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Dairy Cattle Welfare Status Measured by Animal-Linked Parameters Under Tunisian Rearing Conditions

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Additional information is available at the end of the chapter

1. Introduction

To enhance food production and maintain the competitiveness of Tunisian animal agriculture in the global economy, it is imperative that the agricultural industry has access to cutting edge scientific information on animal welfare. The issue of animal welfare has received significant attention from major grocery and food service companies in the world. Animal welfare is also an important issue for consumer confidence in animal production. There are many definitions of the animal welfare. The welfare of an animal has been defined by Fraser and Broom (1990) as its state at it seeks to cope with its environment. Welfare principally concerns both the physical and psychological wellbeing of an animal, which is largely determined by the standard of stockman ship, the system of husbandry and the suitability of the animal f or the environment (FAWC, 2009). Nowadays, the evolution of the worldwide agriculture has come to raise new aspects, and animal welfare is one of them. Public concern about farm animal welfare has steadily grown during recent years. In this context, welfare assessment has many roles such as identifying current welfare problems, checking farm assurance, indicating risk factors leading to a welfare problem, testing the efficacy of interventions, researching tools for evaluating and comparing production systems, environments, management systems, animal genotype etc. (Whay, 2007). Hristov et al. (2008) reported that there is major public demand for improvements in animal welfare, housing conditions and health aspects. The assessment of welfare at farm level can be used as an advisory tool by farmers, as source of information for legislation and as a component of quality assurance schemes for consumers (Napolitano et al., 2005; Webster, 2005; Vučinić, 2006). Welfare is multidimensional and it cannot be measured directly, rather it is inferred

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from external parameters. Therefore, different methods of on-farm monitoring of animal welfare have been developed (Johnsen et al., 2001). Animal welfare (AW) can vary substantially between similar productions systems indicating the major influence of management and it needs to be assessed through indirect indicators (Rousing, 2003; Sørensen et al., 2003). In fact, productivity can be used as an indirect measure of animal welfare (Waiblinger et al., 2002; Breuer et al., 2003). In high-performing dairy herds, cattle that have a positive relationship with their handlers tend to move more quickly into the milking parlor, have smaller flight zones, and are less nervous and more settled (Breuer et al., 2000; Hemsworth et al., 2000; Waiblinger et al., 2002). Adopting this approach to animal care and management can result in greater ease and efficiency of management as well as reduced production losses and, in some cases, increased productivity. A decrease in productivity, such as a drop in milk yield, can indicate a welfare problem. Likewise, decreases in reproductive rates or increases in mortality or morbidity should be clear signs that the welfare of livestock is declining. Illness and injury can indicate poor welfare. Other symptoms of problems are changes in behavior; animals that are lethargic, unwilling to move, or that have become aggressive are unlikely to be doing well (Pawelek & Croney, 2003). The physiological and behavioral responses of dairy cattle to stress can reduce their productivity, their health and their welfare. Dairy cattle that have been selected for high milk production seem particularly susceptible to stress and are at more risk of behavioral, physiological and immune problems and so require higher levels of care and management (Oltenacu & Algers, 2005).Therefore, the main aim of this research was to characterize animal welfare issues under Tunisian conditions by measuring welfare of Holstein population cows through some animal-related measures and testing reactions of cows towards humans on the hypothesis that these reactions reflect validly the human–animal relationship on these farms.

2. Material and methods

The animal-based parameters include observations of physical conditions, animal behaviour observations and examination of the farm's recording. Each selected parameter was included on either the animal observation or record data collection forms. Different approaches for assessing animal welfare at farm level have been developed often with quite different purposes (Johnsen et al. 2001). The scientific assessment of the well-being of an animal involves finding indicators of three broad criteria: 1) a high level of biological functioning; 2) freedom from suffering in the sense of prolonged fear, pain, and other negative experiences; and 3) positive experiences such as comfort and contentment.

2.1. Farms and animals

Information was collected during farm visits to 35 dairy farms located in four Tunisian provinces (Nabeul, Sousse, Monastir and Mahdia). Farms were selected from a sample of 50 cattle farms that responded to a questionnaire. Selection criteria for farm visits were a

minimum herd size of 10 Holstein cows, and participation in milk recording. The herd size of the farms ranged from 10 to 50 lactating animals. The sample was then taken randomly from the farms that fulfilled these criteria. The study was carried out in the Tunisian Sahel. Thirty five farms with horned dairy cows in loose housing were selected for the investigation. There were three types of loose housing: cubicle housing (16), straw bedding pen (15) and straw flow pen (4). On all farms, the rearing method was similar (artificial insemination, calves being separated from the mother at the age of 1 to 7 days and fed by man). Thus all cows were artificially reared and suckled by man, giving all cows a certain degree of habituation to and contact with farmers. A total of 350 Tunisian Holstein cows (46%) heifers (H) and (54%) cows (C) were included in the study.

