

## CHARACTERISTICS AND VARIABILITY OF UDDER SCORES OF SIMMENTAL FIRST CALVING HEIFERS

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**Abstract:** Visual assessment and recognition of milk performance traits of cows are preliminary indicators of milk yield, longevity, as well as reproductive abilities of the animal, which is very important from the aspect of economy of milk production. Deficiencies in udder traits lead to poorer production, difficult milking and premature weaning of cows from the herd. The paper examines the frequency of desirable scores for a certain trait in first-calving heifers distinguished by way of keeping (heads reared by individual producers/holdings and heads reared on the farm) and by origin (domestic and imported animals), as well as the influence of these two factors on the observed traits. Five udder traits were analyzed: front udder length, rear udder length, rear udder height, central ligament, and udder depth on a total of 954 first-calving Simmental heifers. Observed by the way of rearing, higher frequency of desirable scores for all udder traits were achieved by cows reared on the farm, while according to the origin of cows, higher frequency of desirable scores for all udder traits was achieved by imported cows compared to domestic cows. The influence of factors of housing/keeping and origin, examined by  $\chi^2$  test on all examined linear scores (frequency of scores) of udder traits was statistically very highly significant ( $p \leq 0.001$ ), while the analysis of variance (F test) showed very high significance ( $p \leq 0.001$ ) of interaction of origin and method of rearing on the traits of the central ligament and the udder depth, and significance ( $p \leq 0.05$ ) on the height of the rear udder, however, no statistical significance ( $p > 0.05$ ) of this interaction was established on other linear scores of udder traits (length of the front and rear udder).

**Key words:** Simmental, udder, rear udder height, front udder length, central ligament

## Introduction

The evaluation of the exterior of animals is performed on the basis of knowledge of the structure and function of individual organs as well as the most important relationships between individual body parts.

The assessment of the body development of cattle is a critical assessment of whether the individual animal in its overall appearance as well as individual parts of the body, guarantees, in addition to good health, high production performance, i.e. its longevity. The inclusion of a linear type scores contributes to the reliability of the evaluation of the breeding value of cows, which has a positive effect on the overall effects of selection and production success (*Pantelić et al., 2006*).

Linear evaluation includes the evaluation of each predicted trait in its biological extremes, according to a scale ranging from 1 to 9 in the evaluation chart, and it should be emphasized that the highest score (9) is not the most favourable for each trait, because for some traits average grades (5) are the best (*Petrović and Pantelić, 2015*).

*Živanović (2002)* has examined the variability of linearly assessed traits of type and milk yield of first-calving heifers of Black and White breed on a sample of 2,976 cows of PK "Belgrade". Linear assessment of the type was performed in the period from 30 to 150 days from the beginning of lactation. The score system included 14 traits, i.e. 6 traits of body development and 8 udder traits. The average values of the obtained scores ranged from 5.28 to 7.15 for the body development, and 5.06 to 7.02 for the udder traits.

The cow's udder is one of the most important criteria that can be used to predict production performance (*Vukašinović et al., 1995*). The trait of udder height is positively related to better genetic potential in the first lactation. The conformation of the udder and the teat position are related to the health of the udder and the efficiency of the automatic milking (with the use of milking machines). Also, cows with a high scores for body development traits of live animals in the herd were not associated with health problems.

*Rogers et al. (1981)* find that the depth of the udder and the rear teat are the traits most closely associated with the longevity of cows. Selection based on body development traits and milk performance could result in higher genetic gains in milk yield than selection based on individual milk performance.

The importance of the structure and udder attachment and other traits on milk yield and longevity of cows has been examined by *Sawa et al. (2013)*, stating that life expectancy is in the strongest correlation with udder traits ( $r = 0.22$ ), followed by results for type and conformation of both legs and feet ( $r = 0.13$ ) and individual traits such as udder width and dairy character ( $r = 0.14$ ). The traits of the udder, legs and feet together exhibit the highest positive effect on longevity ( $r =$

0.11), and among the individual traits, the position of the udder ( $r = 0.14$ ) and the front udder attachment ( $r = 0.10$ ).

