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Effect of hoof trimming intervention on Physiological indices in dairy lame cows

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Abstract

Hoof lesions and lameness in cattle is currently a serious problem in the dairy industry and significantly affects the health and welfare of animals. Hoof trimming is performed to prevent hoof lesions and improve gait by correction and maintenance of the hoof symmetry and shape. Lameness caused by hoof disorders can be treated by correct hoof trimming. In this study twenty lame cows were selected and lameness index score was given to them (0-5 score). The nutrient requirements of the animals were met as per ICAR (2013) through concentrate feed and *ad libitum* green fodder. Physiological indices were recorded before week of hoof trimming (HT) and after hoof trimming intervention it was recorded on 0th day, 3rd day, 6th day, 8th day, 11th day, 14th day. Our results showed that significant difference ($P \leq 0.05$) in rectal temperature was observed on 0, 3, 6, 8 and 11th day when compared with before week of HT (101.30 ± 0.08) whereas significant increase ($P \leq 0.05$) in heart rate was observed on 0, 3, 6, 8, 11 and 14th day when compared with before week of HT (66.7 ± 0.21). Significant increase ($P > 0.05$) in respiration rate was observed on 0th day (20.45 ± 0.29). From this study it was concluded that the hoof trimming intervention has showed an immediate effect on physiological indices of dairy cows. Further this is a novel improved intervention using angle cutter modified to trim the hoof which is safe and painless compared to conventional Hoof cutter which caused a lot of cutting and bleeding hooves.

Keywords: Hoof trimming, lameness, rectal temperature, heart rate, respiration rate, dairy cows

Introduction

India is the leading milk producing country in the world with 209.96 million tons during 2020-2021, which was contributed by crossbreed cows (28%), indigenous/non-descript cows (20%), indigenous/non-descript buffaloes (49%), exotic cows (1%) and goats (3%). In spite of this increased cattle population, lameness and hoof lesions in cattle are currently a serious problem in the dairy industry and significantly affects the health, welfare of animals and milk production (Westin *et al.*, 2016) [19]. Lameness is a painful and costly disease that affects the productivity of cows through its effects on milk production, culling and reproductive performance (Booth *et al.*, 2004) [3]. Lameness can be defined as the clinical manifestation of painful disorders, mainly related to the locomotors system, resulting in impaired movement or deviation from normal gait or posture. The severity of lameness can vary from stiffness or decreased symmetry of limb movement to an inability to bear weight on a limb, or even total recumbence. After udder health and fertility, hoof diseases were the third most important reason for culling (Landeskuratorium, 2015) [11]. Moreira *et al.* (2018) [12] found that (87.5%) of lame animals suffered from claw lesions and hoof lesions were present in all the cows having lameness. Various researches has shown that Holstein and crossbred dairy cattle are more vulnerable to lameness. Some of the factors causing lameness are inherited factors (stance, weight, constitution, hoof characteristics), nutritional factors (proteins, minerals, vitamins, toxins), infectious causes (bacteria, virus, and rickettsia), environmental factors (climate, housing, road wear and tear) and manage mental practices play a major role in its incidence. Many researchers have also reported that age, parity, stage of lactation and breed will also show significant effect on lameness in dairy cows (Bran *et al.*, 2018) [4]. Trimming is now a fundamental part of lameness management programme in any dairy farms because of its high preventive effects. Trimming of hooves significantly affects the milk fat and milk protein compositions. HT is performed to prevent hoof lesions and improve gait by correction and maintenance of the hoof symmetry and shape, which ensures correct weight bearing. The therapeutic hoof trimming treats foot disorders and significantly effects milk production.

HT has positive effects on decreasing the lameness incidence, reducing the incidence of hoof lesions, and increasing fat and protein contents of milk. Increase and decreasing trends of physiological indices were noticed. The higher incidences of lameness were reported in high yielding cross breed cows in Karnataka. Lameness can be reduced by proper hoof care management and hoof trimming. Thus, the present study was undertaken to know the effect of hoof trimming on Physiological indices of the dairy cows.

