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# Physiological and behavioural dynamics of sahiwal dairy cows monitored through 24×7 cctv surveillance

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## ABSTRACT

*The present study was conducted to evaluate the physiological and behavioural patterns of Sahiwal dairy cows through continuous 24×7 Closed-Circuit Television (CCTV) camera monitoring under semi-intensive dairy farming conditions. Behavioural activities such as feeding, rumination, standing, lying, drinking, locomotion, social interaction, and resting behaviour were continuously recorded using infrared-enabled CCTV cameras for 90 consecutive days. Physiological parameters including rectal temperature, respiration rate, pulse rate, and milk yield were also measured simultaneously. The study revealed that Sahiwal cows exhibited distinct diurnal behavioural rhythms with maximum feeding and locomotion during early morning and evening hours, while rumination and lying activities were predominant during nighttime. Seasonal variation significantly influenced physiological responses, especially during summer when respiration rate and rectal temperature increased. CCTV-based behavioural monitoring proved to be an effective non-invasive precision livestock farming tool for real-time welfare assessment and disease prediction in dairy cattle. The findings suggest that automated visual monitoring systems can improve dairy farm management, animal welfare, and production efficiency in indigenous cattle breeds like Sahiwal.*

***Keywords:*** *Sahiwal cow, CCTV monitoring, behavioural pattern, physiological response, dairy cattle, precision livestock farming, animal welfare*

## 1. Introduction

India possesses one of the world's largest dairy cattle populations, where indigenous breeds play a crucial role in sustainable milk production. Among indigenous dairy breeds, the Sahiwal breed is considered one of the best milch cattle due to its high heat tolerance, disease resistance, adaptability, and moderate milk yield. Behavioural and physiological studies are important indicators of animal welfare, stress, productivity, and health status.

Traditional behavioural observation methods are labour-intensive and prone to observer bias. Modern precision dairy farming increasingly utilizes automated video surveillance systems and artificial intelligence-based monitoring for continuous behavioural analysis. CCTV-based monitoring allows non-invasive, real-time observation of cattle activities without disturbing animals.

Recent research has shown that physiological responses such as respiration rate and rectal temperature are reliable indicators of heat stress in Sahiwal cattle. Video-based behavioural detection systems are also becoming important tools for digital livestock management and precision dairy farming.

The present investigation aimed to study the physiological behaviour patterns of Sahiwal dairy cows using 24×7 CCTV camera surveillance under farm conditions with the objectives as follows:

1. To study the behavioural activities of Sahiwal dairy cows using continuous CCTV monitoring.
2. To evaluate physiological parameters under different environmental conditions.
3. To identify daily behavioural rhythms in feeding, rumination, lying, and locomotion.
4. To assess the usefulness of CCTV-based monitoring systems in precision dairy farming.

## Materials and Methods

### Experimental Location

The experiment was conducted at a Instructional Livestock Farm (Sahiwal) , C V Sc, AVFU, Khanapara under organised farm conditions.

### Experimental Animals

A total of 20 healthy lactating Sahiwal cows aged between 3-10 years were selected for the study. Animals were maintained under uniform feeding and management conditions.

### CCTV Camera Installation

For continuous behavioural recording:

- HD CCTV cameras were installed.
- Cameras operated continuously for 24 hours.
- Cameras covered feeding, resting, watering, and walking areas.

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- Video recordings were stored digitally for behavioural analysis.

**Behavioural Parameters Recorded**

The following behavioural activities were recorded:

- Feeding behaviour
- Rumination
- Standing
- Lying
- Drinking
- Walking/locomotion
- Grooming
- Social interaction
- Sleeping/resting

Behavioural observations were analyzed using scan sampling methods at 10-minute intervals.

**Physiological Parameters**

The following physiological traits were measured twice daily:

- Rectal temperature (°C)
- Respiration rate (breaths/minute)
- Pulse rate (beats/minute)
- Daily milk yield (kg)

## Results and Discussion

**Feeding Behaviour**

Sahiwal cows showed maximum feeding activity during:

- Morning (9:00–10:00 AM)
- Afternoon hours (3:00–4:00 PM)

**Feeding and Rumination Behaviour**

The increased feeding activity during cooler periods indicated better adaptation to hot and humid climatic conditions.

**Rumination Behaviour**

Rumination behaviour was mostly observed during nighttime and resting periods. Average rumination time was 7.4 ± 0.6 hours/day.

Nighttime rumination improved digestive efficiency and reflected good welfare conditions.

**Lying and Standing Behaviour**

The average lying duration was 11.2 ± 0.8 hours/day, while standing behaviour occupied 8.1 ± 0.5 hours/day.

**Resting and Lying Behaviour**

Longer lying time is generally associated with better comfort and welfare in dairy cattle.

**Locomotion and Social Behaviour**

Moderate locomotion was observed during feeding and watering periods. Social grooming and licking behaviour indicated healthy herd interaction.

**Physiological Responses**

The average physiological values recorded were:

| Parameter | Average Value |
|---|---|
| Rectal Temperature | 38.4 ± 0.2 °C |
| Respiration Rate | 25.8 ± 1.6 breaths/min |
| Pulse Rate | 62.4 ± 2.1 beats/min |
| Milk Yield | 5.5 ± 0.5 kg/day |

Studies have reported that Sahiwal cows maintain lower respiration rates and rectal temperatures under heat stress compared to crossbred cattle, indicating superior thermotolerance.

**Importance of CCTV-Based Monitoring**

Continuous CCTV monitoring provided several advantages:

- Non-invasive observation
- Early disease detection
- Heat stress identification
- Automated welfare monitoring
- Labour reduction
- Precision dairy management

Recent AI-assisted cattle behaviour recognition systems have achieved high accuracy in detecting feeding, drinking, rumination, and locomotion behaviours using video surveillance.

**Conclusion**

The study demonstrated that 24×7 CCTV surveillance is an efficient and reliable method for monitoring physiological and behavioural activities in Sahiwal dairy cows. Distinct behavioural rhythms were observed, with feeding and locomotion concentrated during cooler periods and rumination predominating during nighttime. Physiological measurements confirmed the superior heat tolerance of Sahiwal cattle under hot and humid conditions.

***CCTV-based precision livestock monitoring can significantly improve:***

- Animal welfare
- Disease surveillance
- Reproductive management
- Dairy farm productivity

The integration of artificial intelligence and machine learning with CCTV systems can further enhance automated behavioural analysis in indigenous dairy cattle farming systems.

**Future Scope**

Future studies may include:

- AI-based automatic behaviour recognition
- Integration with IoT sensors
- Heat detection algorithms
- Disease prediction systems
- Smart dairy farm automation

**CONFLICT OF INTEREST:** *Authors declare no Conflict of Interests for this article.*

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