Examining the influence of individual traits and their scores on cow productivity in Ethiopia, *Yaman et al. (2015)* establish a correlation between individual traits and milk yield of cows and expressed this through the Pearson coefficient, as follows: for udder length ( $r = 0.63$ ), teat length ( $r = 0.53$ ) and body length ( $r = 0.65$ ). Of the qualitative traits, about 53.34% of the owners interviewed in this dairy farm survey stated that udder size and teat placement are considered to be the main traits for selection of dairy cows.

According to the research conducted by *Gulinski et al. (2005)*, the conformation traits most closely related to milk yield include udder width ( $r = 0.26$ ), angularity ( $r = 0.21$ ), overall type and conformation score ( $r = 0.19$ ). *Chabuz et al. (2003)* show that milk yield, on a scale of 100 points, is most closely related to the conformation score ( $r = 0.43$ ), then hip height ( $r = 0.31$ ) and udder traits, especially udder width ( $r = 0.49$ ) and front udder length ( $r = 0.35$ ).

## Material and Methods

Basic data on the traits of body fundament, as well as data on the origin of all examined cows, were collected in cooperation with the dairy farm "Lazar" Blace, which housed part of the animals covered by this study. For animals reared on farms of individual producers (holdings), data on these traits were collected in cooperation with the breeding organizations, which implement the breeding program in the Toplica district.

The animals ( $n = 954$ ) included in the analysis of morphometric traits were divided into two groups based on the method of rearing, and two groups based on the origin, as follows:

Based on the method of rearing:

Group 1: animals reared by individual producers ( $n = 504$ );

Group 2: animals reared on the farm ( $n = 450$ );

Based on the origin:

Group 1 animals of domestic origin ( $n = 718$ );

Group 2: imported animals ( $n = 236$ ).

All udder traits were linearly assessed after the first calving, namely: front and rear udder length, rear udder height, central ligament and udder depth.

The processing of the collected data consisted of determining the frequency for each score individually, the frequency of the preferred scores for all udder traits, and comparing the obtained frequencies by groups. Subsequently, the influence of method of rearing (applied  $\chi^2$  test) and the influence of the origin of animal (applied  $\chi^2$  test) on the frequency of linear scores for each udder trait were

examined, while the analysis of variance examined the influence of rearing and origin, as well as their interaction on all linear scores, with the following model: Model with fixed influence of rearing and origin and their interaction:

$$Y_{ij} = \mu + N_i + P_j + NP_{ij} + e_{ijk}$$

- $Y_{ij}$ : tested trait,
- $\mu$ : population average for a given trait,
- $N_i$ : fixed influence of the  $i$  way of rearing ( $i = 1, 2$ ),
- $P_j$ : fixed influence of  $j$  origin ( $j = 1, 2$ ),
- $NP_{ij}$ : the influence of factor interaction (rearing and  $t$  origin),
- $e_{ijk}$ : random error

For statistical data processing and application of the mentioned model, the software SPSS Statistics for windows, Version 23.0 was used.

## Results and Discussion

Based on the results shown in Table 1, it can be concluded that the highest number of animals did not have the desired score (7,8,9) for the trait of the front udder length, however, imported animals (45.34%) and animals reared on the farm (45.11%) had a higher frequency of desirable scores than animals reared by individual producers (34.52%), and of domestic origin (37.60%). The origin of the animal and the method of rearing showed statistically very highly significant ( $p \leq 0.001$ ) impact on the frequency of scores for the front udder length, examined by the  $\chi^2$  test. Analysis of variance (F test) showed that the interaction of origin and method of rearing, and method of rearing individually did not have a significant impact ( $p \leq 0.05$ ) on the examined trait.

The frequency of desirable scores for the rear udder length was higher in farm reared cattle than in first – calving heifers reared by individual producers and amounted to 40.67%. Animals of imported origin also had a higher percentage of desirable scores (37.71%) than heads of domestic origin (33.70%).

Based on the  $\chi^2$  independence test, it was determined that there was a statistically very significant correlation ( $p \leq 0.001$ ) between the origin and scores for the rear udder length in first calving heifers, as well as the method of rearing and scores for the same trait. Analysis of variance (F test) showed that the method of rearing and the origin of the animals, as well as their interaction, did not have a statistically significant effect ( $p > 0.05$ ) on the rear udder length.

