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# An Assessment of Indian Livestock Owners' Selective Management Practices for Risk Amelioration of Obstructive Urolithiasis in Water Buffalo Male Calves

Sujoy Khanna[1], Sandeep Potliya[2], Anita Ganguly[2], Harpreet Singh[2], B.R. Maharana[2], Davinder Singh[3], G.R. Gowane[4]

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## ABSTRACT

**Background:** Obstructive urolithiasis is a life-threatening and painful disease in both the sexes of dairy animals. In water buffaloes also, both sexes can be affected, but formation of urinary tract calculi, leading to blockages are primarily observed in male calves.

**Methods:** The present study was carried on 105 uncastrated water buffalo male calves suffering from obstructive urolithiasis. Detailed management and housing practices followed by calf owners were recorded after confirmation of diagnosis. A similar number (n. 105) of healthy uncastrated buffalo male calves during this period were also included in this study as control.

**Result:** Practice of feeding calves with rations high in cereal grains and low in roughage significantly (P<0.01) contributed to development of obstructive urolithiasis. Supplementation of feed with ammonium chloride, vitamins and salt lick along with water accessibility to calves significantly (P<0.01) reduces the occurrence of obstructive urolithiasis. Furthermore, an unprecedented observation regarding the tethering arrangement of calves with their dams after parturition was also found to be significant (P<0.01). Therefore, obstructive urolithiasis in buffalo calves have multifactorial etiologies and pinpointing the exact cause remains elusive. However, beyond the established causative practices, tethering practice may also lead to this condition.

**Key words:** Dietary practices, Grazing, Manger feeding, Obstructive urolithiasis, Tethering.

## INTRODUCTION

Obstructive urolithiasis in bovines is a life-threatening and painful disease (Armstrong, 2023) due to formation of calculi in the urinary tract with its subsequent obstruction by uroliths (Emerick, 1988; Payne, 1989; Radostits *et al*., 2000). Globally, urolithiasis occurs across animal species in both the sexes, but obstruction is not common in females due to shorter length and more flexible lumen of urethra (Radostits *et al*., 2000). In water buffaloes also, both sexes can be affected by obstructive urolithiasis, but formation of urinary tract calculi, leading to blockages are primarily observed in males due to their urinary tract anatomy (Emerick, 1988; Larson, 1996 and Radostits *et al*., 2000; Kushwaha *et al*., 2009). Clinical signs often go unnoticed until the prognosis and emergent need for surgery arise (Armstrong, 2023), posing significant economic implications for the dairy industry, especially in buffaloes, owing to the mortality rate, attributed to urethral or urinary bladder rupture and other economic repercussions reported (Gasthuys *et al*., 1993; Radostits *et al*., 2000; Kushwaha *et al*., 2009,).

Apart from anatomy and physiology of animals, it is ascribed to a combination of practices related to their nutrition and management (Makhdoomi and Gazi, 2013). In male calves, it is mainly linked to rations high in cereal grains, high phosphorus diets, insufficient roughage, decreased water intake, mineralized artesian water, vitamin imbalance, vitamin-A deficiency, livestock grazing in areas with pasture plants containing oxalate, estrogens, or silica and other weaning related dietary changes (Radostits *et al*., 2000; Radostits, 2000; Loretti *et al*., 2003; Sharma *et al*., 2007; Amarpal *et al*., 2013). In addition, one practice pertaining to management that has never been discussed is the preweaning period of buffalo calves which last for 6-12 months, allowing them to suckle directly of their mothers before or after milking (Lopez *et al*., 2008; Rashid *et al*., 2013), during which calf is permanently or occasionally housed or tethered with its dams.

[1]Directorate of Extension Education, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar-125 004, Haryana, India.
[2]Haryana Pashu Vigyan Kendra, Karnal-132001, Haryana, India.
[3]Haryana Pashu Vigyan Kendra, Lala Lajpat Rai University of Veterinary and Animal Sciences, Mahendergarh-125 004, Haryana, India.
[4]Division of Animal Genetics and Breeding, ICAR-National Dairy Research Institute, Karnal-132 001, Haryana, India.

