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Use and Abuse of Sorghum and Jequirity Plants in Cattle

AUTHORS DETAIL

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INTRODUCTION

Sorghum was first domesticated in Africa region and is now considered as an important cereal crop of dry land grown for animal feed, human food, and various other purposes on six continents. Protein makes up 6–25% of sorghum's composition, along with oil (3.4–3.5%), ash (1.2–18%), carbohydrates (70-80.7 percent), and fiber (2.3–2.7%). One of the earliest green forages for animals who are breastfeeding is sorghum. Sorghum that has been steam-flaked digests Organic Matter (11%), Nitrogen (10%), and Starch (25%) more quickly during post ruminal digestion (Zinn et al. 2008) It is a climbing deciduous plant that can get as tall as 6 meters. Although the seeds are deadly, there are several medical benefits of using it. These are used as an emetic, irritant, abortifacient, and contraceptive in medicine. Cattle eyes are treated with crushed Abrus roots when these get white. Alkaloids, phenolic, and flavonoid components extracted by using ethanol, chloroform, and petroleum ether have been found to have antidiarrheal and anti-fertility properties. The potentially lethal neurological condition of tetanus (*Clostridium (C.) tetani* infection) can affect cattle. Deep, necrotic wounds and postpartum metritis are the most typical symptoms of *C. tetani* infection in cattle. The clinical symptoms that precede death include a rapid, irregular heartbeat, breathing problems, restlessness, and anxiety since the heart and brain are the first organs to be impacted by oxygen deprivation.

The fodder provided to cattle can be poisonous too if the fodder is deficient in water or faced drought conditions. This may lead to toxicity to livestock followed by mortality. Sudan grass and sorghum are two separate groups of plants that produce cyanide, which can be toxic and poisonous to livestock under certain conditions i.e., water scarcity or drought. The plants which produce cyanogenetic glucosides are also called cyanogenetic plants during their growing phase (Albright and Clive 1997). Glucosides are glucose molecules that hydrolyze and decompose into glucose sugars, when water is added. During the decomposition process of cyanogenetic plants, the cyanide breaks and loose from its chemical link and transforms into the poisonous hydrocyanic acid, often known as prussic acid and denoted by HCN. The previously existent glucosides and undamaged, still-bonded cyanide are not very poisonous, nonetheless, if specific enzymes are present. These are very harmful to both animals and humans if plant's hydrolysis or chemical degradation enzymes are found together. It might be obtained from various sources. Digestive juices for example the HCl which is already present in the gut may cause hydrolysis to occur (Nath and Sharanya 2021).

Livestock toxicity by plants is often correlated to problems of management and field conditions. Animals typically graze excessively when they are hungry. Overgrazing, corralling, trucking, trailing, or introducing animals to a different range result in behavior changes leading to voracious eating of what they are offered which may lead to toxicity. For instance, animals occasionally ingest plants like greasewood and lupine, and these are poisonous for animals if they eat too much of these very quickly (Forero L and Nader G 2011).

Sorghum Plants

One of the most important cereal crops in the world, sorghum (Sorghum bicolor *L. Moench*) provides feed, food fuel, fiber, and biofuel/chemical feedstocks in a variety of environments and systems of production. Sorghum is the fifth-largest cereal crop in the world (Kerosvich et al. 2005). Sorghum is (a C4 plant) frequently grown in the semi-arid tropics, which are prone to drought. Based on their capacity to produce high yields in the field during drought circumstances, many sorghum cultivars that are drought-tolerant have been discovered (Jagtap et al.1998).

Sorghum is a grain and staple meal that can withstand droughts and is a good source of more than 20 different minerals and protein. Due to environmental and genotypic influences or interactions, the concentration of the protein and mineral elements content in sorghum varies (Gerrano et al. 2016). Sorghum contains ash (1.2-1.8%), protein (6-25%), oil (3.4-3.5%), carbohydrate (71.4-80.7%), and fiber (2.3-2.7%) with 89.2 to 95.3% dry matter based on the type of sorghum cultivated (Gerrano et al. 2016).

Africans first developed sorghum, which is now a significant dry land grain crop used on six different continents for animal feed, human food, and other purposes. Sorghum can withstand heat and drought pretty well (Lacy et al. 2006).

