P-ISSN: 2304-3075; E-ISSN: 2305-4360
International Journal of Veterinary Science
www.ijvets.com; editor@ijvets.com

Mini Review https://doi.org/10.47278/journal.ijvs/2023.095

The Syndrome of Pica or Depraved Appetite in Small Ruminants: A Mini-Review

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Article History: 23-291 Received: 03-Sep-23 Revised: 30-Sep-23 Accepted: 03-Oct-23

ABSTRACT

This mini-review is written to shed light on the syndrome of pica or depraved appetite in small ruminants, sheep, and goats. Contributing factors, clinical, laboratory, and postmortem findings, and control measures are discussed in detail. The condition is a special condition, whereby the diseased animal usually eats abnormal things such as bone, wood, hair, wool, sand, mud, cloth, plastics, robes, and many other objects. Sometimes, the animal may eat its feces. The condition is associated in many cases with a wide variety of dietary deficiencies. As a result of the abnormal appetite, the affected animal starts to lose body weight progressively depending on the acuteness and course of the syndrome. Other complications are watched by different field veterinarians such as toxicity lead poisoning botulism and obstruction of the esophagus and intestines that may be partial or complete. Several predisposing causes are implicated in the etiopathogenesis of this syndrome. Of these contributing etiologies is the shortage in protein, fibers, and some minerals such as cobalt, phosphorus, calcium, magnesium, potassium, sodium, chloride, zinc, cobalt, iron, and copper. Chronic parasitism and ketosis are also important predisposing causes.

Key words: Animal behavior, Body weight gain, Diet, Disease predisposition, Nutrition

INTRODUCTION

Pica, allotrophagia, or geophagia is a special condition of depraved or abnormal appetite, whereby the animals start eating objects that they normally do not eat (Firyal 2007; Nikvand et al. 2018). The disorder is also reported in human beings (Borgna-Pignatti and Zanella 2016; Xiang et al. 2018; Adhikari et al. 2023). The condition differs from licking to actual eating and is usually associated with animals that chew or eat wood (fences, trees, buildings), dirt, bones, or other inanimate objects not usually considered feedstuffs (Smith 2015). Pica is linked in most cases with dietary deficiency, either of bulk or, in some cases, more specifically fiber, or of individual nutrients, particularly salt, cobalt, or phosphorus (Schild et al. 2021).

In farm animals, three main types of pica exist; the chewing of bones (osteophagia), the eating of young (infantophagia), and the eating of feces (coprophagia). However, other types are reported and include wood eating in sheep, bark eating, the eating of carrion, and cannibalism. Salt hunger can result in coat licking, leather chewing, earth-eating, and the drinking of urine (Constable et al. 207). Pica may have dangerous consequences as cannibalism for example may be the cause of many deaths, poisonings particularly lead poisoning and botulism, are common sequelae, foreign bodies leading to reticuloperitonitis or lodging in the alimentary tract leading to a luminal obstruction, accumulations of wool fiber or sand may cause obstruction, perforation of the esophagus or stomach may result from the ingestion of sharp foreign bodies and grazing time is often reduced and livestock may wander away from normal grazing (Melendez et al. 2007).

Allotrophagia is considered a challenge for the farmers as well as for the clinician. The condition has a bad impact on the health, animal productivity, and economics of the herd. The mechanisms of pica are not yet completely understood. It has been associated with a shortage of protein, fibers, and some minerals such as cobalt, phosphorus, calcium, magnesium, potassium, sodium, chloride, zinc, cobalt, iron, and copper. The condition has also been associated with other disorders such as chronic parasitism and ketosis (Firyal 2007; Smith 2015). In many cases, the actual cause of the pica cannot be determined, and corrective measures may have to be prescribed on a trial-and-error basis. Most observational studies identify a relationship between phosphorus deficiency and pica, particularly in ruminants. Horses exhibiting pica may have iron or copper deficiencies (Aytekin et al. 2010). Pica must be differentiated from abnormal behavior

Cite This Article as: Tharwat M and Al-Hawas A, 2023. The syndrome of pica or depraved appetite in small ruminants: A mini-review. International Journal of Veterinary Science x(x): xxxx. https://doi.org/10.47278/journal.ijvs/2023.095

associated with central nervous system diseases, bovine ketosis, and equine behavioral abnormalities associated with boredom (Smith, 2015).

