The milk quality and feasibility analysis of loose housing dairy cows - a case study

Marjan Janžekovič and Črtomir Rozman

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Abstract

The aim of the study was technological and economical analysis of free range cow breeding. The case study analyzed two different systems of holstein-friesian dairy cows breeding. The model total costs enterprise budget was developed for evaluation of economic feasibility of loose housing dairy cows in comparison with tied cow breeding system. Computer supported calculation enabled estimation of the most important economical parameters (net return, total cost, and coefficient of economics). Results obtained show that (at observed input parameters) loose housing system is economically feasible, if there is a minimum of 41 dairy cows with an average milk production of 8610 kg per cow. It was also established that cows need approximately 6 months to fully adapt to the loose housing system.

Key words: loose housing, dairy cows, milk quality, coefficient of economic

Introduction

The intensive animal breeding systems can cause severe environment degradation. However, highly productive animals are extremely sensitive to the environmental changes. The animal welfare can be in direct contradiction with the need for highly intensive and economically successful milk production. (Janžekovič, 2005). Lack of animal welfare (inability to move in tied systems, fear, etc.) can be a major source of stress, a cause of significant production lost, and can make handling difficult and dangerous to both animal and handler (Rushen et al., 1999). According to Potočnik et al. (2004) the animal welfare can only be assured in environments that enable specific behavior for each individual species.

The loose housing (free range) has been recognized as the most efficient, animal friendly and economically feasible milking cow management system (Krohn, 1994; Krohn and Munksgaard, 1993). The natural animal needs should be taken into consideration when planning and constructing a new stall since it influences the reproductive cycle, fertility and the need for veterinary

interventions (Janžekovič, 2005). In this light, Mavsar (2003) emphasizes that many animal injuries are a direct consequence of cow management system. The smaller percentage of teat injuries in loose housing systems is also confirmed by Regula et al. (2004). On the contrary, the injuries in loose housing system occur more often (Sogstad et al., 2005). However, the economic feasibility of different loose housing dairy cattle management systems have been only modestly studied, especially in terms of comparison with more intensive tie stall system.

The aim of this study was the technological end economical comparison of loose housing dairy cattle management system with the tie stall system using a case study approach. The article is organized as follows: firstly the materials (stall and heard) on the selected sample farm are presented, which is followed by the description of research methodology and result where the main differences between both management systems are presented under scrutiny. The conclusion section gives general findings and suggestion for future research.

Materials and methods

Stalls and herd

The case study was conducted on a selected dairy sample farm in North Eastern Slovenia that invested into a new loose housing stall (B). Since the old tied stall (A) was still active in the transition period the direct on-farm comparison of both cattle management systems was enabled. The production parameters from stall A (16 cows) were measured and analyzed from June 2001 to May 2002 and from stall B (27 cows) from June 2002 to May 2003. Likewise, the observation effect of transition to loose system was enabled.

The holstein-friesian cows' average weight was 600 kg. The same feeding ration was used in both management systems. The milk samples were taken in the monthly observation periods and analyzed (content of proteins, fat, lactose and somatic cells). This data was ultimately used for the comparison of both systems while milk quality parameters were also used for the estimation of economic parameters.

The feasibility analysis

The spreadsheet model enterprise budget was developed in order to evaluate economic feasibility of observed management systems. The model enterprise budget is in fact a technologic economic simulation model

(Rednak, 2003.; Volk, 2002; Rozman et al., 2005.). The model enterprise budgets were prepared on the basis of predefined breeding technology in both system (labor usage, feeding ration, stall investment parameters, farm fixed costs). In this way developed and computer supported enterprise budget enables feasibility analysis (calculation of net return, break even price and coefficient of profitability) of both systems using different input parameters.