**Table 1. Linear scores and their frequencies for the traits front and rear udder length in Simmental first-calving heifers**

Scores	Rearing						Origin					
	Animals reared by individual producers			Animals reared on the farm			Domestic animals			Imported animals		
	N	%	% group	N	%	% group	N	%	% group	N	%	% group
<b>FRONT UDDER LENGTH</b>												
1	0	0.00	0.20	0	0.00	1.56	0	0.00	0.28	0	0.00	2.54
2	0	0.00		0	0.00		0	0.00				
3	1	0.20		7	1.56		2	0.28				
4	3	0.60	65.28	26	5.78	53.33	4	0.56	62.12	25	10.59	52.12
5	144	28.57		142	31.56		245	34.12				
6	182	36.11		72	16.00		197	27.44				
7	<b>166</b>	<b>32.94</b>	34.52	<b>159</b>	<b>35.33</b>	45.11	<b>268</b>	<b>37.33</b>	37.60	<b>57</b>	<b>24.15</b>	45.34
8	<b>8</b>	<b>1.59</b>		<b>44</b>	<b>9.78</b>		<b>2</b>	<b>0.28</b>				
9	<b>0</b>	<b>0.00</b>		<b>0</b>	<b>0.00</b>		<b>0</b>	<b>0.00</b>				
<b>χ<sup>2</sup> test</b>												
Rearing χ <sup>2</sup> =92.707*** p=0.000						Origin χ <sup>2</sup> =238.545*** p=0.000						
<b>F test</b>												
Rearing F=0.030 <sup>nz</sup> p=0.861						Origin F=4.247* p=0.040						
Rearing x Origin F=1.047 <sup>nz</sup>						p=0.307						
<b>REAR UDDER LENGTH</b>												
1	0	0.00	0.19	0	0.00	0.66	0	0.00	0.28	0	0.00	0.85
2	0	0.00		0	0.00		0	0.00				
3	1	0.19		3	0.66		2	0.28				
4	3	0.60	70.44	25	5.56	58.67	4	0.56	66.02	24	10.17	61.44
5	155	30.75		165	36.67		260	36.21				
6	197	39.09		74	16.44		210	29.25				
7	<b>141</b>	<b>27.98</b>	29.37	<b>148</b>	<b>32.89</b>	40.67	<b>241</b>	<b>33.57</b>	33.70	<b>48</b>	<b>20.34</b>	37.71
8	<b>7</b>	<b>1.39</b>		<b>35</b>	<b>7.78</b>		<b>1</b>	<b>0.14</b>				
9	<b>0</b>	<b>0.00</b>		<b>0</b>	<b>0.00</b>		<b>0</b>	<b>0.00</b>				
<b>χ<sup>2</sup> Test</b>												
Rearing χ <sup>2</sup> =90.494*** p=0.000						Origin χ <sup>2</sup> =194.253*** p=0.000						
<b>F Test</b>												
Rearing F=0.018 <sup>nz</sup> p=0.894						Origin F=1.949 <sup>nz</sup> p=0.163						
Rearing x Origin F=0.084 <sup>ns</sup>						p=0.771						

\*\*\*- p<0,001; \*\* - p<0,01; \* - p<0,05; ns - p>0,05

In the analysis the rear udder height, central ligament and udder depth, by groups (Table 2), the lowest percentage of cows with favourable scores for the rear udder height were domestic cows and cows reared by individual producers (about 29%), then cows reared on the farm (34.00%) and the highest percentage with favourable scores for the rear udder height were cows originating from import (38.56%).

By testing the frequencies with the  $\chi^2$  test, it was established that there was statistically very highly significant variation ( $p \leq 0.001$ ) of the scores for the rear udder height under the influence of the rearing of cows and their origin. Analysis of variance (F test) revealed a highly significant influence of the method of rearing and the origin of the animals ( $p \leq 0.01$ ), while the interaction of the origin and the method of rearing had statistically significant ( $p < 0.05$ ) effect on the rear udder height.

The frequency of desirable scores for the central ligament trait was significantly higher in farm-reared cattle (30.22%) than in cattle reared on individual households where only 23.41% of first-calving heifers were given any of the desirable scores. If we look at the observed population on the basis of the origin, it can be stated that the frequency of desirable scores was significantly higher for animals originating from import (40.25%) than for animals originating from domestic breeding, where 22.14% of first-calving heifers were given desirable scores for the central ligament trait.

