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Effect of Essential Oil of Laurel (*Laurus nobilis* L.) on Performance, Blood and Fecal Parameters of Holstein Calves during Suckling Period

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Holstein Friesian calf, Essential laurel (*Laurus nobilis* L.) oil, Growth performance, Diarrhea score, Blood parameters.

ABSTRACT

The objective of this study was to analyze the effect of *Laurus nobilis* L. essential oil (600 mg/day) on performance and blood parameters of Holstein calves. The study was started with total of 24 calves, randomly categorized into two groups of 12 (6 males and 6 females) however, it was completed with 23 calves because of dying a female at the 8th week of the trial. Addition of Laurel essential oil into whole milk did not cause any significant change in weekly live weight gain (kg), total weaning live weight gain (kg), weekly chest girth measurements (cm), weaning chest girth (cm), dry matter, roughage and concentrate feed consumption (gr), total milk consumption (kg), feed conversion ratio (kg), total cost and unit cost (P>0.05). However, essential oil contained calf's milk decreased fecal evaluation score and number of days with diarrhea (P<0.05). The calf's serum total cholesterol, glucose, AST, GGT, creatinine, phosphor, calcium, insulin, total T3, total T4, albumin, GH and globulin concentrations did not differ between the groups (P>0.05). Essential laurel oil containing whole milk, on the other hand, lowered serum triglyceride concentration (P<0.05). Altogether these results suggested that the consumption of laurel essential oil (600 mg/day) containing whole milk by calves might have positive influences on their health parameters compared to the control group.

INTRODUCTION

Calf diarrhea causes considerable economic losses in calf rearing around the world due to the growth deficiency, deaths and treatment expenses (Radostits *et al*., 2008). In order to provide protection against the disease and improve the performance of animals, antibiotics such as ionospheres, are commonly used as a feed additive in animal nutrition. It has been previously shown that use of antibiotics as feed additives not only improved the performance as a result of their desirable effects on feed consumption, feed conversion and feces density but also lowered the death rate by advancing the health of animals (Berge *et al*., 2005; Donovan *et al*., 2002; Morrill *et al*., 1977).

Constant use of antibiotics, however, may reduce the animal's resistance to microorganisms and consequently diminish ability to combat the diseases caused by microbial agents. Besides, antibiotic residues in diary products reach a critical level where it threatens the human and animal health due to their carcinogenic and mutagenic properties. It has been also clearly demonstrated that the bacteria, which gained resistance against certain antimicrobial agents over time, could constitute severe problems to combat the disease (Altundağ and Aslım, 2005; Koçyiğit *et al*. 2016). Due to these apparent concerns, the use of antibiotics in animal feed as growth promoting additives was prohibited in European Union in 2005 followed by Turkey in 2006 (Anonymous, 2002, 2005, 2006).

In pursuit of the prohibition of antibiotics as growth stimulants, the researchers focused on studies in enzymes, organic acids, probiotics, prebiotics and natural and reliable products containing phytobiotics (Karayağız and Bülbül, 2014). Especially phytobiotics captured special attention for their antimicrobial, antioxidant, immune stimulant effects, as well as an improver effect on feed consumption, feed conversion and performance (Kutlu and Erdoğan, 2010). Inevitably, use of medicinal plants as an alternative to drugs are recommended to prevent developing possible resistance to known antimicrobial growth stimulants and

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bacteria (Abascal and Yarnell, 2002).

Several studies revealed that some aromatic herbs bear antibacterial, antifungal and antiviral effects along with promoting digestion activities (Helander *et al*., 1998). In addition, Wenk (2000) reported that the herbal extracts, which generally enhance the flavor of the feed, increased digestive secretions and provided an increase in yield by stimulating the protein synthesis whereas McIntosh *et al*. (2000) mentioned that the essential oils reduced the ammonium production and decreased the number of harmful bacteria.

