The welfare of dairy buffalo

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ABSTRACT

The present paper addresses the issue of buffalo welfare. Firstly, the biological characteristics and behavioural needs of buffalo are considered. Subsequently, the effects of intensive farming and some animal-related indicators, to be used for a monitoring scheme of buffalo welfare at farm level, are described. The attention was focused on the following indicators: excessive thinning or fattening assessed with Body Condition Score (BCS) systems; cleanliness (the presence of mud may be considered positively, whereas a thick and compact layer of dung may be regarded negatively); health status (lameness, hoof overgrowth, injuries, etc.); social, aggressive, oral abnormal behaviours; animal-human relationship (avoidance distance at manger); positive indicators (qualitative assessment of behaviour, etc.); housing factors. The indicators are discussed on the basis of their validity (meaningful with respect to animal welfare), reliability (reflecting the tendency to give the same results on repeated measurements) and feasibility (concerning time and money consumed). For some aspects, the differences between buffalo and dairy cattle are also highlighted.

Key words: Dairy buffalo, Welfare, Animal-based indicators, Monitoring system.

RIASSUNTO

IL BENESSERE DELLA BUFALA DA LATTE

Dopo aver accennato alle principali caratteristiche anatomo-fisiologiche e aver messo in evidenza le differenze rispetto alla specie bovina relativamente agli aspetti comportamentale, alimentare, della termoregolazione, riproduttivo, produttivo, ecc., gli Autori affrontano la complessa problematica della valutazione del benessere della specie bufalina. In particolare, viene sottolineato che il sistema di allevamento nel corso degli anni ha subito una profonda evoluzione con riflessi più o meno marcati sul repertorio comportamentale naturale e sulle condizioni di benessere degli animali. A causa della scarsa attenzione finora
riservata alla bufala per questi aspetti, viene evidenziata la necessità della messa a punto di uno specifico sistema di monitoraggio del benessere a livello aziendale sulla base di quanto avvenuto per la bovina da latte. Viene proposto di far riferimento: allo stato di nutrizione valutato con il metodo Body Condition Score (BCS), alla pulizia corporea (distinguendo tra fango, da considerare positivamente, e deiezioni, da considerare negativamente), allo stato di salute (sovracrescita degli unghioni, lesioni, tumefazioni, ecc.), alle interazioni sociali e aggressive e alle anomalie comportamentali, alla qualità del rapporto uomo-animale (distanza di fuga, ecc.), agli indicatori positivi di benessere (utilizzando la valutazione qualitativa del comportamento, ecc.), alle caratteristiche dei ricoveri e delle strutture di allevamento. Ognuno di tali indicatori viene considerato sotto il punto di vista della validità (relazione esistente tra la variabile misurata e ciò che essa dovrebbe valutare in termini di benessere), della ripetibilità (tendenza ad ottenere gli stessi risultati da uno stesso osservatore in occasioni differenti o da più osservatori nel corso della stessa osservazione) e dell’applicabilità (in termini di richiesta di tempi e di costi limitati), evidenziando anche le differenze rispetto alla specie bovina.

Parole chiave: Bufala da latte, Benessere, Osservazione diretta degli animali, Sistemi di monitoraggio.

Introduction

In the present review we describe the biological characteristics and behavioural needs of buffalo under natural conditions. Thereafter, we discuss the effects of intensive farming and some animal-related indicators to be used for a monitoring scheme of buffalo welfare at farm level.

Domestic buffalo (Bubalus bubalis) is classified into two types: River buffalo (milking breed of India, Pakistan, Egypt, and Europe) and Swamp buffalo (found in Eastern Asia and used as a draft animal and for meat purposes). The swamp and river buffaloes have 48 and 50 chromosomes, respectively. They interbreed and produce hybrid progeny with possibly reduced fertility due to unbalanced karyotypes (Gustavsson et al., 1993).

By nature, buffaloes are social animals and live in herds of varying size having clear dominance hierarchies and, in promiscuous groups, headed by a dominant bull. Social status is established at a young age, primarily through subtle gestures and posturing rather than aggressive interactions (Grasso et al., 2004). However, securing social status is an ongoing dynamic process in males and is relatively stable throughout life in females.

