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Impact of claw trimming practice on hematologic and mineral profiles in goats

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Foot problems are a worldwide dilemma for small ruminant producers, as it causes production loss with subsequent economic losses. One of these problems is claw over growth. this study was conducted to investigate effect of claw trimming on hematologic and mineral status of goats and application of ideal claw overgrowth trimming with maintaining healthy outlines. Forty goats were enrolled in this study, 35 goats with overgrowth and 5 control goats. The goats with overgrowth claw underwent trimming process. Bloods samples were withdrawn from each goat for hematologic and mineral profile, x-ray was also performed. In trimmed-claw goats, blood samples were also withdrawn after 5 months post trimming Significant reduction in RBCs, hemoglobin, PCV, Zinc, copper and iron in pre-trimming group compared to control and post-trimming group. Trimming process is important for claw health especially in goats reared on soft bedding where movement is restricted. Claw overgrowth appeared to have significant impact on hematologic and mineral profile of affected goats.

Keywords: Goat, Claw overgrowth, Radiology, Trimming, Mineral status, Hematology.

INTRODUCTION

In Egypt, animals' production of beef and milk are considered a cornerstone in economy. Goats, one of popular animals raised in Egypt with approximate 4.046.238 head in 2015 (FAO, 2017) participate in securing milk and meat source for many people.

Goats, by default, are climber, agile creatures and constantly in motion; some veterinarians advocate addition of gravels and piles of rocks into goat enclosures to ensure claw overgrowth control (Smith and Sherman, 2009). Foot problems are a worldwide dilemma for small ruminant producers, as it causes welfare compromise and production losses with subsequent economic losses (Winter, 2011).

Lameness is defined as locomotion abnormality where animal is unable to bear weight on affected limb (Constable et al., 2016). One of popular foot problems which may lead to lameness is claw overgrowth. It is usually seen in goats and mostly attributed to lack of natural claw wear as a result of soft surfaces (Smith and Sherman, 2009; Gallivan, 2010) especially in those reared in small-scale system. Claw trimming is an essential procedure that should be done once or twice a year (Anzuino et al., 2010).

Claws trimming is valuable procedure to reduce maximum pressure, enlarge floor contact area of the claw to achieve proper heel and toe length for better balancing (Hepworth et al. 2004; Leacha et al., 2005; Zeiner et al., 2007). This practice aimed

to help animals have equal weight distribution to maintain the health status for enhanced production (Ifeanyieze et al., 2016). Abnormal hoof growth may make walking painful and predispose the animal to joint, tendon problems, arthritis and reproductive performance problems (McKendrick et al., 2010; Duberstein et al. 2013; Ajuda et al., 2014; Teke et al., 2014), and consequently constitutes a conundrum related to adequate feed intake (Vermun, 2005).

Trace minerals as copper and zinc have significant impact on hooves epithelium health (Kibar et al., 2016). Zinc is one of key players in keratinization process while copper is effector mineral in activation of "thiol oxidase", an important enzyme for horn cell keratinization (Miller et al. 1998; Tomlinson et al., 2004). It was postulated that claw lesions decreased when mineral availability elevated and that constitute a cornerstone in keeping claw integrity and health (Siciliano-Jones et al., 2008).

For that, this investigation was conducted with two aims: 1- is to investigate effect of claw trimming on hematologic and mineral status of goats. 2- trimming hoof with maintaining healthy outlines.

MATERIALS AND METHODS

Animals enrollment

This study involve enrollment of 40 goats divided as follow, 35 goats with claw overgrowth reared on soft bedding and 5 goats with normal claw reared on the same conditions which acted as control. All animals were husbanded in the educational farm belonging to faculty of veterinary medicine, Cairo University, Egypt.

Sample collections and laboratory investigations

Blood samples were withdrawn from each animal and divided into two tubes, first one was on EDTA-containing tube for clinical hematology, second portion was on plain tube for serum separation. Serum was used to estimate zinc, copper, iron, calcium and phosphorous (spectrum diagnostic Egypt). Samples were collected from control goats and goats with claw overgrowth (pre-trimming and 5 months post-trimming).

Fecal samples were taken from each animal for parasitological examination.

Radiology and curative trimming procedure

X-ray of affected claw (pre-trimming and 5 months post-trimming) and control claw performed using fisher apparatus to take x ray film, lateral view at 48 KV and anterior posterior view at 52 KV, 100cm FFD.

