Effects of hoof trimming on feed consumption, milk yield, oxidant and antioxidant system in dairy cows with hoof deformities

Research Article

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ABSTRACT
In this study is objectived to reveal the importance of hoof trimming (HT) in cows by determining the changes in feed consumption, milk yield, oxidant, and antioxidant parameters in the days before and after HT in cows with hoof deformities. This research was conducted on 12 female Brown Swiss dairy cows late lactation period that had healthy hooves showing symptoms lameness due to hoof deformities. Daily feed consumption and milk yield findings before and after HT were recorded. Total oxidant capacity (TOC) and total antioxidant capacity (TAC) tests for determination of oxidative stress index in serum in blood samples, for the evaluation of antioxidant potential; glutathione peroxidase (GSH-Px), glutathione (GSH), superoxide dismutase (SOD), Vitamin E, A, and C levels were measured. According to the findings of this study, after HT increased feed consumption and milk yield in dairy cows ($P<0.05$). After HT, TOC decreased ($P<0.05$), TAC ($P<0.05$), GSH-Px ($P<0.05$, $P<0.001$), GSH ($P<0.05$, $P<0.001$), SOD ($P<0.05$, $P<0.001$), Vitamin E ($P<0.05$, $P<0.001$) and Vitamin C ($P<0.05$) levels increased significantly, Vitamin A ($P>0.05$) levels did not change significantly. The results of this study showed that the oxidant system was suppressed and the antioxidant system was supported in lactating cows, which was done to prevent lameness due to deformations in the keratin tissue of the hoof, but without lesions in the soft tissue of the hoof.

Keywords: Hoof Trimming, Oxidant and Antioxidant System, Animal Welfare, Cow

INTRODUCTION

Hoof deformities and lameness in dairy cows are an increasingly problem in modern dairy farms (Bicalho and Oikonomou, 2013; Flower et al., 2006). Various factors such as sheltering environment, high productivity, high herd density, and individual sensitivity make cows prone to claw disorders (Bielfeldt et al., 2005; Demirkan et al., 2000; Faye and Lescourret, 1989; Manske et al., 2002; Somers et al., 2003). Lameness causes significant economic losses in dairy cattle farms and the most important reason of this economic loss is the decrease in milk production (Charfeddine and Perez-Cabal, 2017; Demir et al., 2013; Entig et al., 1997; Onyiro et al., 2008; Reader et al., 2011; Sogstad et al., 2007). After the appearance of lameness, the decrease in milk yield, the cow does not want to go to the feeder due to pain, and when it does, barely standing for feed consumption, and therefore feed consumption is reduced. In conclusion, milk yield decreases due to the decrease in feed consumption (Arican et al., 2018; González et al., 2008; Green et al., 2002; Hassall et al., 1993; Warnick et al., 2001). Additionally, to economic losses foot and hoof deformities also adversely influence the cow's welfare (Alvergnas et al., 2019; Stoddard and Cramer, 2017; Yakan and Duzguner, 2019). Therefore, there is a raising awareness of the importance of HT in cattle in terms of animal health and welfare.

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Hoof trimming is done to prevent lesions on the claws and to improve gait by correcting and maintaining foot symmetry and shape, which ensures the correct distribution of weight. Lameness caused by hoof deformities can be treated with correct HT. The correct claw shape helps restore weight-bearing balance and supports recovery from hoof deformities Neveux et al., 2006; Pesenhofer et al., 2006; Shearer and Van Amstel, 2001; Van der Tol et al., 2004; Yakan and Duzguner, 2019). However, the discomfort caused by only deformed hoof structures in the animal and the effect of the correct hoof shape on animal welfare has not been reported. In this study, it was objectived to compare the changes in feed consumption, milk yield, oxidant and antioxidant parameters before and after HT. In addition to previous studies, also with the findings of this study effects of HT on the economy and animal welfare will be revealed.

