

# Exploring Seasonal Patterns in Diet-Related Characteristics and Their Consequences on Obstructed Urolithiasis in Household Livestock

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## Abstract

The term obstructed urolithiasis refers to the formation of urinary stones leading to blockages and the study aims to discern how seasonal dietary patterns can contribute to the occurrence and severity of this condition in household livestock. The present research effort attempted to investigate the occurrence of Obstructed Urolithiasis in Household Livestock such as cattle, goats, horses, sheep and pigs. In the academic year term from May 2019 to April 2020, 810 occurrences were recorded in our study. In comparison with other domesticated livestock, cattle had the greatest occurrence (27.16%). Cattle have been found to be the most affected of the various kinds of animals, followed by goats. There is a strong link among the incidence of obstructive urolithiasis and seasonally, with the highest number of occurrences recorded in the wintertime seasons of December to February. In urolithiasis-affected livestock, the female to-male proportion was, cattle have an occurrence rate of (27.16%), goats have an occurrence rate of (21.85%) and other species in a decreasing sequence include sheep (18.64%), horse (16.17%) as well as pig (16.17%), suggesting a greater incidence in animals of males. Most of the cattle (27.16%) and goats (21.8%) with obstructed urination were similarly administered a grain-rich, high-phosphorus diets, which contributed to Urinary calculus development. The significance of changes in behavior related to seasonal shifts and the livestock's food condition in the development of urolithiasis is substantial. This interaction among the season and dietary imbalances is going to raise the frequency of obstructive urolithiasis in household livestock.

**Keywords:** Seasonal Patterns, Obstructive Urolithiasis, Household Livestock, animals, Species and Grain-rich diet.

## INTRODUCTION

Among domesticated livestock, obstructive urolithiasis is a critical disease with multiple causes. It is a lifestyle illness that affects livestock. Because of a lack of assets, including medical care, cattle raised by remote farmers are impacted. One of the primary causes of deaths in farms, obstructed urolithiasis results in significant financial losses to the cattle business (1). Kidney stones are affecting to 12 percent of people worldwide at a certain point in their lifespan. This is among the most prevalent illnesses of the urinary glands. When kidney stones first develop, usually there are no indications. However, over time, it can cause acute flank discomfort, haematuria (such as blood through the urine), obstruction to flow of urine and hydronephrosis (dilation of the kidneys) (2). Elevated urate, cystine, phosphates, magnesium and oxalic acid (OH) levels found in the urine are the cause for these formations. Regretfully, the condition prevalence has skyrocketed in the last 30 years, probably as a result of external factors such as poor food and lack of activity (3). Initial stage testosterone lack induces penile hypothyroidism, leading to decreased urethral opening length and a lack of urethral process maturation. Age, food and water category, season as well as sterilization were recognized as contributors for illnesses. Calculi tend to reside in the urinary tract; however

they are additionally present in the kidney pelvis and urethral. Calculi expelled by the ureter get caught in the small male the urinary tract, intestinal bending, or preputial hole. Urinary blockage gets worse as an outcome of cystitis, which is a prevalent disease in male sheep, goats and cattle (4).

An imbalance in the calcium-phosphorus balance causes excessive urine phosphate elimination, which is a major contributor to the production of phosphate stones. Diets rich in minerals, along with large quantities of Glycoproteins in the feces of developing livestock, are probably the significant elements in stone formation. Urine pH, decreased water intake, urine stasis, therapy with specific medicines and previous urinary system illness are all indications of urolithiasis. Such predisposed variables work cooperatively or independently to boost stone development (5). This constitutes one of the most dangerous urinary system illnesses found in livestock. Male animals are impacted owing to their unique architecture, which comprises a lengthy, limited, convoluted urethra that is apparent at the colon flexure with ischial arches, as well as a thin urethral tract (6). This condition is quickly diagnosed. However, choosing a treatment approach might be difficult. The kind of blockage determines the therapy of urinary retention. In the event of minor or complete blockages, for example, therapeutic breakdown of uroliths is conceivable and it sometimes offers short-term relief (7). Therapy of obstructive urolithiasis in animals typically necessitates numerous surgical operations due to a variety of factors, such as cystostomy tube removal in the urinary tract, re-blockage and chronic urethral blockage. When all other surgery or medicinal treatments have been exhausted, Perineal urethrostomy (PU) will provide urethral blockage relief. Species by urinary divided urinary constriction, or urinary blockage with many pebbles that are hard to dissolve with urinate acid, are candidates for PU (8). The present research program is titled exploring seasonal cycles in Diet-related factors and its effects on obstructed urolithiasis in domestic livestock.