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An ideal system of cropping should be able to rapidly remove massive volumes of nitrogen and allows countless biosolid applications throughout the season of growing. Crops that are produced for fodder, such as sorghum or Sudan grass × sorghum hybrids, are likely to achieve these goals. Sorghum has an extensive root pattern that is highly efficient at scavenging nitrogen out of the soil and a very high capacity for absorbing nitrogen (Pedersen et al.1995).

Sorghum is a high-standard genome reference and genetic model species of the PACCAD clade (Panicoideae, Arundinoideae, Chloridoideae, Micrairoideae, Arristidoideae, and Danthonioideae) for C4 grasses because it has diversely variable germplasm, standard genomics, and genetic platform, a wide range of adaptations, and utilization as a forage, grain, bioenergy crop, and sugar (~65M hectares) on a global scale. Sorghum is primarily self-pollinated, and its tractable genetics make hybrid/ inbred breeding, quantitative genetic study, and population development possible (Mullet et al. 2014).

Sorghum, the perfect crop for dry locations, is regaining popularity due to its drought resilience and potential biofuels production (SORGHUM: A grain of hope, 2011).

Concentration Table

Sorghum fodder's nutritional analysis has shown that it is an excellent source of nutrients with modestly high protein content and can be used as a viable green fodder to feed animals in regions with insufficient rainfall (Ramana DB et al. 2018). The nutritional analysis of sorghum has been mentioned in Table 1.

Uses of Sorghum

Sorghum is a multipurpose crop in a true sense as it has the potential to satisfy diverse human needs as well as animal dietary needs (Iqbal 2015). Sorghum is an excellent feed for livestock and companion animals (Rooney et al. 1982). Nowadays, livestock consumes around 48% of sorghum grains produced across the world (Dowling et al. 2002). The stem can be utilized as a source of fuel, fiber, and most recently as feedstock for cellulosic ethanol. The grain can be used as food or as animal feed (Wang, Upadhyaya and Dweikat 2016).

Sorghum is either utilized whole or as distillers dried grains in animal feed (Ronda et al. 2019). For dairy cattle in lactation, distillers' grains provide a useful source of energy and protein (Schingoethe et al. 2009).

The feeding of sorghum grain seems to consistently boost starch utilization and milk protein and milk output (Theurer et al. 1999). The more starch is degraded in the rumen, the more ammonia is incorporated into microbial cells during protein synthesis (Leng and Nolan 1984). Dairy cows fed SF sorghum can produce more milk by increasing the fraction of microbial nitrogen and total nitrogen flow to the duodenum (Theurer et al. 1999). Sorghum is one of the oldest cultivated green forages for lactating animals (Iqbal 2015).

To improve the nutrition, health, and performance benefits of foods and create functional foods, sorghum is utilized as a food ingredient and added to other foods (Khalid et al. 2022). The post ruminal digestion of Organic Matter (11%), Nitrogen (10%), and starch (25%), as well as the total tract digestion of Organic Matter (8.3%), Nitrogen (8.2%), and starch (8.9%), were all increased (Phosphorus < 0.01) by steam-flaking sorghum (Zinn et al. 2008). For a cow (450 kg, 5 kg milk/day) suckling a calf, sorghum bran fed at 1 kg per kg milk with a base diet of sorghum stover is sufficient (Mahabile et al. 2000).

Phenolic compounds and fat-soluble compounds (polycosanols) extracted from sorghum are beneficial for the gut microbiota and parameters associated to obesity, inflammation, oxidative stress, dyslipidemia, diabetes, hypertension, and cancer (de Morais Cardoso et al. 2015).

Sorghum meal is also a preferred feed ingredient by newly weaned dairy calves and is considered highly palatable (Miller-Cushon et al. 2014).

It is an important source of B-complex and fat-soluble vitamins (Waniska et al. 2004). It is also a source of a few minerals, proteins (kafirins, which have high levels of polymerization, extensive disulfide bridges, and strong interactions with tannins and starch, rendering proteins resistant to enzymatic breakdown in the digestive tract), lipids, vitamins, and phenolic compounds (Birhanu 2021).