Buffaloes graze a wider range of plants as compared to cattle. The digestibility of crude protein and fibre fractions of the diet is usually greater than in sheep and cattle. This may be due to certain features of buffalo rumen function which are different from that of other ruminants. In fact, buffaloes appear to have a larger rumen, slower rumen movements, a smaller rate of outflow from the rumen, and higher bacterial activity (Jalaludin et al., 1992; Di Lella et al., 1995; Kennedy, 1995; Masucci et al., 1997). Together, feeding and rumination may occupy 60-65% of the animals’ time (Napolitano et al., 2007).

Buffaloes have acquired several morphological features which reinforce their ability to thrive well in shaded, hot, humid areas. For instance, the melanin-pigmented skin of buffaloes is useful for defence against ultraviolet rays. Hair density in adult buffalo is only one-eighth of that in cattle (Hafez et al., 1955), thus facilitating dissipation of heat by convection and radiation. Obviously, also the number of sweat glands is very limited in buffalo compared to cattle, resulting in a lower efficiency of sweating in buffalo than in cattle. Furthermore, the number of sebaceous glands is lower in buffalo than in cattle, however, sebum secretion shows an
opposite trend (Hafez et al., 1955). This provides effective protection to the skin while the animals are in the mud. Moreover, skin in buffaloes is thicker than that of cattle, protecting the nearly bare body surface of buffalo from harmful mechanical and chemical agents, particularly when the animal is exposed to their effects in water and mud while swimming and wallowing (Badreldin and Ghany, 1954; Hafez et al., 1955). These latter behaviours, as well as shade, are essential during the hot season to dissipate body heat. Grooming behaviour is important for body care and for maintaining social structure. Tail swishing is used to remove flies and other irritants. Body areas within reach are licked and scratched, while inaccessible areas are rubbed on available surfaces or groomed by other herd members following solicitation.

The buffalo cows come in heat throughout the year but tend to result more fertile when day light hours decrease, which coincides in tropical areas with greater forage availability (Zicarelli, 1994). The length of the oestrous cycle is similar to that of bovines and is on average 21 days, but there is considerable variation in length of the cycle. In buffaloes, the typical signs of oestrous behaviour (i.e. excitability, standing behaviour) are less pronounced than in cattle (Seren et al., 1992; Zicarelli et al., 1992), whereas the courtship behaviour of buffalo bulls is similar to that reported in bovines. Bulls are able to detect pre-oestrus cows and will remain close to them, exhibiting the characteristic ‘flehmen’ behaviour in response to oestrous urine. Prior to parturition, cows become restless and withdraw from the herd to seek sheltered, secluded areas in which to give birth. A single calf or, more rarely, twins are born following a gestation of around 310 days. Dams keep their newborn calves hidden for several days after birth, returning to them at night and periodically during the day for suckling. Dams are able to identify their calves by their smell, taste, sight and sound (Murphey et al., 1995). Aside from providing nutrition, suckling behaviour per se is important to calves, and those prevented from natural suckling often re-direct this behaviour to themselves, other calves or inanimate objects (Paranhos da Costa et al., 2000). In buffalo cows, the fraction of cisternal milk is lower than in cattle (Thomas, 2005). As a result, lactating buffaloes seem to be sensitive to the slightest change in milking routines, which determines a decrease of milk flow and milk yield (Thomas et al., 2005; Saltalamacchia et al., 2007).