The study (9) stipulated information to help physicians diagnose, treat and handle obstructive urolithiasis in tiny animals. The essay concentrated on pork kept as animals because industrial swine seldom receive rigorous urolithiasis therapy. The material in the paper depends on published studies to the greatest extent feasible, although considering the lack of articles covering obstructed urinary retention in swine. Certain data is relied upon by the researchers' practical knowledge. The study (10) constructed on six-month-old calves that had urethral blockage for seven days. The animal's breeders contact the Upazilla Veterinarian Clinic requesting assistance. Following a medical history coupled with physical checkup, it emerged that the patient's condition had a urethral blockage and required urgent surgery to prevent a urinary bladder collapse.

The research (11) evaluated twenty-three clinical instances of obstructive urolithiasis in male bovine calves with burst urine bladders that were brought to the Department of Veterinarian Surgical & Radiography at RAJUVAS in Bikaner. The medical condition is by examining the patient's narrative and medical findings (bulimia, sadness, unilateral abdominal pain and urethral canal lumps). Each of the livestock required surgery for kidney restoration and passive urine transit pathways until kidney healing occurred and urine continued to flow via regular urethral orifices. The research (12) investigated the progression of bovine urolithiasis by evaluating oxidative/nitrosative, adrenaline and urokinase positions, as well as their connection with illness intensity. Presenting symptoms, ultrasound and laboratory evaluation of the blood as well as stools (creatinine, urine ammonia) served to identify instances of bull calf with obstructive urinary stones. Obstructive urolithiasis is a severe health issue in farm animals, in small calves. The study (13) presented modifications in blood Vitamin D and A amounts in bull calves with obstructed urinary stones. Then it looked into the usefulness of tubes Bladder incision procedure for the therapy of such an illness. The research (14) discovered that urolithiasis remains a complex illness of male cattle that causes major financial losses and animal welfare concerns. Anatomic variables, urinary pH, intake of water, nutrition and hereditary factors are recognized as risks. Clinically, instances of obstructive urolithiasis can be managed by a number of medicinal and surgery therapies, such as tube cystostomy, urinary urethrostomy, kidney marsupialization and variations on these operations to improve patient success. The study (15) sheds a little insight on the role of

*Escherichia coli* and *Staphylococcus aureus* in the development of emphysematous bladder. Urinary stone development is a widespread condition that is rising in rate and prevalence across the world. Executed male cattle feeding rice straw without iron supplements are susceptible to obstructive urolithiasis over time. The research (16) demonstrated Insulin resistance (IR), defined as cell reactivity to diabetes as a result of decreased operation is a frequent comorbid disease. Increased belly fat and a persistent poor-quality inflammation were some of the critical warning signs. As such, IR assessment is best done with caution since several distinct diagnostics pathways result in equal outcomes. Urolithiasis is another condition which is related to IR. The study (17) identified diet suggestions for gouty individuals centered on particular food groups, with little concomitant analyses of nutrition variables and metabolic system. The study explores molecular discoveries and potential treatments for gout, focusing on the metabolism of purine, urea depositing and gouty inflammation. The research (18) classified Urolithiasis as the generation of urine stones in the kidneys. Aromatherapy has gained popularity as a treatment option for urolithiasis all around the globe. Many herbs' anti-lithogenic properties are caused by the suppression of crystal formation and aggregating in the kidneys, hence inhibiting calculogenesis. The study (19) offered the formulation as an assessment of the people impacted by the illness that leads to greater precise identification as well as better therapy, with the goal of reducing the likelihood of recurrence. As a result, urethral is to be regarded a potential diagnosis in every animal which matches the description and exhibits persistent signs. The study (20) contemplated changes in urolith content in canines as well as hazards for urinalysis such as their ages, species, sexuality, neutered position, urolith setting and microbial urolith culturing. The following are the study's key contributions.

