Veterinary Medicine: Research and Reports

Dovepress

open access to scientific and medical research

Open Access Full Text Article

ORIGINAL RESEARCH

Poisonous Plants Seem to Affect Livestock in the Borana, Southern Ethiopia: An Ethnic-Toxicological Approach

Adem Kumbe, Birhanu Hordofa Bekele, Anaf Betelu Onate, Beshir Hussien, Dereje Teshome, Siraj Kelil

Yabello Pastoral and Dryland Agriculture Research Center, Oromia Agricultural Research Institute, Yabello, Ethiopia

Correspondence: Adem Kumbe, Email ademkumbe7@gmail.com

Introduction: Toxic plants are plant species that cause harmful consequences to animals, including physical discomfort, decreased productivity, and death after being consumed or absorbed.

Objective: The study aimed to identify toxic plants in the area, assess their consequences, identify factors causing livestock predisposition to toxic plants, and identify control and prevention methods.

Methods: A cross-sectional study was conducted from July 2019 to June 2021 in the Dire, Dubluk, Yabello, and Moyale districts of the Borana Zone and to collect quantitative and qualitative data, a semi-structured questionnaire and focus group discussions (FGDs) were used.

Results: Thus, based on qualitative analysis, 95% of participants identified harmful plants in the area that could potentially pose significant health risks to animals, out of a total of 120 individuals (46 (38.33%) females and 74 (61.67%) males) in the study area. According to the quantitative study, 31 plants in the study area were identified as toxic to livestock. Among the identified toxic plants were *Pavetta gardeniifolia* (23.63%), *Loudetia flavida* (10%), *Euphorbia tirucalli* (1.36%), *Solanum somalense* (3.2%), *Eragrostis cilianensis* (17.72%), *Sorghum arundinaceum* (17.72%), *Acokanthera schimperi* (4.1%), *Capparis tomentosa* (3.63%), and *Teclea salicifolia* (2.27%). The main factors that exposed livestock to toxic plants were a lack of feed combined with nutritional deficiency (73.6%), sudden ingestion with grass (98.2%), and fresh evergreen and matured attractive whole parts of toxic plants (52.6%). About 41.1% respondents indicated that animal was predisposed during the rainy season. A 42.9% of respondents replied as livestock grazed frequently in the forest area/plateau can affect and cattle (72.8%), which were the most frequently affected animals.

Conclusion: The present study identified different poisonous plants for livestock and their responsible factors based on the community assessment and plant survey.

Recommendations: Therefore, more intervention on the major toxic principles and phytochemistry of the identified plants must be studied.

Keywords: assessment, borana, identification, pavetta gardeniifolia, toxic plant, Ethiopia

Introduction

Poisonous plant species in East Africa, including Ethiopia, have caused significant losses to livestock. Poisonous plants cause physical discomfort, decreased productivity, and even death in animals that are exposed.[1] Plant poisoning occurs when animals intentionally or unintentionally consume poisonous plants during feed shortages or when grazing for extended periods can poison livestock.[2] When edible forages are in short supply in the pastureland due to drought, animals are more vulnerable to ingesting poisonous plants.[3,4] Poisonous plants are often green and appealing to thirsty animals, but deficiency in phosphorus or vitamin A can make these issues worse. Factors such as susceptibility, species, consumption, and plant growth stage or section influence the prevailing effect on the victim.[4]

Plant toxins may be more difficult for animals to detoxify and may cause comparatively more harm due to the toxins' metabolic effects when they are under nutritional stress. As a result, cautious supplemental feeding, and careful observation of grazing animals, and effective grazing management with prior knowledge of poisonous plants in the rangelands may all help to lessen the issue. This is due to the difficulty in distinguishing losses caused by diseases, accidents, predators, and the ingestion of

Received: 7 November 2023
Accepted: 8 February 2024
Published: 13 February 2024

poisonous plants. Disease, inadequate nutrition, and the consumption of poisonous plants can all contribute to poor reproductive performance and weight loss. Some of the negative effects of poisonous plants, such as birth defects, manifest years after ingestion.[5]