Jequirity Plants

The plant *Abrus (A.) precatorius* is a member of the Fabaceae family, also known as the jequirity or rosary pea Chanoti, chirmu, ratti, cham-l-kharosh, gunchi and rosary bean are the common names used in various regions of Pakistan (Oladimeji and Valan 2020). It is a deciduous climbing plant that can grow up to 6 meters, and occasionally up to 9 meters, in length. In order to support themselves, these stems wriggle over the ground and twine with other surrounding plants. To build necklaces and rosaries, the vibrant seeds are frequently utilized as beads. These are poisonous, yet have a lot of medical uses. The extremely toxic chemical abrin, indole alkaloids, and anthocyanins are only a few of the medicinally beneficial compounds found in the seeds. Despite being exceedingly poisonous, these are employed in medicine as an emetic, irritant, abortifacient, and contraceptive. The seeds are also bitter, diaphoretic, expectorant, aphrodisiac, purgative, antiperiodic, and emetic. In many parts of the world, these have been crucial in the conjunctivitis treatment process. Glycyrrhizin and trace levels of the toxin abrin are present in the roots and leaves. These are anti-allergic, anti-inflammatory, and expectorant, in addition to have calming effects (Dp et al. 2021). The nutritional analysis of jequirity plant has been mentioned in Table 2, proximate and mineral composition of leaves in Table 3 and 4 and proximate composition of seeds in Table 5, respectively.

Table 1: Nutrition analysis of Sorghum Plant (Ramana DB et al. 2018)

Parameter	Mean ± SE	Range
Hemicellulose	8.20± 0.79	28.03
ADL	8.39± 0.58	20.85
Silica	3.10± 0.21	7.99
Crude protein	12.42± 0.47	15.95
ADF	68.78± 0.86	30.99
Dry matter	26.30± 0.50	26.26
NDF	76.99± 0.41	12.06
Total Ash	9.18± 0.21	6.93
Cellulose	33.23± 0.71	31.72

Table 2: Concentration Table (Garaniya and Bapodra 2014)

Parameter	Percentage
Crude Protein	8± 0.00
Crude Fiber	2.00 ± 0.00
Crude Fat	6.50 ± 2.12
Ash	7.00 ± 1.41
Moisture	11.00 ± 0.00
Total carbohydrate	65.50 ± 3.12

Table 3: Proximate Composition of Leaves (Paul et al. 2013)

Element	Concentration (mg/100 g)
Calcium (Ca)	231.83 ± 0.204
Iron (Fe)	24.14 ± 0.002
Potassium(K)	246.94 ± 0.252
Magnesium (Mg)	25.66 ± 0.012
Sodium (Na)	94.10 ± 0.145
Zinc (Zn)	6.09 ± 0.020
Copper (Cu)	0.07 ± 0.004

Table 4: Mineral composition of Leaves (Paul et al. 2013)

Parameter	Percentage
carbohydrate	42.42%
Crude Protein	39.20 %
Nitrogen	6.272%
Crude Fiber	9.08%

Table 5: Proximate Composition of seeds (Das et al. 2016)

Element	Concentration (mg/kg)
Magnesium (Mg)	1046
Calcium (Ca)	975
Iron (Fe)	213
Potassium(K)	11132
Zinc (Zn)	48
Phosphorus (P)	2302
Sulfur (S)	1841
Rubidium (Rb)	4.0
Strontium (Sr)	1.0
Manganese (Mn)	25
Copper (Cu)	13
Molybdenum (Mo)	1.0
Lead (Pb)	1.0