Results and discussion

Milk production and quality

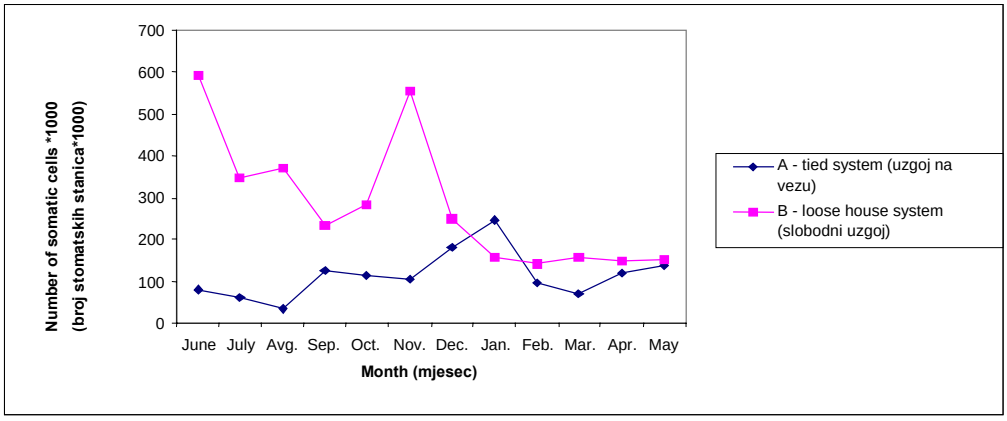
Average milk production per cow has increased for 6 % (490 kg) after transition to loose housing stall. The milk quantity on a milking and feeding day is higher in comparison to tie stall. The fat and protein content has not changed significantly (table 1).

Table 1: Average milk production and quality parameters in investigated period in different housing system

Tablica 1: Prosječna proizvodnja i parametri kvalitete mlijeka u analiziranom razdoblju s obzirom na način držanja

Housing system Način uzgoja	Number of cows Broj krava	Milk production (kg) Proizvodnja mlijeka (kg)	Fat (%) Mast (%)	Protein (%) Proteini (%)	Milk on feeding day (kg) Mlijeka na hranidbeni dan (kg)	Milk on milking day (kg) Mlijeka na muzni dan (kg)
Tied cow (A) Uzgoj na vezu (A)	16	8120	4.17	3.29	22.04	25.29
Free range (B) Slobodni uzgoj (B)	27	8610	4.10	3.23	23.50	25.89

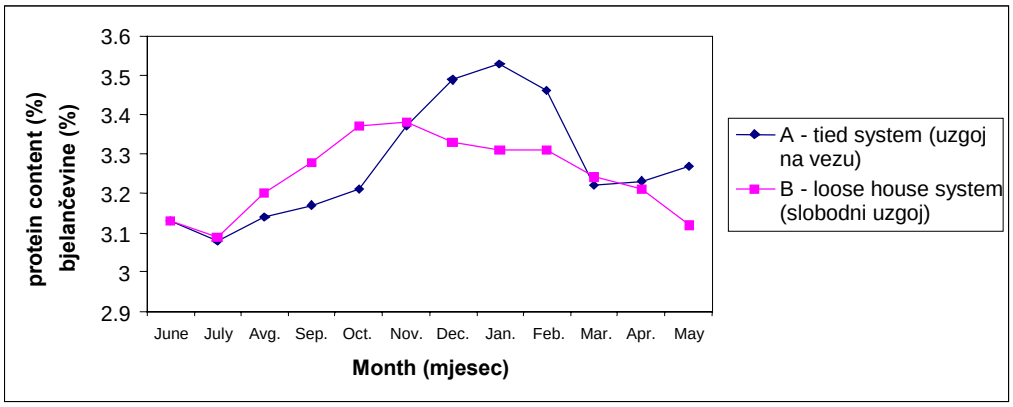
The milk quality parameters as defined in regulations UL 15 /01 and UL 23/02 were analyzed and compared. Due to the fast transition from tie stall to loose housing stall (June 2002) and change of the milking system (autotandem) the animals were exposed to stress which caused higher content of somatic cells in the milk. The number of somatic cells increased till December 2002 and decreased and stabilized in January 2003 (graph. 1). However, it should be also mentioned that the increase of somatic cells number can also be consequence of other factors (mastitis, older animals are more sensitive to infections, lactation period, oscillations daily milking time, stress). It can be assumed that in the case studied, there was a 6 month transition period necessary to fully adapt to the change in the housing system.



