Behaviour and Welfare of Dairy Buffaloes: Pasture or Confinement?

Patricia Mora-Medina[1], Jesús Alfredo Berdugo-Gutiérrez[2], Daniel Mota-Rojas[3,*], Jhon Didier Ruiz-Buitrago[4], José Nava-Adame[3] and Isabel Guerrero-Legarreta[5]

[1]*Livestock Science Department, Universidad Nacional Autónoma de México (UNAM), FESC, State of Mexico, Mexico*

[2]*Latin American Center for the Study of Buffalo, Colombia*

[3]*Neurophysiology, Behavior and Assessment of Welfare in Domestic Animals, Department of Animal Production and Agriculture, Universidad Autónoma Metropolitana (UAM), Mexico City, 04960, Mexico*

[4]*Grupo de Investigación INCACES, Facultad de Medicina Veterinaria y Zootecnia, Universidad CES, Medellin, Colombia*

[5]*Department of Biotechnology, Food Science, Universidad Autónoma Metropolitana-Iztapalapa, (UAM-I), México City, Mexico*

Abstract: This review seeks to integrate recent scientific findings on the behaviour of buffalo cows in different production systems. These issues are discussed in relation to the level of welfare that buffalo cows experience under different production systems. In extensive conditions, the level of welfare is high because the animals are free to express natural behaviours related to feeding (grazing, ruminating) and rest. In contrast, intensified livestock-raising methods and techniques (machine-milking, artificial breeding etc.), first developed for dairy cattle are increasingly being used with water buffaloes in order to increase milk production. Greater knowledge of the biology of dairy buffaloes in aspects linked to physiology, behaviour, and health, together with needed adjustments to their production systems, will indicate options for improving the levels of comfort and welfare of these animals and contribute to increasing the efficiency of this type of dairy production. It is necessary to appreciate the importance of welfare within the entire chain of animal production since each of the scientific aspects considered in this manuscript reflects that animal welfare is not an absolute term, but multidisciplinary, with direct consequences on productivity. The welfare of animals in the production systems must be considered with the aim of ensuring an adequate nutritional, clinical, sanitary and behavioural status of the animals. When these aspects are achieved, production can be maximized and, for this reason, it is essential to maintain a balance between welfare and productivity.

Keywords: Buffaloes, behaviour, welfare, extensive system, intensive system.

INTRODUCTION

The increase in the global demand for animal products in the last decades of the twentieth century has intensified considerably, displacing the traditional systems. This intensification allows increasing the volume of milk and meat production as well as the efficiency of resource utilisation, productivity and food security [1]. However, the intensification can negatively affect the welfare of animals by modifying the environmental conditions (confinement, feeding, etc.). More specifically, the intensification can cause welfare problems if the animals cannot adequately perform social and innate behaviors [2].

There are three factors that are combined and that must be in equilibrium in the production systems: animal, environment, and human; these are, at the same time, determined by an economic factor [3], since farm animals are kept with the aim to gain profit. However, intensive systems applied at their maximum expression can lead to physiological and behavioral imbalances [4, 5]. Currently, the welfare of farm animals such as poultry, cattle, and pigs, among others, have taken great importance due, mainly, to some aspects related to the physical environment in which they live and the different production or housing systems in which they are produced, which are responsible for the welfare and performance of the animals, and quality and costs of the products [6, 7].

Dairy buffaloes have been treated and handled in the same manner as bovines; that is, without considering that this is a more rustic species (with a great capacity to adapt to adverse environments) usually raised in extensive systems, in contrast to dairy cattle, which are more specialized and are bred intensively. What is important is to assess which type of production system will ensure dairy buffaloes higher levels of welfare and comfort that are requirements for

