Hygienic Conditions of Milking Cows in Loose Housing Systems with Different Lying Areas

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Introduction

The number of cows kept in loose housing systems is growing more and more. Loose housing system can lower labour needs per head and get better safety and hygienic conditions for workers; moreover it can improve welfare, health, hygiene and milk quality in dairy cows. Better hygienic conditions for cows improve the health of their udders reducing frequencies and seriousness of mastitis. The main aim of the project funded by the Regional Government of Emilia Romagna was to improve housing systems and waste management in dairy farms in order to obtain a better welfare and hygiene of cows and to reduce costs and environmental impact of dairy farms. An approach of the project was to compare hygienic conditions of cows housed with different loose housing systems used in dairy farms of Emilia Romagna Region.

Methodology

In order to compare hygienic conditions of milking cows in loose housing systems with different lying areas, dirtiness of cows' skin was tested by means of a score method analysing five anatomical parts of their body: sacro-ischiatic part viewed from the back; back side of the udder viewed from the back; front side of the udder viewed from both sides; legs; feet (figure 1). The score for each anatomical part varies from 0 to 2 within the following steps: 0 = clean; 0,5 = a few dirty small areas; 1 = less than 50% covered with dirt; 1,5 = more than 50% covered with dirt; 2 = totally covered with dirt. Therefore the total score for each cow ranges from 0 to 10.

The number of total scores to be collected in each farm are more than 50% of the number of milking cows in the herd; choice of cows to be scored is random. The mean value of the dirtiness total scores of cows tested in each cowshed express the cows' dirtiness score of that cowshed.

Eleven dairy farms have been tested; in each cowshed technical parameters have been analysed: bedding consumption, type of bedding, waste removal system, labour need, electric power, electric usage and machine power for bedding and for manure handling.

The following kinds of lying areas have been compared: cubicles with bedding; cubicles with mattress and bedding; cubicles with mattress and without bedding; cubicles without bedding and mattress, sloped bedded floor and straw yard.

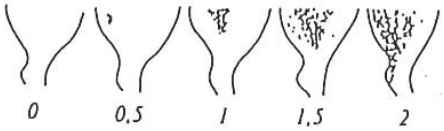
Sacro-ischiatic part viewed from the back	
Back side of the udder viewed from the back	
Front side of the udder viewed from both sides	
Legs	
Feet	

Figure 1: Views of five anatomical parts of cows' body for the assessment of dirtiness score.

Results

Eleven dairy farms have been studied. In order to compare manure handling system and management of lying area of each farm same technical parameters have been analysed (table 1): the type of lying area, the manure handling system, the bedding consumption, the overall electric power of equipment for manure handling, the electric consumption, the overall power of machinery and the labour need for bedding and removing manure.

Cubicles of farms C and D are provided with mats to improve cows' comfort and to avoid or minimise the use of bedding. Farms A, B, C and D are equipped with pumps and with mechanical rotating filters for processing manure in order to separate solids from the liquid manure used for flushing. Cowsheds of farms H, I, L and M are equipped with automatic scraper conveyers. In farm A flushing system works 6 minutes per day by means of a 30 kW electric pump while in both farm C and D a 7,5 kW electric pump works 45 minutes per day.

Gravity flushing system in farm B operates by means of a vertical cylinder shaped tank in which the recycled slurry is stored to achieve the proper pressure through the flush valve.

Table 1. Technical parameters of manure handling systems and dirtiness score of milking cows in 11 cowsheds.

Farm	Lying area	Manure removal system - flooring	Bedding kg/cow*d	Electric power kW	Electric Usage kWh/cow*d	Labour need s/cow*d	Dirtiness Score Mean±SD
A	Cubicles	Pump flushing - solid floor	2,0	33,0	50,9	11	2,58±1,09
B	Cubicles	Gravity flushing - solid floor	1,0	5,0	23,9	10	3,45±1,17
C	Cubicles mats	Pump flushing - slatted floor	0,7	19,7	126,5	10	2,65±1,06
D	Cubicles mats	Pump flushing - slatted floor	0,0	19,7	126,5	0	3,75±1,53
E	Cubicles	Storage pit - slatted floor	0,4	0,0	0,0	9	3,95±1,15
F	Cubicles	Storage pit - slatted floor	0,0	0,0	0,0	0	4,68±1,55
G	Cubicles	Scraper solid - floor	3,3	8,7	31,5	12	2,38±1,21
H	Cubicles	Scraper – solid floor	0,5	8,7	31,5	9	3,70±1,74
I	Sloped floor	Scraper – solid floor	3,0	6,5	20,7	12	5,01±1,67
L	Sloped floor	Scraper – solid floor	2,4	6,5	20,7	11	5,44±1,27
M	Straw yard	Tractor loader/ scraper – solid floor	4,8	5,0	15,3	33	4,47±1,49

The tank is filled using a 2 kW electric pump 80 minutes per day. Mechanical rotating filters operate by means of a 1 kW electric motor and a 2 kW electric pump 218 minutes per day in

farm A, 82 minutes per day in farm B and 230 minutes per day in farms C and D. The highest daily electric usage for removal of dejections has been calculated for farms C and D which are equipped with mechanical filter and flush pump operating for long time during the day. For flushing systems with solid floor the electric usage is higher in farm A than farm B (50,9 vs 23,9 kWh/cow*d) because of the high electric input of the flush pump. For scraper conveyor systems the electric consumption varies from 15,3 kWh/cow*d in straw yard cowshed (farm M) to 31,5 kWh/cow*d in cubicle cowshed (farms G and H). Cubicle cowsheds with storage pits under slatted floor do not consume electric energy, but this advantage can be offset by bad hygienic conditions (relative high concentration of ammonia and hydrogen sulphide, flies proliferation) caused by the fermentation of manure for long time in the storage pits inside the barn. Principally for this reasons this kind of storage is not advisable for building new cowsheds.

