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Behavioural Strategies to Enhance Welfare and Productivity of Stall-fed Goats

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ABSTRACT

Goats are highly adaptable, social, and intelligent livestock, contributing significantly to rural livelihoods, food security, and sustainable agriculture. In India, they constitute 27.74% of the total livestock population, underscoring their economic and ecological importance. The welfare of stall-fed goats is closely linked to their ability to express natural behaviors, including selective feeding, climbing, hiding, social interactions, and cognitive problem-solving. Confinement and limited environmental complexity can restrict these behaviors, leading to stress, aggression, disrupted social hierarchies, and reduced productivity. Modern welfare assessment frameworks, such as the Five Domains model, extend beyond the absence of suffering to include positive experiences, integrating nutrition, environment, health, behavior, and mental state. Management interventions, including environmental enrichment, elevated feeding systems, structured housing, and positive human-animal interactions, have been shown to improve behavioral expression, reduce stress, and enhance growth, reproduction, and milk yield. Aligning husbandry practices with goats natural behaviours supports both welfare and productivity.

Introduction

Goats are recognized as one of the earliest domesticated ruminant species, with archaeological evidence indicating domestication between 10,000 and 6,000 BC (Zeder & Hesse, 2000). In India, the goat population is 148.88 million, constituting 27.74% of the country's total livestock population, as per the 20th Livestock Census (2019). Goats are among the most versatile livestock species, contributing significantly to rural livelihoods, food security, and sustainable agricultural systems. Therefore, ensuring the expression of natural behaviours in goats is particularly important, especially under stall-fed management systems, as this plays a critical role in improving animal welfare.

Animal welfare is commonly assessed using the Five Freedoms framework, developed in the 1960s, which emphasizes protection from hunger and thirst, discomfort, pain, injury and disease, fear and distress, while allowing the expression of natural behaviours (FAWC, 2009).

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Building on this foundation, the Five Domains model proposed by Mellor provides a more comprehensive and proactive approach to animal welfare by incorporating both negative and positive experiences of animals (Mellor et al., 2020). In the Five Domains model, freedom from hunger and thirst corresponds to the Nutrition domain, which focuses on the provision of adequate, balanced, and hygienic feed and water. Freedom from discomfort aligns with the Environment domain, encompassing factors such as space, temperature, air quality, noise, and environmental predictability. Freedom from pain, injury, and disease is reflected in the Health domain, which emphasizes disease prevention, physical fitness, and proactive healthcare. The freedom to express normal behaviour is addressed in the Behaviour domain, highlighting the importance of providing opportunities for species-specific and meaningful behaviours. Finally, freedom from fear and distress is represented by the Mental State domain, which integrates the outcomes of the other domains and focuses on minimizing negative affective states while promoting positive experiences. Overall, the Five Domains model represents a shift from a reactive to a proactive approach to animal welfare assessment,it allows us to assess not just what animals are free from, but what they are free to experience. This framework is especially valuable in behavioural research and welfare interventions, as it helps us design environments and management practices that truly enhance animal lives.

Specific behavior of goats

Naturalness is a key component of animal welfare (Fraser et al., 1997). Behavioural observations of wild and feral animals provide benchmarks for assessing welfare in domesticated populations, as the expression of species-specific behaviours reflects well-being (Yeates, 2018). Housing and management conditions affect animals' ability to perform these innate behaviours (Miranda-de la Lama and Mattiello, 2010), and restricting strongly motivated behaviours can lead to stress and reduced welfare (Friend, 1989).

Feeding behaviour

Goats exhibit highly adaptive feeding behaviour that distinguishes them from other domestic livestock. As browsers, they can forage in a bipedal stance about 8% of feeding time allowing access to diverse vegetation (Pfister et al., 1988). Their narrow oral aperture and shorter jaw enhance dietary selectivity and chewing efficiency, enabling rapid harvesting of small leaves. They also use their muzzle to avoid ingesting leaves with web worms (Berman et al., 2017). When transitioning from open-range browsing to green forage or concentrates, goats require 2–3 weeks for dietary and rumen adaptation. In confined systems, limited feeding space can increase aggression (Jorgensen et al., 2007). Their tolerance to high tannin levels is linked to salivary proteins and rumen microbes (Silanikove et al., 1996). Overall, goats feeding behaviour reflects adaptability, selectivity, and efficiency, supporting survival, welfare, and productivity.

Social behaviour

Goats are social animals with dynamic fission–fusion groups, forming stable cliques of 12–13 individuals and clear dominance hierarchies (Stantley & Dunbar, 2013). Larger groups are more defensive, more socially active, and spend less time resting than smaller ones (Calhim et al., 2006; AWIN, 2015). Horn size influences rank, with males often dominating females (Shi & Dunbar, 2006). Agonistic behaviours, including physical contact and threats, are natural and help maintain hierarchies and access to resources (Blanchard et al., 1993; Miranda-de la Lama & Mattiello, 2010).