The laurel essential oil naturally contains 1.8 Cineol by 35-50% (Ertekin *et al*., 2009). Cineol is the active substance of laurel and retain a broad antimicrobial efficiency against both gram positive and gram negative bacteria (Çabuk *et al*., 2003; Smith-Palmer *et al*., 2002; Evren and Tekgüler, 2011).

Moreover, in a study conducted by Spanghero *et al*. (2007), it has been exhibited that essential oil as feed additive in Holstein calves at suckling period increased the daily body weight gain and enhanced the feed conversion ratio while another group lead by Youssef *et al*. (2008) reported that it boosted performance and immune system enhancement in buffalo calves at the same period. Essential oil has also been shown to improve the body weight gain, feed intake and feed conversion and led to a decrease in fecal score, number of fecal coliform, number of days with diarrhea and unit of body weight cost (Ghosh *et al*., 2010a, b, 2011). Additionally, Ozalpaydin (2014) demonstrated how positively it affected the total milk consumption, daily roughage and feed intake, feed conversion ratio, weaning age, starting roughage and concentrate feed and fecal score whereas its growth and immune system promoting effects were revealed by Garcia *et al*. (2015).

Although there is an accumulating amount of evidence which indicates the advantageous properties of essential oil supplementation on the well-being of different species of livestock, there has been no study to investigate the effect of *Laurus nobilis* L. essential oil on body weight, chest girth size, feed conversion rate and blood parameters of Holstein calves. Therefore, in this study, we aimed to examine how feeding Holstein calves with 600 mg/day of *Laurus nobilis* L. essential oil containing milk till weaning would influence above mentioned parameters in the calves grown in farming conditions.

MATERIALS AND METHODS

Material

Twenty-four newly born Holstein Friesian calves from a private dairy farm located in Kahramanmaraş were subjected to the study. The calves were weighed within 24 h of birth and placed in sheds individually. They were assigned to two treatment groups of twelve randomly based on their sexes (6 males, 6 females). However, a female calf in the control group died on the 8th week of the trial, therefore, the trial was completed with 23 calves.

Methods

The calves were taken away from their mothers' right after delivery and placed in individual sections. In the first four days of birth, calves were fed with colostrum (10% of their birth weight) via milk bottles. From the fifth day on, they began to be fed with 5.5-6 liters of whole milk, three times a day; in the morning, in the evening and at night. The temperature of the feeding milk was at 39-40°C.

The calves were presented with fresh drinking water as needed from the 3rd day and nourished with pellet starter feed and straw from the 7th day of the birth. These conditions were maintained until the end of the study. Pellet and straw were weighted in separate plastic containers and the intakes were recorded daily.

The essential laurel oil (*Laurus nobilis* L.) used in the research were purchased from local market of Hatay, Türkiye and stored at 4°C. The essential laurel oil (*Laurus nobilis* L.) contains 41.52% 1.8-Cineol in material (Karaoğul *et al*., 2012). It was added to the whole milk by which the calves would be fed in such amount that each animal would receive 600 mg/day. The feeding of the calves with oil supplemented milk was initiated on the 5th day after their birth. The body weights of calves were measured weekly through a scale with 0.1-kg-sensitivity. A portable tank was used for heating, mixing and homogenization of the milk. A standard tape was used to measure the chest girth of each calf.

The growth parameters such as daily weight gain, daily feed consumption, feed conservation ratio, weaning weight, and chest girth size were recorded daily. Fecal scores based on a four-point scale were also documented daily as described by Larson *et al*. (1977).

In order to calculate the body weight unit gain cost by the time of weaning, the price of 1 kg of concentrate feed, 1 kg of roughage and 1 L of milk were considered as 1 TL (Turkish Lira), 0.20 TL, and 1.15 TL, respectively. The costs of labor and calf's diarhea treatment were determined as 18.52 and 3.5 TL, in respect to their order. The body weight gain cost was calculated by dividing the total amount of expenditure until the time of weaning by total body weight gain.

