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Assessing Animal Welfare Through Management, Productive and Reproductive Performances and Health Care in a Large Dairy Herd in the North of Tunisia

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Abstract: The objective of this study was to evaluate animal welfare in a large dairy herd in the north of Tunisia. Housing conditions, reproductive and productive performances and health care were studied to assess comfort of Holstein cows in the Complexe Agro-Industriel Ghzala Mateur (CAIGM). Data were collected on the housing system, reproduction (from 2000-2006), milk production (33,829 test-day records from 2004-2006) and culling and death incidence. Barns were found not to meet the standards for cows comfort. There was a degradation of housing conditions because sheds were implemented in low ground, barns concrete coating was deteriorating, litter was in bad shape and there was a persistent draught. Reproductive and productive performances and health indicators reflected also discomfort of cows. In fact, milk production level was low. Mean milk yield was 5150 kg (standard deviation = 1694 kg) recorded over a 320.3 days (standard deviation = 82 days) lactation period. Mean somatic cell count was 634.72×10^3 C mL^{-1} (standard deviation = 1598 C mL^{-1}), indicating probably a high mastitis infection rate. Results on reproduction showed limited fecundity and fertility of cows. Mean calving interval and insemination per conception were 445 days (standard deviation = 97 days) and 2.43 (1.6), respectively. Infertility, dystocia, post-partum calving, leg and metabolic disorders and lung diseases were the main causes of culling and death of cows. Animal welfare may be improved by continuous maintenance of barns and the improvement of housing conditions in the CAIGM in order to allow cows to perform up to their potential.

Key words: Dairy cattle, comfort, health care, reproductive performances, milk production

INTRODUCTION

Lensink (2006) stated that well being of an animal is attained when it reproduces and produces satisfactorily. This subjective notion of well being is an attempt to get closer to the physiological and psychological status of an animal. Lensink (2006) added that the notion of welfare or comfort is not easy to define for a living organism. Some definitions of welfare simply refer to the ideal harmony between an individual and his living environment which may ensure perfect physical and mental states, i.e. well being of an individual is reached when it can easily live in its environment in the absence of constraining factors (Lensink, 2006). Dawkins (1983) has stated that even though the well being is a subjective appreciation of what the animal feels, it can be objectively evaluated by various measurements such as ergonomics (Dawkins, 1983; Barnouin *et al*., 1999), measures of preference (Dawkins, 1983; Veissier *et al*., 1999) and measures of discomfort (Dawkins, 1983; Barnouin *et al*., 1999; Veissier *et al*., 1999). On the other hand, Lensink (2006) added that health status and productive and reproductive performances are a means for evaluating welfare in livestock. These indicators do however, report only lately on unfavourable conditions that the animal has encountered.

Although, links between the odds of deteriorating well being and lodging conditions exist, it may be difficult to establish strong liaison between the non respect of specific technical requirements (e.g., dimensions of building) and the effective state of comfort (Capdeville, 2003). Lensink (2006) summarized comfort in a way that the animal should not feel thirsty or hungry nor be underfed and lives in a comfortable covered space. That is, the living environment ensures protection of the animal from injuries and diseases and allows a normal behavior without anxiety and fear. Dudouet (2004) iterated that housing should not only ensure comfort but also successfully prepares for two critical phases in the production cycle: preparation for reproduction and parturition. Housing systems where animals are in permanent contact with concrete affect health and cause leg lameness (Webster, 2002), welfare (Hughes and

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Duncan, 1988; Singh *et al*., 1993) and productivity (Kossaibati and Esslemont, 1997) of dairy cows. Cows with leg lesions have their milk production reduced. Brisson (2006) showed that economic losses caused by leg lameness are important mainly when these troubles occur in the beginning of lactation. They are major reasons for the involuntary culling of cows because they also limit reproductive performances (Desrochers, 2005). Housing cows on concrete resulted in reduced detected oestrous compared to those recorded on cows housed on litter (Britt *et al*., 1986; Mee, 2004). On the other hand, the litter hygienic state considerably determines somatic cell counts in milk and the occurrence of mastitis in dairy herds. In fact, lower somatic cell counts were found in herds with better hygienic conditions compared to those recorded in other herds with less favourable conditions (Mtaallah *et al*., 2002; Barnouin *et al*., 2004). A badly maintained litter favors pathogen multiplication and may cause clinical and sub-clinical mastitis infections (Mtaallah *et al*., 2002).

The objective of this study was to assess animal welfare by evaluating housing conditions, reproductive and productive performances and health care in a large dairy herd in the north of Tunisia.

