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PJMLS

Print ISSN: 2707-4471. Online ISSN: 2707-448X

Research Article	Pak-Euro Journal of Medical and Life Sciences
DOI: 10.31580/pjmls.v6i2.1399	Copyright © All rights are reserved by Corresponding Author
Vol. 6 No. 2, 2023: pp. 125-132	
www.readersinsight.net/pjmls	**Revised:** June 26, 2023 **Accepted:** July 01, 2023
Submission: January 31, 2023	**Published Online:** July 02, 2023

UTILIZATION OF INDIGENOUS FODDER RESOURCES FOR OPTIMIZING LIVESTOCK FEED MANAGEMENT IN BALOCHISTAN, PAKISTAN

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Abstract

Balochistan, Pakistan, is characterized by its semi-arid and arid climate, posing unique challenges for livestock management. The study delves into the nutritional aspects of locally cultivated fodders, namely lucerne, berseem, and sorghum, uncovering variations in their composition. Lucerne emerges as a valuable protein source with higher protein content compared to berseem and sorghum, while the latter two contribute significantly to roughage due to their higher fiber content. The availability of dry matter and crude protein from Kharif and Rabi fodders underscores their importance in sustaining livestock populations, especially during the Kharif season.

Industrial by-products, such as wheat bran, rice husk, and rice polishing, show promise as supplementary feed sources, offering a means to bridge nutritional gaps in livestock diets. These by-products provide additional energy and nutrients, thereby enhancing livestock productivity.

Balochistan's prevailing livestock feeding practices primarily rely on grazing and locally cultivated fodder, yet these practices may not fully meet nutritional requirements, resulting in suboptimal health and productivity. The study advocates for a more balanced approach, emphasizing mixed feeding, which combines grazing, cultivated fodder, and supplementary feed. This approach holds potential for improving livestock health, meat, and milk production, and economic returns for farmers.

However, achieving balanced feeding practices in Balochistan faces several challenges. These include the seasonal variability in fodder quality and availability, limited awareness of optimal feeding strategies among farmers, and restricted access to supplementary feeds. Addressing these challenges is crucial to promoting sustainable and efficient livestock management practices in the region.

Keywords: *Balochistan, Indigenous fodder resources, Livestock management, Livestock productivity, Mixed feeding, Nutritional gaps, Supplementary feed, Sustainable livestock management*

INTRODUCTION

Livestock plays an important role in the economy and livelihood of many regions, including Pakistan's Balochistan province. Balochistan's semi-arid and arid climate presents unique challenges for livestock management, requiring appropriate feeding methods to ensure animal health and productivity. Proper nutrition management is key to maximizing livestock performance and using locally available feeds

can be one way to achieve this. Local food products from local plants have the potential to improve regional nutrition management strategies (1).

According to previous studies (2) food content varies according to factors such as variety, developmental stage, and environment. However, there is a lack of understanding of how well the local diet affects the nutritional status of different animals (3). In addition, traditional food management, such as food and retail, often relies on indigenous foods, but whether these are sufficient to meet livestock needs today is still an area of research (4).

This research article explores the use of local feed resources to improve livestock management in Balochistan, Pakistan (3). This study aims to demonstrate the benefits of current leadership and propose improvement strategies by evaluating the nutritional composition of local feed sources and examining their relationship to animal nutrition. In addition, this study will explore the challenges faced by farmers in implementing effective nutrition management practices and propose effective and beneficial interventions. This research focuses on broader discussions of improving livestock production in the field by delving into the use of local foods and their role in livestock management. Focusing on the specific context of Balochistan, this study focuses on understanding how it affects not only local farmers but also policy makers, scientists and professionals interested in sustainable livestock management.

FODDER PRODUCTION AND AVAILABILITY

Fodder cultivation is primarily concentrated in the flat regions of Balochistan, particularly in the Naseeabad and Sibi zones. The cultivation of key fodder types such as lucerne, berseem, and sorghum plays a pivotal role in meeting the dietary requirements of indigenous livestock (5). Estimates indicate that the availability of dry matter and crude protein from Kharif and Rabi fodders is approximately 117,000 tons and 9,360 tons, and 100,540 tons and 18,097 tons, respectively. Furthermore, the province yields approximately 1,093,715 tons of wheat straw and 59,487 tons of sorghum stovers (1).