Statistical analysis

Recorded parameters of the study including intakes of roughage, concentrate feed and milk, blood parameters, body weight gain costs, fecal evaluation scores and number

of days with diarrhea were subjected to general linear model (GLM) procedure. The periodical weights were computed with repeated measurements of variance analysis. Means were separated by Duncan Multiple Comparison Test, and mean comparisons of repeated measurements were tested by Bonferroni Multiple Comparison Test (SAS, 2000).

The mathematical model used was as follows:

For periodical weight, intakes of roughage, concentrate feed and milk, blood parameters, body weight costs, fecal evaluation scores and number of days with diarrhea:

$$Y_{ijk} = \mu + a_i + b_j + e_{ijk}$$

For periodical weights:

$$Y_{ijk} = \mu + a_i + b_j + c_k + e_{ijk}$$

Where, Y is performance traits, μ is population mean, a_i is treatment effect, b_j is effect of sex, c_k is period effect and e_{ijk} is normal, independent and occasional error.

RESULTS AND DISCUSSION

Growth performance of calves

The mean birth weights and weekly body weights at the beginning of the trial are presented in Table I. The birth weights between the sexes and treatment groups were found not to differ significantly (P>0.05). Thus, it was possible to state that the treatment groups were distributed homogeneously in terms of birth weights.

However, the sex effect on body weights was determined as statistically significant for at the 2nd , 3rd, 4th, 7th and 8th weeks after the birth (P<0.05) although it was not so for other weeks studied (P>0.05). Nevertheless, male calves were numerically heavier than female calves from birth to the weaning without a statistically significant difference between them.

When the body weights of the animals in the control and the treatment group were compared, it was revealed the values were considerably higher for the treatment groups at the 2nd and 3rd weeks (P<0.05) whereas the difference between them was statistically insignificant for the other weeks (P>0.05). Besides, the calves fed with laurel oil *(Laurus nobilis* L.) supplemented diet exhibited better performance in comparison with the control group in terms of weekly body weight. Compared to the control group, weaning body weights of laurel oil presented calves were 6.5, 8.7, 7.7, 5.6, 1.3, 3.9, 2.3, 3.9 and 1.7% greater for the 1st, 2nd, 3rd, 4th, 5th, 6th, 7th, 8th weeks, respectively.

Previous studies done in different laboratories have reported that adding carvacrol, cinnamic aldehyde, thyme oil or thymol to lamb rations increased the body weight gain, albeit non significantly (Chavez *et al*., 2008; Simitzis *et al*., 2008; Ünal, 2011). Similarly, Tunç (2012) reported that adding humate and propionic acid to calf rations had a positive effect on body weight gain whilst Akkan (2013) showed that saccharomyces and/or manan oligosaccharide supplements in calf rations did not make any effects. On the other hand, including essential oils (Spanghero *et al*., 2007), garlic oil (Ahmed *et al*., 2009; Ghosh *et al*., 2010a, b, 2011), probiotcs (Büyükkılıç-Beyzi, 2012), thymol and carvacrol (Van der Vliet and Cardozo, 2013), thyme oil (Özalpaydın, 2014) in calf and buffalo calf rations improved the body weight gains.

Table I.- Mean values, variance analysis, significance and multiple comparison test results of calf's body weights (kg).