**Corresponding Author:** Davinder Singh, Haryana Pashu Vigyan Kendra, Mahendergarh, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar-125 004, Haryana, India.
Email: dsingh@luvas.edu.in

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Obstructive urolithiasis has been frequently and widely reported in unorganised dairy sector of India (Singh *et al*., 2008; Amarpal *et al*., 2013; Gugjoo *et al*., 2013; Kushwaha *et al*., 2014). However, relevant data concerning the practices leading to development or prevention of this condition in Indian male water buffalo calves are not available. The present study describes some of these Indian livestock owners' selective management practices for risk amelioration of obstructive urolithiasis in water buffalo male calves.

## MATERIALS AND METHODS

### Topography of the studied area

Haryana is a landlocked state in northern India. It lies in the latitude range of 27°39′ to 30°35′N and the longitude range of 74°28′ to 77°36′E. The climate is arid to semi-arid with an average annual precipitation of 354.5 mm. Obstructive urolithiasis in male calves is very prevalent in this region during the winter months from November to February (Saharan *et al*., 2020).

### Data collection

The present investigation was carried on 105 uncastrated buffalo male calves presented for obstructive urolithiasis with intact bladder and urethra at Haryana Pashu Vigyna Kendra, Karnal, LUVAS from November, 2023 to February, 2024. Similar number of healthy uncastrated buffalo male calves (n. 105) during this period were also included in this study as control. Based on the clinical symptoms of calves presented for treatment, tentative diagnosis was further confirmed by ultrasonography. Detailed information regarding selective management practices followed was recorded in a specially designed questionnaire with closed end multiple choice questions to ascertain the true cause of development of obstructive urolithiasis. Pretesting of this questionnaire was carried out with four scientists, five field veterinarians, ten veterinary students and then it was presented for piloting to 10 respondents. The data was collected through physical mode from the respondents who were the owners or caretakers of the male buffalo calves brought to the HPVK for treatment of obstructive urolithiasis.

### Data management and statistical analysis

The responses on the questionnaire sheet were transferred onto Microsoft EXCEL spreadsheet and made compatible for subsequent analysis using the SPSS 20 software (IBM, 2011). Five percent of the questionnaires were checked to detect data errors; no errors were observed. The questions, for which no response was received from the respondents; in those cases, another option was created to get the cumulative proportions 100 per cent. The data were analysed using the Chi squares test (÷2) of association. The statistical significance was tested at 5% and 1% level of significance.

## RESULTS AND DISCUSSION

The findings obtained from the data regarding the association of Indian livestock owners' selective management practices to ameliorate the risk of obstructive urolithiasis in water buffalo male calves are categorized and presented in Table 1, Table 2 and Table 3. All these categorical variables are independent of other factors.

### Dietary practices

The obtained P values (<0.01) indicates that there exists a statistically significant association between the categorical variables, suggesting Low-grain diet and fiber-rich diet association with the occurrence of obstructive urolithiasis (Table 1). Inversely, no such association was found for the grazing pattern of the buffalo calves, as the P value (0.88) is higher (Table 1).

### Low-grain diet

In calves receiving low-grain diet "daily" and "occasionally", "38 (18.1%) out of 123 (58.6%)" and "34 (16.2%) out of 44

**Table 1:** Association of different dietary practices with the development of obstructive urolithiasis. N (%)

| Group | Daily | Occasionally | Never | Not sure | Chi-square |
|---|---|---|---|---|---|
| | | | **Low-grain diet** | | |
| Affected | 38 (18.1%) | 34 (16.2%) | 28 (13.3%) | 5 (2.4%) | 43.47 |
| Healthy | 85 (40.5%) | 10 (4.8%) | 4.3% (9) | 1 (0.5%) | |
| Total | 123 (58.6%) | 44 (21.0%) | 37 (17.6%) | 6 (2.9%) | P (0.00) |
| Fiber-rich diet | | | | | |
| Affected | 40 (19.0%) | 31 (14.8%) | 28 (13.3%) | 6 (2.9%) | 56.59 |
| Healthy | 90 (42.9%) | 13 (6.2%) | 0 (0%) | 2 (1%) | |
| Total | 130 (61.9%) | 44 (21.0%) | 28 (13.3%) | 8 (3.8%) | P (0.00) |
| | | | **Grazing pattern** | | |
| **Group** | **In well-managed pastures** | **On wild grass or natural vegetation** | **In a mix of both pastures and wild grass** | **Zero grazing** | **Chi-square** |
| Affected | 9 (4.3%) | 2 (1.0%) | 4 (1.9%) | 90 (42.9%) | 0.69 |
| Healthy | 11 (5.2%) | 2 (1.0%) | 6 (2.9%) | 86 (41%) | |
| Total | 20 (9.5%) | 4 (1.9%) | 10 (4.8%) | 176 (83.8%) | P (0.88) |