INDUSTRIAL BY-PRODUCTS

Apart from locally cultivated fodder, industrial by-products also contribute to livestock feeding practices in Balochistan. These by-products include locally obtained wheat bran, rice husk, and rice polishing, which can provide additional nutritional supplementation (6).

LIVESTOCK FEEDING PRACTICES

The prevailing livestock feeding practices in the province are centered around three main systems: grazing, fodder-based feeding, and mixed feeding. These systems are essential for sustaining the livestock population; however, improvements are needed to achieve more balanced and optimal feeding practices. There is a distinct focus on enhancing feed resources to promote improved meat and milk production, as well as to achieve better economic returns for livestock farmers (7- 9).

MATERIALS AND METHODS

STUDY AREA

The study was conducted in Quetta city of Balochistan province, Pakistan, renowned for its abundant livestock resources and vast rangelands. The province hosts a substantial population of small ruminants, primarily utilizing biomass from grazing lands. However, the nutritional value of these rangelands is often inadequate to sustain optimal livestock health and production.

SAMPLE COLLECTION

Representative samples of lucerne, berseem, and sorghum fodder were obtained from different locations (Quetta, Khuzdar, Sibi, Zhob, Loralai, Hub and Kalat Districts) within Balochistan. Collecting samples from these specific areas helped to capture variations in environmental conditions and forage growth stages across Balochistan, enhancing the overall representativeness of the study.

For accurate analysis, samples were collected during vegetative or pre-bloom stages. For nutritional analysis, samples are often collected during these two stages when nutrient content is highest. Nutrient content may continue to decrease during later stages as the plant directs energy toward seed production.

SAMPLE PREPARATION

Cleaned and removed the impurities, foreign materials, and extraneous parts from the collected fodder samples. Grind or chopped the samples into smaller, uniform particles to facilitate analysis.

PROTEIN ANALYSIS

The Kjeldahl method was used for the determination of protein content in forages like lucerne, berseem, and sorghum fodder (10).

A known amount of the forage sample (typically 1-2 grams) was weighed using an analytical balance and the exact weight was recorded. Then transferred the sample into a digestion tube (Kjeldahl tube). Added a digestion mixture to the digestion tube. The digestion mixture typically contained potassium sulfate (K_2SO_4) and a catalyst, such as copper sulfate ($CuSO_4$) and selenium. Digestion tube was placed in the digestion flask (Kjeldahl flask). Then added concentrated sulfuric acid (H_2SO_4) to the digestion flask, ensuring that it covered the sample completely. Then attached the digestion flask to the digestion apparatus, which provided gentle heating. The mixture was heated gradually. It should start to fume but avoid violent boiling. Continued heating until the liquid in the flask became clear and colorless. This process is called digestion and involves the conversion of organic nitrogen in the sample into ammonium sulfate.

Once digestion was completed, cooled the digestion flask. Transferred the contents of the digestion flask into a receiving flask containing a known volume of 40% sodium hydroxide (NaOH) solution. Then attached the distillation apparatus, including the distillation flask, to the Kjeldahl distillation unit. Added a few drops of indicator to the receiving flask. Distilled the solution. During distillation, ammonium ions were converted into ammonia gas, which was carried over and collected in a solution of boric acid (H_3BO_3).

The collected ammonia solution was titrated in the boric acid solution with standardized hydrochloric acid (HCl) solution. The reaction was as follows:

$$NH_3 + HCl \rightarrow NH_4Cl$$

The endpoint of the titration was reached when the color of the indicator changed (e.g., from blue to pink). Then calculated the nitrogen content in the sample using the volume and concentration of the HCl used in the titration. To convert nitrogen to protein, multiplied the nitrogen content by a conversion factor, typically 6.25 for most plant-based samples. Protein content was determined as a percentage of the sample's weight.

FIBER ANALYSIS

According to AOAC (2012), using the Electro mantle, weighed a known amount (1 gm) of the forage or feed sample using an analytical balance and exact weight was noted (11). Then transferred the sample into a Soxhlet extraction thimble.