Traits	General (n=23)	Sex		Treatment	
		Male (n=12)	Female (n=11)	Laurel (n=12)	Control (n=11)
Birth Weight	44.00 ± 1.12	45.73 ± 1.59	41.96 ± 1.67	44.41 ± 1.59	43.28 ± 1.67
Week I	46.98 ± 1.03	48.88 ± 1.37	44.91 ± 1.43	48.38 ± 1.37	45.41 ± 1.43
Week II	50.35 ± 1.04	52.03 ± 1.33 [a]	48.53 ± 1.40 [b]	52.38 ± 1.33 [a]	48.18 ± 1.40 [b]
Week III	52.90 ± 0.94	54.71 ± 1.16 [a]	50.87 ± 1.21 [b]	54.76 ± 1.16 [a]	50.82 ± 1.21 [b]
Week IV	56.50 ± 0.89	58.26 ± 1.11 [a]	54.27 ± 1.16 [b]	57.81 ± 1.11	54.72 ± 1.16
Week V	60.65 ± 0.83	62.15 ± 1.16	58.96 ± 1.21	60.96 ± 1.16	60.14 ± 1.21
Week VI	65.52 ± 0.88	66.93 ± 1.19	63.77 ± 1.24	66.61 ± 1.19	64.09 ± 1.24
Week VII	70.66 ± 0.85	72.31 ± 1.14 [a]	68.79 ± 1.20 [b]	71.38 ± 1.14	69.73 ± 1.20
Week VIII	74.89 ± 0.96	76.60 ± 1.21 [a]	72.90 ± 1.26 [b]	76.21 ± 1.21	73.28 ± 1.26
Weaning Weight	77.49 ± 1.19	79.53 ± 1.59	75.21 ± 1.66	78.03 ± 1.59	76.71 ± 1.66
Body Weight Gain	33.53 ± 1.21	34.89 ± 1.55	32.02 ± 1.63	33.89 ± 1.51	33.01 ± 1.58

[a,b], The differences between the mean values indicated with different letters on the same column are significant (P<0.05).

Table II.- Mean values, variance analysis, significance and multiple comparison test results of calf's chest girth sizes (cm).

Traits	General (n=23)	Sex		Treatment	
		Male (n=12)	Female (n=11)	Laurel (n=12)	Control (n=11)
Birth	81.64 ± 0.74	82.20 ± 1.05	80.59 ± 1.10	81.87 ± 1.05	80.92 ± 1.10
Week I	84.37 ± 0.61	85.16 ± 0.86	83.55 ± 0.90	85.25 ± 0.86	83.47 ± 0.90
Week II	86.95 ± 0.54	87.33 ± 0.75	86.35 ± 0.78	87.91 ± 0.75	85.77 ± 0.78
Week III	88.33 ± 0.56	89.08 ± 0.70	87.25 ± 0.73	89.41 ± 0.70 [a]	86.91 ± 0.73 [b]
Week IV	90.12 ± 0.47	90.50 ± 0.54	89.50 ± 0.56	91.50 ± 0.54 [c]	88.00 ± 0.56 [d]
Week V	91.75 ± 0.43	92.25 ± 0.59	91.11 ± 0.62	92.41 ± 0.59	90.94 ± 0.62
Week VI	93.95 ± 0.42	94.25 ± 0.59	93.66 ± 0.62	94.66 ± 0.59	93.24 ± 0.62
Week VII	96.08 ± 0.49	96.50 ± 0.72	95.67 ± 0.75	96.66 ± 0.72	95.50 ± 0.75
Week VIII	98.08 ± 0.51	98.58 ± 0.64	97.44 ± 0.67	99.08 ± 0.64 [a]	96.94 ± 0.67 [b]
Weaning	100.04 ± 0.58	100.66 ± 0.74	99.26 ± 0.77	101.08 ± 0.74[a]	98.84 ± 0.77 [b]

[a,b], The differences between the mean values indicated with different letters on the same column are significant (P<0.05); [c,d], The differences between the mean values indicated with different letters on the same column are significant (P<0.01).

The mean total body weight gain for, laurel fed group, control group and both groups combined were, 33.89 kg, 33.01 kg, and 33.53 ± 1.21 kg, respectively. Until the weaning, the effects of sex and treatment factors on the total body weight gain were not significant (P>0.05). The calves in both sex groups and the calves in both trial groups gained weight up to 76% of their birth weight by the time of weaning. This finding was in accordance with a relatively recent study by Vakili *et al*. (2013) which also demonstrated that essential thyme or cinnamon oil additions to rations did not have any effect on daily body weight gain of the animals studied.

