THE RELATIONSHIPS BETWEEN DIFFERENT GENOTYPE DAIRY COW BODY CONDITION SCORE, MILK UREA CONTENT AND MILK PRODUCTIVITY

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ABSTRACT

The analysis of factors that affect dairy cow milk productivity shows that it is determined not by individual conditions, but by factor groups – genetic, physiological and environmental. The latter is mainly determined by feeding conditions and the quality of feed ration, because it can slow down or promote the expression of cows' hereditary genetic potential. With the increase of dairy cow milk productivity it becomes more and more difficult to ensure that they receive necessary level of feed energy and protein in all their productive life. If in some time period cow is not receiving feed with the necessary energy level, she will start to mobilize the missing nutrients from her own body. One of main energy reserves in cows' body is stored fat and the main indicators for its evaluation is their body condition score (BCS) that allows to make assumptions about metabolic processes in the body. The evaluation methods of BCS in last 20 years are evolved from simple and partially subjective body condition visual evaluation, up to modern and more objective automatic three-dimensional (3D) BCS evaluation cameras. Milk urea content and BCS, if analysed together, can serve as important indicator for feeding efficiency and overall health of cow. If milk urea content is high, but cow BCS is not decreasing, it is possible to presume that it is not connected with animal health problems and there is serious mismanagement with the balance of feed ration, more specific, ineffective use of feed protein. The aim of our study was to evaluate the relationship between dairy cow body condition score, milk urea content and control day milk productivity.

MATERIALS AND METHODS

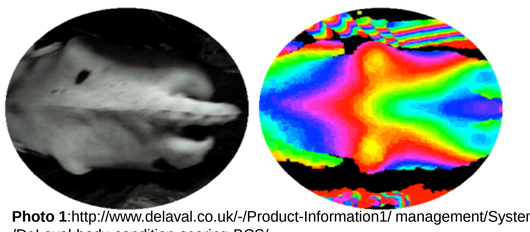

Photo 1:http://www.delaval.co.uk/-/Product-Information1/ management/Systems /DeLaval-body-condition-scoring-BCS/

Photo 2: http://new.llkc.lv/lv/nozares/ lopkopiba/aicinam-uz-fermu-dienu-vecauce

In study were included cows that calved in year 2016 and 2017, and were located in Latvia University of Life Sciences and Technologies (LLU) research and study farm "Vecauce" voluntary milking system (VMS) group. The average milk yield in farm goes over 10 000 kg per lactation. In the VMS group in every given time are located 100 dairy cows. Cows were fed 2 times per day with partially mixed ration, but throughout the day they had access to previously determined amount of fodder in the feeding stations and milking robots. Cows were milked in automatic milking system (AMS) by two robots. The system is equipped with " DeLaval" three dimensional (3D) body condition scoring (BCS) cameras (Photo 1) that each day evaluates cow BCS after each milking.

Monthly control milk samples were analyzed for fat, protein lactose , milk urea, and somatic cells count. All of these parameters were analyzed in accredited milk quality laboratory SIA 'Piensaimnieku Laboratorija' with FOSS instrument CombiFoss FC. In data base were included data about " DeLaval" 3D system obtained BCS scores and recording day milk productivity, composition (milk fat, protein, lactose and urea content) and quality (somatic cell count) from 1st and 2nd lactation were collected from Latvian Agricultural Data Centre data base. To evaluate the relationships of cow genotype and analysed traits, we distributed analysed cows in 3 groups depending on their breed – Holstein Black and White (HBW), Latvian Brown and Holstein Red and White crossbreeds (LB&HRW) and different dairy breed crossbreeds (XP). For study purposes were collected data about 690 HBW milk recordings, 108 LB&HRW recordings and 240 XP cow recordings. To evaluate the effect of BCS on milk productivity and composition characteristics, we distributed cows in 4 different groups depending on BCS 8 days after calving. In the 1st group were included cows with BCS <2.5 points, in 2nd group with BCS 2.51 – 2.99, in 3rd group with BCS 3.00 – 3.49 and in the 4th group were included cows with BCS >than 3.50 points.