**Intensive farming and welfare monitoring**

Dairy buffalo farming is a traditional Italian enterprise which has been conducted for centuries with extensive rearing systems in low-lying swampy areas of central-southern Italy. Recent intensification of rearing techniques has exposed these animals to a rapidly changing environment that imposes physical and psychological stressors previously unknown to this species. The application of the most advanced rearing techniques (machine milking, artificial rearing, loose yard and cubicle housing systems, etc.), even though they may not be appropriate for buffaloes, as developed for dairy cattle, and the consequent increase in milk production, has led to a renewed interest in this species. However, intensive farming has negatively affected several aspects of buffalo welfare. For instance, the lack of space determined the alterations of a number of behavioural and physiological responses in buffalo calves (Grasso et al., 1999; Napolitano et al., 2004), while in buffalo cows the absence of a pool or pothole to bathe in during the hot season induced the suppression of natural behaviours, such as wallowing (Tripaldi et
De Rosa et al., 2004; De Rosa et al., 2007a), and reduced fertility (Di Palo et al., 2001; Zicarelli et al., 2001; Zicarelli et al., 2005). An increased incidence of technopathies, such as vaginal and uterine prolapses, has been associated with unbalanced rations fed to dry cows and inappropriate feeding management from birth to weaning, the latter leading to reduced pelvis development of female calves (Zicarelli, 2000). Reduced reproductive performances in terms of increased calving intervals have been related to the application of out of breeding season mating techniques (Zicarelli, 1997). Machine milking presents both physical (e.g. poor maintenance of the machine) and psychological components (e.g. negative behaviour of the stockperson and calf separation) which may result in milk let down difficulties. In dairy cattle the presence of aversive handlers during milking induce increased heart rates, cortisol level and residual milk (Rushen et al., 1999). Data on buffaloes indicate that oxytocin injections are often performed to allow a complete milk ejection (Saltalamacchia et al., 2007), whereas they are only occasional in dairy cattle milking routine (Bruckmaier, 2005). Other welfare issues raised by intensive farming concern increased morbidity (e.g. diarrhoea in calves, etc.), possibly due to stress-induced immune suppression and poor housing conditions (Di Francia et al., 2008) and development of abnormal behaviours (e.g. allo-suckling in calves and cows, tongue rolling, etc.), which may be attributed to a lack of stimuli in the rearing environment (Redbo, 1990).

The development of a monitoring system for assessing buffalo welfare at farm level is required either to provide a certification system or for comparing different husbandry systems or as an advisory/management tool for the farmer (De Rosa et al., 2005). Unfortunately, only few studies have been conducted on this issue. De Rosa et al. (2003b) evaluated the reliability of some animal-based parameters (avoidance distance, behaviour during milking, etc.), which could be used for assessing buffalo welfare at farm level. Recently, the relationship between the stockperson’s behaviour, buffalo behaviour and prevalence of oxytocin injection at milking was investigated (Saltalamacchia et al., 2007). At present, some welfare monitoring systems have been developed in Europe. These include the animal welfare index TGI35L in Austria (Bartussek, 2001) and the related TGI200 in Germany (Sundrum, 2001), for cattle, pigs and laying hens, the ethical account in Denmark (Sorensen et al., 2001) for dairy cattle and pigs, Bristol Welfare Assurance Programme (Main et al., 2007) in the United Kingdom for dairy cattle, pigs and laying hens, a decision support system for overall welfare assessment of sows in The Netherlands (Bracke et al., 2002), preliminary welfare assessment schemes for dairy cattle and pigs in Italy (Bertoni et al., 1999; Tosi et al., 2001, 2003; Rossi and Gastaldo, 2006) and only for dairy cattle in France (Capdeville and Veissier, 2001). Some of these methods focus on resource criteria, which comprise structural and technical elements (e.g. type of housing, stocking density, etc.) and management-related factors, such as breeding strategies, health plans, etc. Others use animal-based variables (performance criteria) dealing with behaviour, health and physiology of the animals or a combination of resource and performance criteria to obtain a valid assessment of animal welfare (Johnsen et al., 2001). According to Dawkins et al. (2004), resource variables alone are not a good predictor of animal welfare and the assessment should be based on animal measures as they are the results of the interaction between the animals and the environment. The indicators to be included in a scheme for on-farm assessment of animal welfare should be valid (meaningful with re-
spect to animal welfare), reliable (reflecting the tendency to give the same results on repeated measurements), feasible (concerning time, money and other resources) and used throughout Europe. On-farm welfare monitoring systems should provide a standard way of converting welfare-related measures into information that is easily understood by the consumer. This is also one of the main objectives of the European project Integration of animal welfare in the food quality chain: from public concern to improved welfare and transparent quality (Welfare Quality®; www.welfarequality.net) designed to develop European standards for on-farm welfare assessment and product information systems as well as practical strategies for improving animal welfare in cattle, pigs and chickens. From 2007 dairy buffalo have been included in this project. Within the project it has been decided to base welfare assessment essentially on measures taken on animals. Resource and management measures have also been included in the monitoring system either because they can form the basis for the identification of causes when animal-based measures have shown that the welfare of animals on a given unit is poor, or because they can help identify risk factors for future welfare problems, or because animal-related measures may not be available or would be too time-consuming to record (e.g. water provision instead of animal dehydration).