During the experimental period, 6 liters of milk and the laurel oil (600 mg/day) were given to the calves every day. Considering the fact that the main active ingredient of laurel oil is 1.8-Cineol and it consists of nearly 41.52% of the mass, it was calculated that, during this period from the 1st week of study to the time of weaning, 8.17, 7.62, 7.25, 6.79, 6.33, 5.86, 5.43, 5.12 and 4.95 mg of 1.8-Cineol per kg body weight were given to the calves, respectively.

Low level of the active ingredient given per kg of body weight and small sample size may have caused an insignificant effect.

Chest girth measurements

The chest girth sizes of calves in both groups were measured weekly (Table II). The chest girth size was used as an indicator of growth-development and as an important parameter when the periodical body weight measurements were undetectable. In our study, there was no difference of chest girth at birth between sex and treatment groups (P>0.05). Thus, it is possible to state that the trial groups were assigned homogeneously in terms of chest girth at birth.

Within the period until weaning, the effect of sex factor on chest girth size was non-significant (P>0.05). However, from birth to weaning, the chest girth sizes of males were greater than those of females.

The treatment had a significant impact on the chest girth size of the calves on the 3rd and the 8th weeks, and at weaning time (P<0.05). While this impact showed its peak at week 4 (P<0.01), it was found to be insignificant for the remaining weeks (P>0.05).

The calves in laurel group sustained greater chest girth size compared to the control. In terms of weekly chest girth sizes, the calves in laurel group performed better than the control group. In terms of 1st, 2nd, 3rd, 4th, 5th, 6th, 7th, 8th week and at the time of weaning, the calves fed with laurel oil had larger chest girth size as compared to the control group by 2.1, 2.4, 2.8, 3.3, 1.6, 1.5, 1.2, 2.2 and 2.2% seriatim.

Milk and feed and dry matter intake

Intakes of milk, roughage and concentrate feed, dry matter, and feed conservation ratio are presented in Table III. The total milk consumption per calf was 305.41 kg until weaning, and the effects of sex and treatment on it were insignificant (P>0.05). However, over the course of study, male calves consumed in avarage 27.53 kg more milk than female calves, and calves in control group consumed 18.8 kg more milk in comparison to those of treatment group.

Roughage and concentrate feed intakes were 1.68 and 22.71 kg/calf by the weaning. Following the colostrum feeding, the treatment program was applied with concentrate feeding. There was no sex effect on concentrate and roughage feed intakes (P>0.05).

Table III.- Calf's milk, roughage, concentrate intakes, calf's dry matter intake and feed conversion ratio (kg).

Traits	General (n=23)	Sex		Treatment	
		Male (n=12)	Female (n=11)	Laurel (n=12)	Control (n=11)
Roughage intake	1.68 ± 0.11	1.61 ± 0.17	1.76 ± 0.17	1.66 ± 0.16	1.71 ± 0.17
Concentrate feed intake	22.71 ± 1.38	23.03 ± 2.11	22.43 ± 2.22	22.05 ± 2.05	23.40 ± 2.15
Milk consumption	305.41±7.40	318.98 ± 8.50	291.45 ± 8.93	295.82 ± 8.26	314.62 ± 8.66
Dry Matter	60.93 ± 1.92	62.91 ± 2.74	58.93 ± 2.88	59.09 ± 2.66	62.75 ± 2.79
Feed Conversion ratio	1.84 ± 0.06	1.84 ± 0.08	1.85 ± 0.08	1.74 ± 0.07	1.94 ± 0.08

Table IV.- Calf's cost of body weight gain (TL).

Traits	General (n=23)	Sex		Treatment	
		Male (n=12)	Female (n=11)	Laurel (n=12)	Control (n=11)
Total cost	425.15 ± 10.26	437.64 ± 12.86	413.38 ± 13.46	404.94 ± 12.86 [a]	446.07 ± 13.46 [b]
Unit cost	12.92 ± 0.42	13.26 ± 0.54	12.62 ± 0.57	12.15 ± 0.54	13.72 ± 0.57

[a,b], The differences between the mean values indicated with different letters on the same column are significant (P<0.05).

