < 0.05$ ). The different finding reported that EO of cloves reduced pH and increased fiber digestion [16]. Our finding of the reduced CF digestibility might be associated with the antimicrobial effects of NSEO against starch degrading rumen bacteria. Secondary metabolites in EO modify the rumen microbes diversity, although its effects are not clear and consistent [3]. EO of garlic, peppermint, and origanum are reported to decrease the degradation of starch, which is attributed to the lower abundances of the genus *Succinivibrio* [5]. *Succinivibrio dextrinosolvans* was reported as the major rumen bacteria responsible for dextrin and levans fermentation in starch-based diets [17]. Author also suggested that the lower CF degradability as the effect of NSEO might be attributed to the high percentage of concentrate in diet. It was reported that increasing concentrate supplementation negatively affect forage intake and fiber digestibility in goat [1]. Concentrate supplement can reduce digestibility of fiber and organic matter components by altering retention times of digesta in rumen which lead to the changes in rumen fermentation [18].

The coefficient of digestibility is the percent of digested nutrient as compared to the nutrient consumed. This study reported that the coefficients of digestibility

**Table 2.** Effect of NSEO dietary supplementation on nutrient consumption, digestible nutrient and coefficient digestibility of Ettawa Crossbreed Goats (%).

Groups <sup>1)</sup>	DM	OM	CP	CF	EE	NFE	TDN
----- Nutrient Consumption (gram/head/day) -----							
Control	761.76±16.58	662.28 ± 1393	103.70±2,27	125,83±5,54	18.42±0.55	414.33±5.58	685.30 ±1461
1 NSEO	618.70±120.90	540.65 ± 96.31	82.59±15.64	85.05±29.92	14.66± 2.57	358.35±48.25	558.98 ±99.50
2 NSEO	692.46 ± 91.52	602.70 ± 78.62	90.78±12.39	104.96±24.24	15.96± 271	391.48±39.48	622.64 ±81.94
----- Digestible Nutrient (gram/head/day) -----							
Control	578.18±41.45	524.59 ±35.72	78.15 ±9.26	85.31 ±5.58 <sup>a</sup>	14.53 ±1.87	346.60±21.72	542.75 ±35.80
1 NSEO	406.12±140.79	385.28±109.47	47.23±19.86	31.39±34.78 <sup>b</sup>	12.35± 0.53	249.30±54.46	400.71±110.04
2 NSEO	527.54±115.51	477.13 ±94.64	66.27±16.67	67.65 ±28.30 <sup>a</sup>	12.78 ±2.66	330.42±47.74	493.12 ±97.58
----- Coefficient Digestibility (%) -----							
Control	75.93 ± 5.64	79.23 ± 5.50	75.39 ± 8.93	67.92± 5.60 <sup>a</sup>	78.82± 9.43	83.66 ± 5.26	79.22 ± 5.29
1 NSEO	64.44 ± 10.14	70.43 ± 6.99	55.64±12.26	31.07±24.94 <sup>b</sup>	85.5± 11.53	81.78 ± 3.88	70.92 ± 6.42
2 NSEO	75.56 ± 8.99	78.66 ± 3.81	72.22±11.02	61.94±17.47 <sup>a</sup>	79.71± 4.43	84.26 ± 5.40	78.69 ± 7.47

Description: <sup>1)</sup>The dietary supplementation groups are Control, 1 mL NSEO/kg DM total concentrate and 2 mL NSEO/kg DM total concentrate

<sup>a,b</sup> Different superscripts on the same columns within the same parameters are significantly different (P<0.05).

of DM, OM, CP, EE, NFE, and TDN were not affected by NSEO dietary supplementation. Dietary supplementation of NSEO at 1 ml/kg reduced the coefficient of digestibility of CF. This result is in accordance with the CF digested, which was also affected by NSEO supplementation. This finding might also be due to the antimicrobial effects of NSEO against starch digesting rumen bacteria, including genus *Succinivibrio* [5].

#### 4. CONCLUSIONS

The conclusion of this study is that the dietary supplementation of NSEO up to 2 mL/kg DM of total concentrate did not affect nutrient consumption. The dietary supplementation of NSEO up to 1 mL/kg DM of total concentrate reduced CF's digestible and coefficient digestibility, while other nutrients were not affected.

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