Ethnoveterinary Uses of Jequirity Plant

Jequirity Plant has been traditionally used for treatment of different diseases in cattle. On affected areas with swelling, pasted leaves of *Abrus (A.) precatorius* are applied until healing (Ishika 2015). Leaf of *A. precatorius* are also used to treat salivation from the mouth as traditional medication (Usha et al. 2016). Seeds of *A. precatorius* soaked in water for overnight and its paste give instant cure for any urinary trouble and in indigestion in cows (Bharali et al., 2015). The roots of *A. precatorius* has been used to treat blood dysentery. Paste of root along with boiled rice is given to treat dysentery (Deepa et al., 2014). Use of *A. precatorius* in cattle for the expulsion of placenta have been reported (Takhar and Chaudhary 2004). Crushed seed of Abrus given with jaggery in retention of the placenta. 12 to 15 seeds should be fed for placental expulsion (Bhatt et al. 2019). *A. precatorius* have been found useful in curing eye diseases of cattle (Abhijit and De 2010). When cattle's eyes become white, the crushed roots of Abrus are applied. (Shivakoti 2011). Alkaloids, phenolic and flavonoid constituents obtained by ethanol, chloroform, petroleum ether extraction are found useful as antidiarrheal and antifertility agent (Janakiraman et al. 2012). For the treatment of mastitis in milk cow, roots of *A. precatorius* and *Leonotis (L.) nepetifolia* (1:2) is made into a paste and applied as a poultice on the mammary gland twice a day for 3 days (Mandal and Habibur Rahaman 2022). Seeds of *A. precatorius* are also used to treat cattle Helminthiasis. For this purpose, pound seeds, or grinded leaves (0.4kg) mix with 2 L of water, or boiled. Method of preparation is maceration, decoction and then powder extract of seed. Dosage for adult animals is 4-5 mature seeds, 2 seeds for calves or drench 200-300 ml to 50- 70 calves and adults (Matovu et al. 2020). It is also used for treatment of fractures in animals (Garaniya and Bapodra 2014). Seeds of *A. precatorius* are used by Malayali tribes for neck infection (Selvaraju et al. 2011). For the treatment of anthrax, the stem bark of *A. precatorius* is pounded and boiled in water with tubers of *Curculigo (C.) orchioides*, leaves of *Vitex (V.) negundo* (each 50 g), garlic, and pepper (15 g). The resulting decoction is then administered orally once a day for a week (Narayana and Narasimharao 2015). Seed extracts of *A. precatorius* (20 mg) dissolved in drinking water is given once daily for 4 days for the treatment of trypanosomiasis (Pragada and Rao 2012). Leaves of *A. precatorius* is used traditionally for wound healing (Sehgal and Sood 2013). Crushed roots of *A. precatorius* are used to treat cough, cold and pneumonia and seeds are used against constipation (Patil et al. 2015). Cows with an appetite loss are treated with a drink made from *A. precatorius* seed and coconut oil (Guruprasad and Prasad 2019). Regularly, seeds of *A. precatorius* are crushed, soaked in water over night, and administered to the animals in the morning through oral route for three days for the treatment of lack of estrus (Meena and Kumar 2015). For three to five days, young leaves of *A. precatorius* are administered to grazing animals to treat mouth ulcers caused by feeding on very rough leaves (Joseph et al. 2013). To get rid of body lice, cows are fed with the crushed roots of *A. precatorius* (Ahmmed et al. 2010). Leaves of *A. precatorius* are also used for the of Foot and Mouth Disease (FMD) treatment (Nair et al. 2017).

Activity against Pathogens

Methanolic extracts of *A. precatorius* have good activity against veterinary pathogens i.e., *Clostridium (C.) septicum*, *Aspergillus (A.) fumigatus*, *Brucella (B.) abortus*, *Salmonella (S.) enterica* and *Candida (C.) albicans* (Sandhya Deepika D 2021).

Tuberculosis

Bovine tuberculosis (TB) is a condition marked by the progressive growth of certain granulomatous lesions or tubercles in the lymph nodes, lung tissue, or other organs. The cause of the illness is *Mycobacterium (M). bovis*. Nearly all warm-blooded animals, including bison and buffalo, are susceptible to the disease, which can also affect other bovine species. Not all species are equally prone to the illness; some serve as spillover (end) hosts while others serve as maintenance hosts. Seeds of Abrus are used for the treatment of tuberculosis (Garaniya and Bapodra 2014).

Tetanus

Cattle are susceptible to the potentially fatal neurologic disease known as tetanus *(C. tetani* infection). Tetanus's clinical symptoms typically go unnoticed until the disease has progressed to an advanced stage, at which point it is difficult to treat and manage infected animals, and their prognosis is generally not good. Primary clinical signs included erect tail, stiff gait, and prolapsed nictitating membranes also called prolapse of the third eyelid. Gram-positive bacillus (*C. tetani*) produces exotoxins which are the cause of the neuroparalytic syndrome of tetanus. The most common infection sites in cattle for *C. tetani* include deep, necrotic wounds, either surgical or traumatic, necrotic lesions of the vagina or vulva following dystocia, and severe postpartum metritis (Garber and Smith 2011). *A. precatorius* leaves are traditionally used to treat tetanus (Garaniya and Bapodra 2014)

Muscle Relaxant

To treat swollen joints and stiff muscles, mustard oil and crushed leaves of *A. precatorius* are combined and applied topically or wrapped around as a poultice (DeFilipps and Krupnick 2018). Activities of various parts of jequirity plant is mentioned in Table 6.

