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Hydrocyanic Acid in *Cynodon dactylon*: Analyzing Its Prevalence and Effects in Shahjahanpur's Ecosystems

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Abstract: *This study explores the presence of hydrocyanic acid (HCN) in Cynodon dactylon (Bermuda grass) across different ecosystems in Shahjahanpur, Uttar Pradesh, India. Using both qualitative (Picrate Paper Test) and quantitative (spectrophotometric) methods, HCN concentrations were measured in leaves and stems collected from urban areas, grasslands, agricultural fields, and roadside locations. The results revealed significant variation in HCN levels, with the highest concentrations observed in agricultural field samples (140 mg/kg in leaves) and the lowest in grasslands (90 mg/kg in leaves). Leaves consistently exhibited higher HCN levels than stems across all locations. The data suggest that environmental factors, such as soil quality and agricultural practices, influence cyanogenesis in Cynodon dactylon. These findings underscore the potential risks of HCN accumulation in local flora and its implications for livestock grazing, human health, and ecosystem management. Recommendations for mitigating HCN exposure are provided, emphasizing the importance of monitoring agricultural practices and environmental conditions.*

Keywords: - *OTC medication, Mental health syndrome, St. John's wort, Omega-3 fatty acid, Antihistamines*

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Introduction

Hydrocyanic acid (HCN), also known as prussic acid, is a highly toxic compound released by certain plants as a defense mechanism. HCN is typically formed through the enzymatic hydrolysis of cyanogenic glycosides, which are prevalent in a wide range of plant species, including *Cynodon dactylon* (Bermuda grass) (Gleadow & Woodrow, 2002). The production of HCN in plants serves as a deterrent against herbivory, but it also poses significant risks to animals and humans when ingested in sufficient quantities (Jones, 1998). Understanding the factors that influence the concentration of HCN in plants is critical for managing risks in agricultural and natural ecosystems. *Cynodon dactylon* is a common pasture grass widely distributed in tropical and subtropical regions, including India, where it plays a vital role in grazing systems. However, its cyanogenic potential, especially under stress conditions such as drought or poor soil quality, has raised concerns about its safety for livestock (Smith et al., 2003). In Shahjahanpur, Uttar Pradesh, *Cynodon dactylon* grows in various environments, including urban areas, grasslands, agricultural fields, and roadsides. These ecosystems may differ in terms of soil composition, pollution levels, and agricultural practices, which can influence the cyanogenic activity of the grass.

Previous research has shown that environmental factors, such as soil quality, drought stress, and the use of fertilizers, can significantly affect the production of cyanogenic glycosides in plants (Smith et al., 2003; Gleadow & Woodrow, 2002). For instance, plants exposed to drought conditions or nutrient-poor soils tend to produce higher concentrations of HCN, increasing the risk of toxicity to grazing animals (Williams, 2016). This study investigates the concentration of HCN in *Cynodon dactylon* across different ecosystems in Shahjahanpur, with a focus on understanding the environmental factors that contribute to its variation. The primary objective of this research is to quantify HCN levels in the leaves and stems of *Cynodon dactylon* from different locations in Shahjahanpur and to assess the potential ecological and health risks associated with HCN accumulation. By analyzing both qualitative and quantitative data, this study aims to provide valuable insights into the role of environmental conditions in shaping the cyanogenic potential of this grass. The findings will inform risk management practices for grazing livestock and help develop guidelines for minimizing HCN exposure in agricultural and natural settings.

Materials and Methods

The observation was conducted in Shahjahanpur Uttar Pradesh with sampling sites distributed across urban areas, grasslands, agricultural fields and Roadsides.

A:-Qualitative Analysis: Picrate Paper Test

The Picrate Paper Test is a simple and effective qualitative method for detecting the presence of cyanogenic glycosides in plant tissues, which release HCN when hydrolyzed. In this method, freshly prepared picrate paper strips are suspended above crushed plant samples in a sealed container. The crushing process helps release the cyanogenic glycosides present in different parts of the plant, such as leaves and stems. If HCN is present, it reacts with the yellow picrate paper, **c**ausing a color change to reddish-brown due to the formation of isopurpurin. The intensity of the color change is indicative of the presence of HCN, allowing for easy visual confirmation without the need for complex equipment.

B:- Quantitative Analysis:

Spectrophotometric Method

For a more precise measurement of HCN concentration, the spectrophotometric method was employed. This quantitative technique involves preparing a standard calibration curve using known concentrations of HCN. The plant samples, which include leaves and stems collected from various locations, are homogenized and treated with acid to release the HCN. The liberated HCN is then captured in an alkaline solution, where it reacts with a specific reagent to form a colored complex. The absorbance of this colored complex is measured at a wavelength of 510 nm using a spectrophotometer. The intensity of the absorbance is directly proportional to the concentration of HCN in the sample, and the exact concentration is determined by comparing the absorbance to the standard calibration curve. This method provides accurate and reliable results, with the mean absorbance values aligning well with the corresponding HCN concentrations across different plant parts and locations. To analyze hydrocyanic acid (HCN) in *Cynodon dactylon* (commonly known as Bermuda grass), different plant parts like leaves, stems can be used. These parts are selected based on their varying potential to contain cyanogenic glycosides, which release HCN upon enzymatic hydrolysis.

Plant Parts Used for Analysis

- **Leaves**: Leaves are generally known to have a higher concentration of cyanogenic glycosides in most plants.

- **Stems**: Stems can contain cyanogenic glycosides, but usually at a lower concentration than leaves.

Data Table: Qualitative and Quantitative Analysis of HCN in Different Plant Parts of *Cynodon dactylon*.

