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POPULAR SCIENCE ARTICLE

Effect of lunar cycle on estrous cycle and fertility of ruminants: a review based on verifiable evidence

A. Thangamani[1*], B. Vigneshwaran[1], A. Sabarinathan[2], V. Prabaharan[1] and A. Elango[3]

[1]Dept. of Veterinary Gynaecology and Obstetrics, Tamil Nadu Veterinary and Animal Sciences University, Tamil Nadu, India

[2]Veterinary Clinical Complex, Tamil Nadu Veterinary and Animal Sciences University, Tamil Nadu, India

[3]Veterinary College and Research institute, Tamil Nadu Veterinary and Animal Sciences University, Tamil Nadu, India

*Email: thangamtamil19@gmail.com

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ABSTRACT

The lunar cycle of 29.5 days with eight phases from new moon to full moon causes periodic changes in moonlight intensity and earth magnetic field influencing melatonin secretion from pineal gland. Melatonin found in granulosa cells, ovaries and placenta acts as transducer linking lunar rhythm to reproduction in cattle, sheep and goat. Real evidence shows bimodal clustering of calvings, estrus and AI around new and full moon in cattle with higher conception during waning and third quarter, higher fertility around new moon in sheep and early puberty in goats born on full moon. In Indian crossbreds, lunar days cause false estrus with smaller follicles, hence Veterinarian confirmation before AI is essential.

Keywords: Lunar cycle, Estrous cycle, Ruminants, Melatonin, False estrus

Introduction

Reproduction in domestic animals is controlled by internal rhythms and external environmental cues called Zeitgebers. Photoperiod, temperature, humidity and nutrition are major Zeitgebers. Lunar cycle of 29.5 days has been considered since ancient times as a possible synchronizer because it is close to estrous cycle length. Moon does not produce its own light; it reflects sunlight and shows eight phases from new moon to full moon. Recent studies from good quality journals have shown moonlight intensity, magnetic fields, tides and gravitational changes influence biological functions (Andreatta and Tessmar-Raible, 2020).

Lunar cycle

The lunar cycle is the orbit of moon around earth lasting about 29.5 days. It shows eight phases - new moon, waxing crescent, first quarter, waxing gibbous, full moon, waning gibbous, third quarter and waning crescent. New moon is darkest and full moon is brightest. Each waxing/waning phase lasts about one week and new moon, first quarter, full moon, third quarter lasts about one day. This cycle causes changes in moonlight intensity and earth magnetic field (Andreatta and Tessmar-Raible, 2020; Bevington, 2015).

Melatonin

Melatonin is known as sleep hormone but it also influences reproduction (Li *et al.*, 2023). It was first discovered in frog melanocytes where it lightens skin colour (Lerner *et al.*, 1958). In animals it is produced in pineal gland and is also found in reproductive tissues like granulosa cells, ovaries, placenta, oocytes and testes. Seasonal breeders like sheep, goats and horses are heavily influenced by melatonin as it signals short and long days. Pineal gland recognizes light intensity and converts L-Tryptophan to serotonin and then to melatonin (Zhdanova and Tucci, 2003). Due to its amphiphilic nature, it can enter any fluid and cell. Its main functions are behavior, reproduction and thermoregulation. It slows heart rate, reduces motor function and controls circadian genes. LH peaks often occur at night when melatonin is high. Variations in earth magnetic field during lunar cycle are associated with changes in

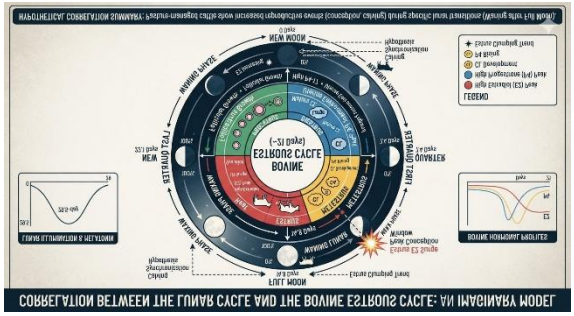


Fig. 1. Effect of lunar cycle on estrous cycle of bovine (imaginary diagram)

melatonin secretion pattern (Burch *et al.*, 2008; Bevington, 2015), hence melatonin is proposed as transducer of lunar effect in farm animals (Aguirre *et al.*, 2021).