MATERIAL and METHOD

Animals

This research was conducted on 12 female Brown Swiss dairy cows aged 3- 6 years with a mean bodyweight of 550 ± 600 kg that was in the late lactation period 4- 6 months pregnant and showing symptoms of lameness due to only hoof deformities (without lesion in the living tissue of the foot) at the Ağrı İbrahim Çeçen University Eleşkirt Celal Oruç Academy of Livestock Production, Education, Research and Application Farm, Ağrı, TR. Data were collected for each cow from the farm registration system: age, the first calving age of cows, two birth intervals, the mean number of calving, days in lactation, number of lactations, lactation stage, daily milk yield, stay or removal age in the herd.

Feeding and Determination of Daily Feed Consumption

Cows were fed the same ration during the research. Concentrate (8 kg milk feed) [Cattle Dairy Feed 18%, Birlik Feed Erzurum, Turkey] and roughage (20 kg corn silage, 4 kg clover dry grass, and 3 kg meadow dry grass) were given immediately after morning and evening milking divided into two in a day fed *ad libitum*. Daily energy needs were computed from the mean weight and daily milk yield to the National Research Council (NRC) requirements (NRC, 1989). To determine the daily feed consumption of each cow during the study, the animals in the study group were kept in separate compartments on the farm. They were subjected to individual feeding. Daily total feed consumption, morning and evening before feeding was determined by weighing the increased feed in front of the animals (Jadever JWQ-30 Digital precision scale). Daily feed consumption findings on days the 1,7 (before HT), 13 (on the day of HT), 19, 25, and 31 (after HT) of the study were recorded. The mean feed composition is given in Table 1. Clean drinking water was always kept in front of the animals.

Table 1. Composition of concentrated and roughage mixes used in the study.

Ingredient	Daily quantity-kg/cow
Concentrated feed	8
Corn silage	20
Clover dry grass	4
Meadow dry grass	3
Salt	0.004
Vitamin-mineral premix*	0.003

*Provided per 1 kg of premix: Vit. A 15000000 IU, Vit D3 3000000 IU, Vit E 30000 mg, Mn 50000 mg, Zn 50000 mg, Fe 50000 mg, Cu 10000 mg, I 800 mg, Co 150 mg, Se 150 mg.

Hoof Trimming

Twelve cows that had healthy hooves showing symptoms lameness due to claw disorder were selected for the study. The health status of the cows was determined by rectal temperature, heart rand respiration rate 12 hours before HT. Cows showing the values of these 3 parameters outside the physiological range were excluded from the study. On days the 13th of the study, it was taken to the travail that provided the standing fixation of the animal for HT. HT was started from the medial hoof in the hind legs and lateral hoof in the anterior legs. Following the method, the horn hoof was trimmed and corrected by the investigator (SY) and this procedure was completed in approximately 15 min. Claws of the cows were trimmed on different days and checked for hoof disease. The hooves of cows were trimmed following a 1-year interval since the previous trim.

Daily Milk Yield

Cows that were in the late lactation stage were chosen for the research. The average days in lactation for the cows were 230.4 (inter 124-289 days) and the average number of calvings was 2.06 times (inter 1-4 times) before HT. The milk yield of 12 cows was recorded twice a day (at 5:00 a.m and 5:00 p.m) on days 1, 7, 13, 19, 25, 31st of the study using an automatic milking system (milkline® milking).

Biochemical Analysis

Blood samples taken on days 1, 7, 13, 19, 25, and 31st of the study were brought to the laboratory as soon as possible and centrifuged at 3000 rpm for 10 minutes at room temperature, and stored at -80 ^{0}C until testing. Total oxidant capacity (TOC) [Bovine (TOC) ELISA kit] and total antioxidant capacity (TAC) [Bovine (TAC) ELISA kit] tests for determination of oxidative stress index in serum samples, from antioxidant enzymes for the evaluation of antioxidant potential; Glutathione Peroxidase (GSH-Px) [Glutathione Peroxidase Assay kit], Glutathione (GSH) [Glutathione Assay kit], Superoxide Dismutase (SOD) [peroxide Dismutase Assay kit] enzyme levels were measured by ELISA using a commercial kit. Vitamin E and A levels, which are antioxidant vitamins, were determined with the help of commercial test kits in accordance with the technique on the HPLC device at Ağrı İbrahim Çeçen University Central Laboratory. Vitamin C levels were determined colorimetrically by the appropriate technique using the phosphotungunstic acid method (Kyaw, 1978) at Ağrı İbrahim Çeçen University Central Laboratory.