(21.0%)" were affected, respectively (Table 1). On the contrary, among calves "never" fed this type of ration diet and were constantly fed grain rich diet, "28 (13.3%) out of 37 (17.6%)" were affected, while 9 (4.3%) did not develop obstructive urolithiasis (Table 1). The likelihood of developing this condition decreases when calves are fed a grain free diet.

### Fiber-rich diet

In calves fed fiber-rich diet "daily" and "occasionally", "40 (19.0%) out of 130 (61.9%)" and "28 (13.3%) out of 28 (13.3%)" were affected with obstructive urolithiasis; respectively (Table 1). "31 (14.8%) out of 44 (21.0%)" calves which were "never" fed fiber-rich diet develop obstructive urolithiasis (Table 1). So, when calves are fed fiber-rich diet, the chances of development of this condition decreases.

### Grazing practice

Most of the calves [90 (42.9%) affected and 86 (41%) healthy] were zero grazed (Table 1). Very few animals were grazed outside on well managed pastures or wild grass. No link was found between calf grazing patterns and the occurrence of obstructive urolithiasis.

### Preventive supplementation practices

The P value (<0.01) indicates a statistically significant association between the categorical variables, suggesting that preventive supplementation of ammonium chloride ($NH_4Cl$), mineral mixture and salt (NaCl) lick in the diet directly affects the occurrence of obstructive urolithiasis in male calves (Table 2).

### Ammonium chloride

In calves receiving diet supplemented with ammonium chloride ($NH_4Cl$) "daily", "weekly" and "occasionally" were "0 (0%) out of 3 (1.4%)", "28 (13.3%) out of 107 (51%)" and "12 (5.7%) out of 22 (10.5%)" were affected with obstructive urolithiasis; respectively (Table 2). On the contrary, in calves whose diet were never supplemented with ammonium chloride ($NH_4Cl$), 56 (26.7%) out of 72 (34.3%) were affected with obstructive urolithiasis (Table 2), indicating preventive association of ammonium chloride ($NH_4Cl$) supplementation.

### Mineral mixture

Among calves receiving a diet supplemented with mineral mixture "daily" and "weekly", "1(0.5%) out of 6 (2.9%)" and "7 (3.3%) out of 99 (47.1%)" were affected, respectively (Table 2). Inverse to this, in calves not fed diets supplemented with mineral mixture, a significant majority of "93 (44.3%) out of 98 (46.7%)" were affected by obstructive urolithiasis (Table 2).

### Salt lick

Among calves provided with a salt lick in addition to their regular diet "daily", only "20 (9.5%) out of 108 (51.4%)" were affected, while 88 (41.9%) were not affected with obstructive urolithiasis (Table 2). While calves which are "never" provided with salt lick, "69 (32.9%) out of 73 (34.8%)" were affected with obstructive urolithiasis (Table 2).

### Tethering practices

The P value (<0.01) indicates a statistically significant association between the categorical variables. This suggests that the tethering practices of the calf with its dam after parturition affecting manger accessibility is associated with the occurrence of obstructive urolithiasis (Table 3).

### Waterer accessibility to tethered calves

Tethered calves having accessibility of waterer "Throughout the day" and "Twice to thrice a day", "0 (0%) out of 4 (1.9%)" and "76 (36.2%) out of 152 (72.4%)" were affected, respectively (Table 3). On the contrary, among tethered calves having waterer accessibility "Once a day", "25 (11.9%) out of 54 (25.7%)" were affected, while 29 (13.8%) did not develop obstructive urolithiasis (Table 3). The P value (0.12) indicates no signification association with the development of obstructive urolithiasis in male buffalo calves (Table 3).