In tables the average trait values were shown as least mean squares ± standard errors. The factor breed impact on cow productivity, BCS and milk quality traits was determined by analysis of variance. Pairwise comparisons between different breeds and lactations occurred by using Bonferroni test. Differences were considered statistically significant when $p < 0.05$. Significant differences ($p < 0.05$) in the tables were marked with different superscripted letters of alphabet (a, b, c, etc.). The mathematical processing was performed using the SPSS for Windows.

RESULTS

Table 1. Average recording control day cow body condition score (BCS), milk yield, composition and quality for different in " Vecauce" farm located dairy cow breeds.

Traits	Breed		
	HBW (n=690)	**LB&HRW** (n=108)	**XP** (n=240)
BCS	3.05 ± 0.01[b]	3.17 ± 0.03[a]	3.11 ± 0.02[ab]
Milk yield, kg	39.8 ± 0.38	40.3 ± 0.96	40.0 ± 0.64
Fat content, %	3.64 ± 0.04[b]	4.01 ± 0.09[a]	3.87 ± 0.06[a]
Protein content, %	3.28 ± 0.02[b]	3.44 ± 0.04[a]	3.36 ± 0.03[a]
Lactose content, %	4.86 ± 0.01	4.84 ± 0.03	4.87 ± 0.02
MU, mg dL^{-1}	33.0 ± 0.35	34.3 ± 0.86	34.4 ± 0.58
SCC, thousands mL^{-1}	156.2 ± 15.87	207.2 ± 39.70	121.8 ± 26.43
Milking day	142.8 ± 4.13	127.0 ± 9.33	146.4 ± 6.88
Lactation	1.78 ± 0.05[b]	3.41 ± 0.13[a]	2.39 ± 0.09[b]

HBW – Holstein Black and White; LB&HBW – Latvian Brown; XP – different dairy breed crossbreed.
a; b _ traits with different superscriptions shows significant differences between breeds ($p < 0.05$).

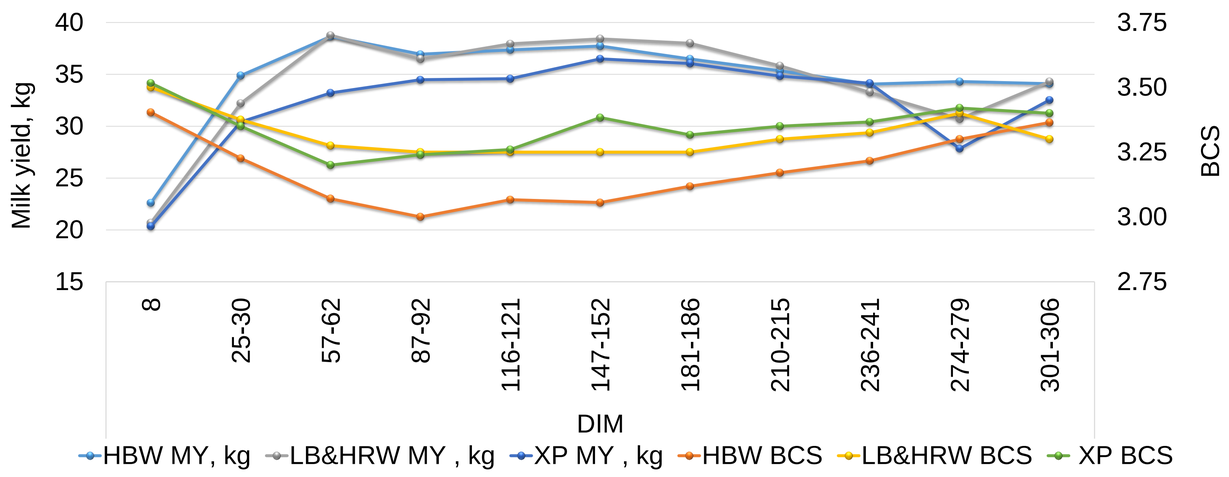

Figure 1. The changes of different breed cow milk productivity and BCS during 1st lactation.