2.2. Assessment of animal welfare indicators

Welfare assessment systems, for use in dairy farms may differ according to both the definition of animal welfare, and the purpose of the welfare assessment. Thus choice of welfare indicators and methods of measurement reflects the basic considerations of how animal welfare is understood. If the farmer wants to improve animal welfare he needs a method to assess animal welfare at herd level. A relevant welfare assessment system should describe the welfare of the animals in the herd, and allow the farmer to assess the development over time and to respond appropriately. Many indicators may possibly be relevant for inclusion in an operational welfare assessment system. So far, assessments of animal welfare relied mainly on resource-based parameters, i.e. measures taken regarding the environment in which the animals are kept, while animal-based measures aim to directly measure the actual welfare status of the animal and thus include indirectly the effect of resource and management factors as well, because of their effect on the animal. Performance and behavior measurements and behavior tests were performed to show whether the animals were adapting to the production system or whether the animals showed any signs of strain. Animal behavior of 10 cows randomly assigned was recorded through one visit in each farm.

2.2.1. Milk yield

A key issue is the extent to which genetic selection for increased production affected the ability of the animals to adapt to the environment in which they find themselves. Reviewing the negative side-effects of selection for high production, Rauw et al. (1998) concluded that "when a population is genetically driven towards high production, fewer resources will be left to respond adequately to other demands like coping with stressors". The key problem as noted by Rauw (2008) is that high productivity in farm animals could mean that there are insufficient resources for adequate coping and hence poor welfare whenever resources are limiting. Data on milk traits (production, fat and protein) of seven consecutive years (2002-2008) were obtained from the official recordings of the farm. Cows which have more than 10 records during complete 305-days lactation were considered. Milking was carried out twice daily.

2.2.2. Fertility

There are strong motives for including reproduction in selective programs, both economical and welfare related (Berglund, 2008). Female fertility cannot be easily defined as a single trait as it comprises different aspects. Some of these aspects are related to the prompt resumption of cyclicity and the showing of recognizable oestrous behavior, while others are related to the ability of the cow to become (and remain) pregnant with a limited number of inseminations (Groen et al., 1997). In addition, cows should have good calving ability and give birth to viable calves (Berglund, 2008). Calving to first service interval (CFSI), calving interval (CI), calving to conception interval (CCI), and number of services per conception (NSC) were extracted from the records of individual cows in each farm. Farmers were also surveyed about aspects of their management system relating to age at first calving of heifers and their management of reproductive health and fertility.

2.2.3. Mastitis and Somatic Cell Counts (SCC)

Data for individual cows were extracted from the farm records and edited to include records from the first three lactations. Data contained multiple somatic cell count (SCC) measurements made during the lactation months for each cow and the number of cases of clinical mastitis. SCC was log-transformed. The lactation number, milk yield, stage of lactation and season of calving are all factors known to affect somatic cell count (Dürr et al. 2008), so they were all included in the analysis. The age of the cow at which it enters each lactation is also known to affect SCC. The total number of cases of mastitis and the number of cows which were treated twice or more were calculated. As many cows received repeated treatments for mastitis, it was necessary to use a criterion to define what a new case was, and what a repeated treatment was. Any treatment started on a new quarter was considered a new case. Any re-treatment of a single quarter within a period of 8 days was considered a repeated case, and greater than 8 days was considered a new case. The number of cases was converted to cases/cow-year for analysis.

2.2.4. Body condition scoring

Every dairy producer has cattle that are too fat or too thin for their stage of lactation. The scoring method involves a manual assessment of the thickness of fat cover and prominence of bone at the tail head and loin area. Methods for assessing energy reserves, the role of assigning BCS in dairy management, and the impact of varying BCS on animal productivity, health, and reproduction are explored from a whole-system viewpoint. Most body condition scoring (BCS) systems in dairy cattle use the 5-point scoring system with quarter point increments. The scale used to measure BCS differs between countries, but low values always reflect emaciation and high values equate to obesity. Visual body condition scores were recorded for all milking cows on the farms. A body condition score is assigned by visual observation of the cow's rump area—primarily the region delimited by the hip bones, the pinbones and the tailhead as shown in figure 1.
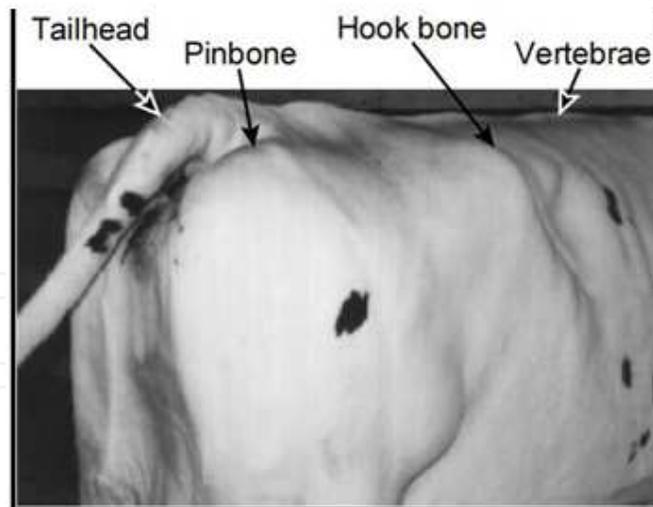
**Figure 1.** Identification of some body parts used to assign body condition scores (Ferguson et al., 1994).