**Table 2:** Association of preventive supplementation practices with the development of obstructive urolithiasis in buffalo calves. N (%)

| Group | Daily | Weekly | Occasionally | Never | Not sure | Chi-square |
|---|---|---|---|---|---|---|
| | | | **Ammonium chloride ($NH_4Cl$)** | | | |
| Affected | 0 (0%) | 28 (13.3%) | 12 (5.7%) | 56 (26.7%) | 6 (2.9%) | 55.71 |
| Healthy | 3 (1.4%) | 79 (37.6%) | 10 (4.8%) | 16 (7.6%) | 0 (0%) | |
| Total | 3 (1.4%) | 107 (51%) | 22 (10.5%) | 72 (34.3%) | 6 (2.9%) | P (0.00) |
| | | | **Mineral Mixture** | | | |
| Affected | 1 (0.5%) | 7 (3.3%) | 4 (1.9%) | 93 (44.3%) | | 154.81 |
| Healthy | 5 (2.4%) | 92 (43.8%) | 3 (1.4%) | 5 (2.4%) | | |
| Total | 6 (2.9%) | 99 (47.1%) | 7 (3.3%) | 98 (46.7%) | | P (0.00) |
| | | | **Salt licks** | | | |
| Affected | 20 (9.5%) | 12 (5.7%) | 4 (1.9%) | 69 (32.9%) | | 104.73 |
| Healthy | 88 (41.9%) | 13 (6.2%) | 0 (0.0%) | 4 (1.9%) | | |
| Total | 108 (51.4%) | 25 (11.9%) | 4 (1.9%) | 73 (34.8%) | | P (0.00) |

### Tethering practice of calf and dam affecting manger accessibility

Among calves and dams kept "Tethered together using the same feeding manger", "58 (27.6%) out of 73 (34.8%)" were affected (Table 3). Conversely, when calves and dams were "Tethered nearby with separate feeding mangers", "30(14.3%) out of 114 (54.3%)" calves develop obstructive urolithiasis (Table 3). However, in cases where they were "Tethered separately with flexible manger use", 17 (8.1%) out of 23 (11.0%) were affected (Table 3). Thus, tethering of calf with dam affecting manager accessibility of calf is significantly (P<0.01) associated with the development of obstructive urolithiasis in male buffalo calves.

The study was designed to rule out and alleviate the influence of seasonal variations in calf management practices in India. It was intentionally coincided with the winter months (November to February), when the maximum number of cases of obstructive urolithiasis are reported, consistent with previous research findings (Kushwaha *et al*., 2009; Parrah *et al*., 2010). All the buffalo male calves were aged between 2 to 9 months. Studies by Kushwaha *et al*. (2009) and Fazili and Ansari (2007) also suggested higher incidence in bovines aged between 2-4 months and 2-6 months, respectively. Higher incidence in male calves may be due to lower testosterone levels in calves, their urethral diameter and insufficient strength of urethral muscles to expel urolith, resulting in obstruction (Radostits *et al*., 2000). Several predisposing factors contribute to the occurrence of obstructive urolithiasis, although the exact mechanism of urolith formation remains unclear (Radostitis *et al*., 2009).

### Dietary practices

The findings in result suggest that Indian livestock owners' dietary practices, particularly diet rich in cereal grains and low in roughage makes the buffalo male calves susceptible to obstructive urolithiasis. Conversely, no association between the grazing pattern of male calves and the incidence of obstructive urolithiasis was found.

