Subacute ruminal acidosis outbreak in feedlot Barki sheep due to faulty fattening practice

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ABSTRACT

Subacute ruminal acidosis (SARA) is an important disorder in producing animals characterized by prolonged periods of low ruminal pH with deleterious effects on animal's health and productivity. SARA was studied usually experimentally due to its subclinical nonspecific presentation. We present here a field outbreak of SARA in feedlot Barki sheep and the related ruminal pathological changes. Rumens of six feedlot sheep fed on high-grain fiber-deficient diets were examined for the pH of their contents as well as any abnormalities in their morphology and tissues. The results revealed that the ruminal juice of affected animals was acidic. Grossly, the ruminal mucosa was grey, hyperemic and severely thickened with multiple areas of epithelial detachment. Histopathologically, the common findings were epithelial desquamation, hydropic degeneration and ulcer formation. In addition, submuscular venular thrombosis and multifocal lesion with eosinophilic granular proteinaceous material mixed with variable numbers of inflammatory cells were noticed. This is, according to the best of the authors' knowledge, the first example of a non-experimental field SARA outbreak in feedlot sheep and its ruminal gross and histopathological picture.

Keywords: *subacute ruminal acidosis, histopathological findings, sheep, feedlot, fattening*

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1. INTRODUCTION

Subacute ruminal acidosis (SARA) is generally a condition characterized by prolonged periods of low ruminal pH. Due to the association between low pH and time during SARA, number of descriptions was provided to determine it. SARA was described as the mean daily ruminal pH between 6.25 and 5.5 [1], as repeated bouts of depressed ruminal pH between 5.0 and 5.5 [2], as well as the duration of episodes where pH is less than a physiologically acceptable value (e.g., pH <5.6 for more than 180 min/d) [3]. SARA may occur in feedlot animals, including sheep, because of feeding them excessive amounts of rapidly fermentable carbohydrates in conjunction with inadequate fiber [4, 5].

As small ruminants, sheep are adapted to digest and metabolize predominantly forage diets [4]. However, in an attempt to augment their growth rates and productivity, those animals may be exposed to consume high-grain fiber-deficient diets. Such changes in diet may lead to excessive accumulation of volatile fatty acids in the rumen exceeding the latter's absorption capacity, resulting in SARA [6].

In contrast to the overt disease which may result from the acute ruminal acidosis (ARA, grain overload), SARA effects are less severe, non-specific and hard to be detected [5]. ARA is characterized by common morbidity and mortality in both small and large ruminants and, clinically, by rumen hypomotility to atony, dehydration, acidemia and diarrhea, changes in hematological and biochemical profiles, depression, incoordination, collapse, and death in severe cases [7-17]. On the other hand, the main clinical signs attributed to SARA are reduced feed intake, decreased milk production, reduced fat and poor body condition score, despite adequate feed intake [4].

Because of its subclinical nature, SARA is very rarely diagnosed in ruminants [4] and it is investigated in sheep by being induced experimentally [5, 18-27]. Therefore, reports describing the disease from SARA in feedlot sheep in a

field setting are lacking. We present here a field SARA outbreak in feedlot Barki sheep due to faulty fattening practice and the consequent morphological and histopathological changes in ruminal tissues. This is, according to the best of the authors' knowledge, the first example of a non-experimental field outbreak of SARA in feedlot sheep.

2. MATERIALS AND METHODS

Six feedlot Barki sheep rumens with abnormal gross characteristics, as well as all other viscera, were presented to evaluate their fitness for human consumption. Those rumens and viscera were parts of carcasses of sacrifice sheep of Eid Al-Adha Muslim feast.

A full case history was taken from the owner. A thorough postmortem inspection involving the whole carcasses, viscera and especially the affected rumens was performed.

Ruminal juice pH was determined using pH test strips (Sigma-Aldrich, Germany). Specimens were collected from the affected rumens for histopathological examination by standard methods. Briefly, ruminal tissue sections were prepared, fixed in 10% neutral buffered formalin, and stained with H&E stain [28]. The stained ruminal tissue sections were then evaluated using light microscope (Carl Zeiss, Germany), under X10 and X40 magnification powers, and imaged using a low-power objective under a light microscope (Carl Zeiss, Germany).