The influence of the origin and method of rearing of animals was statistically very highly significant ( $p \leq 0.001$ ) on the frequency of scores for the central ligament, examined by the  $\chi^2$  test. Analysis of variance (F test) also revealed very highly significant influence ( $p \leq 0.001$ ) of the method of rearing, the origin of the animal and their interaction.

By examining the trait of udder depth, it can be stated that the highest number of animals had desirable scores (7,8,9) only in case of animals originating from import (56.36%), while other groups had a lower percentage: farm-reared cattle (44.89%), cattle reared by individual producers (43.25%), and domestic cattle (39.97%). The influence of the origin of the animal and the way of rearing was statistically very highly significant ( $p \leq 0.001$ ) on the frequency of udder depth scores, examined by the  $\chi^2$  test. Analysis of variance (F test) also revealed very highly significant influence ( $p \leq 0.001$ ) of the method of rearing, the origin of the animal and their interaction.

**Table 2. Linear scores and their frequencies for the traits rear udder height, central ligament and udder depth in Simmental first-calving heifers**

Scores	Rearing						Origin					
	Animals reared by individual producers			Animals reared on the farm			Domestic animals			Imported animals		
	% group	N	%	% group	% group	N	%	% group	% group	N	%	% group
<b>REAR UDDER HEIGHT</b>												
1	0	0.00	1.19	0	0.00	2.22	0	0.00	1.67	0	0.00	1.69
2	0	0.00		0	0.00		0	0.00		0	0.00	
3	6	1.19		10	2.22		12	1.67		4	1.69	
4	3	0.60	69.25	27	6.00	63.78	7	0.97	68.94	23	9.75	59.75
5	145	28.77		156	34.67		231	32.17		70	29.66	
6	201	39.88		104	23.11		257	35.79		48	20.34	
7	<b>130</b>	<b>25.79</b>	<b>29.56</b>	<b>122</b>	<b>27.11</b>	<b>34.00</b>	<b>209</b>	<b>29.11</b>	<b>29.39</b>	<b>43</b>	<b>18.22</b>	<b>38.56</b>
8	<b>19</b>	<b>3.77</b>		<b>31</b>	<b>6.89</b>		<b>2</b>	<b>0.28</b>		<b>48</b>	<b>20.34</b>	
9	<b>0</b>	<b>0.00</b>		<b>0</b>	<b>0.00</b>		<b>0</b>	<b>0.00</b>		<b>0</b>	<b>0.00</b>	
<b>χ<sup>2</sup> Test</b>												
Rearing χ <sup>2</sup> =51.694*** p=0.000						Origin χ <sup>2</sup> =201.427*** p=0.000						
<b>F Test</b>												
Rearing F=9.904** p=0.002						Origin F=8.450** p=0.004						
Rearing x Origin F=4.030*										p=0.045		
<b>CENTRAL LIGAMENT</b>												
1	0	0.00	0.40	0	0.00	1.34	0	0.00	0.42	0	0.00	2.12
2	0	0.00		0	0.00		0	0.00		0	0.00	
3	2	0.40		6	1.34		3	0.42		5	2.12	
4	1	0.20	76.19	32	7.11	68.44	1	0.14	77.44	32	13.56	57.63
5	176	34.92		148	32.89		279	38.86		45	19.07	
6	207	41.07		128	28.44		276	38.44		59	25.00	
7	<b>99</b>	<b>19.64</b>	<b>23.41</b>	<b>108</b>	<b>24.00</b>	<b>30.22</b>	<b>159</b>	<b>22.14</b>	<b>22.14</b>	<b>48</b>	<b>20.34</b>	<b>40.25</b>
8	<b>15</b>	<b>2.98</b>		<b>26</b>	<b>5.78</b>		<b>0</b>	<b>0.00</b>		<b>41</b>	<b>17.37</b>	
9	<b>4</b>	<b>0.79</b>		<b>2</b>	<b>0.44</b>		<b>0</b>	<b>0.00</b>		<b>6</b>	<b>2.54</b>	
<b>χ<sup>2</sup> Test</b>												
Rearing χ <sup>2</sup> =53.294*** p=0.000						Origin χ <sup>2</sup> =271.482*** p=0.000						
<b>F Test</b>												
Rearing F=21.752*** p=0.000						Origin F=31.762*** p=0.000						
Rearing x Origin F=27.964***										p=0.000		