In the present review some animal-related indicators identified within the Welfare Quality® project are discussed focussing on their applicability, whereas the methodological aspects, albeit important, are only briefly considered. A short overview of specific housing factors possibly affecting buffalo welfare is also given.

**Body Condition Scoring**

In the buffalo, as well as in cattle, Body Condition Scoring (BCS) is used as a means to estimate the energy balance, body composition and body stores in place of live weight change. Although in the river buffalo milk production is quite remarkable, from a morphological and metabolic point of view the buffalo is more similar to beef cattle than to dairy animals (Campanile et al., 1998a). Therefore, a BCS system derived from that developed by Lowman et al. (1976) for beef cattle may be used. This method consists of assigning each buffalo cow a score from 0 (severely emaciated) to 5 (very obese) with 0.5 increments. This method was tested under field conditions by the Meat and Livestock Commission (UK) for inter- and intra-observer reliability (Evans, 1978). From the mean components of variance inter- and intra-observer reliability were 0.70 and 0.81, respectively.

This parameter should be used to assess manifest undernutrition (BCS<2.5), with a high prevalence of thin buffaloes being associated with reduced levels of animal welfare. In contrast to cattle, overcondition in buffaloes (BCS>4) is usually not associated with ketosis (Morrow, 1976; Gillund et al., 2001). However, fat buffaloes after calving may show decreased fertility (Campanile, 1998).

**Cleanliness**

The evaluation of body cleanliness may give some information on animal comfort, the attitude of stockpeople and their care for the animals. In dairy cattle, the soiling of skin and hair may reduce thermoregulatory and anti-germal properties of the skin and may cause inflammations of the skin (Winkler et al., 2003).

A cleanliness index for dairy cattle using a five-point scale in five body areas has been developed by Faye and Barnouin (1985). A slight modification of this index was used in a recent study (Napolitano et al., 2005) showing a high degree of repeatability in
all cattle farms considered (n=4), whereas cleanliness repeatability was very low for buffaloes in the sole farm where this variable was monitored. This latter result is likely to be due to the peculiar buffalo behaviour of wallowing aimed to gain protection against solar radiation and dermal parasites. Therefore, the presence of mud on the buffalo skin may be considered positively, whereas a thick and compact layer of dung on the body of the animals may denote a low frequency of litter renewal which may also be associated to high stocking density. As a consequence a modification of the method developed for cattle is required, taking into account the type of body covering.