Statistical Analysis

The one-way analysis of variance (ANOVA) and post hoc Duncan tests were applied to the data to examine the differences among times using the SPSS statistical software package. The findings are showed as average ± SE. A value of P<0.05 was accepted significantly.

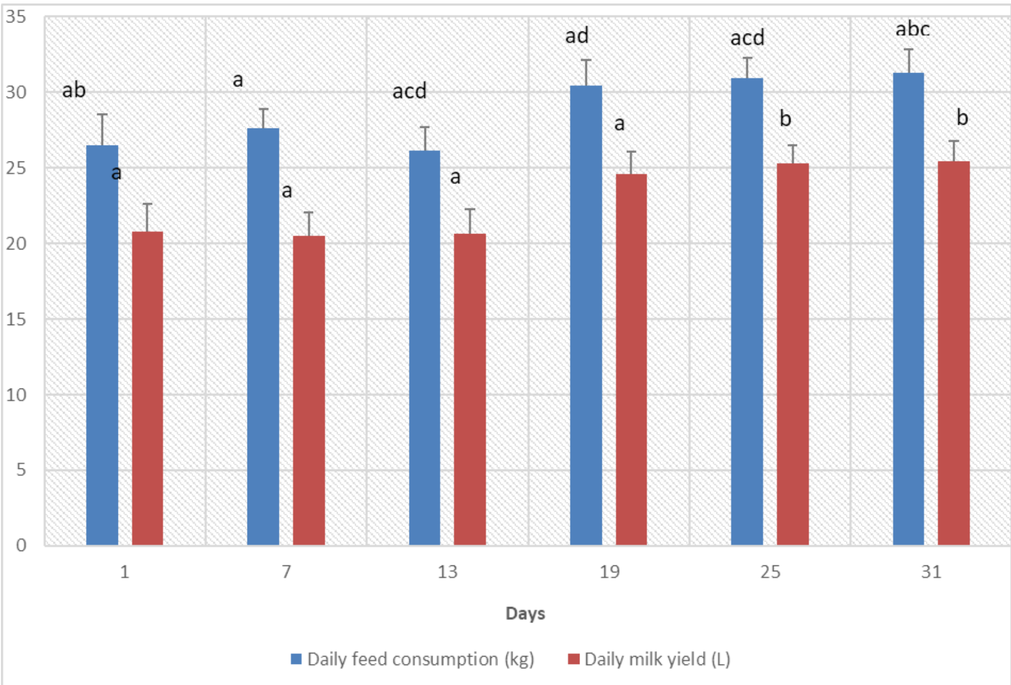
RESULTS

Daily Feed Consumption (kg)

In the findings of daily feed consumption on days 1,7,13,19,25 and 31st, in the comparisons between with the day 1st, days 7,13,19,25 and 31st, no statistically significant difference was found between with the day 1st, days 7 and 13th (P>0.05), a statistically significant result was found between with the day 1st, days 19, 25 and 31st (P<0.05) and feed consumption increased on days 19, 25, 31st according to the day 1st. In comparison between the with the days 7th, days 13, 19, 25 and 31st, no statistically significant difference was found between days 7 and 13th (P>0.05), a statistically significant result was found in the between with the days 7th, days 19, 25 and 31st (P<0.05) and feed consumption increased on days 19, 25, 31st according to days 7. In comparison between with the days 13th, days 19,25, and 31st, statistically significant results were found (P<0.05) and feed consumption increased on days 19, 25, 31st according to days 13th. In the comparisons between with the days 19th, days 25 and 31st, no statistically significant difference was found (P>0.05). No statistically significant difference was found in the comparison between the days 25 and 31st (P>0.05), (Graph 1).