Measurement of the claw was performed to determine the excessive growth by computer software program (Digimizer Image Analysis Tool (MedCalc Software, version 4.2.5.0), using x ray films with fixed unit (figure 1) for measuring length of third phalanx, length of claws and whole length of claw as follow:

Length of third phalanx = length from cornet to end of 3rd phalanx

Length of claw = length from end of 3rd phalanx till end of horney material

length of Whole claw = Length of third phalanx + Length of claw

After marking overgrown part by red marker (figure 2), standard cutting procedure to remove excess part was applied. Overgrown claws were then cut back, and the outer claw was cut to level up with the inner claw by small bits at frequent intervals to avoid bleeding (Ifeanyieze et al., 2016), after trimming procedure, the "Wood block" was needed as corrective item in the case of wounded sole. Sole wounds were identified by pressing trimmed claw and observation of goat's reaction to detect signs of pain.

Statistical analysis

Data of length of overgrown claws pre-trimming, post-trimming and control goats with balanced gait were compared using one- way ANOVA (CoStat statistical software), P value ≤ 0.05, data represent as mean ± standard error.

RESULTS

Excessive overgrowth, x-ray and measurement of overgrowth are shown in table (1) and figures (1-5).

Mean of pre-trimmed claw length was significant increased 6.684±0.638 in comparison either with control 1.517 ± 0.25 or with post-trimming claw length 1.797±0.217. Length of whole growth of pre- trimmed claw was significant increased 11.113 ± 0.69 in comparison with control 4.53 ± 0.39 or with post-trimming claw length 4.622 ± 0.216 as shown in table (1).

Results of hematologic and mineral profiles are shown in table (2). Pre-trimming goats showed significant reduction in RBCs, hemoglobin and PCV compared to control and post-trimming group. Significant reduction in zinc, copper and iron were observed in pre-trimming group compared with post-trimming and control group.

Figure 1: a) Metal ruler with known width as fixed unit on x ray film
B) Marking of overgrowth part

Figure 2: A) radiographic signs of the claw before trimming (the red line refer to length from cornet to end of 3rd phalanx and yellow line refer to overgrowth part) Radiographic Lateral view
B) Radiographic Caudo-cranial view

Figure 3: Radiographic signs of the control normal claw (the red line refer to length from cornet to end of 3rd phalanx and yellow line refer to length of claw)
A) Radiographic Caudo-cranial view
B) Radiographic Lateral view
C) Radiographic Caudo-cranial view
D) Radiographic Lateral view

Table (1): Results of control, pre- and post-trimming claw length

Parameter/unit	Control group	Claw overgrowth group	
		Pretreatment	Post-treatment
Length of 3rd phalanx	3.217 ± 0.150 [b]	4.429 ± 0.175 [a]	2.825± 0.11 [b]
Length of claw	1.517 ± 0.25 [b]	6.684±0.638 [a]	1.797 ± 0.217 [b]
Length of whole claw	4.532± 0.39 [b]	11.113 ± 0.69 [a]	4.622 ± 0.216 [b]

Different letters in the same raw are statistically significant with P value (P≤0.05).
Data represented as (Mean ±SE), P value ≤0.05
The same letters in the same raw are statistically not significant with P value (P≤0.05).

Figure 4: showing radiographic signs of the claw after treatment (the red line refer to length from cornet to end of 3rd phalanx and yellow line refer to length of claw)
A) Radiographic Caudo-cranial view
B) Radiographic Lateral view
C) Radiographic Lateral view
D) Radiographic Caudo-cranial view

Figure 5: Showing the variable length of overgrowth part after trimming

Table 2: Hematologic and mineral profile in control, pre-and post-trimming goats

Parameter/unit	Control group	Claw overgrowth group	
		Pre-treatment	Post-treatment
RBCs count(106/µl)	10.1 ± 1.149[a]	6.683± 0.83[b]	10.75 ± 1.58[a]
PCV (%)	35.366 ± 1.36 [a]	28.11 ±0.99 [b]	38.72 ±2.19 [a]
HB content (g/dl)	11.61 ± 0.38 [a]	9.216 ± 0.51 [b]	12.225± 0.56 [a]
WBCs count (103/ µl)	9.885 ±1.35 [a]	9.994 ±0.56 [a]	12.525 ± 1.54 [a]
Lymphocyte	54.666± 4.58 [a]	55.22± 1.95 [a]	49.75± 10.42 [a]
Monocyte	3.166 ± 0.60 [b]	3.333±0.33 [b]	7.25 ± 2.05 [a]
Eosinophils	6.166 ± 0.74 [a]	7.00 ± 0.83 [a]	6.75 ± 1.25 [a]
Neutrophil	36± 4.05 [a]	34.22± 1.89 [a]	35.775±8.61 [a]
Zinc	94.166 ± 9.18 [a]	72.085 ± 5.35 [b]	78.25 ± 9.27 [ab]
CU	103.166 ± 8.74 [a]	70.96± 10.26 [b]	74.25± 10.60 [ab]
Fe	156.16± 26.62 [a]	97.20 ±9.77 [b]	192.50± 28.09 [a]
Ca	10.348 ± 0.47 [a]	10.93 ± 0.22 [a]	10.35± 0.27 [a]
Ph.	5.625 ± 0.43 [b]	5.25 ± 0.44 [b]	7.76± 0.53[a]

Data represented as (Mean ±SE), P value ≤0.05

Different letters in the same raw are statistically significant with P value (P≤0.05).