As it was possible, the main-flock owner was contacted later, for taking the history of flock feeding and the used concentrate was sampled and analyzed at the National Center for Animal Health, Libya.

3. RESULTS

As anti-mortem examination was not possible with the reported cases, the information regarding their health status before slaughter was fully dependent on the narrative of owner, who claimed that no abnormalities in the animals' health condition were observed prior to sacrifice. The contact with the main-flock owner revealed that those sheep were fed exclusively on a broiler finisher concentrate during the last three months. The results of concentrate sample analysis revealed a fiber content of 4.5%.

On the other hand, the postmortem investigation of the carcasses and viscera revealed no abnormalities except for the rumens, where pathological findings relevant to SARA were detected.

Grossly, the rumen was filled with a green-yellow watery fluid, for which the pH was acidic (Mean of 5.3), as revealed through the pH test strips color sequence. On the mucosal surface of the rumen, several discrete red foci (5-10 cm diameter) with fibrin tags were visible (Fig. 1A). Approximately 80% of the intervening ruminal mucosa was grey and severely thickened with hyperemic borders. Multiple areas of epithelial detachment were also seen (Fig. 1A&B).

Histopathologically, the epithelial desquamation, hydropic degeneration and ulcer formation were the more common findings (Fig. 2A&B). There was a multifocal lesion with eosinophilic granular proteinaceous material mixed with variable numbers of neutrophils, irregularly interspersed multinucleated giant cells, macrophages and smaller numbers of lymphocytes (Fig. 2C). In many vessels, submuscular venular thrombosis was also observed (Fig. 2C). Moderate numbers of fungal hyphae and protozoa were present within the mucosa and submucosa (Fig. 2D). Moreover, mild to moderate hyperkeratosis with hemosiderin pigments were also detected.

4. DISCUSSION

Sheep, like other ruminants, are adapted to use fiber carbohydrates, such as cellulose and hemicellulose, as a main source of energy [5]. for maximizing energy intake and, then, growth rate, feedlot sheep feeding depends currently on the use of highly fermentable diets which, in the lack of fiber source, may result in an increased rate of fermentation and acid production leading to severe clinical state of ARA or a subclinical less severe SARA state [5]. SARA represents a major problem in high-producing ruminants as it decreases feed efficiency and production and predispose animals to disease [23].