*Address correspondence to these authors at the Neurophysiology, Behavior and Assessment of Welfare in Domestic Animals, Universidad Autónoma Metropolitana (UAM), Calzada del hueso 1100, Del. Coyoacan, 04960, Mexico City, Mexico; Tel: (525) 54837535; E-mails: dmota@correo.xoc.uam.mx, dmota100@yahoo.com.mx
ORCID ID: https://orcid.org/0000-0003-0562-0367

optimizing their milk yield [1]. Against this background, our review examines key behavioural indicators in different production systems to offer readers significant feedback on this issue. One consequence of the growing economic interest in consuming foods produced by these animals is that water buffalo-raising has undergone a process of intensification [8-10], but this exposes the animals to novel stimuli generated by the diverse technologies adapted from dairy cattle (e.g. milking machines, more contact with humans, modified diet, reduced space, etc.). These changes affect health (e.g. more lesions), social behaviour (e.g. greater frequency of agonistic encounters), and heat dissipation, and have significant repercussions on milk ejection, product quality and animal welfare [11, 12].

In extensive production systems, buffaloes devote most of their time to two main behavioural categories: feeding (grazing, ruminating) and rest. Another typical behaviour of this species is wallowing and bathing [13]. However, these systems may also have other welfare problems, mainly related to nutrition, water supplementation, parasitic diseases, extreme weather conditions, lameness, predators or lack of supervision [14].

In contrast, intensive or confinement systems are thought to affect negatively the welfare of buffaloes because freedom of choice and movements are restricted; however, this classification is not that simple since in both systems (pasture and confinement) there is an important factor that influences welfare, which is the stress experienced by animals [2, 7, 15].

The increasing intensification of milk production means that more and more buffaloes are raised under conditions of confinement; thus, it is important to pay more attention to farming conditions because they not only restrict this species' natural behaviours but may also cause physiological alterations associated with stress [16].

Against this background, the objective of this review is to integrate recent scientific findings on the behaviour of buffalo cows in different production systems.

THE BEHAVIOUR OF DAIRY BUFFALO

Pasture

It is well-known that suitable environmental stimulation promotes animal welfare and that some signs of good welfare –e.g. playfulness– occur more frequently under adequately-enriched environmental conditions [17-19]. In extensive production systems, buffaloes devote most of their time to two main behavioural categories: feeding (grazing, ruminating) and rest. Another typical behaviour of this species –wallowing and bathing– occurs more often in the hot season, when they provide thermoregulation and protection from ectoparasites [13].

According to Fericean [20], on the prairies of extensive systems, water buffaloes spend over 99% of their time feeding, drinking water, ruminating and resting. In fact, on average feeding and ruminating occupy 60-65% of their time [11]. During the remaining 1%, buffaloes move around and perform various other activities [20].

De Rosa *et al.* [12] observed that if there is a pool of water and the buffaloes are free to move about through larger spaces, then their preferred posture is wallowing, perhaps because it is their main means of dissipating heat, though it might also foster non-agonistic social interaction, since more of these activities (*i.e.*, sniffing, nuzzling) were seen under these conditions. Also, social licking was more apparent when the Buffaloes enjoyed more ample living spaces (36 m^2/head *vs*. 10 m^2/head).

With respect to grazing, size, age, gestation status, and milk production will affect the duration of feeding time [20], but grazing time also decreases under high temperatures and if the land has mud pools. Under these conditions, buffalo cows tend to stay in the muddy water for 4-6 hours every day to get refreshed [20]. In addition to providing shade and a variety of food sources, silvopastoral environments allow buffaloes to express their natural behaviours. In these systems, activities like exploring the surroundings and their co-specifics increase markedly (Figure **1a** and **1b**). In these conditions, buffalo cows are usually hand-milked (Figure **1c**) and often calves are re-joined to the mothers to promote milk ejection.

The natural selection process has led the water buffalo to acquire morphological traits that allow it to adapt to areas with hot, humid climates. One such trait is its melanin-pigmented skin, which provides protection from ultraviolet rays; another is its low hair density, which allows heat to be dissipated by convection and radiation. In hot dry climates, in contrast, the low humidity promotes intense heat loss through evaporation, though this is limited in buffaloes due to their low number of sweat glands. Finally,

respiratory evaporation is less efficient in buffaloes than cattle, for it may cause alkalosis by quickly raising blood pH [13, 21]. Therefore, buffaloes rely on wallowing and the consequent evaporation for efficient heat loss and thermoregulation. This behaviour is usually performed in extensive conditions where buffaloes purposely create potholes for bathing.