MATERIALS AND METHODS

Site of the study: The region of Mateur in the north of Tunisia has a typical Mediterranean climate with two distinct periods: a humid cool winter season and a hot dry summer season. Dominating winds come from the north-west and are intense during the winter season. Hot dry winds are frequent during July. The herd in this study, is part of the Complexe Agro-Tndustriel Ghezala Mateur (CAIGM), a governmental herd managed by the Office des Terres Domaniales (OTD). More than 50% of the soil in the CAIGM is on a plain ground.

Animals: There were 1023 Holstein cows on an intensive management system with no grazing. Cows were housed in 6 barns, each of which was divided into 4 lots. Each pen has around 43 cows. All barns were in free stalls on area covered with straw.

Data collection and description

Housing: The appreciation of the housing system was done by direct observations on conception of buildings and environmental conditions and measures of actual dimensions of locals. Retained records were on barns orientation and implementation, roof types, resting alley per cow, coating type of soil and watering place, ventilation, light and strap systems.

Reproduction: Collected records were on detected oestrous, insemination, conception and calving dates in addition to eventual treatments of reproductive disorders that may have been administered for each cow. Reproduction parameters that were computed included conception rate in the first insemination, (CRI1), percent of non conceived cows after >3 insemination (% more than 3IA), services per conception (IC), calving interval (IVV), calving to first insemination interval (IV-I1) and calving to conception interval (IV-If). Records were for the 2000-2006 period on 2420 cows.

Milk production: There were 33829 test-day milk records collected between 2004 and 2006. Each record included the cow identification number, the rank of lactation, milk yield and the somatic cell count (SCC). Only the first 10 test-day records per lactation were retained. Biologically unacceptable daily milk quantities (<3 or >80 kg) were omitted. No edition was done for SCC. After edition, 26243 test-day records of 3826 lactation remained. Total milk production was determined using the interval method.

Health disorders: Records on various heath troubles, culling and deaths were obtained for the 2004-2006 period and percentages of culling and deaths by major reasons were computed.

RESULTS AND DISCUSSION

Housing environmental conditions: All barns are semi open buildings with free stalls and grounds are partially covered with straw. Barns have central feeding corridors and rest areas were entirely covered with straw. Roofs of barns were in steel and have double sloping. These barns are sufficiently distant from one another and were implemented on low ground. Buildings have their closed side against dominating winds. The access to these buildings is often not easy because of replenished and uncovered roads, which may hamper fluent management activities (feeding, cleaning, etc.).

The resting alley was coated with concrete and is 30 cm above the level of the feeding area. Each cow has at its disposal 3.5 m^2 to lie down when 6-7 m^2 per cow are required in straw covered areas (Lagrenge *et al*., 2006). These dimensions are the minimum required for the cow to be able to move and lie down comfortably in order to avoid injuries and unrest (Ferouillet and Carrier, 2003). The feeding area was around 2.1 m^2 and entirely covered with concrete. Feeding area was 0.7 m/cow. The feeding alley was 4 m width and was also covered with concrete. This corridor allows mechanic manoeuvre necessary for feeding and manure evacuation. Available water is of a good quality (originating fro a barrage) and collective watering places are found in each lot. Barns are equipped with light bulbs (36 watt) to facilitate controls during the night.

Appreciation of cows welfare in the housing environment: Ventilation in the barns is static given buildings are semi-open. Air is permanently changing and hot air is evacuated through the roof. Even though the ventilation system may help reduce heat stress, high temperature and humidity in the summer season are unbearable by cows (Bouraoui *et al*., 2002). High temperatures unfavourably affect fertility of dairy cows (Bouraoui *et al*., 2002). On the other hand, the current of air is a challenge for animals in the winter season.

Straw is the only type of litter used in the CAIGM barns. Three to five kg of straw per cow, are used on a daily basis. However, maintaining animals clean in a straw covered area requires 5-7 kg of straw. De Passille (2005) suggested that straw is an effective means for thermal isolation if the frequency of changing the straw is sufficient, otherwise, unchanged wet straw may enhance bacterial contamination. At the CAIGM, the use of a new straw depends on the litter state, while manure evacuation is done monthly during hot months and twice a month during the humid season. A humid litter is one of the major problems, that faces cows in the CAIGM (Fig. 1 and 2).