Toxic plants pose a significant threat to animals in Borana areas, leading to permanent or worsening liver or kidney disease, physical disturbance, decreased productivity, and even death. Livestock and livestock products are the primary sources of income in pastoral areas, but the lowlands are also home to potentially fatal diseases such as metabolic disorders and poisoning.[6]

Previous report indicated that the presence of toxic plants in the Borana zone. However, there is little information on the identification though there is some verbal evidence about the presence of some toxic plants.[7] Therefore, the study was designed to identify the toxic plants in the study area as well as to assess the consequences of poisonous plants, identify factors that predispose livestock to major toxic plants, identify control and prevention methods practiced in the study area.

Materials and Methods

Study Area

The study was conducted in four districts of the Borana zone, located 570–775 km from Addis Ababa, the capital city of the country, bordering Northern Kenya and the Somali regional state of Ethiopia. Borana has four seasons, which are the long rainy season, the short rainy season, the cold dry season, and the dry season. The Borana receives bimodal rainfall but has an erratic and unreliable distribution. Seasonally, the rain falls in the two seasons, which are categorized as long rainy seasons from March to May and short rainy seasons from September to November. The other two seasons are the cold dry season, which includes the months from June to August, and the long dry season from December to February.[8]

Sampling Methods

The districts were purposively selected based on their proximity to our research center and the availability of toxic plants. The kebeles (the lower local administrations) and household was selected based on the simple random samplings.

Study Population and Sample Size

The 120 respondents that have livestock as well as animal health experts were interviewed and key focus group discussion was made.

Data Collection Method

Interviews with 120 people (30 from each kebele) were conducted through focus groups and a semi-structured questionnaire. During the study period, separate semi-structured interviews, field observations, and plant sample collection were conducted. During the interviews, all pertinent information was acquired, such as the names of the plants in the area, their toxic parts, the species of animals harmed, the age range of the exposed animals, the effects of poisoning, and how to prevent and control with plant poisoning. On the identification of toxic plants, the plant botany expert (Mr. Siraj Kelil) from agroforestry and natural resource department of Yabello Pastoral and Dryland Agriculture Research Center were participated. The collected plants were stored in the center (RefTP1) and the plants' scientific names were determined using standard protocol, and the results were noted on the data collection sheet.

Data Analysis

After being organized using a Microsoft Excel spreadsheet, the names of the plants collected, the data gathered from questionnaires, and any other relevant information were analyzed using SPSS version 20. During the data analysis process, descriptive statistics were employed.

Results

Availability of Toxic Plants

Of those respondents 46 (38.33%) were female and 74 (61.67%) were male (Table 1) and specified 31 plants as poisonous plants. Out of the total of 120 interviewed individuals, 95% reported the existence of toxic plants.

Table 1 The Proportion of Respondents Reported the Presence of Poisonous Plants in Livestock About Districts According to the Sex Division of Respondents

Districts	% of Respondents on the Availability of Toxic Plants		Sex of Respondent		Total
	No	Yes	Female	Male	
Dire	–	25	14 (11.7)	16 (13.3)	30
Dubuluk	4.16	20.83	9 (7.5)	21 (17.5)	30
Moyale	–	25	13 (10.83)	17 (14.2)	30
Yabelo	0.83	24.16	10 (8.3)	20 (16.7)	30
Total	5	95	46 (38.33%)	74 (61.67%)	120

Risk Factors of Exposure

Regarding putative poisonous plants to livestock the exposure to toxic plants was 41.1% rain season, 40.3% dry season, 16.6% (All seasons), and 1.7% (cold dry season based on the seasonal difference in decreasing order (Table 2). Most of those toxic plants occurred in forest areas/plateaus (42.9%) where animals frequently graze followed by Farmland (24.5%), Rangeland/roadside (15.7%), and dung decomposed fertile area (15.7%). Water points (0.8%) were the next areas where these toxic plants were claimed to be found, in decreasing order. The present study showed that shortage of