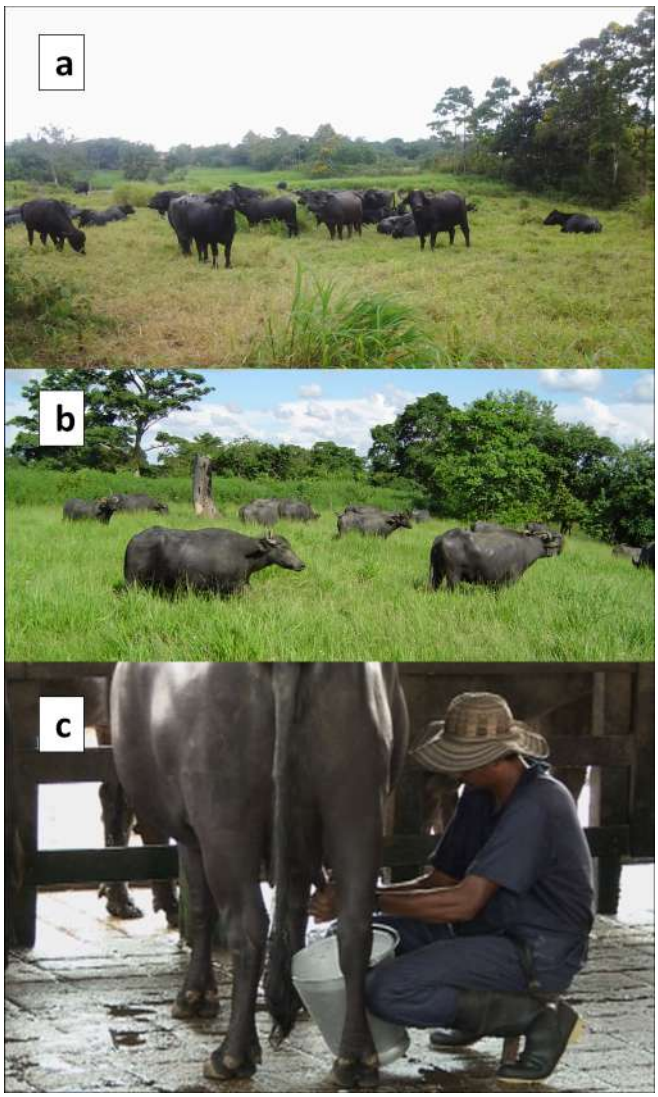

Figure 1: Extensive system (**Pasture**) of dairy buffalo, area of the Bajo Cauca, towns (municipalities) of Caucasia (Antioquia department), Planeta Rica (Córdoba deparment) and Puerto Boyacá (Boyacá Department), Colombia. Animals are kept on pasture (**a**, **b**) and hand-milked (**c**).

Tripaldi *et al.* [16] have demonstrated that when raised in comfortable environments under conditions similar to traditional ones that promote their welfare, buffalo cows show a less pronounced response of the adrenal cortex possibly because they are free to choose the sites where they wish to eat, wallow [16] or explore [13], according to variations in the micro-environmental conditions.

Two findings from that research are that milk production is greater in outdoor systems (8.12 *vs*. 7.77kg), and that cleanliness scores are higher (2.80 *vs*. 2.41) than under conventional indoor conditions. In addition, it was determined that confinement resulted in more animals experiencing lameness (0.01 *vs*. 0.10). Other observations indicate that cows who are free to graze spend more time feeding than those that are kept in confinement and released outdoors later (78 *vs*. 25%, respectively). Finally, both cattle and buffaloes tend to walk greater distances in outdoor systems [13, 22].