This mini review was designed to shed light on the syndrome of pica or depraved appetite in small ruminants, sheep, and goats. Data were collected from the Qassim region, the central region of Saudi Arabia and the Study was extended for 16 years (2007 and 2023). Images described in this review were taken while working and teaching veterinary students at the University Veterinary Hospital, Qassim University, Kingdom of Saudi Arabia. The following topics will be briefly covered, contributing factors, clinical, laboratory, and postmortem findings and control measures, and future directions.

Contributing Factors

As in large ruminants, pica has several contributing factors in sheep and goats. Of these causes gastrointestinal parasitism, malnutrition, ketosis, and mineral deficiency special for cobalt and phosphorus minerals (Constable et al. 2017; Yüksek et al. 2019; Paul et al. 2021). A depraved appetite generally signals a lack of ration ingredients or dietetic malformation, or it can be a bad vice (Chiezey 2010).

Pulling of either wool or hair constitutes an abnormal behavior in sheep and goats reared in an artificial medium (Reinhardt 2005; Huang and Takeda 2017 and 2018). Other predisposing factors include overcrowding, trace minerals deficiency, in particular zinc, copper, iron, calcium, chloride, manganese, and sodium, as well as protein and vitamin A deficiency (Youde and Huaitao 2001; Meyer and Lohse 2002). The abnormal behavior of hair-pulling can be partner-directed or even self-directed and the hair or wool is not only pulled out but also ingested. Females have been found to act wool-pulling more significantly than males (Reinhardt 2005).

The deficiency of phosphorus is usually primary, and it may be dependent on the deficiency of vitamin D (Constable et al. 2017; Schild et al. 2021). This element is crucial in the body for milk production and skeleton building, and its shortage within the body results in inappetence, depraved appetite, and growth retardation (Aytekin and Kalinbacak 2008; Begum et al. 2010). Phosphorus deficiency may also arise sometimes secondary due to increased dietary calcium with a resulting defect in calcium-phosphorus ratio and finally pica (Haskell and Anttilla, 2001). In a recently published study, the erythrocytes, hemoglobin, and hematocrit were significantly low in cows with pica. In addition, several biochemical elements were also reduced including iron, phosphorus, glucose, and copper; however, total proteins, calcium, potassium, sodium, chloride, and albumin did not differ significantly in diseased compared to healthy cows (Mosa et al. 2020).

The trace element cobalt is important for rumen flora to synthesize vitamin cyanocobalamin (B_{12}). If cobalt is deficient in diet, sheep will suffer body weight loss, retarded wool growth, decreased milk production, intense pallor of the mucus membranes and lacrimation (Fig. 1). Deficiency of cobalt also lead to a special hepatic disorder in sheep named ovine white liver disease characterized by anemia, photosensitization, emaciation, hepatic encephalopathy and at postmortem examination by fatty infiltration and grayish discoloration of the liver (Ulvund 1990; Suttle and Jones 2007; Suttle 2010). In Omani goats, it was reported also that hepatic lipidosis can be reproduced experimentally by cobalt and vitamin B_{12} deficiency (Johnson et al. 1999). The deficiency of other trace elements copper, iron, zinc, selenium, and manganese may be primarily due to absence in diet or secondary due to malabsorption of the element, decreased availability in tissues, or increased excretion (Suttle and Jones 2007; Suttle 2010; Cantile and Youssef 2016; Hill and Shannon 2019; Arthington and Ranches 2021; Asín et al. 2021; Helmer et al. 2021).

Clinical, Laboratory, and Postmortem Findings

Pica is usually characterized in small ruminants on presentations by a repeated history of progressive loss of body condition, inappetence, emaciation, decreased fecal output, partial alopecia, and different forms of depraved appetite such as hair licking, wool eating, and occasionally coprophagia (Fig. 2; Fig. 3).