Sorghum Toxicity

Sorghum toxicity has been seen commonly in Pakistan. The syndrome is reported in horses, sheep and cattle. Atherogenic nitriles such as beta-cyan alanine, cyanogenic glycosides, and nitrates have been suggested as basic causative agents (Francis and Charles Kenworthy 1915). The syndrome commonly develops in horses when they have grazed hybrid Sudan pastures for a long time ranging from weeks to months and causes axonal degeneration and myelomalacia in the spinal cord and cerebellum. Sorghum toxicity is characterized by incoordination, cystitis, urinary retention and alopecia on the hind legs due to urine scald (Doggett and Hugh 1970). The urinary bladder dysfunction is related to the spinal cord damage. The incoordination may progress to paralysis. Deformities occur in the fetal musculoskeletal system and abortion may happen in the late pregnancy (Blaney et al. 2010). Although fetal toxicity is not mostly observed in horses, the impact on reproduction is the primary concern. Dietary supplements containing sulfur may be beneficial (Boyd et al. 1938). Pyelonephritis commonly results in death in affected horses. Antibiotic therapy is an option, but if ataxia has started in, a full recovery is rare (Geor RJ 2007).

Mechanism

When first cutting of sorghum is done, and plants are getting ready for next growth, farmers usually do not water it, due to which the wilted, young or stunned plants that develop large quantities of prussic acid (i.e., hydrogen cyanite), which is dangerous for animals and may cause paralysis and death. The overconsumption of sorghum is resulted in to the toxicity (Subrahmanyan D et al. 2008).

Prevention: Sulphur (0.26-0.4%) is given in daily doses for cattle and sheep when climate conditions are favorable for wilting after a prolonged drought (Whitmore JS 2000).

Immediate Treatment

Sodium nitrate 20% solution is given and immediately followed by sodium thiosulphate 20% solution as for cattle and half for sheep. This treatment is only beneficial if given on immediate basis (Subrahmanyan D et al. 2008).

Hydrocyanic Acid/Prussic Acid Toxicity

Hydrogen cyanide (HCN), also known as prussic acid, is an organic compound. Plants normally don't produce it. However, cyanogenetic glycoside can be stored in significant amounts in a number of common plants. In plants, cyanide is present in two forms:

- Free form (hydrocyanic acid)
- Bound form (cyanogenic glycoside)

Cyanogenic glycosides are accumulated in significant amounts. The following plant species frequently result in the prussic acid toxicity in livestock:

- *Acacia*
- *Sudan grass*
- *Sorghum–Sudan grass hybrids*
- *Sorghum halepense* (Johnson grass)
- *Sorghum spp* (Brimer L 2007).

Table 6: Different types of Extracts of the parts of jequirity plants and their activity (Das et al. 2016)

Part of the plant	Type of Extract	Activity
Leaves	water extract	Anti-inflammatory activity
Shoot	methanol	larvicidal activity
Leaves	methanol	bronchodilator activity
Roots, seeds and leaves	Methanol and petroleum ether	Antibacterial Activity
Leaves	ethyl acetate	Antiserotonergic Activity
Seeds	Petroleum ether	Anticancer activity
Leaves	ethyl acetate	Antiserotonergic Activity
Seeds	aqueous extract	Nephroprotective activity
Seeds	ethanol	Anti-oxidant activity
Seeds	ethanolic extract aqueous extract	Anti-fertility activity
Red & white seeds	Ethanol	Anti-arthritic activity
Seeds	hexane, chloroform, methanol and water	Anti-microbial activity
Leaves	chloroform and ethanol	Cytotoxic property