Cows are usually ranked on a scale from 1 to 5. Extremely thin cows are assigned a score of 1 and extremely fat cows, a score of 5 (Fig. 2).

Figure 2. Dairy Cattle Body Condition Scoring Chart (Edmonson et al. 1989)

A body condition score of 1.5 one or two months after calving is not desirable because it indicates severe lack of adequate nutrition (negative energy balance, Fig. 3a). A body condition score of about 3.0 (Fig. 3b) should be typical of a cow recovering body reserves in

mid-lactation (Sprecher et al. 1997). In late lactation and during the dry period,a body condition score of 3.5 may be the most desirable. This body condition score gives the cow sufficient body reserves to minimize the risk of complications at calving while maximizing milk production in early lactation. As milk production declines in late lactation, cows gain body weight efficiently. Overfeeding concentrate is common management mistake. Cows fed too much concentrate in the later part of lactation tend to become obese (Fig. 3c).These cows are likely to have difficult calving and to develop other disorders (fat cow syndrome).

| 1.5 (A) | 3 (B) | 4 (C) |
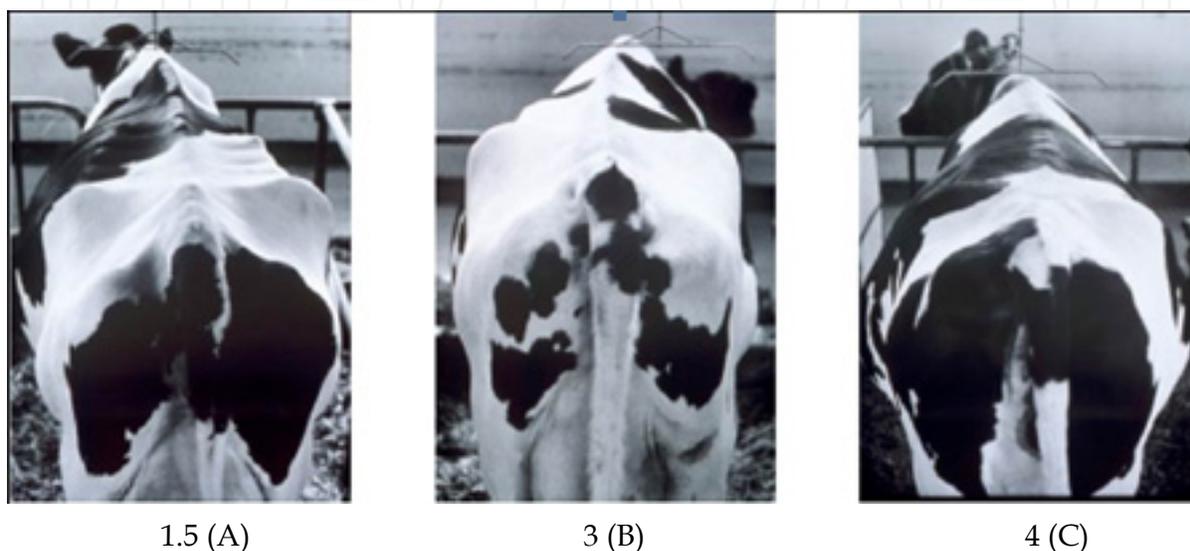
Figure 3. Examples of cows with body condition scores of 1.5 (A), 3 (B) and 4.5 (C) (Sprecher et al. 1997)

2.2.5. Avoidance distance test

The human–animal relationship is an important issue when assessing animal welfare on farms. In many farm animal species, the relationship to humans affects their welfare considerably. A feasible, reliable methodology for assessing responses of cows to humans would be helpful for large scale surveys on this topic. Measuring avoidance distance to assess animals' relationship to humans was shown to be a feasible and stable measure in dairy cow herds (Waiblinger et al. (2003). The measure of avoidance distance was inspired from the method of Waiblinger et al. (2003) and it consists of estimating this distance at the feeding rack (ADF) and inside the stall (ADS). The test person approaches slowly to the animal and the distance was calculated at the moment of withdrawal of the animal or at the moment of touching.

2.2.6. Lameness scoring

Dairy lameness is a very visible well-being issue as well as a production and economic issue. A locomotion score is a qualitative index of a cow's ability to walk normally. Locomotion scoring is a relatively quick and simple qualitative assessment of the ability of cows to walk normally. Visual locomotion scoring of cows is normally used in lameness research as a method to identify lameness. Visually scored on a scale of 1 to 5 (Table 1), where a score of 1

reflects a cow that walks normally and a score of 5 reflects a cow that is three-legged lame, a locomotion score is made in a few seconds per cow. Generally locomotion scores of 2 and 3 are considered to represent subclinically lame cows whereas locomotion scores of 4 and 5 represent those cows that are clinically lame. A locomotion score higher than 1 is not an indication of why the cow's gait is affected, merely the degree of lameness that she is showing (Sprecher et al. 1997).