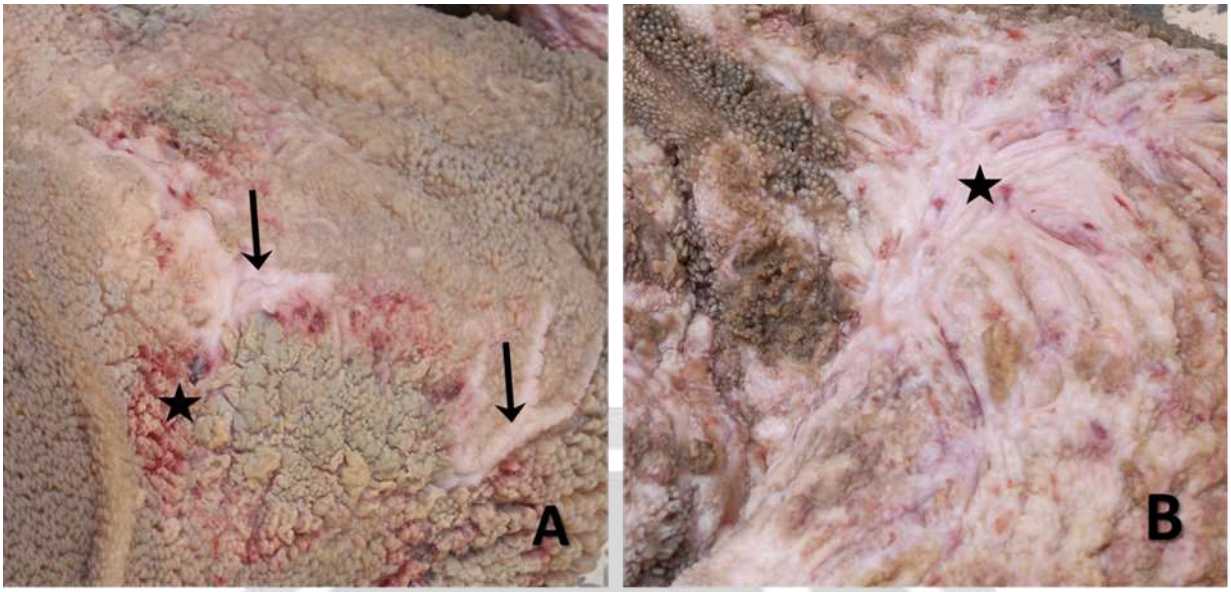

Fig -1: **Gross pathology of subacute ruminal acidosis in feedlot Barki sheep due to high-grain diet. A.** Ruminal mucosa appears grey, hyperemic (asterisk) and severely thickened (arrows). **B.** Moderate hyperkeratosis, erosion and ulceration of the ruminal papillary architecture (asterisk).

Eid Al-Adha is an esteemed annual sacrifice event in Muslim countries. In Libya, sheep are considered among the favorite sacrifice species. For that, high growth rate in feedlot flocks is usually attempted through feeding high-grain diets, mostly in the absence of fiber source, especially during the months when the event getting closer. This study presents a SARA outbreak in feedlot Barki sheep due to such faulty fattening practices and the consequent morphological and histopathological changes in ruminal tissues. This study represents, according to the best of authors' knowledge, the first example of an incidentally-diagnosed non-experimental field outbreak of SARA in feedlot sheep.

The fattening protocol was exclusively dependent on the feeding of poultry-designated concentrate for quite long periods with the absence of source of fibers. It is clear that the motivation of using high-grain diets in this protocol was the sake of faster growth/body gain. The use of a broiler finisher concentrate for feedlot sheep feeding could be attributed to the lack of knowledge and/or the unavailability of concentrate designated for feedlot sheep.

The broiler finisher concentrate used for feedlot sheep feeding was corn-based with 4.5% fiber content. Together with the lack of fibers in the offered diet, the presence of corn in that concentrate might had contributed in SARA development in this case. This is supported by the findings of Lettat et al. who reported, under experimental conditions, that corn feeding was associated with the induction of butyric SARA in sheep, in contrast to wheat and beef pulp feeding which were associated with the induction of lactic acidosis and propionic SARA, respectively [23].

The animals were claimed to be apparently healthy before sacrifice. This history is in accordance with the classical subclinical presentation of SARA under which the ruminal pH decreases to low physiological values but without specific symptoms [5, 29, 30].

The most evident changes due to this SARA outbreak were in the rumens of affected animals. The ruminal juice was acidic and green-yellow in color. To give the best indication of low pH, SARA is often diagnosed experimentally using time below pH 5.6 instead of average pH [31, 32]. Unfortunately, it was not possible to follow low pH on time in our case, as SARA was diagnosed postmortem incidentally in the sacrificed animals and the one-time pH reading was imposed due to that scenario.

Changes in ruminal morphology were noticed in the presented cases. The ruminal mucosae were grey and severely thickened with multiple areas of epithelial detachment and several discrete red foci with fibrin tags were visible. In addition, epithelial desquamation, hydropic degeneration and ulcer formation were noticed histopathologically with

moderate numbers of fungal hyphae and protozoa. In agreement with these findings, it was reported that ruminal acidosis had adverse effects on the ruminal motility, microbial populations and wall morphology [33, 34].