### **Key Contributions**

- Describe the requirements used to choose the research region and the specific species under examination and describe the procedures used to obtain information on the prevalence of blocked urolithiasis in domestic cattle.
- Explain the treatment approaches used to treat blocked urolithiasis in domestic livestock.
- Demonstrate the manner in which descriptive statistics is used to summarize major findings.
- Investigate the prevalence rates of blocked urolithiasis, taking into account differences in animal populations that examine the seasonal trends of blocked urolithiasis and their importance.
- Divide the incidence rates by livestock species in the research area. Analyze the efficacy of each of the treatment approaches utilized during the research and investigate the relationship between dietary components along with the occurrence of blocked urolithiasis, highlighting any imbalances discovered.

### **METHODOLOGY**

The study named "Exploring Seasonal Patterns in Diet-Related Characteristics and their Consequences on Obstructed Urolithiasis in Household Livestock" aims to investigate the evolving connection between seasonal shifts in dietary habits and the development of obstructed urolithiasis in domesticated species in household environments.

#### **Dataset**

The study effort attempted to investigate the livestock, which included cattle 220, sheep 151, horses 131, goats 177 and pigs 131. The domesticated livestock revealed the usual indications of obstructive urolithiasis, such as difficulty in urination, painful urination, Absence of urine production, blood in the urine, low urine output, inability to empty the bladder, urethral rhythmic contractions, intestinal soreness and two-sided dilation of the belly. A diagnosis of obstructive urolithiasis is made according to the medical record, clinical symptoms, radiography and ultrasonographic data. At the moment of diagnosis, more details existed on feed management, bodily state, water/fodder accessibility and present state of health.

### **Incidence and rate inquiry**

A prospective investigation is performed on the rate of obstructive urolithiasis in domesticated livestock from 2012 to 2022 (each annum spanning through May - April). The monthly rate of obstructive urolithiasis has been examined from May 2002 to April 2022 (12 months) to investigate the seasonal frequency structure. At this period, epidemiological data like species and sexuality are gathered for study. The incidence is divided by the entire quantity of obstructed urination patients given in the research by the total population at danger and multiplied by 100.

### **Therapy**

The process of therapy chose based on the kind of blockage. Partial blockages were treated clinically or with a less intrusive procedure such as retrohydropropulsion. Complete blockage is considered a catastrophe and received treatment with several surgical procedures. The proper surgical approach was chosen depending on the livestock's type, degree of blockage, location of obstructions and animal's health.

### **Statistical evaluation**

The acquired Statistical Package for the Social Sciences (SPSS application version 40) was used to analyze the facts. The data from all of the categories are analyzed using the T-test for correlation at P-values of 0.05, 0.01.

## **RESULTS**

This section intends to look into the findings of the shifting relationship between seasonal shifts in food patterns and the formation of blocked urolithiasis in domesticated animals in household environments.

### **The incidence level**

The frequency of obstructive urolithiasis in domesticated livestock is calculated during 10 years, from 2012 to 2022. The overall level is greatest in the term 2021-22 and low in the previous year. The rate of incidence patterns reveals that the appearance of obstructive urolithiasis between various animal species has increased during the previous ten years. The overall proportion of obstructive urolithiasis patients recognized has likewise steadily increased over the last 10 years. The most instances were detected during the training year 2019-17/813 and the fewest of 2017-02/72.