It has been reported that pica resulted in significant changes in the hematological parameters and biochemical variables including phosphorus, calcium, zinc, iron, total proteins, chloride, and sodium (Mohamed 2018). It was reported also that pica in beef cattle is a multifactorial disorder and is associated with low levels of hemoglobin, copper, iron, and selenium, and in addition, a reduced antioxidant activity (Onmaz et al. 2019). In another study conducted by Ocal et al. (2008), low levels of copper, calcium, and zinc were associated with depraved appetite in dairy cattle. The later report suggested also that pica may be a predisposing cause for traumatic reticuloperitonitis in dairy cattle. It was also found that cattle with depraved appetites are characterized biochemically by hypophosphatemia, hypokalemia, hypochloremia, and iron deficiency (Nikvand et al. 2018). In horses with allotrophagia, biochemical changes included decreased hemoglobin, copper, and iron, concentrations, and therefore it was concluded that decreased serum concentrations of copper and iron may be a contributing factor for the etiopathogenesis of depraved appetite in horses (Aytekin et al. 2011).

However, a report described phosphorus deficiency in goats that is characterized by lameness, emaciation, stiffness of the extremities, abnormal curvatures of the long bones, and muscular relaxation, pica was not reported (Shen et al. 2019). In the later report, wool, tooth, blood, and bone phosphorus were significantly low compared to healthy goats and the inorganic phosphorus serum levels were almost half of that in the healthy group. Interestingly, in another report on sheep with phosphorus deficiency, pica was not listed among the presenting complaints that included lameness, emaciation, enlargement of the costochondral junctions, stiffness in the gait, and abnormal curvature in the long bones (Shen et al. 2014). Biochemical measurements in the last report included low phosphorus levels in wool, tooth, bone, and blood and serum inorganic phosphorus levels of the diseased sheep were about half of those in the healthy sheep.

In underdeveloped countries, the field veterinarian did not have the diagnostic tools for confirmation of the presence of foreign bodies within the gastrointestinal tract and especially the rumen. In these circumstances,

A B

Fig. 1: Cobalt deficiency in a sheep and a goat. Image A shows marked pallor of the conjunctival mucus membranes and image B shows facial alopecia due to profuse lacrimation.

A B

Fig. 2: Pica in a goat and a sheep resulted in partial alopecia due to intense hair licking in the goat (A) and wool eating in the sheep (B).

A B

Fig. 3: Pica in a sheep. Image A shows wool and image B shows coprophagia in the same animal.

in many cases referred with a history of depraved appetite and loss of body conditions, the clinician resorts to exploratory rumenotomy. Different materials may be detected incidentally during surgery. Of these found objects are robes and plastic materials (Fig. 4; Fig. 5). Of the frequently discovered materials are the hair and wool balls; their numbers may range from one to multiple (Fig. 6). Due to rumen motility, cross-section in hairballs sometimes appears in goats as an onion-like-appearance (Fig. 7). At postmortem examination, these obstructing objects may also find occluding the rumen in most cases (Fig. 8; Fig. 9). Large amounts of sand may be found in the intestine, reticulum, omasum, abomasum, and particularly in the rumen (Fig. 10).

Control Measures

The provided feed type may affect the foraging behavior and repress abnormal behavior in animals. It was suggested that sheep performing movements similar to their natural foraging behavior while grazing would repress

Fig. 4: Pica in a goat (A) and a sheep (B) resulted in plastic eating. Animals were referred with a history of weight loss and inappetence. The foreign bodies were removed during exploratory rumenotomy.

Fig. 5: Pica in a sheep admitted with a history of reduced feed intake, weight loss and in a dorsal recumbency position (A). Large amounts of plastic materials were detected at rumenotomy (B).

Fig. 6: Pica in a goat. She was admitted with a history of reduced feed intake and depression (A). Hairballs were detected at rumenotomy (B).

wool-biting behavior. Considering sanitation and animal welfare, providing sheep hay may provide an easier method to control wool-biting behavior in housed sheep (Huang and Takeda 2017). In addition, feeding sheep rolled hay, even in low quantities, can provide them with appropriate oral stimulation and is effective in repressing wool-biting behavior (Huang and Takeda 2018).

Predisposing causes of depraved appetite should be corrected. Hygienic disposal of foreign materials should be carried out from livestock farms. Internal and external parasites should be periodically controlled and any shortage in the diet must be corrected. Dietary improvement is also crucial. Calcium phosphorus ratio should be 2:1. Ketosis and trace element deficiency

Fig. 7: Hair (A, C, goats) and wool (E, sheep) balls at postmortem examination due to severe emaciation and off food. Opposite images (B, D, and F) show cut sections in the hair and wool balls on the same side. Interestingly, the cut section of the hairball in the image (D) resembles an onion-like shape.