Daily Milk Yield (L)

In the findings of daily milk yield on days 1,7,13,19,25 and 31st, in the comparisons between with the day 1st, days 7,13,19,25 and 31st, there was no statistically significant difference between with the day 1st, days 7,13 and 19th (P >0.05), a statistically significant difference was found between with the day 1st, days 25 and 31st (P<0.05), milk yield increased on the days 25 and 31st according to the day 1st. In comparisons between with days 7th, days 13, 19, 25 and 31st, there was no statistically significant difference between the with days 7th, days 13 and 19th (P>0.05), the measurement results between with the days 7th, days 25 and 31st were statistically significant (P<0.05), milk yield increased on the 25th and 31st days according to the 7th days. In the comparison between with the days 13th, days 19,25 and 31st, there was no statistically significant difference between days 13 and 19th (P>0.05), a statistically significant difference was found between with the days 13th, days 25 and 31st (P<0.05), and the milk yield increased on the days 25 and 31st according to the days 13th. Found statistically significant difference in the comparison between with the days 19th, days 25 and 31st (P<0.05), and the milk yield increased on the days 25 and 31st according to the days 19th. There was no statistically significant difference in comparison between the days 25 and 31st (P>0.05), (Graph 1).



Graph 1. Daily feed consumption and milk yield findings on days 1, 7, 13, 19, 25 and 31of study. A statistically significant difference was found between values with different letters in the daily feed consumption column (P<0.05). A statistically significant difference was found between the values with different letters in the daily milk yield column (P<0.05).

Oxidant and Antioxidant Parameters

In Total Oxidant Capacity (TOC) measurement results on days 1,7,13,19,25 and 31st, in the comparisons between with the day 1st, days 7,13,19,25 and 31st, no statistically significant difference was found between with the day 1st, days 7 and 13th (*P*>0.05), a statistically significant difference was found in the comparisons between with the day 1st, days 19, 25 and 31st (*P*<0.05), and the TOC decreased on days 19, 25 and 31st according to the day1st. In comparisons between with days 7th, days 13, 19, 25, 31st, there was no statistically significant difference between days 7 and 13 (*P*>0.05), a statistically significant difference was found between with the days 7th, days 19, 25 and 31st (*P*<0.05), and TOC decreased on days 19, 25 and 31st according to days 7th. In the comparison between with the days 13th, days 19,25, and 31st, a statistically significant difference was found between the days 13th, days 19, 25, 31st (*P*<0.05), and TOC decreased on days 19, 25 and 31st according to the days 13th. In the comparisons between with the days 19th, days 25 and 31st, no statistically significant difference was found between the 19th, days 25 and 31st (*P*>0.05). There was no statistically significant difference in comparison between days the 25 and 31st (*P*>0.05).

In Total Antioxidant Capacity (TAC) measurement results on days 1,7,13,19,25 and 31st, in the comparisons between with the day 1st, days 7,13,19,25 and 31st, no statistically significant difference was found between days the 1 and 7th (*P*>0.05), a statistically significant difference was found between the days 1 and13th (*P*<0.05), and TAC decreased on days 13th, no statistically significant difference was found between with day the 1st, days 19, 25, 31st (*P*> 0.05). In the comparisons between with the days 7th, days 13,19,25 and 31st, statistically significant difference was found between the days 7 and 13th (*P*<0.05), and TAC decreased on the days 13th, no statistically significant difference was found between with the days 7th, days 19, 25, 31st (*P*>0.05). In the comparisons between with the days 13th, days 19,25, and 31st, statistically significant difference was found between the days13th, days 19, 25, and 31st (*P* < 0.05), and TAC increased on days 19, 25, 31th. No statistically significant difference was found in the comparisons between the days 19th, days 25 and 31st (*P*>0.05). No statistically significant difference was found between the days 25 and 31st comparisons (*P*>0.05).

In Glutathione Peroxidase (GSH-Px) measurement results on days 1,7,13,19,25 and 31st, in the comparisons between with the day 1st, days 7,13,19,25 and 31st, there was no statistically significant difference between with the day 1st, days 7 and 13th (*P*>0.05), a statistically significant difference was found between the with day 1st, days 19 (*P*<0.05), 25 (*P*<0.05) and 31st (*P*<0.001), GSH-Px activity increased on days 19, 25 and 31st. In comparisons between with days 7th, days 13, 19, 25 and 31st, there was no statistically significant difference between days 7 and 13th (*P* > 0.05), a statistically significant difference was found between with the days 7th, days 19 (*P* < 0.05), 25 (*P*<0.05) and 31st (*P*<0.001), and GSH-Px activity increased on days 19, 25 and 31. In the comparisons between with days the 13th, days 19,25 and 31st, a statistically significant difference was found between with the days 13th, days 19 (*P*<0.05), 25 (*P*<0.05) and 31st (*P*<0.001), GSH-Px activity increased on days 19, 25 and 31st. In the comparison between with the days 19th, days 25 and 31st, there was no statistically significant difference between days the 19th, days 25 and 31st (*P*>0.05).