### **Rate of frequency**

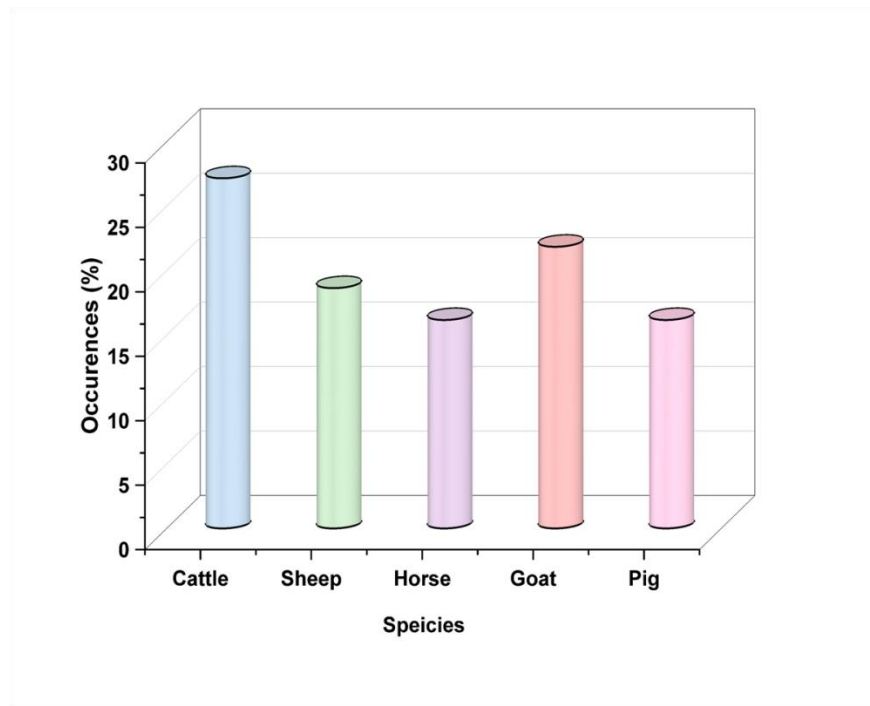
The monthly occurrence rate of obstructive urolithiasis was gathered from May 2021 to April 2022 to analyze species, sex and seasonal spread.

### **Seasonal spread**

The most number of obstructive urolithiasis patients were recorded throughout the wintertime months - 47.32% - and the lowest throughout the monsoon months - 18.44% - throughout June, July, August as well as September. The highest prevalence of urolithiasis in livestock occurred in January (23.42%), followed by February (21.09%) and December (20.45%). The lowest incidence occurred in August, at (5.24%).

### Species allocation

Figure (1) depicts the overall amount of cases detected in different animal species from May 2021 to April 2022 (12 months). Cattle have a (27.16%) occurrence rate, goats have a (21.85%) occurrence rate and other species in decreasing order include sheep (18.64%), horse (16.17%) and pigs (16.17%).



**Figure (1).** Amount of occurrences detected in various species of animals

(Source: Author)

### The allocation by sex

The sex range of obstructive urolithiasis between the various species is estimated. The findings suggested that male animals were more inclined to be affected than females. The female-to-male rates among the diagnosed livestock included 220, 151, 131, 177 and 131 for cattle, sheep, horses, goats and pigs. Table (1) shows the various species of obstructive urolithiasis.

**Table (1).** The female-to-male sex disparity across various species

(Source: Author)

Species	Male	Female	Total
Cattle	102	118	220
Sheep	96	55	151
Horse	58	73	131

Goat	68	109	177
Pig	76	55	131

### Therapy

The types of surgeries adopted to cure Urinary obstruction due to calculi includes Perineal cystostomy with ischial tube placement (cattle), Catheterized bladder drainage (sheep, goat, cattle), Urethral incision (cattle) and Urethrectomy in small livestock (sheep and goat) (Figure (2)). Catheter-assisted bladder drainage is believed to be an effective and cost-effective means of treating cattle obstructive urolithiasis. Cystotomy mainly served on sheep. In goats, livestock with cystorrhexis and Peritoneal urinary extravasation received a dismal outcome.