The same letters in the same raw are statistically not significant with P value (P≤0.05).

Though calcium showed no change in all three groups, phosphorous showed slight elevation in post-trimming group compared to other two groups, however, this elevation is still within reference range.

DISCUSSION

Foot problems are a worldwide dilemma for small ruminant production, as it compromises animals' welfare and associated with production and economic losses (Winter, 2011). One of them is claw overgrowth. In this study, claw overgrowth was observed in goats that its reared on soft bedding material. Claw overgrowth is postulated to be caused by numerous factors, of which soft bedding, though surprisingly, also hard concrete surface as it causes increased wear in particular claw areas and overgrowth in other areas (Smith and Sherman, 1994). Moreover, claw overgrowth cause imbalance and affects weight-bearing (Sasaki et al., 2015) which consequently might affect feed intake (Chapinal et al., 2009).

Length of 3rd phalanx, claw and whole claw were significantly increased in comparison with control and post-trimming data, it was reported that the trimming is an essential procedure advocated for performing 1-2 times/year (Kibar et al., 2016). In order to achieve proper balance, claw trimming is a tool to reduce pressure and attain proper heel and toe balance (Hepworth et al., 2004; Leacha et al., 2005; Zeiner et al., 2007). The claw overgrowth might affect goat behavior and physical performance in addition to lowering of feed intake (Vermun, 2005) which consequently might reflect on hematologic and mineral profiles.

In the present work, hematologic and mineral status evaluations of goats pre- and post-trimming were done. The pre-trimming goats showed significant decrease in RBCs, hemoglobin and PCV compared to control and post-trimming group. In goat medicine, anemia is a classical presentation of different etiologies, for instance, parasites (internal, external and blood parasites), nutritional deficiencies and blood loss (Anumol et al., 2011)

Anemia can be caused by malnutrition and poor absorption of iron which consequently leads to reduction in hemoglobin production (Mathews, 2016). Anemia could be attributed to disruption in iron metabolism in association with copper deficiency (Abd El-Raof and Ghanem, 2006). As anemia progressed, reduction in appetite is expected and decrease the acquired dietary protein uptake by the animal will ensue (Kumar et al. 2015). Though the recorded anemia was improved in post-trimming goat, this may be supported by notion that abnormal claw growth might make walking painful and consequently constitutes a conundrum related to adequate feed intake (Vermun, 2005).

In the current study, reduction in mineral profile particularly in zinc, copper and iron were recorded in pre-trimming goats that have significant increase in claw length in comparison

to post-trimming and control goats, these reductions might reflect its significant role in keratinized cell matrix strength and integrity of claw (Van Riet et al., 2013). Physiologic status of goat might affect mineral status (Salem, 2017). The deficiency of zinc was found to exacerbate anemia of iron deficiency origin (Kelkitli et al., 2016). For keratinization process to complete, constant and proportionate provision of nutrients to epidermal cells is required (Hoblet, 2000), of these nutrients, trace minerals as copper and zinc play an inherent role in keratin synthesis (Mulling et al.,1999).

Copper is a part of "thiol oxidase", an enzyme which form disulfide bonds in keratin filament (O'Dell, 1990). Zinc is a key factor in maintaining integrity of claw (Siciliano-Jones et al., 2008). as many "Zinc-dependent enzymes" are important for keratinocytes differentiation (Cousins, 1996). This may be translated into the recorded reduction in these minerals might cause disruption in keratinization process causing further claw problems. In other animal model, it was concluded that supplementation of zinc and copper were attributed to healthy normal claw structure in hoof of sow (Varagka et al., 2016). Significant reduction in iron was observed, Iron absorption and uptake are reduced due to copper decline (O'Dell and Sunde1997). Copper-iron interaction regulates hephaestin (HP) in gut (Collins et al., 2010). HP (a multi Cu-ferroxidase) is relying on normal levels of copper; it's postulated that reduction in Cu level is linked with reduction of iron uptake as it decreases duodenal HP activities (Reeves et al., 2005).

CONCLUSION

Trimming process is important for claw health especially in goats reared on soft bedding where movement is restricted. Claw overgrowth appeared to have significant impact on hematologic and mineral profile of affected goats.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

AUTHOR CONTRIBUTIONS

All authors contribute equally

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