The total concentrate and roughage feed intakes over course of the study was 22.05 ± 2.05 and 1.66 ± 0.16 kg in laurel group and 23.40 ± 2.15 and 1.71 ± 0.17 kg in control group, respectively. There was no statistical differences of feed intake between the groups (P>0.05). Addition of laurel oil to milk during suckling period did not have any negative effect on roughage and concentrate feed intakes as expected. The roughage and concentrate feed intakes were higher in calves receiving laurel oil by 3 and 6%, respectively compared to the control group although this difference was not statistically significant (P>0.05).

Studies by Alçiçek *et al*. (2003), Dziba *et al*. (2006), Chaves *et al*. (2008), Benchaar *et al*. (2006), Cardozo *et al*. (2006), Ahmed *et al*. (2009), Soltan (2009), Yang *et al*. (2010), Tunç (2012), and Vakili *et al*. (2013) indicated that addition of essential oil acid and/or herbal extracts to rations did not have an effect on feed intakes, which corroborate our results.

The 1.8-Cineol in laurel oil may cause an inhibition of rumen microorganisms and decreasing bacteria in rumen liquid resulting in limitation of the fermentation and decrease in the feed conversion level. Total dry matter intake in male and female calves was 62.91 and 58.93 kg, respectively. Although it was not significant, male calves consumed 6.75% more dry matter than female calves. On the other hand, dry matter intake of laurel fed and control groups were 59.09 and 62.75 kg, respectively, which corresponded to a 6% greater dry matter in treated calves than those of control groups.

Feed conversion

During the experiment period, calves consumed an average of 1.84 kg dry matter per kg of body weight gain. No significant effect of sex and treatment on feed conversion ratio was found (P>0.05). The feed conversion ratio was considerably similar also in male and female calves (1.84 and 1.85). Whereas, calves in laurel group needed 0.20 kg (10%) less nourishment per kg of body weight gain compared to those of control group although it was not a statistically significant (P>0.05)

Costs of body weight gain

The cost of body weight gain of the calves is presented in Table IV. No significant effect of sex and treatment on cost of body weight gain was found in the trial (P>0.05).

The unit body weight costs in laurel supplemented and control groups were calculated as 12.15 and 13.72 TL (Turkish Lira), respectively. The unit body weight gain cost of the calves in laurel group was numerically 11 % cheaper than the control group. On the other hand, the body weight gain cost in female and male calves were estimated as 12.62 and 13.26 TL, respectively, which corresponded to a 5 % less expense for females. Contrary to our results, previous researchers reported that adding carvacrol, cinnamic aldehyde, thyme oil or thymol to lamb rations increased the body weight, though their effects were not statistically significant (Ghosh *et al*, 2010a, b, 2011; Chavez *et al*., 2008; Simitzis *et al*., 2008; Ünal, 2011).

Fecal scoring

During the study, the fecal evaluation was performed weekly, and the relevant scores are shown in Table V. The treatment effect on weekly fecal evaluation score was

found significantly different for only the 1st (diarrhea right after the birth was common) 4th and the 5th weeks (P<0.01). The diarrhea score in laurel group was lower than the control. The sex effect on weekly diarrhea score was not significant (P>0.05) with the exception of the 3rd week.

Earlier researchers (Ghosh *et al*., 2010a, b, 2011; Van der Vliet and Cardozo, 2013) reported that adding essential oil acid and/or herbal extract to rations decreased diarrhea score, which was in agreeement with the present results.

Number of days with diarrhea

While the number of the days with and without diarrhea in laurel group was 33.00 and 23.00, respectively, the respective values in control group were 34.73 and 20.82 (Table VI). Adding laurel oil to calf milk decreased the number of days with diarrhea significantly (P<0.05). Results of earlier studies also confirmed our results (Ghosh *et al*., 2010a, b, 2011; Büyükkılıç-Beyzi, 2012; Van der Vliet and Cardozo, 2013; Akkan, 2013; Özalpaydın, 2014).