### Low-grain diet

Majority of male calves affected with obstructive urolithiasis had a background of being fed a diet rich in cereal grains. They are fed diets rich in cereal grains, instead of a balanced calf starter or weaning ration, leading to urinary calculi because of high protein intake (Bhatt *et al*., 1973). It presents the most significant economic challenge in fattening calves receiving high protein concentrate ration for faster weight gain, potentially contributing to urolithiasis (Radostits *et al*., 2000; Thakur *et al*., 2020). A diet rich in cereal grains and low in roughage increases mucoprotein concentration in urine, which serves as a cementing agent for deposition of oversaturated minerals, thereby increasing the likelihood of calculi formation (Crookshank *et al*., 1965; Radostits *et al*., 2007). Similar to our findings, Ahmed *et al*. (1989) found wheat bran as the primary component in the diets of most animals affected with urolithiasis. It was further reported that wheat bran, characterized by its high phosphorus and low calcium content, might have promoted the formation of phosphate calculi by enhancing the precipitation of phosphate salts in urine. Cereal grain rations, rich in phosphorus and magnesium but relatively low in calcium and potassium, contribute to excessive or imbalanced mineral intake, predisposing them to urolithiasis (McIntosh, 1978; Payne, 1989; Larson, 1996; Radostits *et al*., 2000). It creates conditions favourable for urinary tract calculi formation (Payne 1989; Radostits *et al*., 2000) by inducing the release of antidiuretic (ADH) hormone, causing a marked but transient decrease in urine output and an increase in urine concentration (Bailey, 1981). Furthermore, feeding concentrate diet rich in phosphorus such as wheat bran and rice bran, results in increased phosphate excretion in urine. This, coupled with decreased urine pH, increased urine concentration and concurrent hypovitaminosis A, promotes the formation of uroliths, particularly struvite crystals (Bailey, 1981). Kushwaha *et al*. (2009) also reported the feeding of cereal grains to achieve rapid weight gain and transition from pre-ruminant to ruminant stage as a predisposing factor for occurrence of this disease. It may occur due to excessive or imbalanced intake of minerals in feedlots while fattening cattle receive rations high in cereal grain (Hesse *et al*., 2009). Wang *et al*. (1997) reported a higher incidence of urolithiasis in animals fed with high-grain diets with calcium: phosphorus ratios as low as 1:1.

**Table 3:** Association of tethering practices of the calf with dam after parturition affecting waterer and manger accessibility with the development of obstructive urolithiasis in water buffalo male calves. N (%)

| Group | At all times/ad lib | Twice to thrice a day | Once a day | Chi-square |
|---|---|---|---|---|
| | | **Tethering practice of calf affecting waterer accessibility** | | |
| Affected | 0 (0%) | 76 (36.2%) | 25 (11.9%) | 4.30 |
| Healthy | 4 (1.9%) | 76 (36.2%) | 29 (13.8%) | |
| Total | 4 (1.9%) | 152 (72.4%) | 54 (25.7%) | P (0.12) |
| | | **Tethering practice of calf and dam after parturition affecting manger accessibility** | | |
| **Group** | **Tethered together using the same feeding manger** | **Tethered separately with separate feeding mangers** | **Tethered separately with flexible feeding manger use** | **Chi-square** |
| Affected | 58 (27.6 %) | 30 (14.3%) | 17 (8.1%) | 56.17 |
| Healthy | 15 (7.1%) | 84 (40.0%) | 6 (2.9%) | |
| Total | 73 (34.8%) | 114 (54.3%) | 23 (11.0%) | P (0.00) |

**Fiber-rich diet**

In the buffalo male calves under investigation, the majority of animals which were fed inadequate fiber in their diets reported obstructive urolithiasis. Dietary deficiency of fibre in di*et al*ong with high levels of phosphorus in diet are the major contributing factors (Loretti *et al*., 2003). When provided with sufficient green fodder, the surplus of calcium, silica and oxalates in the diet are primarily excreted in the urine. Excess of phosphorus is mainly excreted through saliva, where it becomes accessible for utilization in the rumen and for reabsorption along the gastrointestinal tract before being excreted in manure. When calves are provided with a diet low in roughage and high in concentrate, they produce lesser amount of saliva. Phosphorus in excess, which cannot be excreted through saliva and gastrointestinal tract, gets transported through the bloodstream to the urinary system for excretion (Chase *et al*., 2017). Crystals develop from excess of these minerals in the urine whenever there is disturbance in urine concentration and pH. Subsequently, uroliths form as these crystals accumulates in the presence of mucoproteins and mucopolysaccharides (Divers, 2022). To compensate for limited green fodder, calf owners may have followed the standard practice of supplementing with additional high-grain concentrate diets, potentially causing urolithiasis.