Another recent research approach consists in evaluating extensive grazing systems that allow dairy farms to conserve biodiversity while promoting landscape ecology [23]. Extensive rearing systems are convenient for species that are already well-adapted to the environment, a category that includes buffaloes and non-productive animals, such as heifers [24]. Extensive systems can also lower production costs and lessen environmental impacts [25], while simultaneously improving animal welfare [10] and promoting product differentiation by implementing quality assurance measures [13, 26].

Confinement

In dairy production systems, welfare includes not only the animals that produce milk but also the newborns, the young females that will be used as replacements and the males in breeding units [27]. Raising calves is one of the most complex activities of dairy production, being very common infectious and parasitic diseases leading to increased levels of mortality [28]. The high level of morbidity and mortality of buffalo calves has important ethical and economic implications. It is likely that the problems of buffalo calf morbidity and mortality, which dairy production systems often face, are directly related to the management of the first days of life, including early maternal separation, artificial rearing, insufficient or late colostrum ingestion, limited space, inadequate bedding, lack of opportunity of social interaction and play, in addition to little interaction with humans [29].

The increasing intensification of milk production means that more and more buffaloes are raised under conditions of confinement; thus, it is important to pay more attention to housing conditions because they not only restrict this species' natural behaviours but may also cause physiological alterations associated with stress due to the restricted space allowance [16].

Indeed, housing conditions are an indirect indicator of buffalo welfare, for if they do not include environmental enrichment, they will generate stress in the animals [16] (Figure **2a** and **2b**).