Score	Clinical description	Description
1	Normal	Stands and walks normally with a level back. Makes long confident strides.
2	Mildly Lame	Stands with flat back, but arches when walks. Gait is slightly abnormal.
3	Moderately Lame	Stands and walks with an arched back and short strides with one or more legs. Slight sinking of dew-claws in limb opposite to the affected limb may be evident.
4	Lame	Arched back standing and walking. Favoring one or more limbs but can still bear some weight on them. Sinking of the dew-claws is evident in the limb opposite to the affected limb.
5	Severely Lame	Pronounced arching of back. Reluctant to move, with almost complete weight transfer off the affected limb.

Table 1. Description of the scale used for scoring lameness (Sprecher et al. 1997)

2.3. Statistical analysis

The data obtained was statistically analyzed using the SAS statistical package, version 9.1 for Windows (SAS Institute Inc, 2006). Spearman correlation was used to determine relationships between variables. Differences in mean values and proportions were respectively examined with t-test and Fisher's exact test, and Kruskal-Wallis test was used for pair-wise comparisons. Analysis of variance (ANOVA) using the General Linear Models procedure with t-test (least-significant-difference, LSD) was used for comparison of avoidance distances. Differences of $P<0.05$ were considered statistically significant. Non parametric tests (Spearman rank correlation, and Kruskal-Wallis test) were used due to the non-normality of the data and the small sample size of the farms (n =35). By using the Kruskal–Wallis test and Mann–Whitney U-tests, it was investigated if farms differed significantly in distribution of age (based on the average herd age). Furthermore, the Kruskal–Wallis test was used to evaluate if farms differed significantly with respect to avoidance distances. For lameness score, a screening process was used whereby each explanatory variable was tested in a univariate analysis. For SCC, hock damage and some aspects of behavior, a LMM (Linear Mixed Models) were used (data had normal distributions, or could be transformed to give a normal distribution).

3. Results

Many welfare problems are the result of animals not being fully adapted to the production system. The consequences of poor welfare include those of disease, injury, starvation, beneficial stimulation, social interaction, housing conditions, deliberate ill treatment, human handling, transport, laboratory procedures, various mutilations, veterinary treatment or genetic change by conventional breeding or by genetic engineering (Broom, 1996).The rapidly changing conditions prevent animals to adjust and cope with the changes (Halverson, 2001). The overview should give the farmer a clear picture of the actual welfare status of the farm. This is a prerequisite when determining the priority of animal welfare considerations in a whole farm framework.

3.1. Milk production

The increase in production has been accompanied by declining ability to reproduce, increasing incidence of health problems, and declining longevity in modern dairy cows. Genetic selection for increased milk yield increasingly is viewed as increasing profit at the expense of reducing animal welfare. The average 305-d lactation milk yield was 5953 kg (with 3.46 and 3.16% content of milk fat and protein, respectively). On average, milk yield at the peak was about 25 kg, and there were a few cows with production exceeding 35 kg. We noted that average milk production varies with herd size. Indeed, according to this study, larger herds showed serious losses in production as herd size increased. In opposition, smaller herds were less affected (P<0.001) as herd size varied. On the other hand the lower value of fat composition indicated a poor health and therefore a poor welfare. Multivariate analyses with the GLM procedure revealed herd size as significant influence on milk production (coefficient of determination r^2 = 0.504) as shown on table 2.

3.2. Somatic cell count

Somatic cell counts (SCC) have long been used as a way of measuring milk quality. And high SCC levels in the milk cause deterioration of the milk quality. The average somatic cell counts amounted to 427.3±90.12 x 1000 cells/ml. Smaller farms had a lower somatic cell count. SCC increased with lactation number (P<0.001) and varied with stage of lactation in a quadratic manner (P<0.001). SCC was highest in the autumn period (P<0.001) and it was associated with cow milk yield (P<0.001). The size of the groups that the animals were housed in also affected SCC, with larger group sizes having the lowest cell counts (F=3.20, P<0.05). However, the season of calving was not significant (P=0.09). Today, mastitis is considered to be a multifactorial disease, closely related to the production system and environment that the cows are kept in. Mastitis risk factors or disease determinants can be classified into three groups: pathogen, host and environmental determinants.

3.3. Fertility

Reproductive performance in dairy cows remains one of the most intriguing issues in cattle production, not in the least because of the complex interactions between different systems

resulting in certain fertility and of the continuous challenges to improve (herd) fertility results. There has been a gradual decline in dairy cow fertility. Fertility traits were 444±101.5, 154±78.4, 82±56.8 days and 2.1±1, respectively for CI, calving to conception interval (CCI), calving to first service interval (CFSI), and NSC. Cows were on average 6.0±1.0 years old. (Table 2). This decline of fertility can be considered an indication of the health costs of the milk production of today's dairy cows.