In analysed cow group the significantly lowest ($p<0.05$) BCS was observed in Holstein Black and White (HBW) breed group, and in average HBW cows characterized with lower milk productivity, milk fat and protein content, and milk urea content. This could be explained with the age of each group – HBW breed cows were significantly younger than Latvian Brown and Holstein Red and White (LB&HRW) and dairy crossbreeds (XP). The highest milk productivity (40.3 ± 0.96 kg) were obtained from LB&HRW cows, they also characterized with the highest BCS, milk fat and protein content and somatic cell count in milk (Table 1).

The BCS 8 days after calving give significant impact on cow milk productivity during lactation.(Table 2) The highest milk yield per day in 1st lactation was obtained from HBW breed cows (38.0 ± 0.79 kg) with the average BCS 3.29 which does not go over optimal 3.50 point border, these cows also had the highest productivity in the 2nd lactation (44.9 ± 1.51 kg). In European dairy herds as optimal milk urea content is defined 15 – 30 mg dL^{-1}. Almost in every group (breed, lactation and BCS) the average MU content goes over the optimum border. It could indicate either on the unreasonable use of feed protein or on metabolic health problems of cows. The obtained results of milk fat and protein content ratio shows that there are not any indication on ketosis or rumen acidosis, that leads to conclusion that the ration, given in analysed cow group, needs to be balanced for current cow needs.

In the first lactation (Figure1) BCS for all cow breeds had smaller changes during the lactation and in the beginning of lactation the highest BCS was for LB&LRW cows (3.52 points) that reaches over recommended 3.50 point score, and the tendency remained until the 301 – 306 day of lactation. The lowest BCS scores during the 1st lactation had HBW breed cows , but in the same time from them were obtained the biggest milk yield. In the second lactation the tendency remained (Figure 2), HBW cows characterized with the lowest BCS, but the most productive at the beginning phase of lactation were cows included in XP group, they also characterized with BCS 3.26 at the beginning and 3.30 points at the end of the lactation.

