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Research Article
Effect of Natural Oil Blend Formulation (NOBF) on Milk Production and Productivity in Dairy Cattle

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Abstract

Background and Objective: The effect of a blend of three essential oils, eucalyptus oil, pine oil and lavender oil, was investigated on dairy cows' performance. The trial's main objective was to evaluate the performance of Natural Oil Blend Formulation as antibiotics and growth promoter replacement by maintaining the milking quality and quantity. **Materials and Methods:** Thirty Holstein Friesian crossbred lactating cows, averaging 514 kg b.wt., were assigned into two groups, 15 cows in each group. The experiments lasted for ten weeks, with the first two weeks as the adaptation period, followed by eight measurement weeks. All cows were weighed at the beginning and end of the experiment. Blood samples were collected from the caudal vein at the end of the trial. The parameters studied were lactation dairy cattle on dry matter intake, body weight and milk production. **Results:** The trial outcome stated that the addition of Natural Oil Blend Formulation (NOBF) has no adverse effect on Dry Matter Intake (DMI), Average Daily Gain (ADG) and Fat-Corrected Milk (FCM) 4%. However, cattle in the treatment group tend to be higher in DMI (0.51 kg, $p = 0.12$) and higher in ADG (0.19 kg, $p = 0.11$). The blood biochemical were unaffected by treatment. However, calcium tends to be higher ($p<0.1$) compared to control. **Conclusion:** In conclusion, NOBF supplementation may improve milking cows' feed utilization and performance, however, the underlying mechanisms leading to this improvement merit further investigation.

Key words: Natural oil blend formulation (NOBF), milking cows, productivity, feed utilization, ruminant livestock, milking machines, dry matter intake

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

The researchers recognized the importance of feed supplement and their role in manipulating rumen fermentation since the 1950s[1]. The investigation on the role of Essential Oil (EO) in rumen fermentation has been intensified recently due to several reasons, like, to explore the alternative growth and performance promoter after the ban on the uses of antibiotics in 2019 and concern over environmental effects of ruminant livestock[2]. EO has been proven to improve the efficiency of nutrient utilization and performance in ruminants and minimize the environment's effects[3,4]. The active components present in the EO play a vital role in altering the ruminal fermentation patterns[5-7]. They also possess' antibacterial activities against both gram-negative and gram-positive bacteria and several foodborne pathogens[8,9]. The range of NOBF and its components is complex in nature and activity[10].

In the present scenario, dairy farming formed the shape of the industry. It adopted the intensive system of managing cows, being milked by milking machines and fed on TMR based on corn silage, lucerne hay or grass[11]. The addition of EO in this farming system has become a common phenomenon. An effort was made to design a formulation by blending three natural essential oils, eucalyptus, pine and lavender, in equal proportion as a feed supplement, which can work efficiently.

The effect of Natural Oil Blend Formulation (NOBF) was investigated on the feed utilization, milk production and composition and rumen parameters of dairy cows. The hypothesis addressed in this paper was that dietary addition of a NOBF would lead to improvements in feed utilization and changes in the rumen microbial population, which would be reflected by an increase in milk production and milk composition changes.

MATERIALS AND METHODS

Natural oil blend formulation (NOBF) preparation and composition: Every single oil, Eucalyptus, Pine and Lavender obtained from the vendors who comply with the strictest industry practices. Each natural oil is obtained through the steam distillation process and should undergo thorough checking for the quality and chemical compositions based on European Pharmacopeia. After the natural oils are declared to pass the quality checking, the mixture of the NOs conducted with the following sequence and percentage: Eucalyptus, Pine and Lavender are added in equal quantities to form the oil mixture mixed with extra light olive oil. Hence, we get a 1% concentration of the final product.

NOBF feed preparation: The NOBF was sprayed and mixed in the table salt at 20 g of NOBF per 10 kg of salt. The NOBF salt was mixed in the cow diet at 2 kg of NOBF-salt per ton of feed. The common salt was used as a carrier of NOBF. No NOBF was added in the control feed but only the salt. Both control and NOBF feed were produced on the same day to avoid dissimilarities in the raw material. Both the experimental groups received the same basal diet with 21% crude protein concentrate.

Animals and experimental design: The study was carried out at the animal research facility of the Faculty of Animal Science, University of Gajah Mada, Yogyakarta, Indonesia from April-July, 2019).

Thirty Holstein Friesian crossbred lactating cows, averaging 514 kg b.wt., were assigned into two groups, 15 cows.

All cows also received ad libitum grass silage (*Brachiaria ruziziensis*, 50 day cutting age), had free access to potable water and were individually housed in a free-stall unit and individually fed according to treatments. The experiments lasted for ten weeks, with the first two weeks as the adaptation period, followed by eight measurement weeks.

Measurement, sample collection and chemical analysis: Residual feeds were weighed for two consecutive days of each period and samples were taken and dried at 60°C for 3 days at the end of the experimental period. The feed samples were composited and subsamples were taken for further chemical analysis. The collected samples were ground and filtered through a 1 mm screen. These were subjected to proximate analysis. The crude protein content was determined by Kjeldahl analysis[12]. The ether extract was determined by using petroleum ether in a Soxhlet system[12]. Neutral detergent fibre and acid detergent fibre were determined using the method described by Van Soest *et al.*[13], adapted for Fiber Analyser. Chemical analysis was expressed based on a final Dry Matter (DM).

Cows were milked twice daily at 05.00 and 15.00 hand milk yields were recorded for each cow. Milk samples (evening and morning) were collected at each milking for two consecutive days for a week and stored at 4°C with a preservative (bronopol tablet, D and F Control System, San Ramon, CA, USA). The samples were used to analyse fat, protein, lactose and solid-not-fat contents using the Milko-Scan S50 analyser (Tecator, Denmark). All cows were weighed at the beginning and end of the experiment.