	All farms	1-10	11-20	>20
Cows (n)	35	16	12	7
MY (Kg)	5953	5678a	6054b	6247b
SCC (1000 cells/ml)	427.3	447a	387b	378b
CI (days)	444	478a	437b	435b
CFSI (days)	82	87a	78b	73b
CCI (days)	154	159a	147b	145b
NSC	2.1	2.3a	1.8ab	1.6b
Age (years)	6	6.3a	6ab	5.8b
Culling rates (%)	23.5	23.8ab	21.8a	27.01b

Different letters indicate significant differences within that part of the column (P<0.05)
MY= Milk yield; SCC= Somatic cell count; CI= Calving interval; CFSI= Calving to First Service Interval; CCI=Calving to Conception Interval; NSC= Number of Services per Conception.

Table 2. Animal-related parameters and selected key features (possible influences) of investigated farms

3.4. Body Condition (BC) scoring

Condition scoring is a technique for assessing the condition of livestock at regular intervals. The purpose of condition scoring is to achieve a balance between economic feeding, good production and good welfare. The body condition score (BCS) of a dairy cow is an assessment of the proportion of body fat that it possesses, and it is recognized by animal scientists and producers as being an important factor in dairy cattle management. Body condition score (BC) ranged from 1.25 to 4 (lactating cattle). The majority of cows were BC score 2.5 (50% cows). The majority of dry cows were BC score 2.75 (65% cows), ranging from BC score 1.5 to 4. We considered a BC score of 2 or less to be classified as 'thin'. The mean number of lactating cows in this category on all farms was 18.9 ± 1.9%, however, this ranged from 1% to 57% of the herd. Body condition affects productivity, reproduction, health and longevity of dairy cows.

3.5. Avoidance distance

The variation in the response of animals to the avoidance distance test is shown in table 4. Individual avoidance distances ranged from 0 to 1.5m, and the percentage of animals that could be touched on a farm ranged from 41 to 97%. Farms differed significantly with respect to individual avoidance distances (P< 0.001) with a minimum farm median of 0.05 m and a maximum farm media of 0.15 m. There was a small but significant correlation between the avoidance distances of individual animals and age (r= -0.14, P= 0.015). At farm level, none of the ADF farm measures was significantly related with mean age of cow (P>0.05). (Table 3)

	Mean	Median	S.D.	Min-Max	25%- 75%	n
			Individual level			
ADF(m)	0.13	0.07	0.141	0- 1.5	0.05 – 0.2	-
			Farm level			
ADF mean (m)	0.13	0.14	0.034	0.08 – 0.18	0.11 – 0.16	10
ADF median(m)	0.08	0.07	0.035	0.05 – 0.15	0.05 – 0.10	10
ADF % touch	61.45	50.75	10.72	39.8 – 70.9	42.5 – 62.5	10
ADF% > 0.2 m	17.4	18.7	8.9	1.8 – 29.2	9.1 – 25.1	10

S.D. standard deviation, 25% and 75% percentile.

Table 3. Descriptive statistics of the different measures calculated for the avoidance distance at the feeding place test (ADF)

Analysis of variance showed a significant difference (P<0.05) between cows and heifers regarding avoidance distance. We conclude that cows have an ADF of 0.33 ± 0.17 m which is considered short compared to those of heifers (0.56±0.37 m), but no significant difference (P=0.11). Regarding ADS, indeed they have similar behavior in the stall. The proportion of animals with ADF 0 were 22 % and 31 % in heifers and cows, respectively and those of animals that tolerated to be touched for 3 seconds and more (ADF0 ≥ 3s) were 24 % and 50 % in heifers and cows, respectively. (Table 4)

|	Avoidance distance (m)		
	Low	Medium	High
ADF-H	0.63±0.07	0.45±0.15	0.47±0.08
ADF- C	0.28±0.01	0.35±0.06	0.26±0.14
ADS-H	1.05±0.10	1.09±0.44	1.01±0.9
ADS- C	0.89±0.16	0.74±0.17	0.88±0.12

No differences were found with Proc GLM (t-test + LSD) (P<0.05); H heifers and C cows.

Table 4. Avoidance distance dairy heifers (H) or cows (C) when tested in the feeding rack (ADF) or inside the stable (ADS) (means ± SEM).

3.6. Lameness

Disease can be regarded as an important welfare indicator, because it is in many cases associated with negative experiences such as pain, discomfort or distress. One indicator in a welfare assessment, at farm level, may be the prevalence and intensity of certain health problems in the herd. Lameness in dairy cattle is an important welfare issue. It certainly stands out as a consequential and complex welfare problem in dairy cattle. Furthermore, the Farm Animal Welfare Council (1997) considers lameness among the best welfare indicators for dairy cattle. The complexity arises because lameness is an obvious sign of many clinical, environmental and management problems (Logue et al., 1998; Ward, 2001). Many factors influence hoof health including genetics, conformation, diet, contagious agents, and hygiene, housing system, animal behavior and management. Regarding lameness, it had a reduced proportion, only 19 cows of 350 (5.4%) showed moderate lameness. A strong increasing trend in the proportion of cows with painful lesions was detected. In both lame