There was no statistically significant difference in comparison between days the 25 and 31st (P>0.05).

In Glutathione (GSH) measurement results on days 1,7,13,19,25 and 31st, in the comparison between with day 1st, days 7,13,19,25 and 31st, a statistically significant difference was found between with the 1st, days 7 and 13st (P<0.05), GSH levels decreased on days 7 and 13th, there was no statistically significant difference between days 1 and 19th (P>0.05), a statistically significant difference was found between with day 1th days 25 and 31st (P<0.001), GSH levels increased on days 25 and 31st. In the comparison between with the days7th, days 13,19, 25 and 31st, there was no statistically significant difference between days 7 and 13th (P> 0.05), a statistically significant difference was found between with days 7th, days 19 (P< 0.05), 25 (P<0.001) and 31st (P<0.001), and GSH level increased on days 19, 25 and 31st. In the comparisons between with the days 13th, days 19, 25 and 31st, there was a statistically significant difference between with 13th, days 19 (P<0.05), 25 (P<0.001) and 31st (P<0.001), and GSH level increased on days 19, 25 and 31st. A statistically significant difference was found in the comparisons between days 19th, days 25 and 31st (P<0.001), and GSH level increased on days 25 and 31st. A statistically significant difference was found in the comparison between the days 25 and 31st (P<0.05), and GSH level increased on days 31st according to 25 days.

In Superoxide dismutase (SOD) measurement results on days 1,7,13,19,25 and 31st, in the comparison between with the day 1st days 7,13,19,25 and 31st, there was no statistically significant difference between with the day 1st, days 7 and 13th (P>0.05), there were statistically significant between with the day 1st, days 19 (P<0.05), 25 (P<0.001) and 31st (P<0.001), and SOD activity increased on days 19, 25 and 31st. In comparisons between with days 7th, days 13, 19, 25 and 31st, there was no statistically significant difference between the measurement results between days 7 and 13th (P>0.05), a statistically significant difference was found between with the days 7th, days 19 (P<0.05), 25 (P<0.001) and 31st (P<0.001), and SOD activity increased on days 19, 25 and 31st. A statistically significant difference was found in the comparison between with days 13th, days 19, 25, and 31st (P<0.001), and the SOD activity increased on days 19, 25, and 31st. A statistically significant difference was found between with the days 19th, days 25 and 31st (P<0.05), and SOD activity increased on days 25 and 31st. There was no statistically significant difference in comparison between the days 25 and 31st (P>0.05).

In Vit C measurement results on days 1,7,13,19,25 and 31st, in the comparison between with the day 1st, days 7,13,19,25 and 31st, there was no statistically significant difference between with the day 1st, days 7 and 13th (P>0.05), there was a statistically significant difference between with the day 1st, the 19th, 25th and 31st days (P<0.05), Vit C level increased on the 19th, 25th and 31st days according to the day 1st. In the comparison between with the day 7th, days 13,19,25 and 31st, while there was no statistically significant difference between the 7th and 13th days, there was a statistically significant difference between the days 7th, 19th, 25th and 31st days (P<0.05). In the comparison between with the day 13th, days 19,25 and 31st, a statistically significant difference was found between the days13th, days 19th, 25th and 31st (P<0.05). In the comparison between with the day 19th, days 25 and 31st, there was no statistically significant difference in comparisons between the 19th, 25th and 31st days (P>0.05). There was no statistically significant difference in comparison between the days 25 and 31st (P>0.05). Vit C level increased after HT.