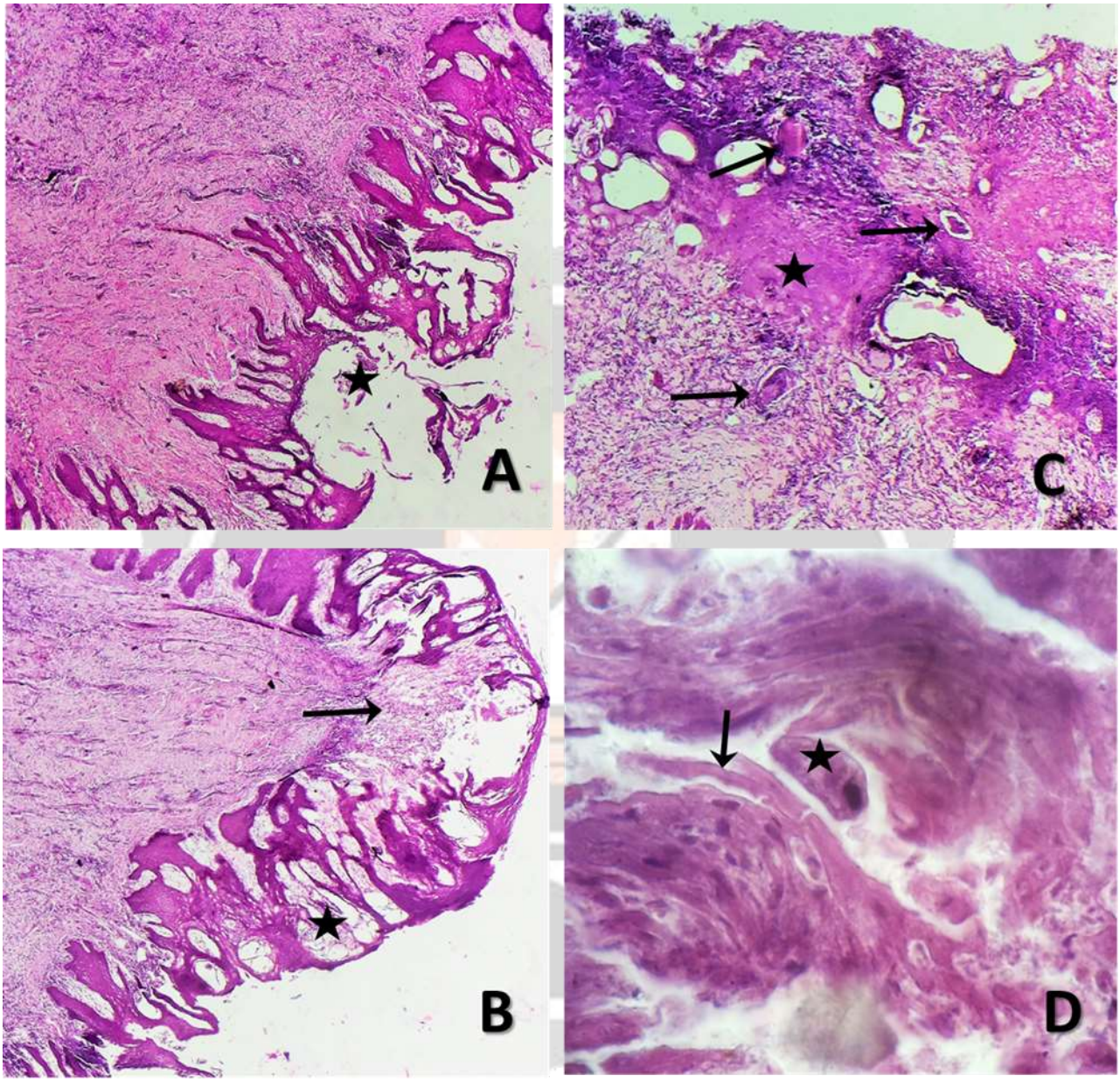

Fig -2: **Histopathological changes (abnormalities) of ruminal tissues due to subacute ruminal acidosis. A.** Epithelial desquamation, mild to moderate hyperkeratosis and ulcer formation (asterisk) (H&E, X10). **B.** The superficial cells of the stratified epithelium displayed Hydropic degeneration (asterisk). Some other segments had necrotic cellular debris associated with neutrophilic infiltration and bacterial aggregates (arrow) (H&E, X10). **C.** Multiple submucosal blood vessels contain fibrin thrombi (arrows) and multifocal eosinophilic granular proteinaceous material mixed with variable numbers of inflammatory cells (asterisk) (H&E, X10). **D.** Fungal hypha (arrow) and a protozoon (asterisk) in the ruminal submucosa (H&E, X40).

5. CONCLUSION

This study presents a SARA field outbreak in Barki feedlot sheep fed on high-grain fiber-deficient diets, with the associated gross morphological and histopathological changes in their rumens. Further efforts are still needed for raising the awareness of feedlot breeders about the nutritional needs, species differences and the optimal feeding protocol for sheep fattening practice.

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