Studies on Some Body Measurements in Romanian Black and White Cows and their Relationships within Body Indices Building-Up

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Abstract
The aim of the study was to assess the new body measurements introduced in use for Romanian Black and White cows belonging to Holstein-Friesian breeds, and their influences on body indices. Researches were carried out on 66 adult Romanian Black and White cows. The following measurements were performed: 1) old: height at withers, oblique body length, and chest depth, and 2) new: height at rump, body length, and body depth. The following indices were calculated: lateral body index, lateral trunk index, and thorax depth index using both old and new measurements. Variability for the body dimensions and indices, both old and new, was low, as well as differences between averages and median. New body dimensions, measured in different points of the cows, differ significantly from the old used dimensions in describing the conformation of the Romanian Black and White cows. Therefore the body indices made up with the new measurements were significantly different compared to the old indices. However, there were high and significant correlations between the old and new body dimensions and indices, showing that there are similar factors that influence them. Further research should be carried out in order to clarify the functional and conformation meaning of the new dimensions and indices.

Keywords: body indices, body measurements, cows, Romanian Black and White.

1. Introduction

During the last decades, European and global cattle breeding associations agreed and worked together to uniform the way cattle are evaluated for their exterior traits [1]. This is a necessity in order to make comparisons among breeds and to be able to estimate the breeding values both for cows and bulls. A principle that was adopted by all the breeding associations was that a minimum number of compulsory traits should be used, thus the obtained results should be comparable between organisations.

For the last decades, the main body dimensions used to assess the type classification of Holstein Friesian cows were switched from the old measurements such as: height at withers, oblique body length, and chest depth to new ones as: height at rump (stature), body length, and body depth [2].
World Holstein Friesian Federation has regular meetings in order to harmonize the linear evaluation of cows, which represents one of the greatest accomplishments of the Federation [3]. The last General Assembly was held in Killarney, Ireland in October 2008. This year (2010) the General Assembly will be held in France.
Studying the conformation of cows could be achieved by analyzing either the body measurements performed or calculating the body indices. Body indices show the percentage ratio of

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interrelationships among body parts that make up the body areas with the same morphological and functional background [4]. These body parts are connected anatomically and physiologically.
Because of the new body measurements used in describing the conformation in Holstein Friesian cows, the old computing equations for the body indices could not be used anymore.
The aim of this paper was to compare the results of calculating the body indices with the new body measurements by replacing the old ones in the same equation, and to assess the meaning of the new results obtained.

2. Materials and methods

Researches were carried out on 66 adult Romanian Black and White cows (Holstein Friesian type), bred and reared at the Didactical Station of the Banat university of Agricultural Sciences and Veterinary Medicine Timişoara. The body measurements, performed in year 2008, were the following: 1) height at withers -HW- from the highest point of the withers to the ground [4], 2) oblique body length -OL- from the centre of humeral joint to the pins [4], 3) chest depth -CD- from the top of the spine to the bottom of the chest [4], 4) height at rump (stature) -HR- from the top of the spine in between hips to ground [3], 5) body length -BL- measured with tape from the highest point of the withers, along the spine, up to the one of the pins [4], and 6) body depth -BD- distance between the top of spine and bottom of barrel at last rib (the deepest point) [3]. Using the first three body measurements, for each cow, the following body indices were calculated [4]: 1) lateral body index -LBI- oblique body length*100/height at withers, 2) lateral trunk index -LTI- chest depth*100/oblique body length, and 3) thorax depth index -TDI- chest depth*100/height at withers. Replacing the old measurements (height at withers, oblique body length, and chest depth) with the new ones (height at rump, body length, and body depth) in the above-mentioned equations we have obtained the new indices, as follows: 1) new lateral body index -NLBI- body length*100/height at rump, 2) new lateral trunk index -NLTI- body depth*100/body length, and 3) new thorax depth index -NTDI- body depth*100/height at rump.
For each cow the body indices were calculated according to their equation. Averages and variance indices were calculated for each body measurements and indices. Comparisons between old and new body indices were carried out using analysis of variability within the group, t-test for dependent samples and Pearson simple correlations. The statistical software used in these inferences was Statistica 7.