and nonlame cows, the greatest proportion of time was spent grazing (~34%), followed by lying with or without ruminating (approximately 29 and 18%, respectively), with <10% time spent in each of the remaining behavioral states (Fig.4). Throughout, lame and nonlame cows spent similar proportions of time grazing, drinking, or ruminating, but lame cows spent less time elevated on their feet (includes standing with or without ruminating, drinking, grazing and walking) and lay down for longer (includes lying with or without rumination). In both lame and nonlame cows, from early morning to midday to evening, the

a)

b)

c)

d)

e)

f)
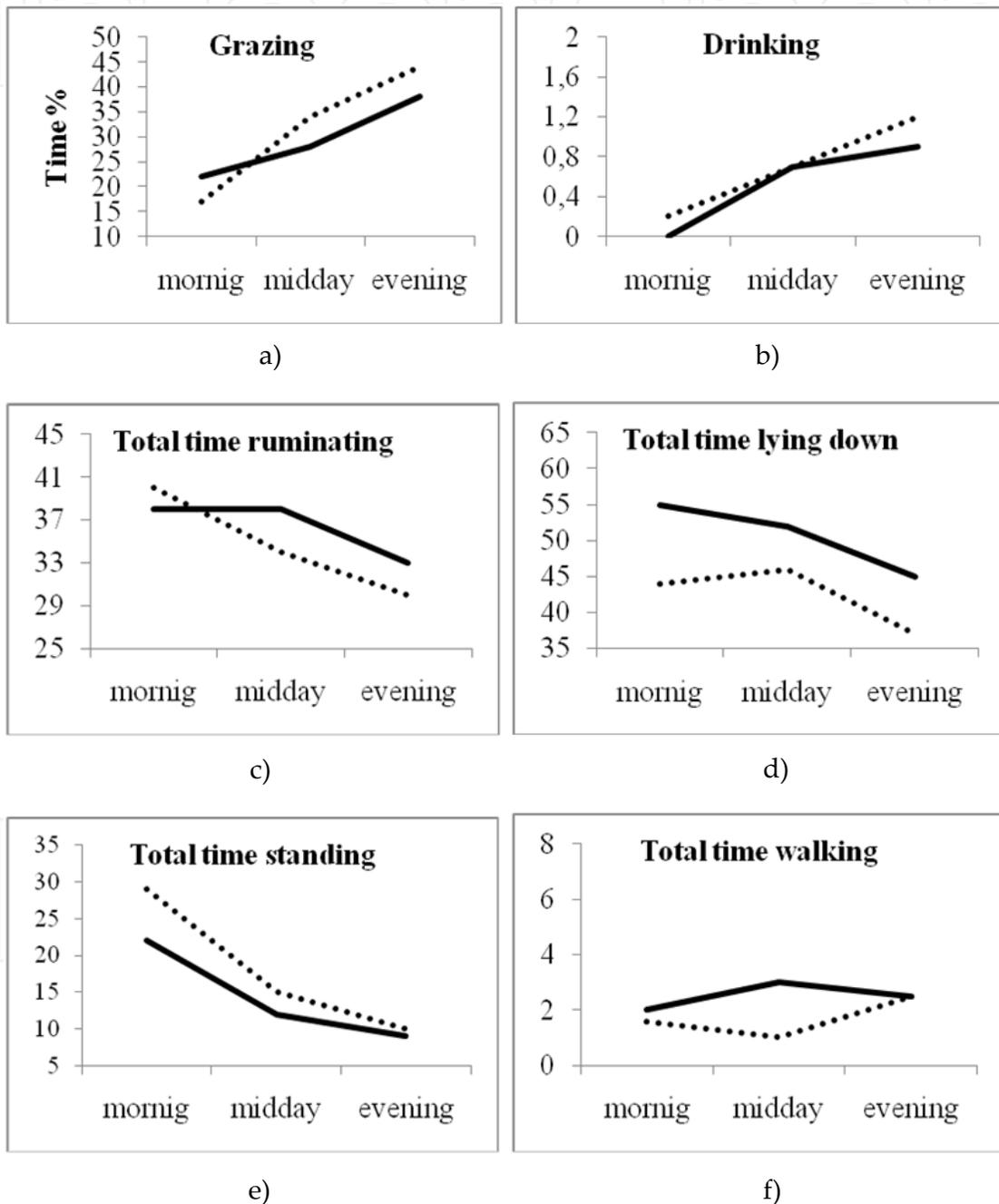
Figure 4. Daily time budgets for lame or nonlame during the morning, midday, and evening, including proportion of scan samples (%) spent a) grazing, b) drinking, c) ruminating, d) lying down, e) standing, and f) walking.

proportion of time spent grazing or drinking increased, whereas time for totals of ruminating, lying, or standing decreased; walking was unaffected by period of day (Fig. 4).

