55th Annual Meeting EAAP, Bled, Slovenia, September 5th-9th, 2004

A proper intensive dairy farming can be optimal for welfare and milk yield

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Abstract - The intensive breeding of dairy cows is often considered at risk of low welfare for the animals. Namely, the high yield has been suggested to be *per se* a cause of well-being reduction. On the contrary we have in many farms demonstrated that high milk yielding cows are not necessarily in a bad welfare condition, while many environmental and management problems can cause a distress situation and a reduced milk yield. To confirm these results, in an average yielding dairy farm, the welfare was assessed according to an Integrated Diagnostic System which considers health status, milk yield and quality, feeding strategy, nutrition status, blood profiles etc.. The same check-up has been repeated a year later, after some attempts to correct the main mistakes that were previously observed: dry and lactating cow diets, n° of cubicles, hygiene conditions, preparation and milking procedures etc.. In one year only part of the previous mistakes have been fully corrected; in spite of the animal response was definitively improved suggesting a better welfare situation. Namely better teat and body condition scores, a reduction of open days, the almost complete disappearance of legs and feet lesions. At the same time, the milk yield (25.2 *vs* 20.1 kg/d) and SCC (283 *vs* 456 n°/ml) were also improved.
Again it is confirmed that better breeding techniques can optimize the animal welfare and raise milk yield in the intensive systems also.

Keywords: Welfare assessment, Integrated Diagnostic System, Intensive farming, dairy cow

Introduction

The practical importance of domestic animals does not need any demonstration, but besides the farmers exploiting pigs, cows, hens and horses to get meat, milk, eggs, work-leisure, etc., there are people that like to exploit cats, dogs, birds in cage or their apartments to satisfy material as well as psychological need, and this can became like a therapy (Six, 1999).
In the past few decades the activities of the animal rights movements against intensive farming have gained widespread support, and the European Community has introduced several laws to satisfy this expression of public opinion (Burgat, 2001). Dairy cow farms are often considered unsuitable to guarantee the required level of welfare to the animals. In particular, among the reasons more often quoted, there is the so-called "unnatural" milk productivity of cows, requiring a specific diet which is markedly different in comparison to pasture (Rollin, 2001).

Animal welfare (or well-being) is certainly a challenge for the animal breeders of this beginning of millennium. Unfortunately, there are different feelings of how to measure it: animalists have an ideological justification mainly based on the human concept of welfare (often with more claims respect to the actual human standard); otherwise the breeders often consider mainly the immediate economical response with few attention to longer term effects and to the ethic aspects. It is therefore time to find an acceptable compromise between these extreme positions, trying to reduce the animalist claims as well as to convince the breeders about the real animal needs (Bertoni, 1999). Nevertheless, to do this, a substantial agreement about welfare concept and its evaluation would be essential.
Unfortunately, there are different feelings regarding the welfare of animals. Some criteria were established (FAWC, 1993) as the so-called "five freedoms" and in part are easily acceptable, others are difficult to be understood, while some others are impossible. The main difficulty arises from

the fact that too often welfare concerns are dominated by human perceptions and evaluations of welfare standards are maybe based on what the observer believes is good or bad (Newman, 1994). Therefore, the ways to define the animal welfare are not always universally accepted (Fraser and Broom, 1990; Broom and Johnson, 1993; Webster, 1994; Appleby and Hughes, 1997; Bertoni and Calamari, 2001), and this is also true for the assessment of animal welfare.

Despite these methodological difficulties, some comparisons are been established; thus several evidences suggest that also extensive breeding, if not properly managed, could cause poor welfare conditions (uncertainty water and feed availability, parasites and infectious diseases, climate excess etc.) as summarized by Bertoni and Calamari (2001). On the contrary we have in many farms demonstrated that high milk yielding cows are not necessarily in a bad welfare condition, while many environmental and management problems can cause a distress situation and, consequently, reduced milk yield (Trevisi *et al.*, 2003).

This suggests that one of the welfare key is the proper application of the chosen breeding system, while the major importance for welfare evaluation would be attributed to the animal response (behaviour, health and physiology), besides performances.

Aim of this research was to confirm our previous results, namely that good management support welfare and good performances. In an average yielding dairy farm, the welfare was assessed, according to an Integrated Diagnostic System (IDS), before and after some management adjustments.

Materials and Methods

The trial was carried out in an average yielding Italian Friesian dairy herd (111 cows), located in the area of Parmesan cheese. The herd was characterized by relatively low milk production, low fertility and high incidences of health problems. Lactating cows were kept in free stall barn, equipped with cubicles and concentrate autofeeders, while dry cows and pregnant heifers were kept in free stall barn with deep litter and were moved in a tied stall some days before calving. Cows were fed with two meals of hay (alfalfa and May-hay for lactating and grass or May-hay for dry cows and heifers) and concentrate, administered by autofeeders for lactating cows only.