Materials and Methods

Experimental design

An experiment was conducted in Bengaluru area by selecting the animals based on the required criteria. In this study twenty lame cows of mixed parity were selected for hoof trimming. The nutrient requirements of the animals were met as per ICAR (2013) through concentrate feed and *ad libitum* green fodder. Cows were offered 2-3 kg of concentrates during milking time at the rate of 400g per litre of milk produced. Around 20 kg of green fodder consisting of Maize and Napier crops and 3-5 kg of dry fodder consisting of ragi straw as dry fodder was offered daily. The feed was offered twice daily. Care was taken to ensure that feed was provided at same levels throughout the study period and to nullify any effects of feed on lameness. Lameness index score was allotted to the lame animals as mentioned by (Sprecher *et al.*, 1997) [15] 1-5 score card. Rectal temperature, heart rate, respiration rate was recorded before hoof trimming prior to one week. After recording these parameters for one week, hoof trimming was performed on these animals. Then after performing hoof trimming these observations were recorded again. Physiological indices were recorded on 0th, 3rd, 6th, 8th, 11th and 14th day after hoof trimming. The recordings were compared before and after hoof trimming. Functional hoof trimming, also referred to as 'the Dutch method', was adopted in this study. The basic instruments used were hoof knives, chisel, hammer, Hoof cutter, hoof tester and long handle nippers and electric hand held angle cutter grinder (Plate 1). In dairy farms specially designed crate was used for restraining the animals and for hoof trimming. The data collected on parameters such as rectal temperature, heart rate, respiration rate were systematically classified and were analyzed using Paired t test and statistical analysis was done with the help of SPSS 16.0 statistical software package.

Physiological indices

Rectal Temperature (RT)

The Rectal Temperature (RT) was measured by inserting clinical digital thermometer per rectally and observation was recorded after one minute. Due care was taken to ensure that the thermometer was placed obliquely and touching the lumen of the rectum. The RT was recorded and expressed in Degree Fahrenheit (°F).

Heart rate (HR)

Heart Rate of the animals was assessed by using a stethoscope which was placed behind the cow's left elbow against the chest wall. The heart rate was recorded and expressed in beats per minute.

Respiration rate (RR)

The respiration rate was recorded by observing the breaths by placing the palm near nostrils and counting the number of

breaths in one minute.

Results and Discussion

Incidence of hoof lesions in dairy cows

After hoof trimming, few claw diseases like sole hemorrhage, white line disease, sole ulcer, digital dermatitis, double hoof, and overgrown hoofs were detected in animals. Out of the total claw lesions in the herd, (5%) were affected with double hoof, (5%) were affected with digital dermatitis, (5%) with sole hemorrhages, (20%) with white line disease, (30%) with sole ulcers and (35%) were effected with overgrown hoof. Incidence of hoof lesions is depicted in fig 1.

Physiological Indices

The results for physiological indices like rectal temperature, Heart Rate and Respiration Rate were described below.

1. Rectal Temperature

The data on mean rectal temperature before week and after hoof trimming intervention under this study have been presented in Table 1 and graphically depicted in Figure 2. The mean rectal temperature of the animals one week before HT was 101.30±0.08, after hoof trimming mean on 0th day was 104.52±0.05, on 3rd day it was 104.29±0.04, on 6th day it was 102.75±0.07, on 8th day it was 101.74±0.09, on 11th day it was 101.62±0.07 and on 14th day it was 101.50±0.17. The results showed that there was significant difference ($P \leq 0.05$) in rectal temperature on 0th day, 3rd day, 6th day, 8th day and 11th day ($P=0.000$, $P=0.000$, $P=0.000$, $P=0.001$, $P=0.003$) when compared with before week of hoof trimming. Whereas on 14th day there was no significant difference ($P > 0.05$) when compared with before week of hoof trimming ($P=0.140$).