For bedding operations farms A, B, G, H, I and L need a tractor (100 kW) equipped with front fork lift and a tractor (70 kW) with trailed spreader. Farm M need also a tractor-mounted front bucket for removing manure from the straw yard. Suitable machinery for bedding in cowsheds C and E are a tractor (100 kW) with tractor-mounted front lift and a small tractor (20 kW) with a light trailer for not crashing slatted floor during distribution.

Two types of bedding materials are used: sawdust, in farms A, C, E and H, and straw in farms B, I, L and M. The use of bedding requires extra labour for distribution and for removing manure from straw yards; this is the main disadvantage of using bedding. Obviously this kind of labour can be avoided in cubicles cowshed without using bedding.

Table 2. Dirtiness score for milking cows in loose housing systems with different lying areas.

Farms N.	Lying area	Dirtiness score Means
8	Cubicles	3,31^{A}
2	Sloped floor	5,21^{C}
1	Straw yard	4,47^{B}
General sample mean		3,84

$^{A, B, C}$) $P < 0,01$

Dirtiness scores have been collected from 804 Holstein milking cows; the number of cows tested per farm varies from 60 to 99. The study highlights significant differences (one-way ANOVA) among means of dirtiness scores of cows housed with different housing systems (table 2) and with different amount of bedding (table 3).

Table 3. Dirtiness score for milking cows housed in cubicles with different amount of bedding.

Farm	Manure handling system	Bedding (kg/cow*d)	Dirtiness score (means)
G	Scraper – solid floor	3,3	2,38[A]
A	Flushing – solid floor	2,0	2,58[A]
B	Flushing – solid floor	1,0	3,45[B]
H	Scraper – solid floor	0,5	3,70[BC]
E	Flushing – slatted floor	0,4	3,95[C]
F	Flushing – slatted floor	0,0	4,68[D]

[A, B, C, D]) P < 0,01

Cows housed with cubicles are less dirty (3,31) than cows housed with straw yards (4,47) or sloped floor (5,21). Moreover relevant differences of dirtiness scores have been found in cowsheds provided with cubicles without mats (table 3). Best hygienic conditions of cows have been founded in farm G in which the lowest dirtiness score of cows (mean value 2,38) is connected with the use of large quantity of bedding (3,3 kg/cow*d). Good hygienic conditions of milking cows have been found also in farm A (mean value of the dirtiness score of 2,58) in which cubicles are provided with 2 kg/cow*d of bedding.

The study points out the worst hygienic conditions of cowsheds of farm F where cubicles are not bedded and are not provided with mattress; for this farm the mean dirtiness score (4,68) is almost twice the score of farm G (mean 2,38) and is between the mean values of straw yard cowshed (4,47) and sloped floor cowsheds (5,21). Intermediate values of dirtiness scores have been calculated for farm B, H and E. For cowsheds of farms C and D with cubicles provided with mattress, one-way ANOVA points out a significant difference (P<0,01) between dirtiness scores of cows housed using 0,7 kg/cow*d of sawdust (2,65) and cows without using bedding (3,75); the first value is quite similar to the mean score of farm A (2,58) in which an amount of 2 kg/cow*d is used instead of using 0,7 kg/cow*d. A quite significant difference (P=0,05) has been found between dirtiness score of cows in farms I (5,01) and L (5,44) with sloped floor in lying areas and different usage of straw; the mean scores are very high for both farms, but the highest score has been found in the farm I using less bedding than farm L (2,4 kg/cow*d vs 3 kg/cow*d).

Conclusions

The research shows the importance of housing systems to keep milking cows in acceptable hygienic conditions. Cows' dirtiness is higher in cowshed with sloped bedded floors or straw

yards than in cowshed with cubicles, even if the consumption of bedding is high. Best hygienic conditions have been found in cubicle cowsheds using 3,3 kg/cow*d of straw and 2 kg/cow*d of sawdust.

In freestall barns good hygienic conditions for cows cannot be achieved avoiding cubicles in lying area and proper amounts of bedding and or synthetic mattress. Cubicles equipped with synthetic mattress without bedding can assure to cows acceptable hygienic conditions; nevertheless cows' dirtiness can be reduced very much using bedding in this kind of cowsheds.

The use of bedding increases labour need for distribution of straw or sawdust and, especially, for manure removal in straw yards. Cubicles equipped with mattress can be adopted in order to lower labour requirements and costs for bedding supply. Gravity flushing system uses less electric power and electric energy than pump flushing and scraper conveyor systems for cubicle cowshed. For these reasons gravity flushing system combined with cubicles provided with mattress and proper amount of bedding in lying area seems to be suitable especially for middle and large scale modern cowsheds in order to assure to milking cows good hygienic conditions and to minimise electric consumption and labour requirements.

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