**Figure (2).** (a) many uroliths discovered in the tails and (b) Microscopic level Urinary calculi in the urine

“[Source: <https://www.largeanimalreview.com/index.php/lar/article/view/254/131>]”

### Imbalanced diet

Most of the goats and cattle with obstructive urolithiasis received an entirely phosphorous-rich grain meal with little to no Ca<sup>2+</sup> (calcium ion). This species got a small fraction of amount of leafy food. The acute lack of livestock feed in recent years is the major cause forcing farmers to supply additional grains. Table (2) shows the dietary habits of cattle as well as goats with blocked urolithiasis diagnosed between May 2021 and April 2022 (12 months).

**Table (2).** The dietary condition of cattle and goats

(Source: Author)

Species	Dietary Types		Total	Livestock given a grain-rich diets %
	High in grains	Nutritious		

Goat	267	136	403	66.25 %
cattle	289	74	363	79.61%

As of a 99% assurance level (significant  $p < 0.001$ ) is an intimate connection between eating habit and the presence of obstructed urolithiasis as  $p$ -value is small/significant giving a value of Zero. This reveals that grain-fed goats and cattle are prone to obstructed urination.

## DISCUSSION

Obstructive urolithiasis in livestock is a complex illness. The calculi obstruction appears anywhere in the urinary system and differs between livestock. The highest rate occurs during the winter months of each year, which is related to decreased water consumption and a shortage of accessible green food, resulting in Vitamin A insufficiency. The biggest occurrence of obstructive urolithiasis occurred during the wintertime – 47.32% and lowest during the monsoon months – 18.44%. This is suggesting an obvious connection between the occurrence of urolithiasis and variables such as access to water and hydration. Throughout high wintertime, animals' drinking habits can decrease, producing in super-saturation of urine substances, precipitating and stones development, which can lead to urinary tract blockage. Another investigation discovered that the occurrence rate for urolithiasis is highest during January (15.29%) and lowest during October (2.85%). Each year, a general trend of incidence implies more cases of urolithiasis throughout the seasons of October and February. The most common form of obstructive urolithiasis seen in our research in wintertime might be owing to some combination of variables such as decreased intake of water, lack of water production and higher concentrated feed because of decreased fodder supply. The cause of obstructed bladder stones is to rise much lower during the monsoon period due to a greater supply of rainfall and feed. In this study, the female to the male rates between the identified animals were 220, 151, 131, 177 and 131 for cattle, sheep, horse, goat and pig, respectively. The data show that male livestock are more prone. They are more susceptible to getting a case of obstructed a condition compared to their female equivalents. Each gender of livestock are susceptible to obstructive urolithiasis, however occurrence is higher in male due to anatomical differences. Obstruction develops in the narrowest parts of the kidneys. The biggest risk variable in goats is earlier ligation and a heavy grain diet.

Castrating at a young age causes males to obstruct urolithiasis because testosterone, a hormone, is vital in the growth of the urethral. As an outcome, testosterone deprivation in early growing animals can affect urethral growth, leading to constriction of the penile urethra. Concentration diets, particularly those high in bran from wheat, expose cattle to the production of stones. According to the current study, a substantial number of animals with obstructive urolithiasis are fed on grain-rich diets (goats 66.25%, cattle 79.61%). Feeding phosphorus-rich concentration rations will result in a discrepancy in the calcium-to-phosphorus spectrum. The result of a disparity in phosphorus as well as calcium outflow through the urine. As a result, malnutrition is a key contributing factor in the development of urolithiasis in goats and cattle. In the current investigation, cattle have a (27.16%) occurrence rate, goats have a (21.85%) occurrence rate as well as other species in decreasing order include sheep (18.64%), horses (16.17%) along with pigs (16.17%) possess the potential for effective water usage and consume less water than sheep. This innate biological process that promotes water use efficiency by lowering urine production can have a significant impact in the greater frequency of obstructive urolithiasis in this kind of animal. Male goats and cattle are more vulnerable than females owing to physical differences such as urethral bending besides the presence of a urinary procedure with a limited measurement that includes stones typically settle. This hormonal feature, together with seasonal and nutritional circumstances, has affected the production of uroliths in cattle. The outlook is determined by the moment of appearance and the animal's health. Infections that are neglected and destroyed have a terrible prediction, upon the beginning of uremic signs. Apathy, sadness, thick hair coat, decreased weight, fatigue,

ammoniac smell, reduced kidney function and anemia are the uremic indications. Obstructive urolithiasis in domesticated livestock must be treated as a medical urgency needing surgical intervention. Adequate and prompt medical surgery, together with additional treatment, improves the outlook for recovery.