In Vit E measurement results, in the comparison between with the day 1st, days 7,13,19,25 and 31st, no statistically significant difference was found between with the day 1st, days 7,13,19th (P>0.05), there was a statistically significant difference between days 25th (P<0.05) and 31st (P<0.001). Vit E level increased on the 25th and 31st days compared to the day 1st. In the comparison between with the day 7th, days 13,19,25 and 31st, there was no statistically significant difference between with the days 7th, days 13th and 19th (P>0.05), while there was a statistically significant difference between days 25th (P<0.05) and 31st (P<0.001). In the comparison between with the day 13th, days 19,25 and 31st, there was no significant difference in the comparisons between the 13th and 19th days (P>0.05), there was a statistically significant difference in the comparisons between days 25th (P<0.05) and 31st (P<0.001). There was a statistically significant difference in the comparisons between with the days 19th, 25th and 31st days (P<0.05). There was a statistically significant difference in the comparisons between the 25th and 31st days (P<0.05). Vit E level increased after HT.

In Vit A measurement results, there was no statistically significant difference in comparisons between all time (P>0.05).

Measurement results of oxidant and antioxidant parameters on days 1,7,13,19,25,31st of the study are given in Table 2.

Table 2. Measurement results of oxidant and antioxidant parameters on days 1,7,13,19,25,31st of study.

Time (days)	TOC (µmol/L)	TAC (U/mL)	GSH-Px (mmol/L)	GSH (mmol/L)	SOD (U/mL)	Vit C (mg/L)	Vit E (mg/L)	Vit A (mg/L)
1	64.29 ± 5.71^{a}	4.27 ± 0.22^{a}	4.51 ± 0.43^{a}	15.08 ± 0.45^{a}	8.05 ± 0.25^{a}	5.84 ± 0.94^{a}	5.11 ± 0.28^{a}	0.51 ± 0.05^{a}
7	60.00 ± 5.34^{a}	4.07 ± 0.26^{a}	4.46 ± 0.33^{a}	12.43 ± 0.62^{ab}	7.80 ± 0.29^{a}	5.69 ± 0.71^{a}	5.44 ± 1.13^{a}	0.58 ± 0.51^{a}
13	70.00 ± 7.87^{a}	3.87 ± 0.28^{ab}	4.43 ± 0.26^{a}	13.50 ± 0.48^{ab}	7.71 ± 0.20^{a}	5.01 ± 0.21^{a}	5.28 ± 2.11^{a}	0.46 ± 0.45^{a}
19	45.71 ± 4.81^{ab}	4.44 ± 0.12^{a}	6.00 ± 0.38^{ab}	16.06 ± 0.67^{a}	9.67 ± 0.49^{ab}	6.99 ± 078^{b}	5.49 ± 3.12^{a}	0.44 ± 0.43^{a}
25	41.43 ± 4.04^{ab}	4.51 ± 0.10^{a}	5.90 ± 0.24^{ab}	22.97 ± 1.11^{abc}	10.61 ± 0.36^{abc}	7.39 ± 0.76^{b}	7.11 ± 0.22^{b}	0.51 ± 0.21^{a}
31	42.86 ± 7.14^{ab}	4.43±0.11^{a}	6.50 ± 0.14^{ab}	26.83 ± 1.34^{abcd}	10.64 ± 0.24^{abc}	7.45 ± 0.55^{b}	8.13 ± 2.66^{ab}	0.43 ± 0.11^{a}

TOC: Total Oxidant Capacity; TAC: Total Antioxidant Capacity; GSH-Px: Glutathione Peroxidase; GSH: Glutathione; SOD: Superoxide Dismutase; Vitamin E, A, and C. Statistically significant difference was found between values with different letters in the same line (P<0.05, P<0.001).

DISCUSSION

Many factors genetics, season, shelter type, herd size, exercise, lying surface, age, pregnancy and lactation, and feeding conditions are effective on foot health. One or more of these factors come together to determine the herd's foot health (Cramer et al., 2009; Dippel et al., 2009; Frankena et al., 2009; Van der Waaij et al., 2005). Regular hoof trimming is the only way to minimize the effects of these factors (Van Hertem et al., 2014). Functional HT, disrupts the vicious circle of excessive mechanical load on the claw, ensuring that the weight is evenly distributed on both claws. Healthy claw tissue production is stimulated as the pressure on keratogenic cells will increase with routine HT in thin bottomed animals (Bryan et al., 2012; Erol et al., 2019; Kummer et al., 2009; Van der Tol et al., 2004).