Wet bedding reduced the time that cows spent lying by 5 hours per day and increased the time spent perching with just 2 feet in the stall. Reduced amounts of bedding and/or replacing the bedding less also often leads to cows standing for longer periods of time. Factors that increase the time cows spend standing also increase the stress on the hooves.

4. Discussion

4.1. Milk yield

The results of the current study showed that milk production varies due to improvement selection goal, feeding strategies, milking systems, health programs and breeding systems and management. Significant correlations have been found between human-animal interactions and milk yield in dairy cows, this agrees with results of some studies (Breuer et al., 2000; Hemsworth et al., 2000; Waiblinger et al., 2006). The main items that influence the comfort of a dairy cow include housing condition (Hristov et al., 2006), bedding, flooring, and ventilation (Hristov et al., 2007), nutrition, water quality, sanitation (DEFRA, 2003; Webster, 2005) and milking equipment. However, many welfare problems are the consequence of a non-adaptation of the animal to the production system. Comfort and cleanliness of animals is dependent not only on amount and type of bedding, but also in animal stocking density, type of shelter, temperature and humidity levels.

4.2. Mastitis

The results of our study have shown that mastitis reamains a great problem in Tunisian dairy farms as well as many other countries. Ferguson et al. (2007) reported the prevalence of mastitis in Sicily (35.4 %), Tenhagen et al. (2006) in Germany (26.4 %) and Pitkälä et al. (2004) in Finland (30.6 %). In this study we noticed associations between hygiene scores and udder health parameters and an interaction between stockperson and mammary gland health. Hence, mastitis, however it occurs, is a severe welfare problem. In a 1990 study of 370 cow herds and 45,133 cows, Oltenacu et al. (1990) found that trampled teats and udder injuries were the most serious risk factors for clinical mastitis in tied cows. Oltenacu & Ekesbo (1994), studying Swedish Friesian cows, found that high production predisposed cows for mastitis and that the risk of mastitis was greater for calving in July and August and increased with age at calving. Castillo-Juarez et al. (2000) and Kearney et al. (2004) showed that the magnitude of the antagonistic genetic correlations between milk yield and somatic cell score and between milk yield and conception rate were significantly higher in a poor environment relative to a good environment. The genetic antagonism between mastitis resistance and production traits has been well established. In their review, Mrode and Swanson (1996) reported a weighted-average genetic correlation between Somatic Cell Score (SCS) and milk yield in first lactation of 0.14. Pryce and Brotherstone (1999) and Rupp and Boichard (1999) reported similar results.

4.3. Fertility

The mean calving interval of Holstein cows has increased considerably. This prolongation is mainly caused by the lengthening of the calving to first insemination interval (Moreels, 2002). Realizing the complex nature of fertility, it is not surprising to find that ideal fertility criteria are extremely difficult to reach. As selection has led to higher milk production per cow, there have been steady increases in reproductive problems. This result was confirmed by Moberg (2000) and Kaltas & Chrousos (2007) who concluded that during stress, the reproductive axes may be inhibited at several levels. Royal et al. (2000) noted that the calving rate of the modern dairy cow is declining at approximately 1% per year and first service conception rates are below 40%. Washburn et al. (2000) noted a marked decline in reproductive performance in dairy herds over the past 25 to 30 years. They described a 1998 report on over 70 Kentucky dairy farms in which average days open had increased by 27 days between 1976 and 1996 and the number of services per pregnancy increased from 1.62 (with a 62% conception rate) to 2.91 (with a 34% conception rate).

4.4. Avoidance distance

Management practices associated with fear and pain are also viewed very negatively by animal scientists and veterinarians (Heleski et al., 2004, 2005). The analysis of variance showed a significant difference in avoidance distance between cows and heifers. This difference can be explained by a good habituation and adaptation of cows through farmer's attitudes during milking and feeding practices and the intensity of visits and treatment of the animal. These results are in agreement with those of Garcia (2009) and Waiblinger et al. (2003) who did not found consistent influence of age on avoidance distance, since there were herds with positive and negative Spearman correlation, yet most of them were very low and not significant. ADS correlated moderately with ADF (0.49, P<0.05), supporting the reliability of the two tests, although Windschnurer et al. (2008) found a stronger correlation (0.7-0.9) in a study on 16 commercial dairy farms. The greater distances in ADS test were expected, since ADS was tested immediately after ADF on the same animal. Waiblinger et al. (2003) found a strong relationship between animals' reactions to humans, particularly avoidance distance inside the stable, and the continuity, quality and quantity of daily contact and handling, and with the frequency of friendly interactions with the farmer (human-animal interactions). Other authors also revealed negative associations between avoidance distances and positive behavior of farmer in dairy farms (Hemsworth et al., 2000; Windschnurer et al., 2009). Accordingly, there are several evidences that positive interactions ease handling and milking (increase productivity) and can reduce mastitis by promoting adequate milk flow, which has, additionally to improved welfare, an economic impact (EFSA, 2009). Comparing the results of the present study with the ones from a protocol developed by Why et al. (2003), where the shortest distance between observer and cow at moment of withdrawal, average flight distance categories A (best) to E (worst), were used to grade the welfare of 53 dairy farms in this case, mean avoidance distances (ADF and ADS) would be included in the A category (0.6 – 1.1 m). Even though, a margin of progression seems to exist, since some animals showed strong avoidance. Programs that aim