We observed that on the day of hoof trimming and on 3rd day rectal temperature was increased. The increased rectal temperature was also observed on 6th day. On 8th day onwards decrease in rectal temperature was observed and it continued up to 14th day which is almost equal to before week of hoof trimming. When compared with before week of hoof trimming rectal temperature was similar on 14th day after hoof trimming. The findings obtained in our study are similar to the findings of Talvio (2020) [17], where they found higher temperatures on day of hoof trimming. Similar to this, we found higher rectal temperature on day of HT and normal temperature was recorded on 8th day.

In contrast to our results, Chavan (2018) [6] reported that there was no significant difference in rectal temperature. But in our study, significant difference ($P < 0.05$) was observed in rectal temperatures on 0th day, 3rd day, 6th day, 8th day and 11th day. This may be due to handling stress, time taken for HT, and severity of the lesions that animals exhibited. The findings obtained in our study, are contrast with the findings of Passos *et al.* (2017) [13] where they suggested that rectal temperatures were not significantly different before and after trimming irrespective of type of lesion. In our study significant difference ($P \leq 0.05$) was observed. The results of our study are in agreement with Dar *et al.* (2015), where they observed significant difference in mean \pm SE values of rectal temperatures ($P \leq 0.05$). In our study, a significant difference ($P \leq 0.05$) was observed in rectal temperature in our study. Results obtained in our study are also in agreement with Ansari *et al.* (2014) [1]. The results of the present study are in close agreement with findings of Sharma *et al.* (2012) [14].

Heart Rate

The data on mean heart rate beats per minute (bpm) for before week and after hoof trimming intervention under this study have been presented in Table 2 and graphically depicted in Figure 3. The mean heart rate of the animals one week before HT was 66.7 ± 0.21 , after hoof trimming mean on 0th day was 72.65 ± 0.49 , on 3rd day it was 72.05 ± 0.30 , on 6th day it was 70.75 ± 0.18 , on 8th day it was 69.30 ± 0.21 , on 11th day it was 68.00 ± 0.32 and on 14th day it was 65.70 ± 0.39 . The results showed that there was significant difference ($P \leq 0.05$) in heart rate on 0th day, 3rd day, 6th day, 8th day ($P = 0.000$), 11th day and 14th day ($P = 0.006$, $P = 0.007$) when compared with before week of hoof trimming. A significant difference was noticed on all the days after hoof trimming when compared to before week of hoof trimming.

We observed that on the day of hoof trimming heart rate was increased and on 3rd day and 6th day also it was increased. On 8th day onwards decrease in heart rate was observed and it continued up to 14th day which is almost equal to before week of hoof trimming. When compared with before week of hoof trimming heart rate was similar to 14th day after hoof trimming. The results obtained are in agreement with Kovacs *et al.* (2015) [9] where they reported significant increase in heart rate. The results of our study showed that there was significant difference ($P \leq 0.05$) in heart rate on 0th day, 3rd day, 6th day, 8th day, 11th day and 14th day when compared with before week of HT. This may be due to handling stress and time of HT.

The findings of our study are similar to the results of Chavan (2018) [6], where they reported statistically significant increase in heart rates. The results obtained in our study showed significant increase in heart rate but had no clinical significance. This may be due to handling stress, time taken for HT, and severity of the lesions that animals exhibited. The results from our study showed that a significance difference in relation to heart rate after HT, which is in contrast with the results obtained by Yakan and Duzguner (2019) [20] where they reported that there were no significant changes in heart rate during HT ($P > 0.05$). The findings obtained in our study are in contrast with the findings of Passos *et al.* (2017) [13], where they suggested that heart rates were not significantly different before and after trimming irrespective of type of lesion. The results from our study showed that significance difference in relation to heart rate after HT. The results of our study are not in agreement with Dar *et al.* (2015) [7] and Ansari *et al.* (2014) [1] where they reported no significant changes in heart rate. Whereas in our study changes in the heart rate are significant. The results obtained in our study are also in agreement with Chapinal *et al.* (2010) [5], where they showed that the heart rate was increased significantly in trimmed cows. The results of our study also showed that there was significant increase in heart rate in initial days of HT and it reached normal on 14th day.