Table 2 Summary of Risks of Exposure to Toxic Plants

Variables	Risk Factors for Toxic Plant Exposure	No of Respondent	Percent
Common habitat/Distribution/	Everywhere/range	18	15.7
	Forest area/plateau	49	42.9
	Farmland	28	24.5
	Fertile area decomposed with dung	18	15.7
	Around water point	1	0.8
Toxic part	Leaves	13	11.4
	Evergreen and matured whole part	60	52.6
	Leaves and seed	39	34.2
	Seed	2	1.7
Abundant season	Short rainy season	3	2.6
	Dry season	46	40.3
	Long rainy season	44	38.5
	All-season	19	16.6
	Cold dry season	2	1.7
Mode of infection	Ingestion	112	98.2
	Body Contact	2	1.7
Effective form	Leaves	9	7.8
	Fresh and matured all part	37	32.4
	Matured seed	68	59.6
Reason of exposure	Deficiency/shortage of feed	84	73.6
	Sudden consumption of grass	26	22.8
	Accidental body contact	1	0.8
	Shortage of water	3	2.6
Frequencies of exposure	Repeated exposure/multiple	83	72.8
	Single	31	27.2
Animal species	Bovine	83	72.8
	Camel	6	5.3
	Camel, Bovine, Caprine	11	9.6
	Bovine and Caprine	12	10.5
	All Animals	2	1.8

feed in combination with nutritional deficiency (73.6%), sudden consumption of grass (22.8%), shortage of water (2.6%), and accidental body contact (0.8%) were major predisposing factors for animals to poisonous plants. Regarding poisoning of livestock by parts of plants, the study revealed that ingestion or contact of fresh evergreen and matured whole parts contributes 52.6%, followed by Leaves and seed (34.2%), fresh and dry leaves (11.4%), and seed (1.7%) of the toxic plant (Table 3).

Table 3 Summary of Poisonous Plants and Their Characteristics

Vernacular Name	Scientific Name	Frequency %	Flowering Time	Flower Color	Distribution/ Common Habitat	Toxic Part	Abundant Season
Gaadallaa	*Pavetta gardeniifolia*	52 (23.63)	Bona	White	Forest	Leaves and seed	Bona
Ardaa	*Eragrostis cilianensis* (All.) Vign. ex Janchen	28 (17.72)	Bona	White	Fertile cattle barn area	All part	Gana
Fincoo	*Sorghum arundinaceum* (Desv.) Stapf	28 (17.72)	Adolessa	White	Farm land	All part	Gana
Seerricha/marra dhiigaa	*Loudetia flavida* (Stapf) C. E. Hubb	22 (10)	Bona	Red	Forest	All part	All season
Tabarii	NA	15 (6.82)	Bona	White	Everywhere/rang	All part	All season
Qaraaruu	*Acokanthera schimperi* (A. DC.) Schweinf	9 (4.1)	Bona	White	Forest	Leaves and seed	All season
Ogoraa gaalaa	Capparis tomentosa Lam	8(3.63)	Adolessa	Yellow	Forest	Leaves	Bona
Hiddii gaagee	*Solanum somalense* Franchet	7 (3.2)	Bona	White	Everywhere/range	Only seed	Bona
Hadheessaa	*Teclea salicifolia* Engl.	5 (2.27)	Adolessa	White	Forest	Leaves	Adoolessa
Aannoo	*Euphorbia tirucalli* L	3 (1.36)	Adolessa	White	Everywhere/range	All part	Adoolessa
Ejersa	*Olea europaea* subsp. *cuspidata* (Wall. Ex. G. Don) Cif.	3 (1.36)	Bona	White	Forest	Leaves	Adoolessa
Banjii	*Datura stramonium*	3 (1.36)	Bona	White	Range	Leaves/seed	Gana
Kuubaa	Parthenium hysterophorus	3 (1.36)	Bona	White	Everywhere/range	All part	Bona
Qobboo	*Ricinus communis* L	3 (1.36)	Bona	White	On the fertile area of the removed barn	Can be leaves and/ or seed	Bona
Argeessa	*Aloe species*	2 (0.9)	Bona	Red	Everywhere/range	Leaves	Bona
Boobiyaa	Kalanchoe sp	2 (0.9)	No flower	No any color	Forest	All part	Bona
Doobbii	*Tragia pungens* (Forssk.) Mu¨ll. Arg.	2 (0.9)	All season	White	Removed cattle barn fertile with dung	All part	Bona
Halquuqaa	*Haricot bean*	2 (0.9)	Bona	Red	Farmland	Only seed	Bona
Haxaawwoo	*Becium verticillifolium* (Bake) Cufod.	2 (0.9)	Bona	White	Farmland	Leaves	Bona and ganna
Qorsa diidaa	Euphorbia sp	2 (0.9)	Bona	Red	Removed cattle barn fertile with dung	All part	Adoolessa
Darguu	*Tephrosia pentaphylla* (Roxb.) G. Don.	1 (0.45)	Bona	White	Water point	Leaves	Bona
Gaalee	*Psydrax schimperiana* (A. Rich.) Bridson	1 (0.45)	Bona	White	Forest	All part	Bona