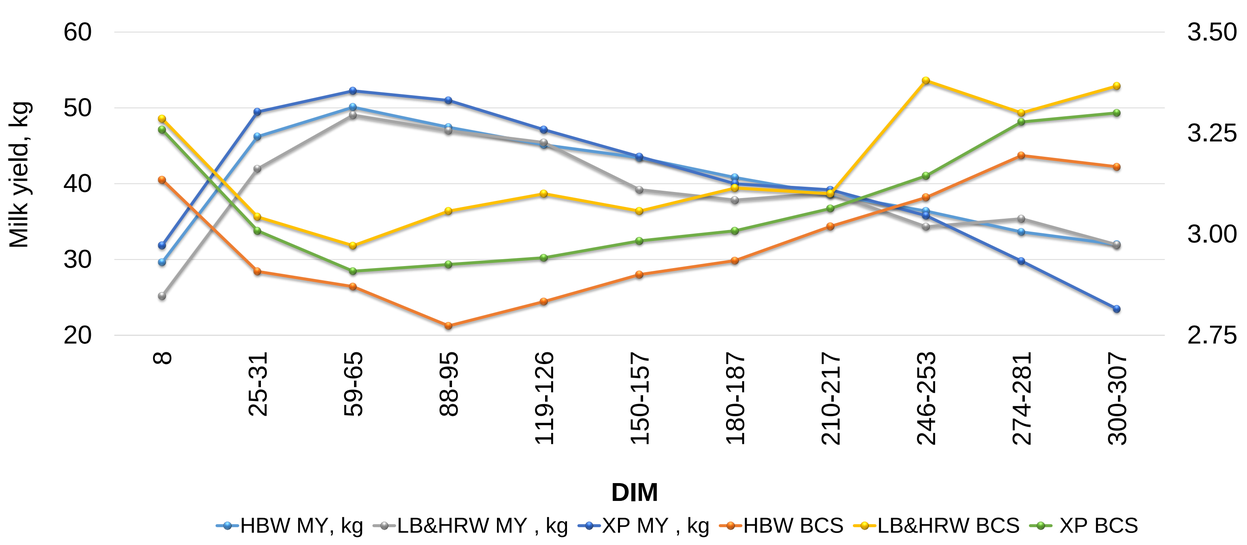

Figure 2. The changes of milk yield and BCS for different breed cows during 2nd lactation.

Table 2. The changes of BCS, milk yield (MY) milk urea content (MU) and milk fat to protein ratio (F:P) for cows of different breeds and lactations depending on BCS in 8th day after calving

Breed	Lactation	BCS	MY	MU	F:P
BCS = 1 (< 2.5)					
LB&HRW	2 (n= 8)	2.21 ± 0.10	39.4 ± 3.00	23.7 ± 2.96	1.44 ±0.09
BCS= 2 (2.51-2.99)					
HM	2 (n=97)	2.74 ± 0.03	42.2 ± 0.81	34.6 ± 0.79	1.08 ± 0.03
BCS= 3 (3.0-3.49)					
HM	1 (n=160)	3.06 ± 0.02	35.3 ± 0.63[a]	32.0 ± 0.62	1.15 ± 0.02
	2 (n=152)	3.05 ± 0.02	43.4 ±0.65[b]	32.7 ± 0.64	1.14 ± 0.02
LB&HRW	1 (n=9)	3.21 ± 0.09	42.5 ±2.66	38.4 ± 2.61	1.12 ± 0.08
	2 (n=27)	3.12 ± 0.05	44.6 ± 1.54	40.1 ± 1.51	1.11 ± 0.05
XP	1 (n=10)	3.07 ± 0.08	31.2 ± 2.53[a]	31.6 ± 2.48	1.28 ± 0.08
	2 (n=102)	2.99 ± 0.03	43.4 ± 0.78[b]	35.6 ± 0.76	1.17 ± 0.02
BCS= 4 (3.5 <)					
HM	1 (n=101)	3.29 ± 0.03	38.0 ± 0.79[a]	33.9 ± 0.79	1.06 ± 0.02
	2 (n=28)	3.14 ± 0.05	44.9 ± 1.51[b]	31.5 ± 1.48	1.16 ± 0.05
LB&HRW	1 (n=24)	3.33 ± 0.05	34.4 ± 1.63	32.4 ± 1.59	1.28 ± 0.05
	2 (n=18)	3.34 ± 0.06	40.5 ± 1.83	30.3 ± 1.79	1.23 ± 0.06
XP	1 (n=52)	3.36 ± 0.04	32.7 ± 1.11[a]	32.6 ± 1.09	1.05 ± 0.03
	2 (n=26)	3.11 ± 0.05	44.4 ± 1.57[b]	34.7 ± 1.54	1.30 ± 0.05

CONCLUSIONS

The evaluation of different dairy cow traits can help to understand different aspects of cows life. The knowledge of objective BCS results in combination with milk composition indicators can be used to evaluate dairy cow metabolic and reproduction health it can also be used for the evaluation of the quality of feed ration and welfare conditions in the farm. It is very important to keep feeding and housing conditions in farm optimal for dairy cow needs, because the over or underfeeding not only increase the risk of metabolic diseases occurrence, but also it significantly reduce cows productivity level and reproductive performance that can lead to large financial losses.

ACKNOWLEDGEMENTS

The funding for this paper was received from VPP project " Genetic research on local dairy cows and pigs economically important traits to produce quality food products, development and approbation of natural origin feed components for animals' nutrition (LIVESTOCK)"