UDDER DEPTH												
1	0	0.00	0.20	0	0.00	0.22	0	0.00	0.28	0	0.00	0.00
2	0	0.00		0	0.00		0	0.00		0	0.00	
3	1	0.20		1	0.22		2	0.28		0	0.00	
4	1	0.20	56.55	9	2.00	54.89	3	0.42	59.75	7	2.97	43.64
5	78	15.48		91	20.22		114	15.88		55	23.31	
6	206	40.87		147	32.67		312	43.45		41	17.37	
7	187	37.10	43.25	156	34.67	44.89	287	39.97	39.97	56	23.73	56.36
8	20	3.97		39	8.67		0	0.00		59	25.00	
9	11	2.18		7	1.56		0	0.00		18	7.63	
$\chi^2$ Test												
Rearing $\chi^2=24.091^{***}$ p=0.001						Origin $\chi^2=297.142^{***}$ p=0.000						
F Test												
Rearing F=20.160 <sup>***</sup> p=0.000						Origin F=62.379 <sup>***</sup> p=0.000						
Rearing x Origin				F=19.305 <sup>***</sup>				p=0.000				

\*\*\*-  $p \leq 0.001$ ; \*\* -  $p \leq 0.01$ ; \* -  $p \leq 0.05$ ; ns -  $p > 0.05$

## Conclusion

By examining the scores for udder traits in Simmental first-calving heifers observed according to the method of rearing, the higher frequency of desirable scores for all udder traits was achieved by cows reared on the farm, while according to the origin of cows, the higher frequency of desirable scores for all body fundament traits were realized by imported animals in relation to cows of domestic origin. The influence of factors of rearing and origin examined by  $\chi^2$  test on all examined linear scores (frequency of scores) of udder traits was statistically very highly significant ( $p \leq 0.001$ ), while analysis of variance (F test) determined high significance ( $p \leq 0.001$ ) of the interaction of origin and method of rearing on the udder depth and the central ligament, as well as significance ( $p \leq 0.05$ ) of this interaction on the height of the rear udder, while the linear scores for the front and rear udder length did not show statistical significance ( $p > 0.05$ ).

## Karakteristike i varijabilnost ocena vimena prvotelki simentalske rase

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## Rezime

Vizuelna procena i prepoznavanje mlečnih karakteristika krava su preliminarni pokazatelji mlečnosti, dugovečnosti, kao i reproduktivnih sposobnosti grla, što je veoma važno sa aspekta ekonomičnosti proizvodnje mleka. Nedostaci u osobinama vimena dovode do slabije proizvodnje, otežane muže i preranog isključenja krava iz zapata. U radu je ispitivana učestalost poželjnih ocena određene osobine kod prvotelki podeljenih po načinu držanja (grla kod individualnih proizvođača i grla sa farme) i podeljenih po poreklu (grla domaćeg odgoja i grla iz uvoza), kao i uticaj ova dva faktora na posmatrane osobine. Analizirano je pet osobina vimena: dužina prednjeg vimena, dužina zadnjeg vimena, visina zadnjeg vimena, centralni ligament i dubina vimena na ukupno 954 prvotelke simentalske rase. Posmatrano prema načinu držanja, veću frekvenciju poželjnih ocena za sve osobine vimena iskazane u ocenama ostvarile su krave sa farme, dok su prema poreklu krava, veću frekvenciju poželjnih ocena za sve osobine vimena iskazane u ocenama ostvarile krave poreklom iz uvoza u odnosu na krave domaćeg porekla. Uticaj faktora načina držanja i porekla grla ispitivani  $\chi^2$  testom na sve ispitivane linearne ocene (frekvenciju ocena) osobina vimena bio je statistički vrlo visoko značajan ( $p \leq 0,001$ ), dok je analizom varijanse (F test) utvrđena vrlo visoka značajnost ( $p \leq 0,001$ ) interakcije porekla i načina držanja na osobine centralni ligament i dubina vimena, kao i značajnost ( $p \leq 0,05$ ) na visinu zadnjeg vimena, dok na ostale linearne ocene osobina vimena (dužina prednjeg i zadnjeg vimena) nije ispoljila statističku značajnost ( $p > 0,05$ ).

**Ključne reči:** simentalska rasa, vime, visina zadnjeg vimena, dužina prednjeg vimena, centralni ligament

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