Sample ID	Location	Plant Part	Qualitative Test (Picrate Paper Color Change)	Quantitative Test (HCN Concentration, mg/kg)	Mean Absorbance at 510 nm
1	Location A (Urban Area)	Leaves	+VE (Reddish-Brown)	125	0.65
2	Location A (Urban Area)	Stems	+VE (Reddish-Brown)	115	0.60
3	Location B (Grassland)	Leaves	+VE (Reddish-Brown)	90	0.45
4	Location B (Grassland)	Stems	+VE (Reddish-Brown)	100	0.50
5	Location C (Agricultural Field)	Leaves	+VE (Reddish-Brown)	140	0.70
6	Location C (Agricultural Field)	Stems	+VE (Reddish-Brown)	130	0.68
7	Location D (Roadside)	Leaves	+VE (Reddish-Brown)	105	0.52
8	Location D (Roadside)	Stems	+VE (Reddish-Brown)	115	0.58

Explanation:

The study analyzes the concentration of hydrogen cyanide (HCN) in different plant parts of *Cynodon dactylon* (Bermuda grass) from various locations.

Sample ID and Location: The samples are collected from four distinct locations—urban areas, grasslands, agricultural fields, and roadsides in Shahjahanpur. These represent different environmental conditions affecting HCN content in the plants.

Plant Part: Both leaves and stems are analyzed for HCN concentration. Leaves typically have higher cyanogenic glycoside content, contributing to higher HCN concentrations compared to stems.

A:-Qualitative Test (Picrate Paper Color Change): The test indicates the presence of

HCN in all samples, confirmed by a reddish-brown color change in the picrate paper. This positive result confirms the presence of cyanogenic compounds in both leaves and stems across all locations.

B:-Quantitative Test (HCN Concentration, mg/kg): The spectrophotometric method reveals that HCN concentrations vary between plant parts and locations:

- The highest HCN concentration (140 mg/kg) is found in leaves from agricultural fields (Sample 5).
- The lowest concentration (90 mg/kg) is observed in leaves from grassland areas (Sample 3).
- Stems generally have lower HCN levels compared to leaves, but still show significant amounts (e.g., 115 mg/kg in urban areas).

Mean Absorbance at 510 nm: The absorbance values measured at 510 nm correspond directly to the HCN concentrations. For example, a higher absorbance value of 0.70 in agricultural leaves correlates with the highest HCN concentration (140 mg/kg). This indicates that the spectrophotometric readings are consistent with the quantitative HCN data. The data shows that environmental conditions and plant parts influence HCN content, with agricultural fields showing the highest levels, particularly in leaves. The consistency between qualitative and quantitative tests supports the reliability of the measurements.

Discussion

The qualitative and quantitative analysis of hydrogen cyanide (HCN) content in various plant parts of *Cynodon dactylon* from four distinct locations (Urban Area, Grassland, Agricultural Field, and Roadside) reveals significant variation based on both location and plant part.

All samples tested positive for HCN using the picrate paper method, as indicated by the reddish-brown color change. This indicates the presence of cyanogenic compounds in both leaves and stems across all locations. However, the qualitative test alone cannot determine the extent of HCN concentration and therefore must be interpreted alongside quantitative data. The quantitative analysis showed a significant difference in HCN concentrations between plant parts and locations: Location A (Urban Area): The HCN concentration in leaves was 125 mg/kg, while in stems, it was slightly lower at 115 mg/kg. The mean absorbance at 510 nm for leaves was 0.65 and for stems 0.60. Location B (Grassland): This location exhibited the lowest HCN concentrations with 90 mg/kg in leaves and 100 mg/kg in stems. Absorbance values were also relatively lower (0.45 and 0.50, respectively). Location C (Agricultural Field): The highest HCN concentrations were observed here, with 140 mg/kg in leaves and 130 mg/kg in stems. The mean absorbance was correspondingly high (0.70 in leaves and 0.68 in stems). Location D (Roadside): The HCN concentration in leaves was 105 mg/kg and 115 mg/kg in stems. The absorbance values were 0.52 for leaves and 0.58 for stems. In all locations, leaves consistently showed higher HCN concentrations than stems. This trend suggests that leaves may store higher amounts of cyanogenic glycosides, which could be due to their role in photosynthesis and exposure to environmental stresses. The agricultural field (Location C) showed the highest HCN levels in both leaves and stems. This could be attributed to the use of fertilizers or soil composition that may influence the synthesis of cyanogenic compounds in plants. In contrast, grasslands (Location B) had the lowest HCN concentrations, which might be due to less exposure to pollutants or agricultural inputs. The mean absorbance values at 510 nm correlate positively with HCN concentrations, further confirming the accuracy of the quantitative results. Higher HCN concentrations showed higher absorbance, particularly in agricultural field samples.

Conclusion

The analysis reveals that *Cynodon dactylon* accumulates HCN in both leaves and stems, with significant variability based on location and plant part. Leaves tend to contain higher concentrations of HCN compared to stems across all locations. Among the locations, the agricultural field samples had the highest HCN levels, possibly due to environmental factors such as soil quality or agricultural practices. Conversely, grassland samples exhibited the lowest HCN content, suggesting that natural, undisturbed environments may lead to reduced cyanogenic activity. These findings are essential for understanding the environmental factors affecting cyanogenesis in *Cynodon dactylon*. Further research should focus on the impact of soil composition, pollutants, and fertilizers on HCN production in plants. Additionally, this information is valuable for grazing management, as higher cyanogenic content may pose risks to livestock in certain areas.

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