Blood parameters

Blood samples of twenty three calves were taken individually, and parameters including Albumin, aspartate aminotranspherase (AST), phosphorus, gama-glutamyltranspherase (GGT), glucose, calcium (Ca), cholesterol, triglyceride, tetraiodotironin (T4), triiodotirnonin (T3), globulin, insulin, growth hormone (GH) and creatinine levels were analyzed (Table VII).

Sex did not affect any blood parameters of calves with the exception of triiodotironin (T3) (P<0.05). Additionally, the treatment was found to be not influencing any blood parameters other than triglyceride levels (P<0.05). Similar results about blood parameters were also revealed by Sırakaya (2008) and Vakili *et al*. (2013).

The main active ingredient of laurel oil is 1.8-Cineol by 41.52%. Triglyceride concentration of calves in laurel group was discovered to be lower than the control group (P<0.05). Ünlü and Erkek (2013) also reported comparable results, inferring that adding thyme and garlic essential oils to whole milk would lower serum cholesterol levels (P≤0.05).

Table V.- Number of days with diarrhea.

Traits	General (n=23)	Sex		Treatment	
		Male (n=12)	Female (n=11)	Laurel (n=12)	Control (n=11)
Number of normal days	27.17 ± 2.01	26.50 ± 2.22	27.35 ± 2.33	33.00 ± 2.22 ^{c}	20.85 ± 2.33 ^{d}
Number of soft days	20.52 ± 1.57	20.33 ± 1.64	21.19 ± 1.72	15.66 ± 1.64 ^{c}	25.85 ± 1.72 ^{d}
Number of loose days	6.13 ± 0.66	6.58 ± 0.87	5.74 ± 0.91	5.00 ± 0.87	7.32 ± 0.91
Number of liquid days	1.95 ± 0.28	2.16 ± 0.38	1.69 ± 0.40	2.33 ± 0.38	1.52 ± 0.40
Number of days with diarrhea	28.60 ± 1.95	29.08 ± 2.18	28.62 ± 2.28	23.00 ± 2.18 ^{c}	34.70 ± 2.28 ^{d}

^{c,d}, The differences between the mean values indicated with different letters on the same column are significant (P<0.01).

Table VI.- Calf's fecal evaluation scores by weeks.

Traits	General (n=23)	Sex		Treatment	
		Male (n=12)	Female (n=11)	Laurel (n=12)	Control (n=11)
Week I	12.54 ± 1.00	11.16 ± 0.97	13.46 ± 1.02	9.25 ± 0.97 ^{c}	15.37 ± 1.02 ^{d}
Week II	14.54 ± 0.89	14.22 ± 1.40	14.91 ± 1.36	15.08 ± 1.34	14.05 ± 1.40
Week III	13.79 ± 0.89	16.16 ± 1.12 ^{a}	11.57 ± 1.17 ^{b}	13.58 ± 1.12	14.15 ± 1.17
Week IV	9.87 ± 0.58	10.25 ± 0.72	9.09 ± 0.76	8.58 ± 0.72 ^{a}	10.76 ± 0.76 ^{b}
Week V	10.91 ± 0.64	11.00 ± 0.79	10.80 ± 0.82	9.08 ± 0.79 ^{a}	12.71 ± 0.82 ^{b}
Week VI	11.45 ± 0.60	11.16 ± 0.89	11.98 ± 0.93	11.75 ± 0.89	11.40 ± 0.93
Week VII	10.70 ± 0.69	10.33 ± 1.03	10.90 ± 1.07	10.66 ± 1.03	10.57 ± 1.07
Week VIII	11.34 ± 0.72	11.08 ± 1.00	11.73 ± 1.04	10.33 ± 1.00	12.48 ± 1.04

^{a,b}, The differences between the mean values indicated with different letters on the same column are significant (P<0.05); ^{c,d}, The differences between the mean values indicated with different letters on the same column are significant (P<0.01).