## CONCLUSION

Urolithiasis seems as most common in goat species, then in cattle species in this research. According to findings from a rate survey undertaken over the last ten years, the occurrence of obstructive urolithiasis across several species of animals is on the rise. This rise has been ascribed to a gradual shift in cattle management techniques, a shortage of food, a lack of understanding about a healthy food composition and harsh meteorological circumstances. A complicated association occurs between elements such as organisms, gender, species, hydration consumption, hydration status, climate, nutritionally balanced diet, castration time, managerial parameters and some metabolic quirks, all of which lead to the prevalence of urinary retention in livestock. Among such factors, behavioral shifts linked with seasonality and animal's food condition play a key influence in the development of urolithiasis. This interaction among the season and nutritional imbalance is going to result in a greater prevalence of obstructive urolithiasis. For effective and economical administration, detailed understandings of the variables that determine the incidence of obstructive urolithiasis are essential. The future work will investigate the complex reasons, hazards and prospective ways to manage of blocked bladder stones, in animals at home. Considering the importance of this disease in the field of veterinarians, the study aims to unearth special insights that might influence specific therapies and enhance general well-being of animals. Researchers intend to use an integrated strategy to explore the dietary, genetic and external factors which contribute to blocked urolithiasis, opening up possibilities for improved preventative therapy methods.

## REFERENCE

- [1] Ranjith, K. M., Suresh, L., & Suheb, S. (2019). Surgical Management of Obstructive Urolithiasis in a Goat. *Intas Polivet*, 20(1), 104-106.
- [2] Aldaher, H. S., Kadhim, S. Z., Al-Roub, N. M., Alsadi, A. H., Salam, D. A., & Tillo, E. A. (2021). Evaluating the understanding about kidney stones among adults in the United Arab Emirates. *Journal of Taibah University Medical Sciences*, 16(5), 788-793. <https://doi.org/10.1016/j.jtumed.2021.04.005>
- [3] Wigner, P., Bijak, M., & Saluk-Bijak, J. (2022). Probiotics in the prevention of the calcium oxalate urolithiasis. *Cells*, 11(2), 284. <https://doi.org/10.3390/cells11020284>
- [4] Biswas, S. (2020). *DIAGNOSTIC EVALUATION OF THE OBSTRUCTIVE UROLITHIASIS IN RUMINANTS* (Doctoral dissertation, Chattogram Veterinary and Animal Sciences University Chattogram-4225, Bangladesh).
- [5] Lorenzett, M. P., Cruz, R. A., Cecco, B. S., Schwertz, C. I., Hammerschmitt, M. E., Schu, D. T., ... & P Pavarini, S. (2019). Obstructive urolithiasis in growing-finishing pigs. *Pesquisa Veterinária Brasileira*, 39, 382-387. <https://doi.org/10.1590/1678-5150-PVB-6229>
- [6] Nair, S. S., Jennes, D., Hansoge, A., Ramankutty, S., Sainulabdeen, A., & KD, J. M. (2022). Caprine Obstructive Urolithiasis—A Review. <https://dx.doi.org/10.5455/ijlr.20211031064642>
- [7] Meharu, M. B. (2022). Surgical management of the urogenital problem in male cattle. *Int J Vet Sci Res*, 8(4), 160-163.
- [8] Oman, R. E., Reppert, E. J., Streeter, R. N., & Jones, M. (2019). Outcome and complications in goats treated by perineal urethrostomy for obstructive urolithiasis: 25 cases (2010-2017). *Journal of veterinary internal medicine*, 33(1), 292-296. <https://doi.org/10.1111/jvim.15360>
- [9] Simpson, K. M., Oman, R. E., & Depenbrock, S. M. (2022). Diagnosis and management of obstructive urolithiasis in miniature pigs. *Journal of the American Veterinary Medical Association*, 260(S2), S72-S79. <https://doi.org/10.2460/javma.22.02.0058>
- [10] Shaparan, M. (2022). *Surgical management of obstructive urolithiasis in a male calf: A case study*. Chattogram Veterinary & Animal Sciences University.