Respiration Rate

The data on mean respiration rate (number of breaths per minute) for before week and after hoof trimming intervention under this study have been presented in Table 3 and graphically depicted in Figure 4. The mean respiration rate of animals one week before HT was 20.25 ± 0.12 , after hoof trimming mean on 0th day was 20.45 ± 0.29 , on 3rd day it was 21.00 ± 0.31 , on 6th day it was 21.45 ± 0.29 , on 8th day it was 20.65 ± 0.32 , on 11th day it was 20.10 ± 0.34 and on 14th day it

was 20.15 ± 0.33 . The results showed that there was no significant difference ($P > 0.05$) in respiration rate on 0th day ($P = 0.490$). On 3rd day and 6th day significant difference ($P \leq 0.05$) was observed when compared with before week of hoof trimming ($P = 0.040$, $P = 0.001$). Whereas on 8th day, 11th and 14th day, no significant difference ($P > 0.05$) was observed when compared with before week of hoof trimming ($P = 0.659$, $P = 0.785$).

We observed that on the day of hoof trimming respiration rate was increased. The increased respiration rate was also observed on 3rd day and 6th day. On 8th day onwards decrease in respiration rate was observed and it continued up to 14th day which is similar to before week of hoof trimming. When compared with before week of hoof trimming respiration rate was similar on 14th day after hoof trimming. The findings of our study are similar to the results of Chavan (2018) [6], where they reported statistically significant increase in respiration rates. The results obtained in our study showed a significant increase in respiration rate but had no clinical significance. This may be due to handling stress, time taken for HT and severity of the lesions that animals exhibited. The results from our study showed that a significant difference in respiration rate after HT, which is in agreement with the results obtained by Yakan and Duzguner (2019) [20], who reported that there was significant changes in respiratory rate. The results of our study are similar with the results of Passos *et al.* (2017) [13], where they reported that there were no significant changes in respiration rate after HT. The results of our study also showed that there were no significant changes in respiratory rate after HT.

The results of our study are in agreement with Dar *et al.* (2015) [7], where they observed no significant difference in respiration rate. In our study, we also observed no significant changes in respiratory rate. Results obtained in our study are also in agreement with Ansari *et al.* (2014) [1]. The results obtained in our study are also in agreement with Chapinal *et al.* (2010) [5], where they showed that the respiration rate was increased significantly in trimmed cows. The results of our study also showed that there was a significant increase in respiration rate after HT. This may be due to handling stress. Overall HT doesn't effected the physiological indices mostly except on the day of HT. Apart from this all physiological indices retained to normal within few days and it also showed that HT has a positive effect on physiological indices.

Conclusion

Taking in to consideration all the results recorded in the present study, it could be concluded that Hoof Trimming (HT) intervention on Physiological indices like heart rate, respiratory rates and rectal temperature increased significantly in the initial days but returned to normal in lame animals. The hoof trimming process has a significant improvement on the cow's locomotion. So HT can be recommended for farmers when the animals are identified as lame as it helped the animals in reducing the lameness. Apart from this hoof trimming time, environmental factors such as flooring system and management style, and the animal related factors such as lactation period and stage, number of milking, breed and age affect the Physiological indices like heart rate, respiratory rates and rectal temperature positively or negatively. It is recommended that these factors should be considered in future studies. In light of all this information, HT is necessary to ensure healthy claws, prevent lameness and increasing the

performance of dairy cows. Further this is a novel improved intervention using angle cutter modified to trim the hoof

which is safe and painless compared to conventional Hoof cutter which caused a lot of cutting and bleeding hooves.