3. Results and discussion

Averages and dispersion indices for body dimensions are shown in Table 1. One could observe that both old and new body dimensions had a low variability within the group (from 3.12% in height at rump to 5.68 in body length), but what is it the most important is that new measures used have similar variability with the old ones. For example, for the stature of the cow, the new dimension height at rump had a variability of 3.12% while the variability of the old dimension used was 3.15%. Initially, the switch from one measurement to another was made exactly because it was said that height at withers yield more variability within groups compared to height at rump. This was not the case for our data.

Table 1. Averages, variance indices, and significance for body dimensions in Romanian Black and White cows

Dimension	MU	Average ± SEM	SD	v%	Median
Height at withers (HW)	cm	136.0±0.53^{a}	4.28	3.15	135.5
Height at rump (stature) (HR)	cm	137.7±0.53^{a}	4.30	3.12	138.0
Oblique body length (OL)	cm	167.9±1.17^{b}	9.51	5.66	168.5
Body length (BL)	cm	149.5±1.05^{b}	8.50	5.68	149.0
Chest depth (CD)	cm	75.8±0.40^{c}	3.21	4.24	76.0
Body depth (BD)	cm	79.9±0.39^{c}	3.18	3.98	80.0

Values with same superscript on the column differed significantly at $p<0.001$

Also, Table 1 data show that both for old and new dimensions the distance between the average and the median (the middle measurement when values are arranged in increasing order [5]) was low,

being slightly lower for the new body dimensions. This suggests that values' grouping was good, following a normal distribution (Figure 1).

The data grouping described above gave us the reason to apply a significance test to assess the differences among old and new body dimensions. As it was presumed the differences were very significant for all the three sets of body dimensions (see Table 1).Romanian Black and White cows were 1.7 cm taller at rump than at withers, results consistent with older literature data that state the difference should not exceed 1 inch.

Oblique body length is 18.4 cm higher than body length, explained with that the later is measured horizontally, while the former is measured in diagonal of the cow's body.

Chest depth was 4.1 cm lower than body depth, which is natural for dairy cows having a larger size of the thorax at the rear end allowing a greater volume of the abdominal area and digestive tract. This gives the trapezoidal shape of the dairy cows from the side view.

Table 2 presents the central and dispersion parameters for body indices calculated with old and new body dimensions. It is to note that the variability for all the body indices was low, and ranged between 3.45% for the thorax depth index and 5.30% for lateral trunk index. Also, the difference between the average and the median for each trait, old and new, was low, varying from 0.9 percentage points in lateral body index to 0.1 percentage points in thorax depth index.

Obviously, because the significant difference between the body dimensions that are used to compute these indices, there were significant differences between the old and new body indices.

Lateral body index was 14.8 percentage points higher than the new lateral body index, due to OL being higher than BL and HW being lower than HR. Thus, in the new index the difference between body length and stature is not that high as it was in the old index.

Because of lower chest depth compared to body depth and higher oblique body length compared to body length, the old lateral trunk index was 8.4 percentage points smaller than the new lateral trunk index (Table 2). Because of the way the new body measurements that make up this index are measured we believe that the new index express more accurately the relationship between the body depth and length than the old index. More investigations are to be carried out to establish limit values for different breeds and categories.