**Health status**

Lameness is a major welfare problem in dairy cattle which is often associated with pain and discomfort of long duration. In these animals lameness can be assessed using different gait scores (Sprecher et al., 1997; Breuer et al., 2000; Winckler and Willen, 2001). A simplification of Winckler and Willen’s method is based on scores ranging from 0 to 2, where 0 is assigned when the animal is not lame (timing of steps and weight-bearing equal on all of four feet), 1 is given when the cow is lame (limp, irregular foot fall, weight not born for equal time on each of the four feet), 2 is attributed when the subject is severely lame (strong reluctance to bear weight on one limb, or more than one limb affected). This disease may be caused by several different factors, such as unbalanced nutrition, flooring, social behaviour and related time spent standing, etc. (Galindo et al., 2000; Winckler and Willen, 2001). In particular, submissive animals spend more time in the passageways in slurry and on concrete floors where the hooves are more exposed to risk factors of sole and soft tissue lesions (Galindo et al., 2000). Previous studies reported a significant correlation between lameness and claw disorders of cows and high inter-observer reliability (Winckler and Willen, 2001). However, in a study conducted on 3 buffalo farms (Napolitano et al., 2005), lameness was virtually absent, which may be attributed to either lower feeding regimen or differences in metabolism compared to cattle (Campanile et al., 1998b). Although pathological conditions affecting the feet of buffaloes are rare, claw overgrowth and corkscrew claws can be frequently observed on buffalo farms (Cammarano and Marino, 2003). This latter claw abnormality may have a genetic basis and bulls carrying this defect are usually excluded from reproduction. Therefore, in a monitoring system for assessing buffalo welfare at farm level, the proportion of animals with poor claw conformation (corkscrew claws, abnormal angle of pastern, etc.) and claw overgrowth (long toes, excessive heel depth, etc.), as indicated by Whay et al. (2003) for dairy cattle, could be considered; lameness due to its low incidence, may be less important. As suggested for cattle (Leeb et al., 2004), a normal claw should present the following features: angled less than 50°, plane surface, little or no space between claws and unbent claw.

Skin lesions and swelling reflect the impact of the surrounding environment on the animal body. Alteration can be caused by contact with hard floors, pressure and hits against feed rack and cubicle partitions, etc. For cattle many scoring systems have been proposed (Wechsler et al., 2000; Leeb et al., 2004). Leeb et al. (2004) suggested recording any hairless patches, coat thinning in response to parasites, callosity, swelling and lesions (wounds and scabs) on the body area. In particular, lesions larger than 2 cm should be noted. This system may also be used for buffalo cows albeit giving particular attention to hairless areas due to the fact that adult buffaloes normally present a sparse hair coat.
Disease and mortality among dairy buffaloes is a problem both in terms of welfare and economic loss. Welfare assessment protocols designed for the assessment of individual farms may take into account parameters which directly or indirectly reflect their health. Data regarding health are sometimes recorded on a routine basis, yet may not be readily available, or may be recorded in variable formats. Respiratory, enteric and reproductive problems, including prolapses and mastitis, mortality and culling rate due to disease and accidents should be noted.

Resting, social and oral abnormal behaviours

Only few studies on resting behaviour of buffaloes are available to date. Grasso et al. (2001) observed that buffalo calves kept in a restricted space (1.2 m²/head) lie and rest for a shorter time and, when lying, have a higher number of bent legs compared with animals kept in larger space (2.1 m²/head). In addition, lying patterns may be restricted by other buffaloes which could cause the interruption of pen mate resting by stepping on them (Napolitano et al., 2004). Animals also show decreased levels of lying idle, which is likely to represent a fundamental form of resting. In cattle, an inadequate environment may reduce the ease with which animals change position from standing to lying by increasing the risk of falls and collision against cubicle partitions. Therefore, it has been proposed to record the time needed to lie down and the percentage of animals colliding with housing equipment during lying down (Winckler et al., 2003).

Agonistic interactions and subsequent injuries are an emerging problem in buffaloes farming. In recent years, space allowance has been dramatically reduced as a consequence of farming intensification: presently animals are usually kept in barns (5-10 m²/head) with outdoor paddock (8-14 m²/head), whereas in the past they were free to roam in marshland. Animals are not dehorned and free to perform any agonistic behaviour. However, in restricted space social contacts are forced and flight opportunities markedly reduced for subordinate subjects. In addition, one or more bulls are usually left in the herd since a specific and effective technique of artificial insemination is not available and males, in particular the older ones, tend to be more aggressive toward females and younger males. A further element of social disturbance is that primiparous buffalow cows are often not separated from multiparous animals. Social rank is correlated with age, weight and seniority in the group (Grasso et al., 2004). Primiparous cows occupy the lowest ranks with obviously more frequent problems of skin lesions and injuries to the udder.