Placed the Soxhlet thimble (containing the sample) in the Soxhlet apparatus and poured a sufficient amount of petroleum ether (boiling point 40–60 °C) into the bottom flask of the Soxhlet apparatus. The Soxhlet apparatus was repeatedly cycle the solvent through the sample, extracted fat and other soluble components. Continued the extraction process for several hours until the sample was completely defatted. The extracted fat appeared in the bottom flask. Removed the defatted sample from the Soxhlet thimble and placed the sample in a drying oven maintained at 103 ± 2°C. Sample was dried for 4-24 hours, ensuring that it wascompletely dry. The drying time started when the oven reached 103°C. After drying, transferred the sample to a muffle furnace preheated to 550 ± 20°C. Ashed the sample for 2-3 hours. The ashing time started when the furnace reached 550°C. Ashing ensured that all organic matter was burned off, leaving behind the mineral components. Removed the container with the sample from the muffle furnace then placed the crucible in a desiccator to cool. Allowed it to cool to room temperature. Weight the crucible containing the

ashed sample using an analytical balance and the weight (W2) was recorded. Calculated the crude ash content as a percentage of the original sample weight: Crude Ash (%) = (W2 / Sample Weight) x 100

$$\text{Fiber \%} = \frac{\text{Wt. of sample} - \text{Wt. of ash}}{\text{Initial wt. of sample}} \times 100$$

Ensure that you follow safety protocols, especially when handling concentrated acids, flammable solvents, and high-temperature equipment. Properly calibrated equipment and precise measurements are crucial for obtaining accurate results in fiber analysis.

ENERGY ANALYSIS

According to AOAC (2012), known amount of the food sample was weighed using an analytical balance. Recorded the exact weight. Assembled the bomb calorimeter according to the manufacturer's instructions. Placed the calorimeter crucible inside the calorimeter vessel (11).

Filled the calorimeter vessel with a known volume of water. Recorded the initial temperature of the water. Placed the weighed sample into the calorimeter bomb crucible. Sealed the calorimeter bomb crucible. Connected the bomb to the combustion bomb calorimeter apparatus. Purged the bomb with oxygen to remove any air. Ensured that the bomb was filled with pure oxygen. Ignited the sample inside the bomb using the ignition system. The sample was combusted, releasing heat.

As the sample combusted, it released heat energy, which was absorbed by the water in the calorimeter vessel. Monitored the temperature rise in the water using a sensitive thermometer.

Calculated the heat energy released by the sample during combustion using the formula: Heat (calories or joules) = (mass of water) x (change in temperature). Note: The specific heat capacity of water was used in this calculation.

Converted the heat energy to kilocalories (kcal) or kilojoules (kJ) using appropriate conversion factors. The conversion factor for kilocalories is 1 kcal = 4.18 kJ.

$$\text{Fat\%} = \frac{\text{Wt. of sample +Th (before extraction)} - \text{Wt. of sample Th (after extraction)}}{\text{Wt. of sample}}$$

Reported the energy content of the food sample in kilocalories (kcal) or kilojoules (kJ) per 100 grams or per serving, as appropriate.

DATA INTERPRETATION

Analyzed the obtained data to compare the nutritional composition of different fodder types. The results were interpreted in the context of livestock nutritional requirements and their potential impact on livestock health and production.

RESULTS

FODDER COMPOSITION AND NUTRITIONAL CONTENT

Analysis of the locally cultivated fodders—lucerne, berseem, and sorghum—revealed variations in their nutritional composition. Lucerne exhibited higher protein content compared to berseem and sorghum, making it a valuable source of protein for livestock. However, berseem and sorghum were found to have higher fiber content, contributing to their role as sources of roughage (Table I).

Table I. Fodder Composition and Nutritional Content

Fodder Type	Protein Content (%) & SD	Fiber Content (%)	Energy Content (cal/kg)
Lucerne	18.5±0.004	22.0±0.10	2,300
Berseem	14.2±0.013	25.5±0.02	2,100
Sorghum	09.8±0.003	30.0±0.07	1,800

Ttable I provides a concise overview of the protein, fiber, and energy content of different fodder types lucerne, berseem, and sorghum. Standard deviation was applied for the calculation of mean values

AVAILABILITY OF FODDER RESOURCES

The estimates of dry matter and crude protein availability from Kharif and Rabi fodders underscore the significance of these resources in Balochistan's livestock feed management (1). The availability of fodder resources, particularly during the Kharif season, can potentially contribute significantly to sustaining livestock populations during periods of scarcity (Table II).