**Grazing practice**

In our investigation, majority of livestock owners follow the practice of zero grazing for their calves. They primarily have integrated cultivation, which combines fodder production with calf rearing. Grazing practice was found to be insignificant for development of this condition. However, according to Loreetti *et al*. (2003), grazing of livestock in pastures abundant in oxalates, estrogen, or silica makes them prone to developing various types of calculi, including silica, carbonates, or oxalate. Deficiency of vitamin A led to epithelial cell desquamation and establishment of nidus for urolith formation (Radostits *et al*., 2000). The disease process might be influenced by geographic location, as different regions offer distinct grazing options and hay varieties (Chase *et al*., 2017; Divers *et al*., 1989). Animals grazing on high-calcium clover or alfalfa or consuming such hay types may develop calcium-based uroliths. Although obstructive urolithiasis typically occurs sporadically, outbreaks impacting large number of animals from a geographical location have also been documented (Manning and Blaney, 1986; Radostits *et al*., 2000). Urolith formation increases if there is a significant amount of magnesium in the diet leading to magnesium ammonium phosphate stone formation (Hesse *et al*., 2009).

**Preventive supplementation practices**

Indian livestock owners' dietary supplementation practices, particularly inclusion of ammonium chloride, mineral mixture and salt in diet of calves, significantly decreases the susceptibility of buffalo calves to urolithiasis.

**Ammonium chloride**

Alkalinity of calf urine encourages the development of uroliths, primarily composed of magnesium ammonium phosphate (struvite), calcium phosphate and calcium carbonate (apatite) (Gutierrez *et al*., 2000). Uroliths become more soluble on acidifying the urine, thereby preventing their precipitation in the urine. Acidification of urine can be achieved by supplementation of the diet of calves with ammonium chloride (Nausadar) salt at a daily supplementation ranging from 0.5 to 1% of the total dry matter intake, or at 2% of the concentrate ration, or at a dosage of 225-500 mg/kg body weight/day (Amarpal *et al*., 2013). However, its poor palatability makes feeding of calves challenging, often necessitating its mixture with concentrate feed. Alternatively, it can also be blended with a sugar solution (jaggery or syrup) and orally administered by drenching. However, prolonged supplementation with ammonium chloride may lead to urine acidification refractoriness, thus it is recommended to supplement for three weeks followed by discontinuation for a week (Khan *et al*., 2022). Ammonium chloride boluses having a pH as low as 4.5 can also be administered, however, too much acid in the rumen may destroy beneficial bacteria and cause rumen acidosis resulting in weight loss and inappetence (Khan *et al*., 2022). For animals fed diets rich in cereal grains, apart from ensuring proper Ca:P ratio, urine-acidifying agents like ammonium chloride to promote crystal excretion and dissolution may also be employed as preventive measure.

**Mineral mixture**

Obstructive urolithiasis arise from either excessive or an imbalanced intake of minerals (Hesse *et al*., 2009), particularly as buffalo male calves undergo fattening on rations rich in cereal grains, which have high levels of phosphorus and magnesium content coupled with relatively low levels of calcium and potassium (Radostits *et al*., 2007). According to data published by Department of Soil Science, majority of the soils of the Haryana, India are under high status (60%) of available phosphorus (Gyawali *et al*., 2016). An imbalance between calcium and phosphorus leads to increased urinary phosphate excretion, which is an important factor in the formation of phosphate calculi (Makhdoomi and Ghazi, 2013). Maintaining an adequate dietary ratio of calcium to phosphorus, ideally around 2:1 is very important due to their inverse relationship, with considerations for mineral bioavailability (Divers, 2022). Diets high in phosphorus and low in calcium increase the risk of phosphate urolith formation in animals. Calcium in supplemented mineral mixture has tendency of effectively dissolving struvite crystals. (Funaba *et al*., 2001). It has emerged as a promising, short-term strategy for dissolving struvite crystals and calculi, possibly because of its capacity to lower urine pH, dissolve calculi and correct a low Ca:P ratio. It is imperative to maintain the calcium-phosphorus ratio in the diet at an optimal level, which can be done through mineral mixture supplementation (Wang *et al*., 1997).