Although no scientific data on buffalo allogrooming are available, in cattle social licking can play a role as tension-reducing behaviour as well as in reinforcing and stabilising social relationships, thus functioning as cohesive interaction along with head resting (Winckler et al., 2002; Wasilewski, 2003). In this species, beneficial effects of allogrooming have been observed by Wood (1977) and Sato (1984), who found a positive correlation between being licked vs. milk production and weight gain, respectively. Therefore, the inclusion of this indicator in buffaloes may be recommended.

Heifers and adult dairy cattle have been shown to develop or increase the time spent performing stereotypies as a response to tethering (Redbo, 1990), restrictive allotments and decrease in eating duration (Redbo et al., 1996; Redbo and Nordblad, 1997). In buffalo oral abnormal behaviours should be studied more extensively. Cross-sucking is often observed in young animals resulting in inflammation or injuries at the prepuce, teats or navel, but it is also displayed by
lactating animals resulting in milk loss. Thus, the assessment of social, oral, and resting behaviours in a buffalo welfare monitoring protocol should be performed by continuous behavioural observations for a feasible period of time soon after feeding.

Stockmanship and animal-human relationship
Numerous studies have demonstrated that stockmanship can affect behaviour and productivity of dairy (Hemsworth et al., 2002) and beef cattle (Lensink et al., 2001). Stockmanship includes a variety of facets that may impact on animal welfare, including technical skills, early observation of disease and injury, good handling and empathetic behaviour (Hemsworth and Coleman, 1998). The quality of the stockmanship can be assessed using attitude questionnaires or direct observation of stockpeople behaviour when interacting with animals (Hemsworth et al., 2002; Waiblinger et al., 2002). However, observation of stockpeople can affect their behaviour towards the animals, whereas answers to questionnaires may be unreliable. In contrast, behavioural tests aiming to assess the reactions of animals to humans may be more informative. In particular, avoidance distance is considered as an indicator of the quality of the relationship between farm animals and stockpeople (Hemsworth et al., 2000; Waiblinger et al., 2002). It has been defined as the distance between an observer and the point at which the animal moves away when the subject is approached at a speed of one step/second (Waiblinger et al., 2002). This can be assessed inside the pen or at the feeding rack. De Rosa et al. (2003b) observed a lower avoidance distance in buffalo compared to cattle. This result can be attributed to the fact that the buffalo is generally recognised as being more curious than cattle. The different degree of curiosity of the two animal species could be interpreted in terms of neophobia or motivation to explore. The same authors observed a high degree of reliability for this variable. For buffaloes, due to the presence of the bulls in the herd, the test should be performed at the feeding rack for safety reasons.

Even though avoidance distance is deemed to reflect more appropriately the human-animal relationship from the animals’ perspective (Waiblinger et al., 2002), in dairy cattle a correlation between human behaviour and cow restlessness during milking was found (Breuer et al., 2000; Hemsworth et al., 2000). These authors observed that the use of negative tactile interactions, loud harsh vocalisations and quick movements had negative effects on animal calmness, whereas the use of soft and quiet vocalisations and movements produced opposite results. The presence of aversive handlers during milking also induced increased heart rate, cortisol levels and residual milk (Ruschen et al., 1999; Hemsworth et al., 2000); all of which are expressions of fear and stress. Buffaloes often tend to release the milk incompletely in response to various environmental factors, thus handlers make use of oxytocin injections to gather the residual product. Such injections can often cause iatrogenic abscesses. Recently, Salta-lamacchia et al. (2007) observed that positive interactions (talking quietly, petting and gentle touching) of the stockperson were negatively related to buffalo restlessness at milking. In addition, restlessness at milking was positively correlated to the use of oxytocin injections to allow a complete milk ejection. Prevalence of oxytocin injection proved to be highly reliable. However, these variables are time consuming and may be replaced with the prevalence of animals presenting iatrogenic abscesses in the hindequarter, although more studies on its reliability are needed.
**Indicators of positive animal welfare**

More comfortable lying postures (sternal recumbency with the head tucked against the flank and lateral recumbency with a higher number of stretched legs) may be a sign of reduced vigilance and/or thermal comfort and are likely to be assumed only if the animal confidence in the predictability of its environment is high (Grasso et al., 2003).