Cows stay standing on concrete area during feeding. These areas are often wet during bad weather because barns were implemented on low ground (Fig. 2). Wet grounds covered with manure considerably increase sliding and falling down and reduce mobility of cows. De Passille (2005) also reported that wet damaged concrete are associated with leg troubles (Fig. 3). Bouchard (2003) found that cows with medium to high leg lameness scores have IV-IA1 and IV-IF intervals longer than cows with low lameness scores and consequently a reduced fertility. In fact, Desrochers (2005) suggested the installation of soft undamaged floors where cows walk and stand up for long time. Limping cows prefer walking on soft dry floors to reduce pain. Some cows in the CAIGM had damaged teats or have lost a whole quarter (Fig. 4). Cows may have their teats damaged when they slide on a wet floor. Ferouillet and Carrier (2003) reported that weakened cows following calving or from sickness or those with developed mammary have greater risks of teat injuries by sliding on damaged wet floors. Therefore, litter should be frequently changed, sufficient and maintained clean and dry to avoid mammary gland injuries and reduce mastitis incidence.

Drinkable water is available through collective watering places and cows do not have to move long

Fig. 1: Resting area in the winter season

Fig. 2: Feeding area in the winter season

Fig. 3: A limping cow

Fig. 4: A cow with teat trauma

distances to reach water. The access to water becomes difficult when the floor becomes wet in rainy days which may reduce water consumption by cows. Those cows are fed through pipe stalls with an American strap system. These pipe stalls are vertical and do not have a 20° inclination recommended for the comfort of the animal (CIGR, 1994). Inclining the pipe stalls would ease feed consumption by cows and reduces injuries (CIGR, 1994). Many cows had lesions in the neck. These lesions occur when tie stalls are low (Ferouillet and Carrier, 2003). The height of the pipe stalls was 115 cm initially meant to host Friesian cows while Holstein cows have greater stature (Anderson, 2002). They are up to 150 cm in height in their first lactation.

Cows performances indicators

Milk production: Mean milk yield for all lactations using the interval method was 5150 kg (S.D. = 1694 kg) over a 320.3 days (standard deviation = 82 days) lactation period (Table 1). This performance level is lower than that (6548.5 kg) reported for first lactation cows in 351.1 days (Rekik *et al*., 2006). The mean SCC was 634.72×10^3 C mL^{-1} (Table 1) and the standard deviation was large (15989) implying an important heterogeneity of the quality of produced milk. Somatic cell level in the milk tank in the CAIGM is higher than that reported by Normand *et al*. (2000), in the US which was near 310×10^3 C mL^{-1}, but is still comparable to that found by Mtaallah *et al*. (2002), in 21 Tunisian farms. Somatic cell levels found for the French dairy breeds ranged from $133\text{-}215\times10^3$ C mL^{-1} (Rupp *et al*., 2000). Furthermore, marketable milk should include less than 750×10^3 C mL^{-1} in the US and less than 400×10^3 C mL^{-1} in the EU countries (Miller *et al*., 2004). High somatic cell milk content found in this study, may probably indicate high mastitis infection rate. Actually, housing conditions were unsatisfactory because of wet litter and a limited resting area per cow. Cows in most of herds in the study by Mtaallah *et al*. (2002) had sufficient resting area at their disposal.

Reproductive performances: Almost all computed reproduction parameters were below expectations during the last 7 years in the CAIGM. Fertility and fecundity in the herds are unsatisfactory nearing a critical situation (Table 2 and 3). Actually only 17.8% of cows were inseminated between 70 and 90 days post-partum and only 28.4 of cows had IV-I1 intervals between 45 and 70 days (Table 2). The number of cows inseminated beyond 90 days post-partum was very high (40%). The ideal for putting dairy cows to reproduction after calving is between 45 and 70 days. A lengthened interval before conception following calving would lengthen the IV-V

Table 1: Means of daily somatic cell count (CCS), milk yield and days in milk (DIM)

	N	Mean	S.D.	Min	Max
CCS (10^3C mL^{-1})	6537	634.72	1598.93	2	28945
Milk yield (kg)	2732	5150	1693.63	700.30	11417
DIM (d)	2732	320.3	81.5	80	439

Table 2: Fecundity of dairy cows in the CAIGM[1] herds (2000- 2006)

Fecundity measure	Class	Percentage	Objective (%)
Calving to first insemination interval (IV-IA1)	IV-IA1≤50	14.8	0
	50<IV-IA1≤70	28.4	100
	70<IV-IA1≤90	17.8	0
	IV-IA1>90	39.0	0
Mean IV-IA1 (d)	-	93 (51)[a]	
Calving to conception interval (IV-IF)	IV-IF≤90	29.1	
	90<IV-IF≤110	10.2	
	1V-IF>110	60.7	>25
Mean IV-IF (d)	-	154 (86)[a]	
Calving interval (IV-V)	IV-V≤365	24.8	0
	365<IV-V≤400	17.0	100
	IV-V>400	58.2	0
Mean IV-V (d)	-	445 (97)[a]	