Table 1: Paired t test analysis for Rectal Temperature (°F) in dairy cows one week before HT and after HT on day 0, 3, 6, 8, 11 and 14

Days	Mean ± SE	P value
One week Before HT	101.30±0.08 ^a	
0 th day	104.52±0.05 ^b	0.000
3 rd day	104.29±0.04 ^b	0.000
6 th day	102.75±0.07 ^b	0.000
8 th day	101.74±0.09 ^b	0.001
11 th day	101.62±0.07 ^b	0.003
14 th day	101.50±0.17 ^a	0.140

Note: Means within a column bearing different superscripts differ significantly (P≤0.05)

Table 2: Paired t test analysis for Heart Rate (bpm) in dairy cows one week before HT and after HT on day 0, 3, 6, 8, 11 and 14

Days	Mean ± SE	P value
One week Before HT	66.7±0.21 ^a	
0 th day	72.65±0.49 ^b	0.000
3 rd day	72.05±0.30 ^b	0.000
6 th day	70.75±0.18 ^b	0.000
8 th day	69.30±0.21 ^b	0.000
11 th day	68.00±0.32 ^b	0.006
14 th day	65.70±0.39 ^a	0.007

Note: Means within a column bearing different superscripts differ significantly (P≤0.05)

Table 3: Paired t test analysis for Respiration Rate (number of breaths per minute) in dairy cows one week before HT and after HT on day 0, 3, 6, 8, 11 and 14

Days	Mean ± SE	P value
One week Before HT	20.25±0.12 ^a	
0 th day	20.45±0.29 ^a	0.490
3 rd day	21.00±0.31 ^b	0.040
6 th day	21.45±0.29 ^b	0.001
8 th day	20.65±0.32 ^a	0.148
11 th day	20.10±0.34 ^a	0.659
14 th day	20.15±0.33 ^a	0.785

Note: Means within a column bearing different superscripts differ significantly (P≤0.05)