The starting situation of herd was detected according to our Integrated Diagnostic System (Bertoni *et al.*, 1999), which considers several features of herd: the housing situation, the type and frequency of cow diseases, the group management, the feeding accuracy (diet composition for each group), the milk yield and quality, the health care as well as the general aspect of animals (body condition, faecal status, rumination, lameness etc.). Furthermore, to confirm the real welfare status of cows our IDS suggests blood analysis; a representative number of subjects (6 cows) either in dry and early-lactating phase (25-90 days in milk), were bled from jugular vein. The blood samples were collected in Li-heparin tube before morning hay distribution. The samples were analyzed for the parameters of the Piacenza Metabolic Profile (Bertoni *et al.*, 1998). On the same cows, a clinical examination was performed evaluating several physio-pathological aspects. In particular, BCS (ADAS, 1989), faecal score (Skidmore *et al.*, 1996), coat cleaning conditions (Faye and Barnouin, 1985), teat score (Neijenhuis, 1998), trimming score (Blowey, 1993), locomotion score (Manson and Leaver, 1988; Wells *et al.*, 1993; Sprecher *et al.*, 1997), foot and limb injuries has been evaluated. Finally, average daily milk yield on the day of inspection as well as the milk composition from the fortnightly routinely controls were recorded.

Afterwards, several changes for lactating and dry cows were gradually introduced in the herd, according to the unsatisfactory situation raised from the preliminary phase. Subsequently, about one year later, the evaluation of the herd status according to our Integrated Diagnostic System was repeated with the same protocol.

The statistical evaluation between beginning and final herd status was carried out by one-way ANOVA analysis [proc. GLM, SAS Institute, version 8 (TS M0)].

Table 1 - Milk yield, its composition and fertility indices before and after changes to improve farm situation.

		Before	*After*
Milk Yield	Kg/d/cow	20.12	25.17
Fat	%	3.41	3.30
Protein	%	3.28	3.32
Somatic Cell Count	n/ml	456000	283000
Calving / 1st insemination interval	d	103.0±57.6	80.3±33.1
Open days	d	174.8±86.5	94.0±28.5**
Insemination per pregnancy	N°	1.8±1.0	1.6±1.0
Pregnant cows at 1st insemination	%	50	69

Difference between *Before* and *After* on the same physiological phase: ** - P<0.01

Results and Discussion

The results of the first clinical examination have confirmed that farm was characterized by a very high percentage of cows with more or less serious health problems: 63.8% at the time of inspection. Lameness and limb injuries (37.9% of cows) as well as skin lesions and ectoparasites (22%) were largely widespread. On the contrary, despite the high level of SCC (456000 n°/ml), only 1.8% of cows suffered of clinical mastitis. Furthermore, some diseases were recorded by the farmer in the previous year; from them, only ketosis-anorexia and lameness were relevant and affecting about the 50% and the 30% of cows respectively.

As shown in table 1 milk yield (20.1 kg/cow/d) and fertility indices (103 days the interval between calving and 1st insemination, 174.8 open days) were also very poor. Despites the low production, milk fat and protein contents were also unsatisfactory: 3.41% and 3.28% respectively.

The results of physio-pathological indices, BCS, faecal score, cleaning score, teat score, locomotion and trimming score, evaluated first time on a representative group of lactating or dry cows, are shown in table 2. These scores showed a general poor conditions of herd. In particular, cows appeared very thin in both stages (particularly in lactation), showed a high frequency of rough teat callosity, of foot or limb injuries and of quite dirty coat. In addition, the digestive functionality of lactating cows appeared also inadequate, as suggested by the low percentage of ruminating cows at a given time.

Diets for dry and lactating cows are shown in table 3. Besides the low dry matter intake (only 17.8 kg/d), fresh cows received a diet with a low protein content, particularly of the soluble fraction, a high starch and energy content in relation to the average milk yield and an insufficient supply of intestinal buffer. Instead, dry cows received a diet very poor in fermentable carbohydrates, with an inadequate amount of starch.

At blood level (table 4) were confirmed some of the previous results. In detail, fresh

Table 2 – Physio-pathological indices of dry and fresh cows before and after changes to improve farm situation.