Table VII.- Mean values, variance analysis, significance and multiple comparison test results of calf's blood values.

Traits	General (n=23)	Sex		Treatment	
		Male (n=12)	Female (n=11)	Laurel (n=12)	Control (n=11)
Albumin g/dL	3.26 ± 0.02	3.31 ± 0.033	3.22 ± 0.035	3.25 ± 0.032	3.28 ± 0.033
AST U/L	44.78 ± 3.74	49.91 ± 5.56	39.32 ± 5.85	43.09 ± 5.33	46.14 ± 5.59
Phosphorus mg/dL	8.96 ± 0.24	9.00 ± 0.36	8.95 ± 0.38	8.76 ± 0.35	9.19 ± 0.37
GGT U/L	20.00 ± 1.22	19.43 ± 1.84	20.68 ± 1.93	19.22 ± 1.76	20.89 ± 1.85
Glucose mg/dL	111.69 ± 4.41	117.22 ± 6.46	105.72 ± 6.80	110.83 ± 6.19	112.10 ± 6.50
Ca mg/dL	9.29 ± 0.13	9.11 ± 0.20	9.47 ± 0.21	9.40 ± 0.19	9.18 ± 0.20
Cholesterol mg/dL	123.13 ± 5.43	122.60 ± 8.11	123.29 ± 8.53	127.52 ± 7.77	118.36 ± 8.15
Triglyceride mg/dL	28.39 ± 3.23	33.78 ± 3.93	23.20 ± 4.14	20.84 ± 3.77[a]	36.14 ± 3.95[b]
T4 nmol/L	91.44 ± 7.91	77.43 ± 10.55	107.84 ±11.10	80.42 ± 10.11	104.85 ± 10.60
T3 nmol/L	3.02 ± 0.21	2.42 ± 0.27[a]	3.67 ± 0.29[b]	3.14 ± 0.26	2.96 ± 0.27
Globulin g/dL	2.59 ± 0.07	2.63 ± 0.11	2.56 ± 0.11	2.51 ± 0.10	2.68 ± 0.11
Insulin pmol/L	102.65 ± 12.16	101.13 ± 18.83	104.71 ± 19.81	98.40 ± 18.05	107.44 ± 18.93
GH ng/mL	5.27 ± 0.20	5.43 ± 0.29	5.11 ± 0.31	5.15 ± 0.28	5.39 ± 0.29
Creatinine mg/dL	0.92 ± 0.02	0.95 ± 0.035	0.89 ± 0.037	0.94 ± 0.034	0.90 ± 0.036

[a,b], The differences between the mean values indicated with different letters on the same column are significant (P<0.05).

CONCLUSION AND RECOMMENDATIONS

The objective of this study was to determine the effects of essential laurel oil added (600 mg/d) whole milk on the body weight gain, chest girth sizes, health and blood parameters of Holstein calves during suckling period.

Based on the results, addition of laurel oil into whole milk did not have significant effects on feed intake, body weight gain cost and feed conversion ratio, however it had a biologically significant effect on health parameters. These effects were considered as a feed additive containing natural growth hormone potential for calf performance. The feed intakes became lower when the diet of the calves supplemented with essential laurel oil. The improvement in feed conversion ratio and low number of days with diarrhea was the positive effects of laurel oil in calves.

The potential significant effect of essential laurel oil on calf performance might depend on the harvesting region and time of product. In this study, the amount of the active ingredient given per kg of body weight was low, which may be the reason of observed insignificancy in certain parameters. Finally, fixed milk consumption versus lower roughage use during milk suckling period may preclude these results. Therefore, additional experimental designs for feeding programs are needed with various doses.

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Statement of conflicts of ınterest

The authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest (such as honoraria, educational grants, participation in speakers' bureaus, membership, employment, consultancies, stock ownership, or other equity interest, and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

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