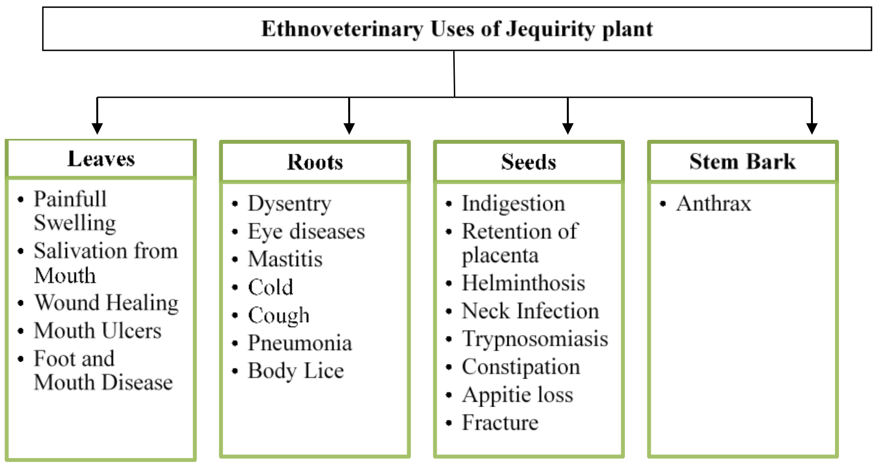

Fig 1: Ethnoveterinary uses of Jequirity Plant.

Toxicity symptoms typically appear 15 to 20 minutes after ingesting the poison. Death happens quickly, in acute cases within 1-2 hours after the clinical manifestations become apparent, or in around 2-3 minutes (Robson and Sarah 2007). Animals are frequently discovered dead with no obvious clinical symptoms or signs. Because the heart and brain are the first organs to suffer from hypoxemia, clinical symptoms that appear before death include breathing problems, a rapid, weak, irregular heartbeat, restlessness, anxiety, and depression. Other symptoms include salivation, bloating, terminal convulsions, and bright red mucous membranes (Carrigan and Gardner 1982).

On the basis of clinical and/or post-mortem findings, prussic acid poisoning is diagnosed. Additionally, the blood may appear bright red and poorly clot during post-mortem inspection. A few hours after death, the blood will turn dark again, the muscles may be dark, and there may be hemorrhages on the surface of the heart as well as in the trachea and lungs (Muwel et al. 2018). A brick red color on filter paper indicates the cyanide. The glycoside breaks down to create free HCN when wilting, frosting, or stunting damages the plant cells. Physical disruption (i.e., mastication) may also release HCN (Beasley DM ad Glass WI 1998).

Pathophysiology

HCN/Cyanide containing compound → impairs oxidation (cytochrome oxidase enzyme system) → histotoxic anoxia → dyspnea, convulsions, tremors and finally death (Beasley DM and Glass WI 1998.)

Treatment

- Establish oxygen transport at the cellular level
- Sodium nitrite @ 20mg/kg body weight IV (10g/100ml of distilled water or normal saline)
- Carefully repeated @ 10mg/kg every 2 to 4 hours
- Sodium thiosulfate @ 500mg/kg body weight IV
- Sodium thiosulfate @ 30g/cow/buffalo PO (to detoxify remaining HCN in rumen)
- Methylene blue @ 4-22 mg/kg IV (if doubt about nitrate poisoning) (Subrahmanyan D et al. 2008)

Seeds of Jequirity (*A. precatorius*)

A. precatorius can be found all over the tropical region. It is a perennial vine with trailing twine that bears oval, glossy red and black seeds along with yellow or red blooms. Jewelry and necklaces feature seeds as beads. Seeds of *A. precatorius* possess a powerful phytotoxin known as abrin. It is largely used by chammers or leather workers for cattle malicious toxicity. The decorated seeds are soaked in water and ground into a mass, which is made into small, sharp pointed spikes (hind. *Sui* or *sutli* in local language) and hardened in the sun. For use, two of the spikes are edged in a brick and inserted by their base into two holes at the edge of a wooden handle. A forcible blow is then stuck with the handle, driving the protruding spikes into the animal flesh, where they are left, causing death in 18-24 hours. The site of insertion is ingeniously selected so that symptoms are selected as according to the disease prevailing that time. For example, the cheeks are selected when there is outbreak of hemorrhagic septicemia, in the hind quarter when black quarter is prevailing. Sometimes, other poisons like madar, arsenic, latex, aconite, etc. are added to *sui* to augment its destruction action (Van Kampen 1970). In horse oral toxicity is characterized by; inappetence, violent purging, lassitude, shivering, in coordination and paralysis. In *sui* toxicity, there is local edema, anorexia, fever, later sub normal temperature, convulsions, coma and death (Soldán et al. 2001) In cattle, salivation, nasal discharge, nausea, vomiting, profuse hemorrhagic diarrhea with watery feces, occasionally ulcerative lesions in mouth and dehydration, stiffness of muscle, incoordination, muscular spasms, ataxia, convulsions, trembling, paralysis, coma and death is common (Ballantyne et al. 1972).