		Animal Condition Scores			
	Scale	***Before***		***After***	
		Dry (n=6)	***Fresh*** (n=6)	***Dry*** (n=6)	***Fresh*** (n=6)
Body Condition	0 - 5	2.40±*0.4*	1.94±*0.4*	2.31±*0.3*	2.20±*0.2*
Faeces	1 – 5	3.50±*0.4*	2.8±*0.2*	2.9±*0.3*	2.5±*0.4*
Cleanliness#	0 – 5	2.88±*0.6*	2.13±*1.0*	3.83±*1.4*	3.25±*1.5*
Teat##	0 – 4		2.64±*1.0*		3.17±*1.0*
Locomotion#	1 – 5	1.28±*0.3*	1.57±*0.9*	1.25±*0.4*	1.50±*0.9*
Trimming##	1 – 5	3.50±*0.6*	3.75±*0.3*	3.35±*0.6*	3.33±*0.5*

 # - Higher values indicate worst situation; ## - Higher values indicate better situation

Table 3 - Main diet features of dry and lactating cows, before and after changes to improve farm situation.

	Before		*After*	
	Dry	***Fresh***	***Dry***	***Fresh***
DMI (kg/cow/d)	11.4	17.8	11.8	20.3
UFL (U/kg d.m.)	0.65	0.93	0.68	0.92
CP (% d.m.)	11.6	13.29	11.5	16.8
Soluble Protein %CP	23.4	22.1	25.7	24.5
Starch (% d.m.)	3.5	28.3	9.8	23.3
NDF (% d.m.)	56.8	33.2	52.3	33.4
Calcium (% d.m.)	0.77	1.02	0.62	0.98
Phosphorus (% d.m.)	0.26	0.38	0.34	0.45

cows showed a:

- low level of urea, consequence of low dry matter and crude protein intake;
- low level of zinc and high of haptoglobin (but not of ceruloplasmin) as well as a relatively low levels of albumin and cholesterol, likely consequences of inflammatory problems and of the acute phase response of the liver;
- high, and very changeable, values of βOHB, consequences of lower dry matter intake.

Conversely, dry cows showed a slightly better situation.

This herd evaluation, mainly based on physiological, pathological and performance indices, had permitted, together the ergonomic evaluation, the discovery of some major mistakes which could justify the poor conditions of cows. In detail:

- the high incidence of foot and limb injuries seems attributable to inadequate structures and equipments. In fact, despite the available surface appeared adequate (about 9.5 m^2/cow, 35% of which as external paddock), the following mistakes are been suggested: uncomfortable cubicles (very long, neck rail too forward, front wall too close, insufficient straw renewing, rear curb too high); slippery floor in feeding area and poor paddock characteristics (dirty, difficult access and absence of shadow structures),

Table 4 – Some metabolic indexes in dry and fresh cows, before and after changes to improve farm situation.

	Before		*After*	
	Dry (n=6)	***Fresh*** (n=6)	***Dry*** (n=6)	***Fresh*** (n=6)
PCV (l/l)	0.31±*0.04*	0.30±*0.02*	0.31±*0.01*	0.31±*0.03*
Glucose (mmol/l)	3.84±*0.28*	4.03±*0.39*	3.81±*0.26*	3.91±*0.18*
Urea (mmol/l)	4.11±*0.94*	4.38±*1.82*	4.64±*0.91*	3.65±*0.50*
Calcium (mmol/l)	2.88±*0.20*	2.58±*0.12*	2.69±*0.24*	2.77±*0.19*
Magnesium (mmol/l)	1.08±*0.07*	1.12±*0.09**	1.09±*0.05*	1.31±*0.13**
Zinc (μmol/l)	10.82±*2.12*	9.45±*2.25*	11.79±*2.42*	8.82±*1.82*
Ceruloplasmin (μmol/l)	2.85±*0.34***	2.98±*0.22***	4.50±*0.59***	4.83±*1.39***
Haptoglobin (g/l)	0.122±*0.07*	0.300±*0.47*	0.19±*0.18*	0.34±*0.44*
Globulin (g/l)	43.16±*5.03*	42.37±*5.12**	39.26±*10.02*	49.61±*3.65**
Albumin (g/l)	36.28±*0.80*	35.11±*1.99*	35.67±*1.51*	36.58±*2.26*
Cholesterol (mmol/l)	3.93±*0.89***	4.76±*1.62**	2.48±*0.28***	6.58±*0.84**
ALP (U/ml)	39.60±*27.12*	44.31±*19.44*	45.34±*11.93*	45.83±*5.96*
GOT (U/ml)	99.33±*27.00**	89.83±*16.00*	64.48±*7.91**	94.39±*23.69*
GGT (U/ml)	22.50±*6.89*	30.35±*17.13*	18.63±*1.91*	28.77±*3.54*
Bilirubin (μmol/l)	0.99±*0.41***	1.82±*0.64**	2.35±*0.86***	3.06±*0.97**
Creatinine (μmol/l)	105.71±*4.40*	94.52±*11.75*	102.1±*15.3*	87.1±*4.9*
NEFA (mmol/l)	0.095±*0.040*	0.130±*0.054*	0.125±*0.002*	0.202±*0.180*
βHOB (mmol/l)	0.688±*0.463*	0.517±*0.470*	0.421±*0.024*	0.347±*0.110*