(*Continued*)

Table 3 (Continued).

Vernacular Name	Scientific Name	Frequency %	Flowering Time	Flower Color	Distribution/ Common Habitat	Toxic Part	Abundant Season
Gambora	Cactus	1 (0.45)	Bona	Red	Everywhere/range	Leaves/spine	Adoolessa
Hadaa	*Osteospermum vaillantii* (Decne.) T. Norl.	1 (0.45)	Bona	Yellow	Everywhere/range	Leaves	Bona and ganna
Hiddii loonii	*Solanum giganteum* Jacq.	1 (0.45)	Bona	Yellow	Everywhere/range	Only seed	Bona
Hiddii waatoo	*Solanum incanum* L.	1 (0.45)	Adolessa	White	Everywhere/range	Leaves	Bona
Illaadduu	*Echinochloa haploclada* (Stapf) Stpaf	1 (0.45)	Adolessa	Green	Around ELA	Leaves	Gana
Luuccolee	*Bothriochloa insculpta* (A. Rich.) A. Camus	1 (0.45)	Bona	Red	Forest	All part	Adoolessa
Raafuu	*Amaranthus thunbergii* Moq.	1 (0.45)	Bona	White	Forest	Leaves and seed	Gana
Qundhii		1 (0.45)	Bona	Red	Around ELA	Leaves and seed	Gana
Missingaa	*Sorghum bicolor*	1 (0.45)	Hagayya and ganna	White	Farm land	Leaves and seed	Gana
Tummaa		1 (0.45)	No flower	No color	Everywhere/range	Leaves	Gana

The Reports of Toxic Plants in the Study Area

The main putative poisonous plants were *Pavetta gardeniifolia* (23.63%), *Eragrostis cilianensis* (17.72), *Loudetia flavida* (10%), *Acokanthera schimperi* (4.1), *Capparis tomentosa* (3.63), Solanum sp (3.2), *Teclea salicifolia* (2.27), *Euphorbia tirucalli* (1.36), reported in the study area. Common clinical symptoms complained of by the respondents about the poisonous plants were bloating, diarrhea, depression, incoordination, weakness, salivations, bloody urine, thorny tongue, and mouth, loss of appetite, restlessness, inability to stand, depression, and coma (Table 4).

Table 4 Effect of the Poisonous Plant on Livestock

Vernacular Name	Affected Animal Species	Age	Mode of Infection
Gaadallaa	Bovine	All age	Ingestion
Ardaa	Bovine	All age	Ingestion
Fincoo	Bovine	All age	Ingestion
Search	Bovine, Caprine	All age	Ingestion
Tabarii	Camel, Bovine, Caprine	All age	Ingestion
Qaraaruu	Bovine, Caprine	All age	Ingestion
Goraa gaalaa	Camel	Young	Ingestion
Hiddii gaagee	Camel, Bovine, Caprine	All age	Ingestion
Hadheessaa	Ovine	All age	Ingestion
Aannoo	Camel and caprine	Young	Ingestion
Ejersa	Bovine, Caprine	All age	Ingestion
Banjii	Caprine	Adult	Ingestion
Kuubaa	Bovine	All age	Ingestion
Qobboo	Bovine	All age	Ingestion
Argeessa	Bovine	All age	Ingestion
Boobiyaa	Camel	Adult	Ingestion
Doobbii	All Animal	All age	Contact

(*Continued*)

Table 4 (Continued).