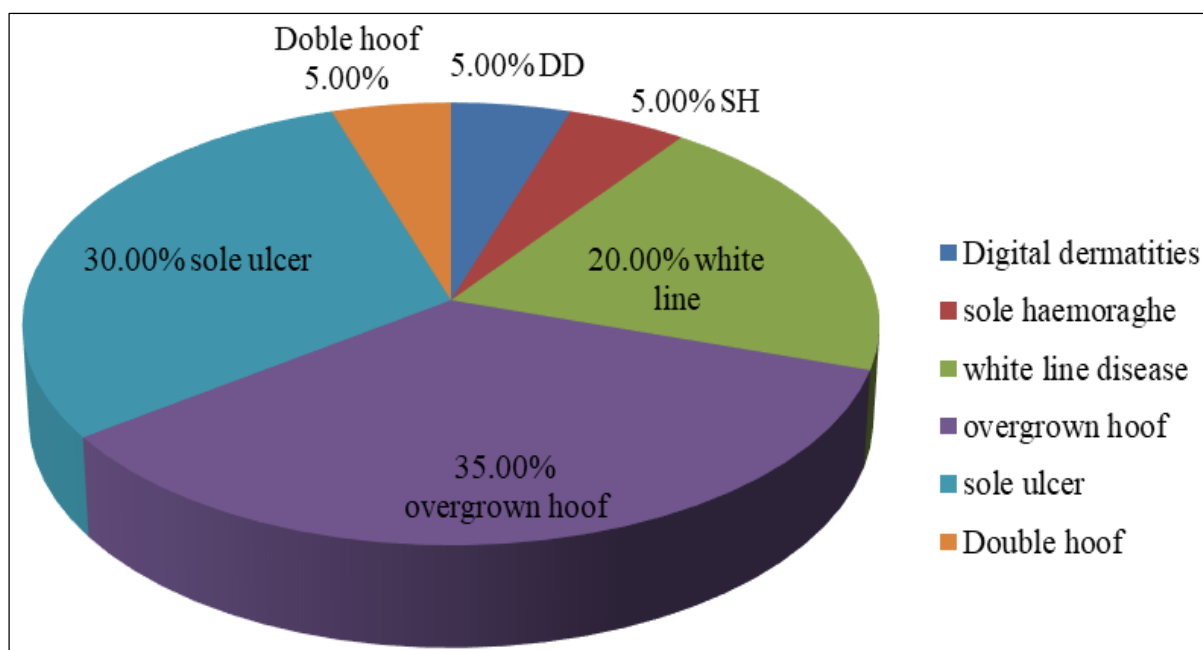


Fig 1: Incidence of hoof affections in dairy cows

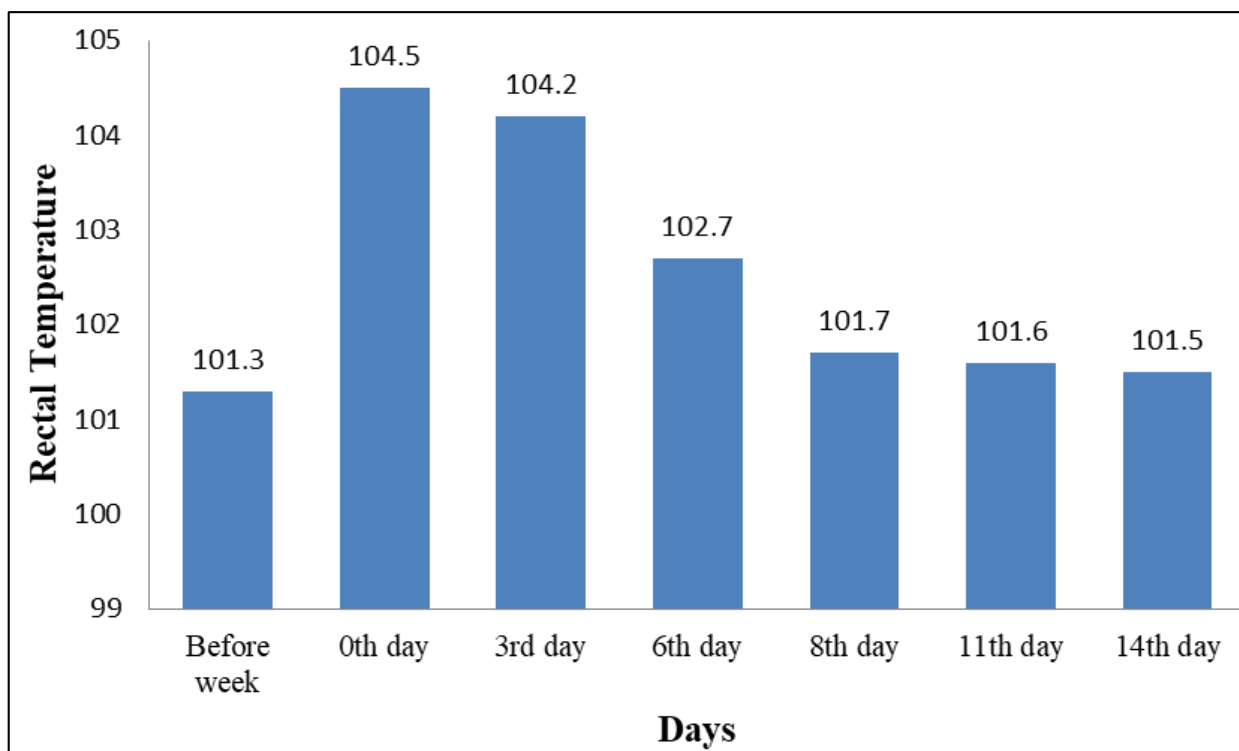


Fig 2: Comparison of Rectal Temperature (°F) in dairy cows one week before HT and after HT on day 0, 3, 6, 8, 11 and 14