- [11] Pooniya, R., Jhirwal, S. K., Saini, R., Kumar, S., Palsania, A. K., & Bishnoi, P. (2019). Evaluation of surgico-therapeutic management in obstructive urolithiasis with cystorrhesis in male cattle calves. *The Pharma Innovational Journal*, 8, 519-523.
- [12] Thakur, N., Choudhary, S. S., Chethan, G. E., & Dey, S. (2019). Urokinase alteration and its correlation with disease severity and oxidative/nitrosative stress in buffalo calves with obstructive urolithiasis. *Research in veterinary science*, 127, 18-26. <https://doi.org/10.1016/j.rvsc.2019.10.007>
- [13] Abdallah, A., Ezzeldeen, S., Eisa, E., Abd El Raouf, M., & Bayoumi, Y. (2021). Obstructive urolithiasis in buffalo calves (*Bubalus bubalis*): Serum changes of Vitamins A and D and efficacy of surgical management using tube cystostomy. *Veterinary World*, 14 (1): 129-136. Abstract. <https://doi.org/10.14202%2Fvetworld.2021.129-136>
- [14] Cook, M. J. (2023, August). Winning strategies against urolithiasis. In *American Association of Bovine Practitioners Conference Proceedings* (pp. 98-101).
- [15] Giri, D. K., Jolhe, D. K., Ghosh, R. C., Kashyap, D. K., Sonkusale, P. M., & Gumasta, P. PATHOMORPHOLOGICAL ALTERATIONS DURING OBSTRUCTIVE UROLITHIASIS IN A BUFFALO CALF (*Bubalus bubalis*) Devesh Kumar Giri<sup>1\*</sup>, DK Jolhe<sup>1</sup>, RC Ghosh<sup>1</sup>, DK Kashyap<sup>2</sup>, PM Sonkusale<sup>1</sup> and Poomima Gumasta<sup>1</sup>.
- [16] Lubawy, M., & Formanowicz, D. (2022). Insulin Resistance and Urolithiasis as a Challenge for a Dietitian. *International Journal of Environmental Research and Public Health*, 19(12), 7160. <https://doi.org/10.3390/ijerph19127160>
- [17] Zhang, Y., Chen, S., Yuan, M., Xu, Y., & Xu, H. (2022). Gout and diet: a comprehensive review of mechanisms and management. *Nutrients*, 14(17), 3525. <https://doi.org/10.3390/nu14173525>
- [18] Sharun<sup>1</sup>, K., Haritha, C. V., Jambagi, K., Chandran, D., Yattoo, M. I., Tuli, H. S., & Dhama, K. (2021). Potential Herbs for the Management of Urolithiasis in Veterinary Medicine-A Mini Review. *Indian Vet. J.*, 98(06), 09-16.
- [19] de Carvalho Brilhante, A. B., Mansano, C. F. M., & Macente, B. I. (2022). Retrospective of urolithiasis in dogs and cats at the Veterinary Hospital University Brazil–Fernandópolis/State of São Paulo between January 2018 and April 2019. *Research, Society and Development*, 11(11), e397111133585-e397111133585. <http://dx.doi.org/10.33448/rsd-v11i11.33585>
- [20] Kocpcny, L., Palm, C. A., Segev, G., & Westropp, J. L. (2021). Urolithiasis in dogs: Evaluation of trends in urolith composition and risk factors (2006-2018). *Journal of veterinary internal medicine*, 35(3), 1406-1415. <https://doi.org/10.1111/jvim.16114>