Vernacular Name	Affected Animal Species	Age	Mode of Infection
Halquuqaa	Caprine	All age	Ingestion
Haxaawwoo	Bovine	Adult	Ingestion
Qorsa Diidaa	Bovine, Caprine	Young	Ingestion
Darguu	Camel	Adult	Ingestion
Gaalee	Bovine	All age	Ingestion
Gambora	Bovine/caprine	All age	Ingestion
Hadaa	Bovine	Adult	Ingestion
Hadhawa	Bovine	All age	Ingestion
Hiddii loonii	Bovine	All age	Ingestion
Hiddii Waatoo	Camel, Bovine, Caprine	All age	Ingestion
Illaadduu	Bovine, Caprine	All age	Ingestion
Luuccolee	Bovine	All age	Ingestion
Raafuu	Bovine, Caprine and ovine	All age	Ingestion
Qundhii	Bovine	Adult	Ingestion
Missingaa	Bovine, Caprine	All age	Ingestion
Tummaa	Bovine	All age	Ingestion

Discussion

According to respondents, animal exposure to toxic plants was 41.1% rain season, 40.3% dry season, 16.6% all seasons, and 1.7% cold dry season based on the seasonal difference in decreasing order. This agrees with the findings of Horo Guduru Wollega,[9] Wondo Genet,[10] and peri-urban areas of Woliso and Wonchi,[11] and this could be because of the plant's expansive growth and evergreening characteristics during the scarcity of animal feed. Those poisonous plants were reported to occur in forest areas/plateaus (42.9%) where animals frequently graze followed by farmland (24.5%), Rangeland/roadside (15.7%), dung decomposed fertile area (15.7%), and water points (0.8%) were the next areas where these toxic plants were claimed to be found, in decreasing order. The present study agrees with the study undertaken in Woliso and Wonchi towns by Sisay et al,[11] and is lower than the finding of Kassa and Abdi[10] whose report showed 39.2% (rangeland) and 31.4% (farmland), and higher than forest (20.4%).

The present study showed that shortage of feed in combination with nutritional deficiency (73.6%), sudden consumption of grass (22.8%), shortage of water (2.6%), and accidental body contact (0.8%) were major predisposing factors for animals to poisonous plants. This also agrees with previous works,[10,12] and this might be because to the development of large forage plants that grazing animals can easily access.[2] While animals on a healthy diet are less likely to eat harmful plants and are better able to detoxify the tiny amount consumed, hungry animals are less discriminating about their foraging and consume significant quantities of toxic plants within a short period of time.[13] A lack of nutrients can also raise the likelihood that livestock will consume poisonous plants.[14] The outcome of this investigation was also consistent with the results of studies conducted in North Central America.[15]

Regarding poisoning of livestock by parts of plants, the study revealed that ingestion or contact of fresh evergreen and matured whole parts contributes 52.6%, followed by Leaves and seed (34.2%), fresh and dry leaves (11.4%), and seed (1.7%) of the toxic plant. This is in agreement with research findings from the Nekemte town area,[16] central Ethiopia,[17] and Wondo Genet.[10]

Cattle are the animals that are impacted most frequently, according to the participants. This is consistent with Kebede et al's findings.[16] Large animals are less picky and spend more time foraging. Small ruminants, on the other hand, require less feed but are less susceptible to poisonous plants,[16,17] more selective eaters, and spend more time looking for high-quality fodder.[18,19]