Table 2. Averages, variance indices, and significance for body indices in Romanian Black and White cows

Index	MU	Average ± SEM	SD	v%	Median
Lateral body index (LBI)	%	123.4±0.68[a]	5.56	4.50	124.3
New lateral body index (NLBI)	%	108.6±0.63[a]	5.10	4.69	108.3
Lateral trunk index (LTI)	%	45.2±0.30[b]	2.40	5.30	44.7
New lateral trunk index (NLTI)	%	53.6±0.34[b]	2.78	5.19	53.1
Thorax depth index (TDI)	%	55.7±0.24[c]	1.92	3.45	55.6
New thorax depth index (NTDI)	%	58.1±0.29[c]	2.38	4.10	57.8

Values with same superscript on the column differed significantly at $p<0.001$

Both new body dimensions that make up the new thorax depth index were higher than old dimensions; therefore the old thorax index was 2.4 percentage points lower than the new index. We do not know how to explain the values of the new index. The old thorax depth index was used to explain the troubles that animals have during the growth period, which lead to a lower body depth and reduced capacity for vital organs in the thorax (heart and lungs). In the new index the rear thorax depth, at the limit between thorax cavity and abdominal cavity, is divided to a rear body height (height at rump), that is not lined up with the fixed points used for measuring the body depth. We consider that, also, in this case further researches are required.

Studying further the relationships between the old and new body dimensions and indices, we have computed the simple linear regression between them (Table 3). As it was shown in Table 3, for

studied dimensions and indices there was a significant correlation ($p<0.05$) between the old and new values.

Correlation is not a cause-effect test, but a test that shows if both compared values are determined by the same factors.

The highest correlation was observed between the depth dimensions, r=0.85, then it was followed by height dimensions (r=0.78) and length dimensions (0.63). This means that depth, either chest or body, is determined by the same factors in greater extent compared to length. The probable explanation of this is that length dimensions occur earlier in the ontogeny of an animal organism, while depth dimensions develop later in an animal life, mostly during the extra-uterine life. For this reason the depth dimensions are subjected to more influential factors.

The relationships between body indexes were lower than those for body dimensions. The highest correlation was observed for lateral trunk index (r=0.74), while for the other two indices the correlation coefficient was at the lower limit of significance, taking vales from 0.32 in lateral body index to 0.36 in thorax index.

Table 3. Pearson simple correlations between new and old body dimensions and indices in Romanian Black and White cows

Traits	Correlation coefficient	p
HW-HR	0.78	*
OL-BL	0.63	*
CD-BD	0.85	*
LBI-NLBI	0.32	*
LTI-NLTI	0.74	*
TDI-NTDI	0.36	*

* - $p<0.05$

In order to have a better insight of the significance of correlation coefficient Figures 1 and 2 show the regression lines for the highest correlation and for the lowest correlation.