**Salt lick**

Incorporation of salt (NaCl) lick decreased the occurrence of obstructive urolithiasis. When salt lick was made accessible to calves, enhanced water intake may be associated with reduced calculi formation, thereby reducing its occurrence. These results align with previous research, which observed a substantial decrease in renal calculi among lambs receiving higher NaCl (Udall, 1962). The conclusion is drawn that NaCl directly inhibits the conditions conducive to urolith formation. Previous studies have demonstrated that the chloride component of NaCl inhibits crystal growth (Udall and Chow, 1964; Udall *et al*., 1962), potentially by promoting the formation of more soluble salt forms compared to magnesium and calcium phosphate. Chloride ions from salt can bind with excess magnesium, which is more soluble than magnesium phosphate; and mucoproteins, which decrease phosphate binding, thereby decreasing calculi formation (Divers, 2022).

**Tethering practices**

Tethering buffalo calves with dams in unorganized Indian dairies increase the risk of obstructive urolithiasis due to shared manger access, highlighting a need for improved management practices.

**Waterer accessibility to tethered calves**

Though no association regarding accessibility to waterer was found, but maximum occurrence during winters may be attributed to reduced water intake along with decreased green fodder availability potentially leading to Vitamin A deficiency (Radostits, 2000; Amarpal *et al*., 2013). Calves with inadequate water intake owing to limited access to clean and fresh water, results in concentration of urinary salts and creating favourable conditions for urinary calculi formation (Blood *et al*., 1989). During peak winters also, animals may experience a decline in water intake, leading to increased urinary solute saturation, precipitating calculi formation and urinary tract obstruction (Parrah *et al*., 2010). Also, livestock owners primarily rely on ground water sources, directly or indirectly, to meet their animals' water needs. The mineral profile of water of the region where study was conducted reveals higher total dissolved solids (132-552) than the critical level (<500) and medium hardness levels (Calcium Carbonate 50-180) within the critical limit (<300) in ground water sources (Saharan *et al*., 2020), but it did not lead to urolithiasis.

**Tethering practice of calf and dam affecting manger accessibility**

Remarkably, our study reveals that the tethering pattern of buffalo male calf with dam post-parturition emerges as a significant factor influencing the development of obstructive urolithiasis. A dearth of prior research on this aspect within the context of Indian livestock rearing conditions as well as in unorganised dairy sector is also witnessed. Nearby tethering, using the same manger or close but separate placement of mangers for calf and the dam results in calf consuming feed and fodder intended for the dam, a situation that calf owners find it difficult to control or are unaware about this issue. Scientific housing pattern and management practices are not adopted by majority of the buffalo owners of India (Tadavi *et al*., 2017) and majority had no provision of the wall separating their animals in the sheds (Patel *et al*., 2019). Notably, when calves and dams are tethered together and share the same manger, the incidence of affected calves is strikingly high. Conversely, when calves and dams are tethered nearby with separate but adjacent feeding mangers, a notably lower incidence of affected calves is observed. Specifically, tethering calves alongside dams and sharing feeding mangers poses the highest risk, while maintaining separate but nearby arrangements for calves and dams appears to mitigate the incidence of obstructive urolithiasis.

## CONCLUSION

Obstructive urolithiasis in buffalo male calves is a disease with multifactorial etiologies. Pinpointing the exact and only cause of obstructive urolithiasis from the selective management practices in water buffalo male calves remains elusive due to the intricate interactions involved. However, in Indian rearing conditions and unorganized dairies worldwide, beyond the established practices, a new practice leading to development of this condition may be the tethering arrangement and shared manger placements for calf and dam. This setup leads to calves consuming feed meant for the dam, a situation that is challenging for owners to control or even notice.

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**Declarations**

The authors confirm that the ethical policies of the journal, as noted on the journal's author guidelines page, have been adhered to. No ethical approval was required for performing such a study on animals presented in clinics for treatment. The study was granted permission by the Director of Extension Education, LUVAS, Hisar (India).

**Conflict of interest statement**

The authors declare no competing interests.

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