Fig. 8: Pica in a goat admitted with a history of reduced feed intake, weight loss, and in a lateral recumbency position (A). Hairballs and plastic materials were detected at postmortem examination (B).

Fig. 9: Pica in a sheep. It was referred for postmortem examination immediacy after death (A). necropsy revealed wool balls, plastic material, and robes within the rumen (B).

Fig. 10: Pica in a female sheep resulted in sand eating. The animal has been admitted with a history of reduced feed intake and depression (A) and the owner donated it to our clinic. At postmortem examination, a large amount of sand was found in the rumen (B).

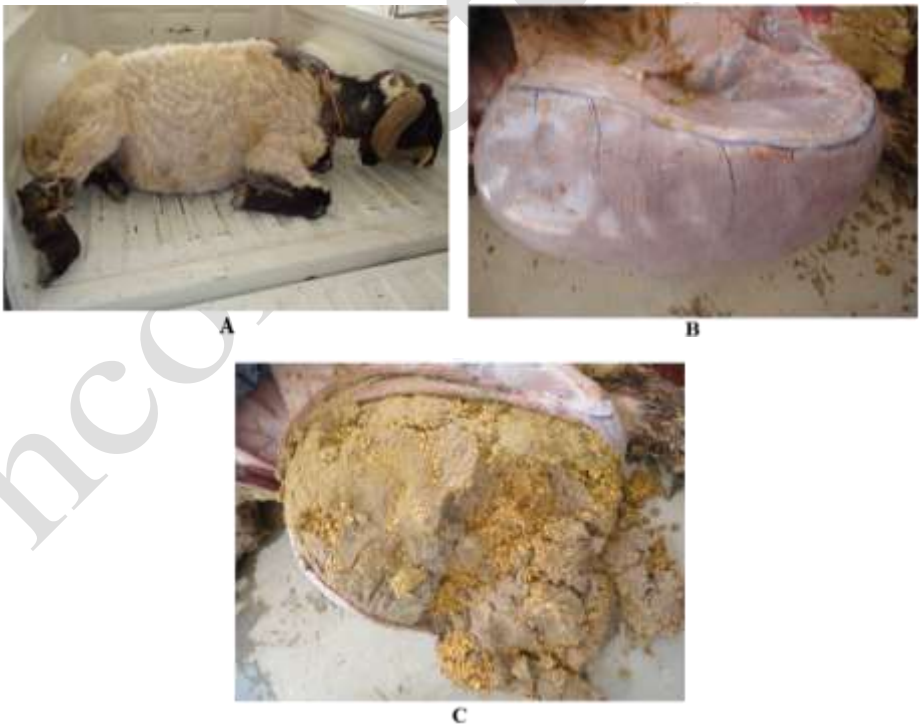

Fig. 11: Pica in a ram. Total wool clipping was performed to prevent wool eating. The animal has been admitted with a history of reduced feed intake, depression, and in a recumbent position (A). At postmortem examination, the abomasum was severely impacted by a large amount of sand (B and C) (abomasal emptying defect).

especially for cobalt, copper, iron, zinc, and manganese should also be treated, and therefore mineral blocks should be provided all over the year and not on special occasions (Constable et al. 2017; Asín et al. 2021; Helmer et al. 2021). In unresponsive cases or those with undetermined causes for hair licking or wool eating, some owners resort to complete clipping of hair or wool, but this process sometimes is too late (Fig. 11).

Conclusion

Pica or deprived appetite is a critical condition in small ruminants (sheep and goats). It is observed usually when the affected animal ingests any found object other than its normal diet. Dietary abnormalities such as minerals or protein deficiency, parasitism, malnutrition, and ketosis are predisposing factors. Major complications may include progressive weight loss, choking, poisoning, and even death. Therefore, substantial economic losses always take place as a result of this syndrome.

Author's Contribution: Mohamed Tharwat: Planned and designed the study, carried out the practical work and drafted the manuscript. Abdulla Al-Hawas: Shared in designing the study, and practical work. Both authors read, revised, and approved the final manuscript.

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