Pavetta gardeniifolia (23.63%), *Eragrostis cilianensis* (17.72), *Loudetia flavida* (10%), *Acokanthera schimperi* (4.1), *Capparis tomentosa* (3.63), *Solanum sp* (3.2), *Teclea salicifolia* (2.27), *Euphorbia tirucalli* (1.36) were identified plants in the area. The majority of the plants found in this study were comparable to those found by Abebe et al (2012)[20] in the

Borana Zone as well as Getahun and Beze's[21] recorded findings in Holeta. The subjects included in this study were reported with vernacular name of Gaaddallaa, Marra dhigaa, Qorsa diidaa, Mishingaa, Ardaa, Tabari, Ogora gaalaa, Hadha, Bobiya, Finchoo, Aannoo, Hidi, and Qobboo. These subjects were also included in the Abebe et al (2012) study conducted in the Borana Zone.[20]

Several of the toxic plants found in the study area have also been reported to exist in other regions of Ethiopia. *Datura stramonium, Sorghum bicolor, Solanum incanum Ricinus communis, and Amaranthus spp.)*,[9–11] *Euphorbia tirucalli*,[9,10] *Olea Africana*,[9] *Aloe species*,[10] *and Euphorbia sp*[10] were reported from Woliso and Wonchi towns, Bako, Horo Buluk, and Afar, respectively.

Numerous variables, including the condition of the plant, its stage of growth, the portion consumed, its species, and the victim's vulnerability, affect the dominant effect.[4] According to the majority of respondents in the study area, animals poisoned by *P. gardeniifolia* do not exhibit any symptoms prior to death, and the presence of plant seeds in the animal's stomach can corroborate the poisoning. Some respondents, however, expressed dissatisfaction over the fact that animals poisoned by the herb displayed symptoms such as diarrhea and bloating. Animals that consume *Sorghum arundinaceum* and *Loudetia flavida* urinate blood, and those that consume Hiddii gaagee go blind. This result is comparable to the reported results of Getahun and Beze[21] in Holeta, as well as the findings of the Borana Zone byAbebe et al.[20]

To include in the conclusion, In the study area, 31 poisonous plants for livestock were identified. Most frequently mentioned were *Pavetta gardeniifolia, Loudetia flavida, Euphorbia tirucalli, Solanum somalense, Eragrostis cilianensis, Sorghum arundinaceum, Acokanthera schimperi, Capparis tomentosa, and Teclea salicifolia*. As part of the recommendation, preventive measures and the use of remedies that are traditionally practiced by livestock owners should be supported. Intervention in the major toxic principles and phytochemistry of the different identified plant species is needed, and Further study on plant dynamics and compatibility with livestock production is required to overcome the impacts of poisonous plants.

Data Sharing Statement

Upon request, the corresponding author can obtain the study's datasets by email at ademkumbe7@gmail.com.

Ethical Statements

The study proposal has been evaluated and accepted by the Oromia Agriculture Research Institute's review committee with Ref.1/2019. The committee approved the verbal informed consent and Pastoralists were verbally told about the study's objectives before it began because they could not write or read, and the only household representative signed the consent form supplied for the survey. A consent form was included in the proposal write-up during the proposal development process. The review committee approved the study after reviewing the consent form (IQQO/2019). The information obtained was kept confidential and was not shared with a third party. We assure that we accept and agree study complies with the Declaration of Helsinki on the publication of the article.

Acknowledgments

The authors thank the Oromia Agriculture Research Institute for supporting this study. Pastoralists are greatly appreciated for providing valuable information during interviews.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, and acquisition of data, analysis and interpretation. In all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Disclosure

The authors report no conflicting interests in this work.