Effect on domestic animals

A) Cattle:

Cattle are non-seasonal polyestrous animals with cycle of 18-24 days. Estrus signs are mucus discharge, mounting and restlessness (Roelofs *et al.*, 2010; Mattoni *et al.*, 1988).

- Large studies from India and Venezuela found a greater number of artificial inseminations, calvings, first postpartum estrus and pregnancies cluster around new moon and full moon days compared to other days (Subramaniam *et al.*, 1991; Aguirre *et al.*, 2021). This bimodal pattern is seen in both Brahman crossbreds and crossbred dairy cows.
- In Holstein cows in Japan, calvings were found to increase from waxing gibbous to full moon phase (Yonezawa *et al.*, 2016).
- In USA organic dairy farm study with large records, pregnancy at first AI was lowest during new moon period and highest during third quarter and days surrounding full moon (Schatte, 2024). Days directly after new moon were least favourable for conception.
- In Indian crossbred cattle field study at Orathanadu (Sandhiya *et al.*, 2023), animals showing estrus like signs on lunar days were examined by ultrasonography. Only a little more than half were in true estrus and fit for AI. Remaining animals were either pregnant, in mid-cycle estrus or showed no estrus characters. The dominant follicle size during lunar days was smaller than follicle size during normal estrus days, indicating lunar influence on follicular dynamics and false estrus.
- One old study in dairy heifers found estrus was uniformly distributed over lunar cycle with no effect (Roy *et al.*, 1980), showing regional and managemental differences.

B) Sheep:

Sheep are short-day breeders breeding in fall. Study on Churra ewes with more than two thousand AIs found lunar phases influence fertility, with higher fertility around new moon and lower around crescent phase (Palacios and Abecia, 2014). Another large flock study found more ewes came in estrus and became pregnant during full moon and third quarter period (Horak and Potucek, 1978).

C) Goat:

Goats are also short-day breeders. Study on goats grouped by birth lunar phase showed goats born on full moon phase attained puberty earlier, exhibited estrus earlier and had higher progesterone and cervical mucus indicating early reproductive maturity (El-Darawany *et al.*, 2021).

Importance of this scenario

- For calving management - Since more calvings cluster around new and full moon, farmer can give more supervision during those days to reduce dystocia losses (Aguirre *et al.*, 2021).
- For avoiding economic loss - Many animals showing heat on lunar days are actually pregnant or in mid-cycle stage (Sandhiya *et al.*, 2023). So rectal examination or USG is mandatory before AI on lunar days.
- For improving conception - Waning phase and third quarter period shows better conception than crescent and new moon period (Aguirre *et al.*, 2021; Schatte, 2024). This information can be used for planning timed AI and synchronization protocols.
- For understanding physiology - Lunar light and magnetic field changes affect melatonin which in turn affects LH pulsatility and follicular dynamics (Li *et al.*, 2023).

Conclusion

Overall opinion is that lunar cycle has little to no strong effect as sole determinant, but has weak association as a minor environmental factor. It shows bimodal rhythm with more reproductive events around new moon and full moon in cattle, better fertility around new moon in sheep and early puberty in goats born on full moon. In Indian crossbreds, lunar days cause falser estrus with smaller follicles. Therefore, lunar calendar should not be used alone for breeding decisions. Standard AM-PM rule and estrus detection tools should continue, with extra care and veterinary confirmation on lunar days. Future studies should focus on hormonal profiling of melatonin, LH and progesterone in open-housed animals.

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