In research by Aoki *et al*. (2006), walking behavior, limb angles, back posture and vertical movement of the back while walking were measured after HT. Walking speed, stride length, and stride speed were found to increase significantly after HT. Phillips *et al*. (2000) have shown that HT body weight is distributed evenly on the foot and therefore on the claws and suggested a corresponding influence on posture. Nishimori *et al*. (2006) reported a possibility that a change in weight-bearing and posture may affect dry matter intake. They showed that by measuring different blood measurement parameters, cows started eating more roughage after HT. In the present study, each cow included in the study were subjected to individual feeding separate compartment to determine the effect on feed consumption of HT and daily feed consumption was measured on days 1,7,13,19,25 and 31st of the study. Cows' claws were trimmed on days the 13th of the study. Although the day of the HT was not statistically significant, the feed consumption of cows decreased temporarily compared to the 1st and 7th days of the study. The slightly reduced in feed consumption on the day of trimming can be attributed to the stress occurring in the animal due to HT, interruption of the daily routine and the fact that it does not yet take the normal shape of the claw and does not press the ground completely and does not adapt to the new claw of the animal, on the days following HT in cows had a decrease in activity for all these reasons feed consumption decreased. In the measurements made on the 19th, 25th, and 31st days after HT feed consumption was found to increase statistically significantly. Feed consumption started to increase on days the 6th (on days the 19th of study) after HT may be attributed to the normal shape of the claw and the animal can comfortably step on the ground. Lastly, the increase in feed consumption after HT can be attributed to getting healthy claws of the animals. It was also revealed by the findings of this study that HT increased feed consumption in cows.

Claw health has a pronounced effect on milk production (Charfeddine and Perez-Cabal., 2017; Coulon et al., 1996; Demirkan et al., 2000; Entig et al., 1997; Flower et al., 2006; Reader et al., 2011). Cows with painful hoof disorders eat less food, are less willing to move, and as a result, they can yield less milk than cows without claw disorders. Likely, the decrease in milk production associated with foot and claw lesions is due to raised energy requirement due to pain, which may also be current without a decrease in feed consumption or a noticeable lameness (Bielfeldt et al., 2005; Flower et al., 2006; Kyaw, 1978; Reader et al., 2011). Several studies showed the expected decrease in milk production in cows with claw and limb disorders. A study by Sogstad *et al*. (2007) reported that cows yielded more milk then HT than they did before HT. In another study by Kibar and Caglayan (2016), they determined that HT of a one-time hoof increased milk production in dairy cattle with hoof disorders in commercial dairy farms. But in some studies, higher milk yield was not detected after HT. A study investigated the effects on milk yield of one-time HT by Nishimori *et al*. (2006) demonstrated that milk yield did not change after HT. Taguchi *et al*. (2001) have reported a similar experiment, but no differences in milk production and composition were showed in their research. As many researchers have reported (Bielfeldt et al., 2005; Demir et al., 2013; Dippel et al., 2009; Van der Tool et al., 2004;) milk yield in the lactation stage is effected by herd factors such as management and nutrition and individual factors as genetics, parity, and disease. Differences in the literature about the influence of lameness and hoof disorders on milk production are comparatively the conclusion of these complex effects. In the current study, daily milk yield findings were recorded on days 1,7,13,19,25, and 31st of the research to determine the effect of HT on milk yield in healthy cows. No diversity was showed in milk production in the measurements made on days 1,7 (before HT), 13 (on the day of HT). On the day of HT, the daily milk yield showed not change according to days 1 and 7th, and also the time needed for the complete HT procedure with a mean of 15 minutes was very short. On the 6th day after the HT (19th days of the study), milk yield was increased, though not statistically significant. On the 25 and 31st days of the study (after HT), a statistically significant difference was observed in the increase of milk yield. On days 10th after HT on the daily milk yield had recovered to its original value (on days 25th of study) and final measurements were made on the 31st day of the study. Accordingly, milk yield after HT was higher than before HT. Subsequently, milk yield was increased after HT. Results of the current study concurred with the findings of some researchers (Bryan et al., 2012; Kibar and Caglayan, 2016; Sogstad et al., 2007) increased in the milk yield following HT. Increased milk production after HT can be increased feed consumption as a conclusion of having healthier hooves and walking more comfortably and standing because of smooth hoof figure then HT. In the current study, a 0.9 positive relation between feed consumption and daily milk yield was also shown.