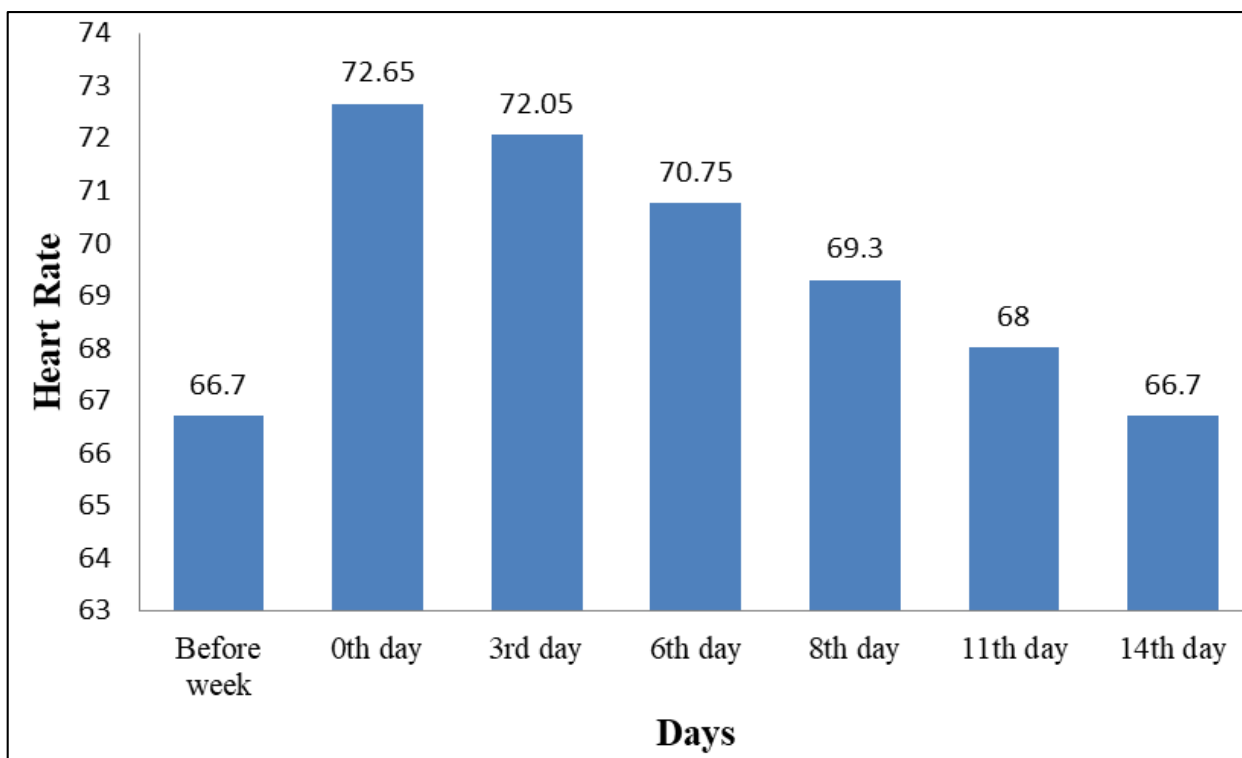


Fig 3: Comparison of Heart Rate (bpm) in dairy cows one week before HT and after HT on day 0, 3, 6, 8, 11 and 14