to improve stock people's attitude and behavior toward dairy cattle can reduce flight distance from humans and increase milk (protein and fat) yield (Hemsworth et al., 2002). Furthermore, the attitude of the stockperson towards interacting with farm animals is an important determinant of the stockperson's behavior and thus the animal's fear of humans (Hemsworth, 2004; Waiblinger et al., 2006). The results confirm our hypothesis, that the avoidance distance validly reflects the human–animal relationship. This is in line with earlier results, where avoidance distance was correlated with the behavior of the farmer (Waiblinger et al., 2002). In experimental studies, avoidance reactions of cattle were influenced by previous experience of positive or negative handling (Munksgaard et al., 2001; Hemsworth, 2004; Waiblinger et al., 2006). The average age of the cows did not confound the assessment of human–animal relationship on the farms in our study. Also within farms, there was no consistent influence of the age of the cows on avoidance distance.

4.5. Body condition scoring

Body condition is a subjective assessment of the amount of fat, or amount of stored energy, a cow carries. Body condition changes throughout the lactation cycle. Cows in early lactation are in negative energy balance and losing body condition (mobilizing body reserves). Our found are in agreement with those of Studer (1998) who explained that high producing cows whose body condition score declines by 0.5 to 1.0 during lactation often experience anoestrus. However, a loss of condition score of about 1.0 during lactation was normal in the review presented by Broster & Broster (1998) and Popescu et al. (2009). An ideal body condition score is 3.0. Dechow et al. (2001) found that higher body condition scores were favorably related genetically to reproductive performance during lactation. While higher body scores during lactation were moderately negatively related to milk production, both genetically and phenotypically.

4.6. Lameness

Lameness is a crucial welfare issue in modern dairy production (Vermunt, 2007). It indicates a painful state and discomfort and is regarded as one of the most serious welfare problems in cattle. In our study, a significant percentage of dairy cattle (59) have severe lameness, this can be a sign of poor overall welfare standards within the herd. Hristov et al. (2008) noticed that lameness is indisputably the major welfare problem for the dairy cow. Our findings are in agreement with those of Webster (2005) who reported that half the cows go lame in any one year and 20% are lame at any one time. Lameness in any cow is usually a sign that they are in pain, ill-health and discomfort. It clearly affects cow welfare, as well as their performance and production (Bergsten, 2001; Ward, 2001; DEFRA, 2003; Hristov et al., 2008). Lameness in dairy cows impacts negatively on herd welfare and productivity. It is thought to be closely associated with avoidance of pain caused by limb lesions and, particularly in dairy cattle, by hoof lesions (Dyer et al 2007). It certainly stands out as a consequential and complex welfare problem in dairy cattle (Bergesten, 200; Rajkondawar et al., 2001; Ward, 2001). Leach et al. (2008) advise that a limited number of available cubicles are a high risk factor for lameness; in addition, deep bedding and soft lying surface play a key role

promoting comfort and reducing lameness. Comparing lameness prevalence in this study with the one from a protocol developed by Whay et al. (2003), where categories A (best) to E (worst) graded the welfare of 53 dairy farms, the E category (lameness prevalence of 30–50 %) would be the most adequate to classify the studied sample if only cows (59%, 95% CI = 42–75%) were considered, or D category (24-30%), if both cows and heifers were counted (27%, 95% C= 18–38%). Lameness prevalence was the major welfare problem identified within the studied parameters. Silva et al. (2008) have also pointed out hock lesions as a major welfare problem in a study of 50 Northwest Portuguese dairy farms. The current study demonstrated that lame cows spend less time elevated on their feet, due in part to spending less time standing and walking compared with non lame cows. This is in agreement with the results of Almeida et al. (2008) and Gonzales et al. (2008) who found that lameness significantly decreases feeding time. As shown in many other studies, the age of the cow and the time of year have a large effect on levels of lameness. Lameness prevalence was 12-87 % with the mean value of 27 ± 17 %. Esslemont & Kossaibati (1996) reported 24 % lameness in a survey of 90 herds in 1992-1993, while in another survey (Kossaibati & Esslemont, 1999), performed on 50 farms during 1995-1996, lameness reached 38%. Herd lameness has been estimated at 22 % by recent studies in the UK (Whay, 2003) and Wisconsin, USA (Cook, 2003) and Clarkson et al. (1996). Our findings of lameness (23%) are in accordance with these authors. Herd lameness has been estimated at 22% by studies undertaken in the UK (Whay, 2002) and Wisconsin, USA (Cook, 2003). Whay et al. (2003) report that there has been little improvement in herd lameness levels over the last decade and the FAWC (1997) claim lameness is a greater problem now than it was 40 years ago.

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