Claw disorders can be responsible for the deterioration of animal welfare by causing pain and stress in cattle (Bustamante et al., 2015; O'Callaghan et al., 2003; Shearer et al., 2013; Stock et al., 2015). Oxidant and antioxidant parameters are often used to assess pain and stress in animals (Erol et al., 2019). However, in the literature searches, no publication investigating the effect on the oxidant and antioxidant system of HT to evaluate the pain and stress caused by claw disorder in cattle. For this reason, this study also aimed to determine the effect on oxidant and antioxidant systems of HT in cows.

Under normal conditions, oxidants and antioxidants are in balance in the organism. However, in situations such as inflammation, infection, pain, and stress, this balance is disrupted in favor of oxidants, and free radicals occur, which can cause damage to cells or tissues (Halliwell and Gutteridge, 1989).

It is recommended to measure TOC and TAC to determine the oxidant and antioxidant status in the organism and their balance. In this study, a significant decrease in TOC values was observed in the measurement results after the HT. In TAC measurements, the day of HT decreased significantly and showed a significant increase in measurement days after HT. GSH-Px is the most effective of antioxidant enzymes. It is responsible for the destruction of intracellular hydroperoxides. By converting H_2O_2 to water, it prevents the formation of methemoglobin and protects the membrane lipids against peroxide anion and protects the integrity of the cell membrane. GSH-Px values were significantly lower before and on the days of HT, there was a significant increase in the measurements made after HT. GSH is an important intracellular nonenzymatic antioxidant. Its oxidized form is involved in inhibition of free radicals, stabilization of reduced sulfhydryl groups, and regeneration of tocopherol and ascorbate. It also acts as the cofactor of GSH-Px. GSH values were significantly lower before HT and on the days of HT, there was a significant increase in the measurements made after HT. SOD is the first enzyme to act in the anti-oxidative system, which is found in the mitochondria matrix of hepatocytes, erythrocytes, and brain cells. It has a stable structure. It catalyzes the reaction that converts O_2- to H_2O_2. SOD values were significantly lower before HT and on the days of HT, there was a significant increase in the measurements made after HT. The low levels of GSH-Px, GSH, SOD before HT are thought to be due to their use in order to neutralize the radicals that occur due to oxidative stress developing during lameness.

The synergism between Vitamin C and E in preventing lipid peroxidation is well known. While Vitamin C increases the antioxidant effect of Vitamin E, it also reduces its consumption. Under normal conditions, Vitamin C is synthesized by the liver of adult cattle and this synthesis is sufficient for physiological needs. However, ruminants are susceptible to deficiencies due to the destruction of Vitamin C by the rumen microflora. Vitamin C deficiency also reduces the body's defense power against infections. In the present study, it is noteworthy that after HT, Vitamin E and C levels were significantly increased in cattle compared to before. It is thought that the reason for this situation is the decrease in feed consumption due to lameness and the increasing use due to developing oxidative stress. On the other hand, in Vitamin A levels, no significant change was observed in concentrations at study through. This may be related to the use of vitamins such as E and C primarily during oxidative stress.

This study showed that after HT, the oxidant system was suppressed and the antioxidant system was supported in dairy cows. In this study, it has been shown with the findings of the antioxidant defense system that HT increases animal welfare in cattle.

CONCLUSION

In this study, an increase in feed consumption and milk yield was observed after HT. At the same time, in this study where the effects of HT on the oxidant and antioxidant system were investigated, it was observed that the oxidant system was suppressed and the antioxidant system was supported after the HT. In light of all this information, the hypothesis that HT the necessity of regular claw trimming to ensure healthy claws and prevent lameness is clear, and it is, therefore, an integral part of improving the welfare of cattle was confirmed.

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Ethical approval:

This animal work was carried out in accordance with the guidelines and approval of the Animal Welfare, Experimentation and Ethics Committee (AWEEC) of the Çukurova University, [Permission Number: 058 / 06.07.2017].

Conflict of interest:

No conflict of interest.

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