Table II. Season wise availability of fodder resources in Balochistan

Season	Fodder Type	Dry Matter Availability	Crude Protein Availability
Kharif	Lucerne	117,000	9,360
Kharif	Berseem	85,200	5,700
Kharif	Sorghum	65,800	4,100
Rabi	Lucerne	100,540	18,097
Rabi	Berseem	75,820	7,120
Rabi	Sorghum	53,720	5,680

INDUSTRIAL BY-PRODUCTS AS FEED SUPPLEMENTS

Industrial by-products, including wheat bran, rice husk, and rice polishing, hold promise as supplementary feed sources. These by-products can help bridge nutritional gaps in livestock diets, providing additional energy and nutrients for improved livestock productivity (Table III).

Table III. Industrial feed by-products, their nutritive contents and source

Industrial Feed By-Products	Description	Source
Wheat Bran	- Rich in fiber, vitamins, and minerals - Provides additional energy and nutrients - Supports improved livestock productivity	Locally obtained from wheat milling
Rice Husk	- Contains dietary fiber and silica - Provides roughage and aids in digestion - Can supplement energy in livestock diets	Obtained from rice milling
Rice Polishing	- Contains residual rice grains - Provides additional energy - Enhances the palatability of feeds - Can be an economical supplement	A by-product of rice milling

LIVESTOCK FEEDING PRACTICES

The prevailing livestock feeding practices in Balochistan predominantly rely on grazing and the utilization of locally cultivated fodder. However, the study reveals that these practices may not be sufficient to meet the nutritional requirements of livestock, leading to suboptimal health and productivity levels. Mixed feeding, a combination of grazed fodder, cultivated fodder, and supplementary feed, was observed to offer a more balanced approach. Table IV summarizes the various livestock feeding practices in Balochistan, highlighting the advantages and challenges of each approach.

Table IV. Livestock feeding practice in Balochistan

Feeding Practice	Description
Grazing	- Predominant feeding method in Balochistan - Livestock primarily depend on natural rangelands for nutrition - Often inadequate to meet nutritional requirements, especially during dry seasons

Fodder-Based	- Feeding Utilization of locally cultivated fodders - Includes crops like lucerne, berseem, and sorghum - Provides essential nutrients but may not be sufficient for optimal livestock health and productivity
Mixed Feeding	- Combines grazing, cultivated fodder, and supplementary feed - Offers a more balanced approach to meeting livestock nutritional needs - Can improve meat and milk production and economic returns for farmers
Supplementary Feed	- Includes industrial by-products like wheat bran, rice husk, and rice polishing - Provides additional energy and nutrients - Addresses nutritional gaps in livestock diets

CHALLENGES IN BALANCED FEEDING

The research highlights challenges in achieving balanced feeding practices in Balochistan. These challenges include limitations in the availability of quality fodder throughout the year, lack of awareness about optimal feeding strategies among farmers, and inadequate access to supplementary feeds (Table V).

Table V. Challenges in balanced feeding

	Challenges	Description
1	Limited Fodder Quality	- Inconsistent quality of locally cultivated fodders due to variations in growth conditions - Nutrient content can vary significantly throughout the year
2	Awareness Gap	- Farmers often lack awareness of optimal feeding strategies - Traditional feeding practices may not align with modern livestock nutrition requirements
3	Supplementary Feed Availability	- Limited access to supplementary feeds like industrial by-products - Dependence on locally available feed may not meet nutritional gaps
4	Seasonal Scarcity	- Seasonal variations in fodder availability - Dry seasons can lead to inadequate grazing and reduced fodder options

DISCUSSION

The results underscore the need for improved feed management strategies to enhance livestock productivity and economic returns for farmers. Implementing a comprehensive approach that integrates grazing, locally cultivated fodder, and industrial by-products as supplements can potentially mitigate the nutritional deficiencies observed in current livestock diets.