Cognitive behaviour

Cognition in goats involves perception, memory, learning, and decision-making (Shettleworth, 2010). Goats are curious problem-solvers with long-term memory, retaining solutions for up to 10 months (Briefer et al., 2014), and display contrafreeloading, preferring to work for rewards even when freely available (Rosenberger et al., 2020). They understand object permanence and use social learning, recognizing individuals and responding to others' attention and intentions (Nawroth et al., 2015).

Hiding behaviour

Feral goats use natural shelters like caves for safety, weather, and predator protection, and kids instinctively hide after birth (Stachowicz et al., 2019; Lickliter, 1984). In commercial systems, hiding opportunities are rare, yet goats still seek concealed areas to rest or avoid social tension, especially in large groups (Zobel et al., 2017, 2019). Providing sheltered and hiding spaces supports natural behaviour and reduces aggression (Boe & Ehrlenbruch, 2013).

Other behaviour

Goats are natural climbers with strong limbs and excellent balance, enabling them to scale rocks and trees. They prefer resting alone or in pairs, often near walls or solid structures rather than in open spaces, likely for security from predators. During the breeding season, bucks display pronounced sexual behaviours such as strong odour emission, tongue flapping, and urinating on their beard and mouth as signals to females and rivals

(Fritz, 2017). Female social hierarchy also affects reproduction, with dominant does displacing subordinates and lower-ranking individuals often ovulating later (Alvarez et al., 2003). A single buck can typically inseminate many does in one season. Goat gestation lasts about 150 days, and twins are common depending on genetics and nutrition (Shi et al., 2003). After birth, the dam licks the kid to stimulate and bond, recognising it within hours through vocal and scent cues (Terrazas et al., 2003). Kids follow a "hider" strategy for up to a week before joining their mothers and forming peer groups (O'Brien, 1984).

Behavioural problems in stall-fed goats

Behavioral problems in stall-fed goats are mainly caused by confinement, which restricts movement and prevents natural exploration. This can lead to abnormal or stereotypic behaviours, increased aggression, and social stress from disrupted hierarchies. Lack of cognitive and environmental stimulation further exacerbates stress, making restricted movement a key factor in impaired welfare (Battini et al., 2014).

Managemental intervention to improve welfare and productivity

Environmental enrichment

Environmental enrichment involves modifying an animal's environment to promote natural behaviors, cognitive stimulation, and reduced stress (Veissier et al., 2024). It enhances physical health, cognitive abilities, and coping skills (Dickson et al., 2024), and is especially important in livestock to counteract stress and behavioral restrictions from conventional husbandry, particularly during sensitive stages like weaning (Lee, Oh, & Kim, 2025). In goats, environmental enrichment (EE) improves behavior. In dwarf goats, structural and cognitive enrichment increased activity, competence, and curiosity, though cortisol levels stayed similar (Clark, 2017). Turkish Saanen kids in enriched pens with ramps, barrels, and tires showed more exploratory behaviors after weaning (Tölü et al., 2016).

Feeding management

Goats naturally browse at various heights, but floor-level feeders limit this behaviour. Elevated feeders, which require goats to raise their head and neck, increase dry matter intake (0.34 kg vs 0.18 kg) and support natural feeding behaviour, improving welfare (Neave et al., 2018). Aligning feeding systems with natural browsing may also reduce parasite risk and enhance vigilance (Lu, 1988). Key indicators of good feeding include optimal body condition, a healthy coat, and normal feeder/drinker behaviour (Battini et al., 2014).

Human animal relationship

Human-animal relationships (HAR) describe how animals perceive and respond to humans, from fear and avoidance to positive contact (Waiblinger et al., 2006; Claxton, 2011). Evaluating HAR helps improve welfare, as calm and frequent human interactions reduce fear, aggression, and flight responses in goats (Miller et al., 2018). Positive HAR also facilitates handling, increases stockperson satisfaction, and should be treated as an essential part of routine husbandry (Beaujouan et al., 2021; Celozzi et al., 2022).

Housing management

Goats naturally form small, flexible social groups, but commercial dairy systems often house very large herds, which can increase aggression and stress (Zobel et al., 2019). Herd size and stocking density affect social behaviour, resting, and welfare, with adequate space (3–4.5 m^2 per adult) and open areas supporting normal movement, exploration, and positive interactions (Miranda-de la Lama & Mattiello, 2010; Thakur et al., 2017). Introducing goats to unfamiliar herds can trigger aggression, reduce productivity, and increase injury risk. Proper housing, including clean bedding and comfortable resting surfaces, is essential for welfare, while behavioural indicators help monitor comfort and detect problems early.

Conclusion

Behaviour is central to the welfare and productivity of stall-fed goats. Goats are intelligent, social animals with strong motivations to browse, explore, climb, and interact. Restricting these behaviours in intensive systems can cause stress and reduce performance. Observing behaviour is a non-invasive tool to assess welfare and detect problems early. When goats are comfortable and able to express natural behaviours, they eat better, grow faster, and produce more milk, creating a positive cycle between welfare and productivity. Incorporating behavioural knowledge, enrichment, and welfare-friendly housing is essential for sustainable and efficient goat farming, especially in tropical and smallholder systems.

Conflicts of interest and financial disclosures

The authors state that there are no conflicts of interest to disclose.

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