Graph 1: Average number of somatic cells in the milk

Grafikon 1: Prosječni broj somatskih stanica u mlijeku

Average content of protein (graph 2) oscillated from 3.08% to 3.48 % in both systems which correspond to the base value (UL 15 /01 and UL 23/02). The protein content in winter months (from October to April) was higher in the tie housing system.

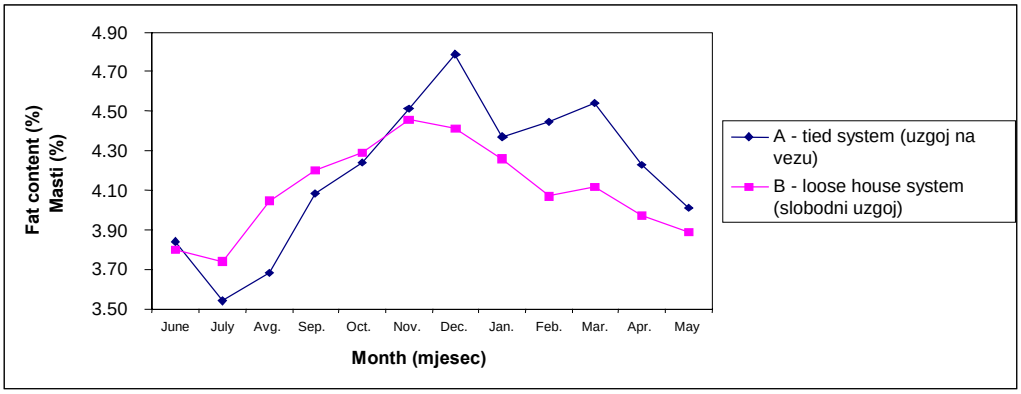


Graph 2: Average content of protein in the milk

Grafikon 2: Prosječne vrijednosti proteina u mlijeku

The lower content of protein in the tied system during the summer months can be explained by time limitation of grazing (8 hours) while grazing in the loose system was not timely limited. Consequently, the consummation of dry matter was lower in the tie system which contributed to lower milk production and protein content.

The milk fat content is oscillating between two consecutive milking or from day to day. It is also influenced by genotype as well as the environment.

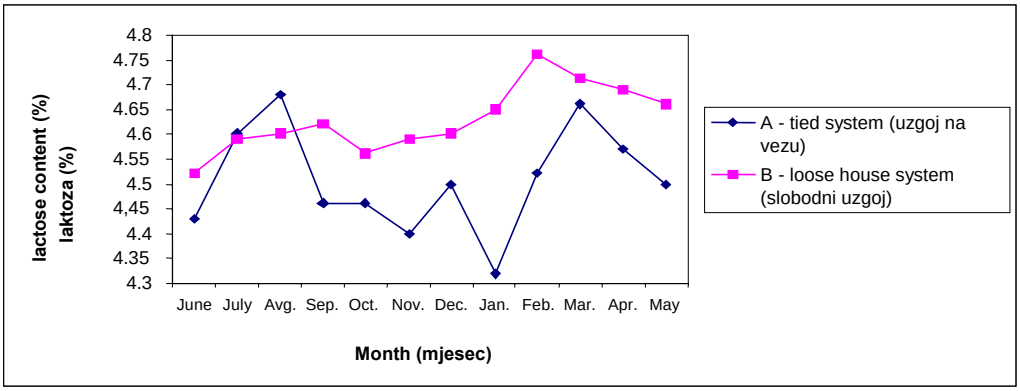


Graph 3: Average content of fat in the milk

Grafikon 3: Prosječne vrijednosti masti u mlijeku

The low fat contents during summer months (graph 3) can be explained by feeding ration based on grazing with lower contents of structural fibers in the feeding rations. The share of acetic acid is therefore lower and acetic acid: propionic acid ratio is lower than 3:1. The fat content in milk is consequently lower. After the winter feeding ration has been applied, the fat content increases.

The lactose content is higher in loose housing system. However, the lactose content is lower in winter months. The oscillation of lactose content is less intensive than protein and fat content but the close connection between number of somatic cells and lactose content can be observed.