Emergency Treatment

Gastric lavage is used to remove the toxin from the stomach as soon as possible. Then, activated charcoal, demulcents, and saline purgatives are used. In case of toxicity, symptomatic and supportive treatment is given to the animal. Anti-abrin serum, papain and HCL by mouth, saline purges and are choline. Remains of *sui* should be removed and wound should be washed with $KMNO_4$ lotion. It is considered as the chemical toxicity. No specific antidote is available (Egekeze et al. 1980).

Aversion (Training livestock to avoid eating toxic plants)

It's crucial to comprehend the factors at play when beneficial forage turns into a toxic plant in order to prevent toxicity. It might be challenging to make a definitive diagnosis of potential plant poisoning. It's crucial to be aware of the poisonous plants that are present wherever you go and to know exactly which circumstances they can harm animals. When assessing disease and lost production in cattle, toxic plants are one of the major contributors to financial loss for the animals (Rohila N et al. 2018). Toxic plants can affect animals in many ways, including death, chronic illness, debilitation, birth defects, decreased weight gain, increased parturition interval, abortion and photosensitization. Other factors to take into account include forage loss, additional fencing, higher labor and administration costs, and frequent interference with the proper forage collection, in addition to more evident losses. By giving animals a certain food and then giving them emetics to make them feel nauseous, it is possible to train animals to avoid eating that food. The animal avoids eating the food since it tastes bad because of the disease it has been given. A proposed technique to stop livestock poisoning from attractive and widespread hazardous plants is conditioned food aversion (CFA). Cattle have been trained to avoid eating tall larkspur (*Delphinium barbeyi L. Huth*), a particularly troublesome toxic plant. However, in field grazing situations, a number of factors affect the development and maintenance of dietary aversions. Animals' capacities to acquire and maintain aversions may vary depending on their age and gender (Rosenberger et al. 1979). Strength of the aversion depends on the novelty of the plant and the severity of the produced illness. Animals are motivated to try the avoided meal by social pressure or peer pressure, and the aversion will vanish if it is not reinforced. For certain animals, it may be challenging to transfer the aversion they developed in a controlled environment like a pen to a complex vegetation community in the wild. If these challenges can be resolved, CFA might be a useful technique for lowering the risk of poisoning on rangelands with toxic plant infestations (Kellerman et al. 2005). In Pakistan, the majority of rangelands are heavily populated with toxic plants. Naturally, the majority of wild and domestic animals that graze on rangelands do not die suddenly after ingesting harmful plants. Grazing animals employ a variety of physiological or behavioral adaptations that are interconnected to lower the danger of poisoning (Durrani MJ et al. 2010.). Control strategies are based on:

(1) Changing diet to avoid or reduce toxicity ingestion (learning behavior)
(2) Dilute the toxin by selecting a mixed diet (hunger reduce)
(3) Allowing cyclical or intermittent consumption of a toxin (boost immunity)

Aversive conditioning and random consequences, in which animals learn from the positive or bad effects of consuming different forages, are essential tenets of these three techniques (Church and David 1991). Losses of domestic livestock prove that learning is not a perfect preventive strategy. However, with knowledge, the majority of livestock can graze on ranges with hazardous plants and thrive (Yousef and Mohamed 1985).

Conclusion

The domestic livestock are more frequently affected by toxic plants than wild ungulates are likely due to human management mistakes that often outweigh coping mechanisms. Additionally, compared to cattle, wildlife probably has a higher tolerance and ability to detoxify poisons. Better is to do not let the livestock to graze plants that are wilted, immature, drought-stressed, or injured by frost. Never let livestock graze sorghum that is only 50 cm tall. Before letting livestock graze, feed them hay to satisfy their hunger. Poisoning risk will be decreased if the material is fed as silage. Correct ensilage for three weeks reduces toxin levels by about 50%. Some of the poison will be expelled as gas when feeding out. It is still advised to test this feed before using it. In order to get rid of any free prussic acid, linseed gruel needs to be properly cooked. Sulfur supplements can be added to feed as a preventative measure.

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