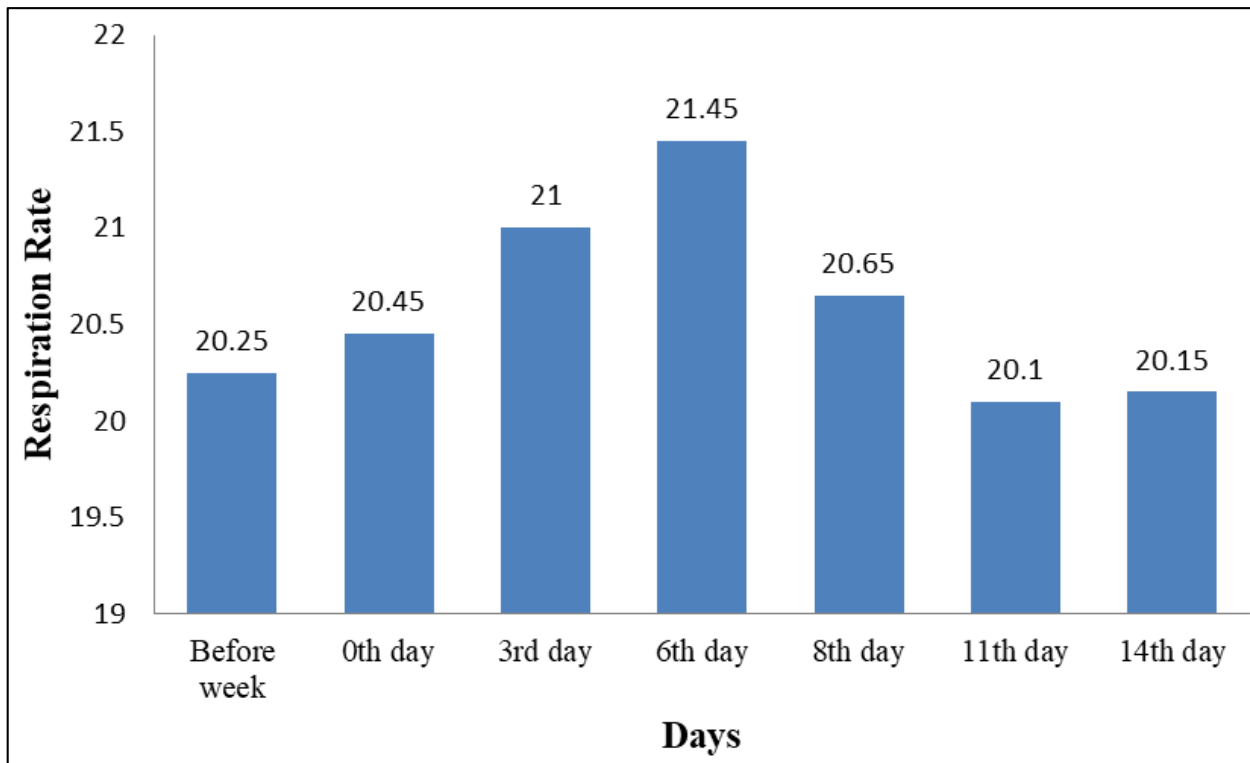


Fig 4: Comparison of Respiration Rate (number of breaths per minute) in dairy cows one week before HT and after HT on day 0, 3, 6, 8, 11 and 14

Pictures of instruments used for hoof trimming

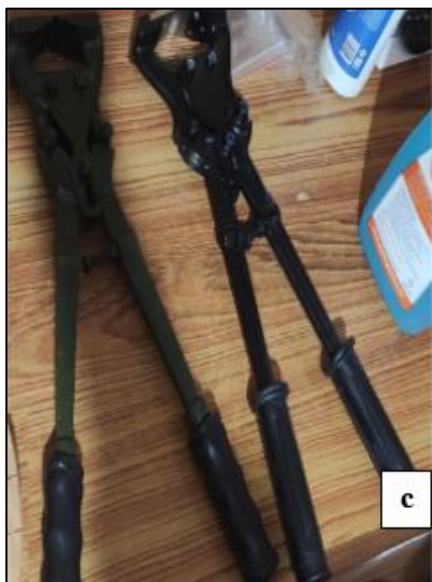




Plate 1: Equipments used for HT, Right and left hoof knives a), Specially designed Travis for HT b), Hoof cutter c), Multipurpose Electric Angle grinder d), Multipurpose Cutter blade e)

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