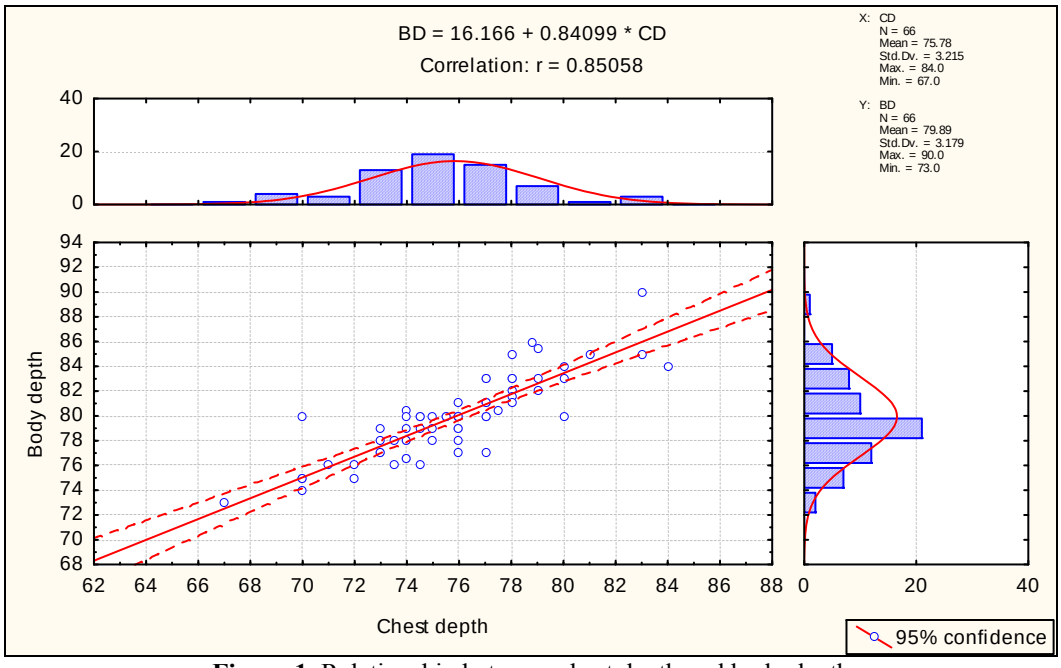

Figure 1. Relationship between chest depth and body depth

Figure 1 presents the regression line and confidence limits for the correlation between the chest depth and body depth. For a correlation rather high (r=0.85) the points on the graph are distributed along the regression line and very close to it. Also, the distribution of the values for the both dimensions is approaching the normal distribution.

Figure 2 show the regression line and confidence limits for lowest correlation, between the old and new lateral body index. As one can see the point are spread far away from the regression line, making the confidence limits to drift away from this. Also, the distribution of the values within each index is not complying with the normal distribution.

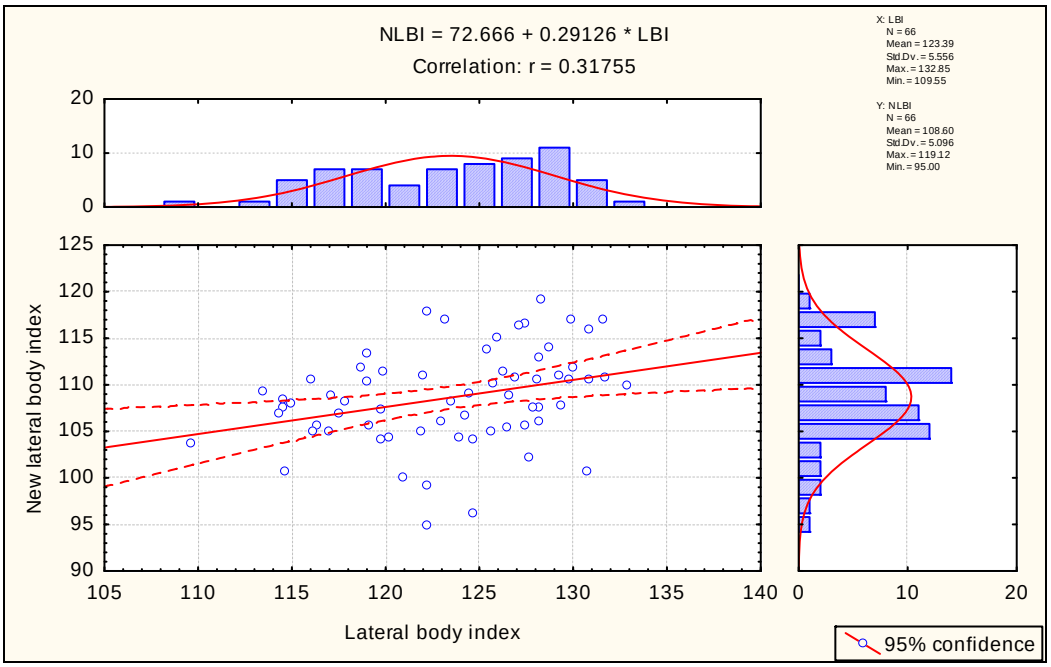

Figure 2. Relationship between Lateral body index and new lateral body index

4. Conclusions

New body dimensions, measured in different points of the cows, differ significantly from the old used dimensions in describing the conformation of the Romanian Black and White cows. Therefore the body indices made up with the new measurements were significantly different compared to the old indices. Also, the significance for conformation and functional description of the cows' body could be altered with the new body dimensions. However, there were high and significant correlations between the old and new body dimensions and indices, showing that there are similar factors that influence them. Further research should be carried out in order to clarify the functional and conformation meaning of the new dimensions and indices.

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