Difference between *Before* and *After* on the same physiological phase: * - P<0.05; ** - P<0.01

inadequate number of cubicles and of feeding bunk places (about 15% less in each group);
- the high level of somatic cell count (likely sub-clinical mastitis) seems related to inadequate milking procedure as well as to a insufficient cleaning of cubicles;
- the after calving anorexia or ketosis is due to the slow increase of dry matter intake at the beginning of lactation, likely related to a wrong management of the transition period (lack of autofeeder during dry period, the shift in tied barn some days before calving, the too slow increase of concentrate availability during the 1st month of lactation, the inadequate concentrate composition).

After this preliminary phase, several changes were gradually introduced in the herd, with the aim to improve the breeding technique. Most of them concerning the diet (the easiest): concentrate of lactating cows was modified (more protein, mainly soluble, and more rumen and intestinal buffers), the amount of concentrate after calving was raised more quickly, the fresh cows received an energy-protein supplement (1 kg/cow/d) in the manger and their drinking water was added with 0.2% of propylene glycol. In addition, dry cows and late pregnant heifers also received the concentrate by the autofeeder and they remained in a free stall barn until calving time. Changes in main features of diets are been shown in table 3. Furthermore, other changes regarded: a systematic vaccination against IBR and BVD, more frequent renewing of chopped straw in the cubicle (every 2 days), more frequent feet bath (twice a week), a systematic check of the milking machine, a reduction of stripping time at the end of milking, an increase of feeding bunk places for lactating cows and a balance of the number of cows according to the number of cubicles (in the fresh group only). Most of the changes are shown in the table 5.

The changes caused an important increase of dry matter intake in fresh cows (+14%, table 3). This ameliorated care of the animals have also caused a substantial improvement of the performances as exhibited in table 1: the milk yield increased of 25% while the reproductive parameters showed a marked reduction of open days (94.0±28.5 d) and an increase of cows pregnant at 1st insemination (69% *vs* 50%). Conversely, milk composition was not substantially modified, despite somatic cell count showed a tendency to the decrease.

Physio-pathological conditions of fresh cows seemed also improved (table 2), as demonstrated by the higher BCS of fresh cows (+0.26 points), in spite of the higher milk yield level, and by the best score of teat (i.e. with a reduced rough callosity). Nevertheless, any change reached a significant statistical level. Dry cows showed only a modest variations: reduction of faecal score (due to increase of starch in the diet) and a worsening of the cleanliness score, likely due to the second evaluation during a quite rainy period.

Conversely, the blood indices showed a contradictory modifications. In fact, after management changes, indices of inflammatory response were not reduced, or rather increased as the ceruloplasmin ($P<0.01$ *vs* before) and globulins. Nevertheless, total cholesterol ($P<0.05$ *vs* before) and albumin (n.s.) were increased and βOHB was markedly reduced (n.s.)

Table 5 - Some structure features and equipments in dry and lactating cows, before and after changes to improve farm situation.

Structures and Equipments				
	Before		*After*	
	Dry	***Lactating***	***Dry***	***Lactating***
Number of animals	17	112	15	99
Bunk places/cows (%)	100	85.6	100	100
Cubicles /cows (%)	-	85.6*	-	100
Renew Straw in Cubicles (time/wk)	-	1	-	3
Feet Bath (time/wk)	-	1	-	2

*** 100% in fresh cow group**

suggesting an ameliorated liver functionality and a decreased ketonemia.
Therefore the suggested changes to improve breeding conditions, unfortunately only those made possible according to their complexity and costs, were not able to solve all the problems. Furthermore, we cannot be sure about the complete application of all the changes because it was a commercial herd; namely the level of blood urea of lactating cows was too low for the calculated level of crude protein in the diet.

Conclusions

The results we have showed seem to clearly demonstrate that many farm situations can be improved, despite not always in a decisive manner. Furthermore, it has been confirmed (Trevisi *et al.*, 2003) that high genetic merit cows:

- can be improperly managed and then they show many health problems, but performances are also impaired;
- can be properly managed and in this case they produce more milk and show better welfare conditions.

To conclude, the intensive dairy farming - also when high yielding cows are utilized - needs an appropriate skill, but it can allow good welfare conditions for animals.

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