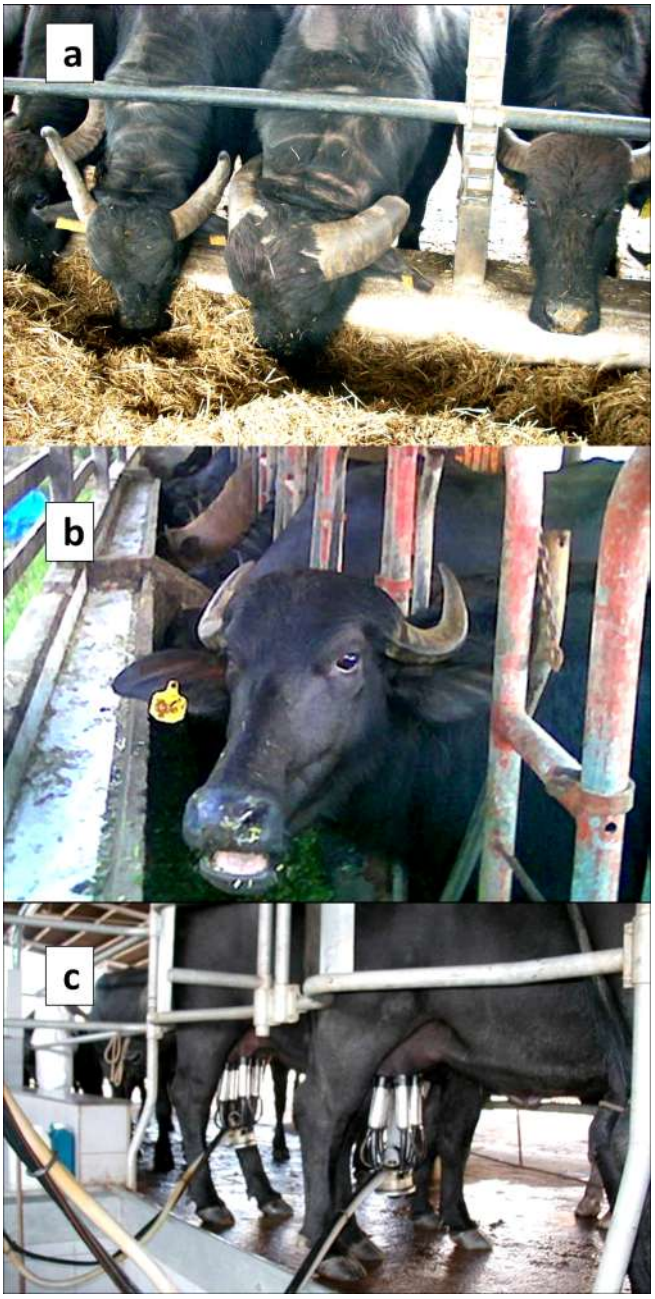

Figure 2: Intensive system of dairy buffalo, area of the Bajo Cauca, towns (municipalities) of Caucasia (Antioquia department), Planeta Rica (Córdoba department) and Puerto Boyacá (Boyacá Department), Colombia. Animals are kept indoorsure (**a**, **b**) and machine-milked (**c**).

Another consequence of higher dairy buffalo production is an increase in the use of intensive management facilities, including the mechanisation of routine activities on farms [30, 31]. In recent years, water buffalo-raising has been increasingly characterised by the incorporation of methods designed to intensify production, coupled with modern livestock-raising techniques implemented initially for dairy cattle (milking machines, artificial rearing, and artificial insemination, among others) in order to generate higher milk yields. But under these conditions animals are exposed to novel environmental conditions that can trigger stress, both physical and physiological [12] (Figure **2c**).

In their work, Tripaldi *et al.* [16], studied the effect of two rearing systems on the behavioural and physiological responses of buffalo cows. The systems assessed were: 1) with, and 2) without a broad, open-air yard with varied vegetation and watering holes or pools where the cows could bath and wallow, similar to those found in traditional systems. In their work, the buffalo cows kept under intensive conditions had extended periods of idling since there was no access to yards or pools that enriched the environment of the corresponding outdoor group [16]. The authors concluded that one enriching element necessary for buffaloes is the presence of open spaces with mud pools because they were found to favour milk production in the hotter, more humid months of the year [12]. It should be noted that lower activity levels were also reflected in a higher percentage of time spent in various “resting” postures including lying down [13].

In order to address the machine milking issue, Cavallina *et al.* [32] applied the focal sampling technique to determine –through observation– the behavioural responses of primiparous and multiparous buffalo cows to the milking routine. Their results showed that primiparous buffaloes had a higher frequency of acute, stress-related behaviours while being milked that included kicking (36.67% *vs*. 24.36%), defecating (5% *vs*. 2.56%), pulling the teat out of the milking cup (11.67% *vs*. 5.13%), and urinating (48.33% *vs*. 11.54%).

The results of other research show that keeping and feeding dairy cows in enclosed yards causes an increase in lameness and mastitis and, possibly, agonistic behaviours, while also reducing walking time [33]. Moreover, reduced ruminant motility is seen in dairy buffaloes that experience problems with their hooves or legs, and haematological indexes revealed significant decreases in Hb, PCV and TEC [34]. It has further been shown that tie-stall conditions, sometimes used in small familiar buffalo enterprises, may neglect fundamental biological and behavioural needs of the

animals and, therefore, cause serious difficulties for their welfare [35].

Buffaloes maintained in intensive conditions with no access to pasture or water for wallowing have longer periods of inactivity and spend less time exploring. Confinement also entails space reduction, but no studies have yet specifically examined this issue in order to ascertain precise requirements for water buffaloes. Restricting the space available to these animals can impact several aspects, including health (frequent injuries), social behaviour (more agonistic interactions), fertility, and heat dissipation [13].

CONCLUSIONS

The welfare of animals in different production systems must be considered with the aim of ensuring an adequate nutritional, clinical, sanitary and behavioural state of the animals. The critical points of intensive and extensive systems are different; however, when these aspects are satisfied, production can be improved in qualitative and quantitative terms in both extensive and intensive systems and, for this reason, it is essential to maintain a balance between welfare and productivity. The welfare of buffaloes should be promoted through the entire chain of animal production since each phase has an impact on animal welfare and process quality with potential effects on consumer acceptance.

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