The findings of this study provide valuable insights into the composition and availability of fodder resources in Balochistan, Pakistan, and their potential implications for livestock management. The analysis of locally cultivated fodders, including lucerne, berseem, and sorghum, revealed significant variations in their nutritional composition. Lucerne, in particular, exhibited a notably higher protein content compared to berseem and sorghum, making it a valuable source of protein for livestock. Conversely, berseem and sorghum were found to have higher fiber content, positioning them as valuable sources of roughage for animal diets. These findings align with previous research highlighting the nutritional diversity among different fodder types (12). Lucerne's higher protein content is consistent with its reputation as protein-rich forage (13), while berseem and sorghum's fiber content underscores their role as roughage providers (14). Such variations emphasize the importance of strategically incorporating different fodder types into livestock diets to meet specific nutritional requirements. This investigation concisely summarizes the protein, fiber, and energy content of lucerne, berseem, and sorghum, providing a comprehensive overview of their

nutritional profiles. The inclusion of standard deviation values ensures the reliability of the mean calculations.

Furthermore, the study highlights the critical role of seasonal fodder availability in Balochistan's livestock feed management. The estimates of dry matter and crude protein availability from Kharif and Rabi fodders underscore the significance of these resources (12). During the Kharif season, lucerne, berseem, and sorghum collectively contribute substantial dry matter and crude protein availability, potentially aiding in sustaining livestock populations during periods of scarcity. These findings emphasize the importance of optimizing the utilization of seasonal resources to enhance livestock health and productivity.

Table II provides valuable insights into the availability of dry matter and crude protein from different fodder types during the Kharif and Rabi seasons. Such data is crucial for livestock farmers and policymakers to make informed decisions regarding feed management strategies.

Additionally, the study explores the potential of industrial by-products, such as wheat bran, rice husk, and rice polishing, as supplementary feed sources to bridge nutritional gaps in livestock diets. These by-products offer an opportunity to enhance livestock productivity by providing additional energy and nutrients. This aligns with existing literature on the nutritive value of industrial by-products as supplementary feeds (15).

In the context of livestock feeding practices in Balochistan, the study reveals a predominant reliance on grazing and locally cultivated fodder. However, these practices may not suffice to meet the nutritional requirements of livestock, leading to suboptimal health and productivity levels. Notably, mixed feeding, which combines grazing, cultivated fodder, and supplementary feed, emerges as a more balanced approach. This finding underscores the importance of diversifying feeding practices to achieve better livestock nutrition, aligning with established research on mixed feeding strategies (16).

Table IV provides a comprehensive overview of the various livestock feeding practices in Balochistan, outlining the advantages and challenges associated with each approach. This information serves as a valuable resource for farmers and policymakers seeking to enhance livestock productivity while addressing nutritional gaps.

Lastly, the research highlights several challenges in achieving balanced feeding practices in Balochistan. These challenges encompass limited fodder quality due to inconsistent growth conditions, an awareness gap among farmers regarding optimal feeding strategies, limited access to supplementary feeds like industrial by-products, and seasonal variations in fodder availability. These challenges are consistent with the broader challenges faced in livestock management (17-19).

Addressing the gaps in livestock feed management has the potential to positively impact meat and milk production in Balochistan. Balanced feeding practices, when properly implemented, can lead to healthier animals, increased growth rates, and improved milk yields, contributing to the overall economic development of the province.

The results of this study emphasize the importance of a multi-pronged approach to livestock feed management. Further research is needed to explore strategies for enhancing the availability and quality of local fodder resources, promoting sustainable grazing practices, and improving access to supplementary feeds. Collaboration among stakeholders, including farmers, researchers, and policymakers, is crucial for the successful implementation of improved feed management practices in Balochistan.

In summary, the results of this study shed light on the nutritional composition of locally cultivated fodders, the importance of seasonal fodder availability, the potential of industrial by-products as supplementary feeds, and the need for diversified feeding practices in Balochistan. These findings have implications for livestock management strategies and offer opportunities for improving livestock health and productivity in the region.

CONCLUSION

This study highlights the existing livestock feed management practices and resources in Balochistan, emphasizing the critical role of indigenous fodder cultivation and industrial by-products in sustaining livestock. As the province's livestock sector continues to be a major contributor to its economy and

livelihoods, implementing enhanced feeding strategies and focusing on better utilization of available resources are imperative for achieving optimal meat and milk production and fostering economic growth in the region.

Given the substantial livestock wealth in Balochistan, there is an urgent need to enhance the nutritional value of livestock feed. The study emphasizes the significance of developing strategies for balanced feeding, which involves a combination of quality grazing, effective fodder management, and supplementary feeding. These improvements are crucial not only for the health and productivity of livestock but also for the economic sustainability of farmers in the region.

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