In cattle, a high degree of behaviour synchronisation (performed contemporary to other members of the group) within the herd may indicate a positive welfare state, in particular for subordinate animals (Metz, 1983). Theoretically, also in buffaloes subordinate animals may be able to meet their basic feeding and resting requirements displaying these behaviours when the competition for a particular resource is low (e.g. feeding at night and resting while the majority is involved in ingestive activities). However, their welfare state would be improved if they could choose, along with the other members of the group, when and where they perform such behaviours, thus allowing each animal, including the subordinate, to be fully integrated herd members.

As already stated for resting and agonistic behaviours, periods of increased expression and feasible methods should be identified before the inclusion of these behaviours in a buffalo welfare monitoring scheme.

A new methodology called “qualitative assessment of animal behaviour” has been primarily developed in pigs. It does not measure what an animal does, but rather describes how a subject interacts with the environment (Wemelsfelder et al., 2001). Recently, this method has been successfully applied also to dairy cattle (Rousing and Wemelsfelder, 2006), dairy buffaloes (De Rosa et al., 2003a) and horses (Napolitano et al., 2008). This method relies on a number of terms which are freely generated by observers. Thus, when positive aspects are observed they can be rated on a quantitative scale. The qualitative assessment method was firstly developed to describe the behaviour of the animals at an individual level. However, its integrative approach may facilitate the interpretation of separate behavioural and physiological measurements, thus allowing its application in animal welfare assessment at farm level. Both inter- and intra-observer reliability of qualitative assessment of animal behaviour were satisfactory (Wemelsfelder et al., 2001). As this method requires adaptation for on-farm welfare monitoring purposes, a fixed qualitative rating scale has been developed describing the expressive behavioural repertoire (‘body language’) of cattle (Wemelsfelder et al., 2006). This scale, after appropriate modifications, can also be applied to the buffaloes (De Rosa et al., 2007b).

**Housing factors**

The welfare of farm animals is not simply limited to the animal’s functioning and performance. They should also be able to develop normally and to express species-specific behaviours in order to adapt to the environment in relation to their innate natures. The provision of barren housing systems irrespective of the animals’ natural behaviour and needs may reduce the welfare of livestock such as buffaloes, which have been subjected to intensive farming in recent years. In particular, in recent years in order to improve milk hygiene and to reduce the time for cleaning the udder at milking as well as minimise disease transmission, potholes and pools, typical of the traditional system, have been abolished or in some cases replaced by spray systems. Tripaldi et al. (2004) and De Rosa et al. (2007a) observed that the provision of a housing system enriched with potholes and spontaneous vegetation, thus closer to natural conditions,
De Rosa et al. was able to improve the welfare of buffalo cows. These animals were able to express their species-specific natural behaviours, such as wallowing and grazing. Accordingly, a higher level of fertility was observed in buffalo cows which had access to a pool compared to animals provided with showers to facilitate thermoregulation (Zicarelli et al., 2001). In addition, a reduced calving interval and higher conception rate was observed in animals provided with a pool (Di Palo et al., 2001). Higher space allowance was also associated with higher milk production in buffaloes (Zicarelli et al., 2005; De Rosa et al., 2007a). Therefore, for on-farm buffalo welfare monitoring the provision of systems aiming at alleviating heat stress, particularly those allowing the expression of natural thermoregulatory behaviour, should be positively considered.

Conclusions

There is growing interest in the EU in promoting production and rearing methods which better consider domestic animal welfare than has been done hitherto. Therefore, in order to protect buffaloes from effects of the marked intensification of farming techniques detrimental to animal welfare the development of a monitoring scheme of welfare is needed. Its application may help to improve both the consumer perception of the chain production quality as well as farm management and housing conditions. It is essential that the final monitoring scheme developed within Welfare Quality® be as reliable as possible. Besides testing the large scale feasibility of the system, the data will be analysed and the measures further refined to produce a final scheme that has the desired balance between sensitivity and complexity for wide scale use. In addition, to inform consumers about the welfare status of the animals, the data will be integrated into a single overall assessment of animal welfare using the methods developed in multicriteria decision theory (Botreau et al., 2007).

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