Table 3: Fertility of dairy cows in the CAIGM[1] (2000-2006)

Fertility measure	Realised (%)	Objective
Conceptions per first insemination	34.5	>60
Percentage of return rate after more than 3 insemination (% 3IA et +)	36.8	<15
Services per conception (IC)	2.43 (1.6)[a]	<1.6

[a]Standard deviation; [1]Complexe Agro-Industriel Ghzala Mateur, Tunisia

interval and reduces fecundity of dairy herds. Cows conceived before 90 days post calving represented around 29.1% of total cows, which is far below the 85% advanced by Bonnes *et al.* (2005). Conceived cows between 90 and 110 accounted for 10.2% of total cows when it is recommended that the maximum of cows (if not all) should have IV-IF intervals lower than 110 days (Bonnes *et al*., 2005). In the CAIGM, more than 60% of cows have IV-IF intervals >110 days. Cows with one calf per year represented only 24% while those calving in more than 400 days were around 50%. Those figures are unsatisfactory given that milk production is too low to keep cows producing for long periods of time.

Fertility of the herd was also unsatisfactory. Only 34.5% of cows conceived a fter the first insemination, far below the 60% objective. On the other hand, the percentage of cows that required >3 inseminations to conceive was up to 36.8%, indicating a low fertility level. The IC (services per conception) was also high (2.34) greater than the 1.6 value recommended in dairy cows (Metge, 1990).

Health status: Culling and mortality rates of cows were 25 and 5.4%, respectively. Major reasons of culling and deaths of cows are given in Table 4 and 5. Infertility (Table 4) was the main reason (40%) for culling in the CAIGM. The percentage of culled cows for advanced age was 23.7%. According to Metge (1990), conception

Table 4: Major reasons for culling dairy cows in the CAIGM

Reason	(%)
Advanced age and general weakness	23.7
Repeated abortion	1.8
Leg lameness	21.0
Respiratory troubles	18.8
Chronic diarrhoea	5.8
Infertility	33.9
Uterine infection	5.4
Low milk production	1.8
Dystocia and post-partum disorders	6.3

Table 5: Major reasons of death losses of dairy cows in the CAIGM[1]

Reason	(%)
Advanced age and general weakness	4.0
Respiratory troubles	21.6
Uterine infection	5.9
Metabolic troubles	19.6
Dystocia and post-partum disorders	48.9

[1]Complexe Agro-Industriel Ghzala Mateur, Tunisia

rate is maximal in heifers, lower in lactating cows and decreases with age. On the other hand, post-partum health disorders increase and fertility rates decrease with age. Leg lameness, as expected, was an important reason for culling cows (21%) in the CAIGM (Table 4). Leg lesions are not only a source of unrest for cows, but also limit their movement and consequently limit feed consumption and reduce reproductive performances. Health disorders could be reduced in the CAIGM by improving litter quality and continuous maintenance of the hard damaged concrete ground. That is, improving housing conditions to facilitate safe movements of cows in the barns. Respiratory pathologies resulted in high number of culling that reached 18.8 and were the cause of 21.8% of death losses (Table 4 and 5), which can be easily avoided by reducing air currents during the winter season (Maillard, 2005). Post-partum pathologies accounted for almost 50% of cows deaths. In addition to deaths, post-partum disorders reduce production and reproduction performances and increased veterinary costs. There were also deaths incurred by metabolic disorders. The percentage of these deaths was around 19.6%, which is in relation to the feeding system and management.

CONCLUSION

In this study, the focus was on the welfare of dairy cows in a large herd in the north of tunisia. The housing system was found to be a source of unrest for cows. Deteriorating housing conditions were mainly caused by the implementation of barns in low ground which increase humidly in the wet season. Furthermore, the ground was made of hard and damaged concrete. With increased humidly, the ground becomes wet and risky for cows. It causes not only the unrest of animals but also leg lameness, accidents and limited movements. Unrest and difficulties in movements reduce food consumption, hamper reproduction and limit economic returns of dairy operations. In fact, milk production was low and fecundity and fertility parameters were unsatisfactory. Furthermore, high percentages of deaths and culling were caused by deteriorating housing conditions. Infertility, dystocia, post-partum disorders, leg lameness and respiratory and metabolic pathologies were the major reasons for culling and death losses of dairy cows in the CAIGM. Improving housing conditions and monitoring feeding and calving may substantially improve living conditions of cows and consequently improve reproductive and production performances.

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