Blood samples were collected from the caudal vein at the end of the trial (3 hrs after the morning feeding) by a heparinised syringe. Samples were centrifuged at 3,500×g for

15 min at 4°C and collected plasma was immediately bought to the laboratory and frozen at -20°C until analysed. The collected samples of plasma concentrations of glucose, urea-N, total protein, albumin, globulin and haematology parameter were determined using an autoanalyser (Alyson 300i Abbot, USA).

Statistical analysis: The obtained data were analyzed using SPSS software, version 16 (IBM, 2011). Data variables were determined using a T-test. All comparisons were made at a 5% level of significance.

RESULTS AND DISCUSSION

Presented in Table 1 is the effect of NOBF blend essential oil in the ratio of lactation dairy cattle on dry matter intake, body weight and milk production. The addition of NOBF does not affect DMI, ADG and FCM 4%. However, cattle in the treatment group tend to be higher in DMI (0.51 kg, $p = 0.12$) and higher in ADG (0.19 kg, $p = 0.11$).

The effect of NOBF supplementation on cows' blood chemicals (minerals parameter) is presented in Table 2. The measured biochemical parameters were matching with the standard when they were on NOBF formulations. The calcium level of 33.22 mg kg^{-1} was lower than control (34.38 mg kg^{-1}). The magnesium level of the NOBF group was 8.95 mg kg^{-1}, which was lower than the control (9.51 mg kg^{-1}). Whereas the iron, zinc, sodium level of NOBF group was almost the same as control. The NOBF affected the blood biochemical parameters, which are shown in Table 2. There was a quantitative increase in milk productivity.

During the lactating period, imbalance nutrient, including mineral, will affect body weight loss and dairy cattle's milk production. The minerals that are undernutrition, especially during early lactation, risk excessive bone mineral mobilization in favour of milk production. This condition may also impair animal health and reproductive performances. The utilization of antibiotics and growth promotors (AGP) to maintain animal health and increasing productive livestock performance was banned in many countries, including Indonesia. Essential oils as an alternative use of AGP replacer has been documented and gained much interest in recent years. It was reported that essential oil has an anti-microbial property, immunostimulant, thus improving the animals' health status[14,15].

These study outcomes are similar to Tassoul and Shaver[16] and Serbester[17], who reported that the mixture of supplemental dietary plant essential oils was unaffected on milk yield and milk composition. Vakili *et al.*[18] reported that the addition of thyme and cinnamon essential oils did not affect the ADG and DMI. However, some studies[19-22] reported

Table 1: Productivity of experimental NOBF group and control group of dairy cattle

	Treatment			
Item	Control	NOBF	Standard deviation	p-value
DMI (kg/d/head)	18.18	18.69	0.92	0.12
Body weight (kg)				
Initial BW (kg)	514.20	514.44	62.46	0.5
Final BW (kg)	547.30	557.30	60.34	0.36
ADG (kg/day)	0.68	0.87	0.35	0.11
Milk production (4% FCM)				
First 3 weeks (1-21)				
Initial	12.11	13.00	2.93	0.26
Day 21	10.91	11.77	2.74	0.26
Day 42	12.37	12.07	3.63	0.43

DMI: Dry matter intake, FCM: Fat-corrected milk, BW: Body weight and ADG: Average daily gain (weight)

Table 2: Effect of mineral premix enrich with NOBF in the ration of lactation dairy cattle on blood biochemical

	Treatment			
Blood biochemicals (mg kg^{-1})	Control	NOBF	Standard deviation	p-value
Calcium	34.38	33.22	5.85	0.09
Magnesium	9.51	8.95	2.62	0.94
Phosphorus	100.94	90.56	16.46	0.16
Fe	3.27	3.26	0.61	0.45
Zinc	0.58	0.40	0.29	0.58
Sodium	219.49	216.68	21.19	0.17
Chloride	671.74	662.31	106.88	0.60

that diets supplemented with essential oils tended to increase feed intake (DMI) and more ADG. Benchaar *et al.*[10] valuated monensin (350 mg day^{-1}) and EO (CRINA, 750 mg day^{-1}) in lactating dairy cows and reported an interaction ($p<0.04$) between the treatments for DMI (% of BW), EO increased DMI when supplemented with monensin.

The implication of the present study states that the uses of Natural Oil Blend Formulation have an overall impact on dairy cattle's milk productivity. It enhances milk production by keeping the mineral in balance. The application and mixing of NOBF in the feed concentrate or the feed-in practical and doable. The current trial also showed no negative impact of NOBF on the cattle performance and the milk quality and quantity. Therefore, it is recommended to use the NOBF in the dairy cattle for better quality and productivity of the milk.

CONCLUSION

The Natural Oil Blend Formulation (NOBF) was developed using three essential oils with immunomodulating properties. The formulation helped the milking cows balance their metabolic function and convert the rest of the energy into milk formation. The used dose of 2 kg per ton of NOBF in feed did not negatively impact the cow's productivity and measured biochemical parameters. The experiment was conducted for a short period, eight weeks. The next plan would be to run for six months with a large number of cows. The NOBF can be provided to the animal by mixing in the feed and the drinking water.

SIGNIFICANCE STATEMENTS

This study discovered the development of a Natural Oil Blend Formulation that can enhance milk quality and quantity in dairy cattle. This study will help researchers uncover the critical areas of healthy and nutrient-balanced milk production with extra benefits. This new theory of using essential oil may open an era of the drug-free and sustainable dairy industry.

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