Graph 4: Average content of lactose in the milk

Grafikon 4: Prosječne vrijednosti laktoze u mlijeku

The average lactose content in loose housing system was 4.62 % and 4,50% in tie stall. This can be explained by the fact that there is a smaller number of mastitis infections and less metabolic interferences in the loose housing system in comparison to the tie stall system.

Feasibility analysis

The model spread sheet enterprise budget was used in order to conduct feasibility analysis of both cow housing systems. Following alternatives were analysed:

- tied system with 16 (TS I) and 27 (TS II) milking cows
- loose housing system (LHS) with 27(I), 41 (II) and 54 (III) milking cows

Table 2: Indicators of economic feasibility for analyzed milk production systems

Tablica 2: Procjena vrijednosti nekih ekonomskih parametara uzgoja na vezu i slobodnog uzgoja muznih krava kod prodajne cijene mlijeka 0,26 €/kg mlijeka

	TS I.	TS II.	LHS I.	LHS II.	LHS III.
Numbers of animals Broj životinja	20	35	35	50	58
Number of milking cows Broj muznih krava	16	27	27	41	54
Product price (€ kg^{-1}) Cijena mlijeka	0.26	0.26	0.26	0.26	0.26
Total costs (€) Ukupni troškovi	33.513	60.641	63.410	90.698	105.716
Financial result (€) Financijski rezultat	506	-3.233	-2.538	1.737	16.028
Total revenue (€) Ukupni prihod	34.019	57.408	60.872	92.435	121.744
Break even price (€ l^{-1}) Cijena koštanja	0.26	0.28	0.27	0.26	0.23
Coefficient of economics* Koeficient ekonomičnosti	1.02	0.95	0.96	1.02	1.15

* calculated as total revenue / total costs

The spreadsheet model based feasibility analysis (table 2) shows positive financial result for LHS system II and III at estimated milk production 8 160 kg / cow and at estimated model input parameters (0.26 €/kg, fat content 3.74%; protein content 3.14%). The size of the herd (table 2) also has a deciding impact on production feasibility. The analysis shows that LHS is economically feasible if there is a minimum of 41 cows in the herd.

Conclusions

From the case study results it can be concluded that after transition shock (from tied system to loose housing system), which is demonstrated by a higher number of somatic cells and lower lactose content, the milk production stabilizes and is 6% higher in comparison to tied system. The contents of protein and fat in both systems do not differ significantly.

The loose system at given investment and estimated production rates is economically feasible with 41 cows in the herd. The transition to loose housing system is related to the initial investment as well as to increase in number of milking cows.

The described case study enables detailed comparison of both systems and also demonstrates main differences between the systems. However, further study with large numbers of dairy cows, corresponding observation system and detailed statistical analysis of results would be suggested.

ANALIZA EKONOMSKE OPRAVDANOSTI I KVALITETE MLIJEKA KOD SLOBODNOG DRŽANJA KRAVA - "CASE STUDY"

Sažetak

Cilj rada bila je usporedba između vezanog i slobodnog držanja krava. Koristeći "case study" pristup analizirane su tehnološko ekonomske značajke oba sustava držanja krava. Za oba sustava razvijena je modelna kalkulacija troškova proizvodnje koja omogoćava analizu nekih indikatora ekonomske efikasnosti proizvodnje (financijski rezultat, cijena koštanja, koeficijent ekonomičnosti). Rezultati pokazuju, da je sistem slobodnog držanja ekonomski opravdan za minimalno 41 muznu kravu u stadu s prosječnom proizvodnjom mlijeka 8 610 kg po grlu. Također smo ustanovili, potrebno je barem 6 mjeseci za potpunu prilagodbu životinja na slobodni sustav držanja.

Ključne riječi: slobodno držanje, krave muzare, kakvoća mlijeka, koeficijent ekonomičnosti

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Author address - Adrese autora:
Marjan Janžekovič, Assistant professor Ph.D.
Črtomir Rozman, Assistant professor Ph.D.
University of Maribor, Faculty of Agriculture, Vrbanska 30, Maribor, Slovenia,

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