References

1. Mekonnen Y. A survey of plants (potentially) toxic to livestock in Ethiopian flora. *Ethiop J Sci*. 1994;17:9–32.
2. Panter KE, Gardner DR, Lee ST, et al. Important poisonous plants of the United States. *Veterinary Toxicol*. 2007;1:837–889.
3. Hart CR, Carpenter BB. *Toxic range plants*. AgriLife Extension, Texas A and M University System; 2001.
4. Botha CJ, Penrith ML. Poisonous plants of veterinary and human importance in Southern Africa. *J Ethnopharmacol*. 2008;119:549–558. doi:10.1016/j.jep.2008.07.022
5. Holechek JI. Do most livestock losses to poisonous plants result from "poor" range management. *J Range Management*. 2002;55:270–276.
6. Tashale S. *The Ethno-Veterinary Practice of Borana Pastoralists and Their Possible Contribution to Livestock Production and Management*. Debreziet, Ethiopia: National Veterinary Institute (NVI); 2004.
7. Bedane A, Berecha B, Numery A. Survey of Ethno-veterinary Medicines in Borana Zone of Oromia Regional State, Southern Ethiopia. *J Range Management*. 2009;32.
8. BZAO. *Borena Zone Agriculture Office*; 2023.
9. Gurmesa D, Abdeta D. Identification of Poisonous Plants and Their Toxics Effects on Livestock in Horo Buluk District, Horo Guduru Wollega Zone, Oromia Regional State, Western Ethiopia. *Biomedical J Sci Tech Res*. 2019;23(3):17391–17395.
10. Kassa BA, Abdi AT. Factors influencing the adoption of climate-smart agricultural practice by small-scale farming households in Wondo Genet, Southern Ethiopia. *Sage Open*. 2022;12(3):21582440221121604. doi:10.1177/21582440221121604
11. Sisay B, Bayu Y, Kiros A, Wondimu A. Toxic Plants of Livestock in peri-urban kebeles of Woliso and Wonchi towns, South West Shewa Zone of Oromia Regional State, Ethiopia. *East Af J Veterinary Animal Sci*. 2018;2(2):91–98.
12. Fikadu Y, Kebede G. Livestock in and Around Bako District, West Showa Zone of Oromia Regional State, Western Ethiopia. *J Range Management*. 2018.
13. Rook AJ, Dumont B, Isselstein J, et al. Matching type of livestock to desired biodiversity outcomes in pastures – a review. *Biol. Conserv*. 2004;119 (2):137–150. doi:10.1016/j.biocon.2003.11.010
14. Lopez-Ortiz S, Panter KE, Pfister JA, Launchbaugh KL. The effect of body condition on disposition of alkaloids from silvery lupine (Lupinus argenteus Pursh) in sheep. *J Anim Sci*. 2004;82(9):2798–2805. doi:10.2527/2004.8292798x
15. Martinson KB, Hovda L, Murphy M, Weicherding P. *Plants Poisonous or Harmful to Horses in the North Central United States*. University of Minnesota Cooperative Extension Service; 2007.
16. Kebede A, Zenebe T, Abera D, Kebede G. Assessment of poisonous plants to livestock in and around nekemte area, East Wollega Zone of Oromia Regional State, Western Ethiopia. *Nat Sci*. 2015;13(8):8–13.
17. Abera D, Jibat T, Sori T, Feyisa A, Beyene T. Assessment of plant and chemical poisoning in livestock in central Ethiopia. *J Environ Anal Toxicol*. 2014;4(215):2161–2525.
18. Lyons RK, Machen RV Interpreting grazing behavior. L-5385. Texas AgriLife Extension Service. Grazing Management; 2000. Available from: http://animalscience.tamu.edu/files/2012/04/beef-interpreting-grazingbehavior.pdf. Accessed February 8, 2024.
19. Mosavat N, Chamani M. A review: comparison between grazing behavior of cattle and sheep. *Global J Biodiversity Sci Management*. 2013;3 (2):138–140.
20. Abebe A, Eik LO, Holand Ø, Ådnøy T, Tolera A. Pastoralists' perceptions of feed scarcity and livestock poisoning in southern rangelands, Ethiopia. *Trop Anim Health Prod*. 2012;44(1):149–157. doi:10.1007/s11250-011-9902-5
21. Getahun TK, Beze WD. Documentation of Major Poisonous Plant on Livestock in Ethiopia. *J Dis Med Plants*. 2019;5(2):39–44. doi:10.11648/j.jdmp.20190502.13