

Electronic Journal of Polish Agricultural Universities is the very first Polish scientific journal published exclusively on the Internet, founded on January 1, 1998 by the following agricultural universities and higher schools of agriculture: University of Technology and Agriculture of Bydgoszcz, Agricultural University of Cracow, Agricultural University of Lublin, Agricultural University of Poznan, Higher School of Agriculture and Teacher Training Siedlce, Agricultural University of Szczecin, and Agricultural University of Wrocław.



**ELECTRONIC
JOURNAL
OF POLISH
AGRICULTURAL
UNIVERSITIES**

**2000
Volume 3
Issue 2
Series
ANIMAL HUSBANDRY**

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KUCZAJ M., PAWLINA E., KRUSZYŃSKI W., AKIŃCZA J. 2000. RELATIONS BETWEEN BODY FRAME AND MILK PERFORMANCE OF BLACK-WHITE COWS IMPORTED FROM HOLLAND *Electronic Journal of Polish Agricultural Universities*, Animal Husbandry, Volume 3, Issue 2.

Available Online <http://www.ejpau.media.pl>

RELATIONS BETWEEN BODY FRAME AND MILK PERFORMANCE OF BLACK-WHITE COWS IMPORTED FROM HOLLAND

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ABSTRACT

Black-White cows imported from Holland are characterized by the correct body build. For the 305 days of lactation milk yield averaged 7795 kg with 4,41% fat and 3,35% protein content. The average milk yield as FCM per 100 kg of body weight was 1294 kg. Ratio of milk, fat and protein yield obtained at first 100 days of lactation was respectively: 36,2; 36,7 and 33,8% as compared to the 305 days lactation Indices: the ratio of

protein to fat content (SBT), the difference between fat and protein content in milk (RTB) and the Sanders index were respectively: 0,77; 1,06 and 254. Phenotypic correlation coefficients between milk performance traits and body measurements were low in values and quite often negative. The only strong relation for the 305 days of lactation was reported between milk protein content and the depth of chest ($r = - 0,39$; $P \leq 0,01$).

Key words: cows, body frame, milk performance, correlations

INTRODUCTION

To improve the native population of Black-White and Red-White cattle in Poland sires of Holstein-Friesian (HF) breed have been extensively used for more than 25 years. In result of the upgrading, the cow population with high share of HF genes was formed. It is characterized by the better milk performance [3, 6, 14], the correct udder conformation [13, 14, 17] and the larger body frame [4, 15, 16].

The body build of animals is very important as the breeding and performance objective. The research of many authors [3, 7, 11] had shown significant relations existing between body conformation and milk production traits. Research emphasizing existence of significant relations between the body conformation and a milk production confirm the appropriateness of body conformation traits use for breeding purposes.

The aim of the present study was to describe the performance as well as relations between body build and milk production of the recent generation of the Black-White cattle imported to Poland from Holland.

MATERIALS AND METHODS

The material consisted of 54 Black-White cows with a high share of HF genes (87,5 - 100%) which were bought in Holland and in the years 1999 – 2000 have been performing as the primiparous dams in the Pedigree Breeding Centre (OHZ) Kamieniec Żąbkowicki.

Animals were kept in confinement system, having an access to the paddock for 2 hours per day. Most cows calved in 1999 year: the age at calving averaged 25,7 months. The body build of primiparous cows was evaluated once, between 100 and 180 days after calving. Measured were: height at withers and sacrum, width at points of shoulders, hips, trochanter bones and pin bones, width and depth of forechest, length of rump, oblique length of trunk, thigh spiral circumference, chest and cannon bone girth. The cow's body weight was estimated from the chest girth measurement taken with a tape.

A description of the milk performance was based on monthly milking tests and a laboratory analysis of milk samples. Standard milk analyses were performed using the apparatus Milkoscan and Combifoss (OSHZ Kraków - Wrocław and Opole branches). Milk, fat and protein yields and milk fat and milk protein contents obtained for the first 100 days and for 305 days of lactation were analyzed. Indices describing relations between milk components for 305 days lactation were calculated: the ratio of protein to fat content (SBT), difference between the fat and protein content of milk (RTB), relative share of milk, fat and protein yields obtained for the first 100 milking days in total yields for 305 days lactation and the Sanders index describing ratio of the maximum daily yield to the total milk yield for 305 days lactation.

The obtained results were presented statistically (\bar{x} , sd) and the correlation coefficients were calculated between a milk yield and composition traits in the first lactation (305 days) and the body measurements of cows.

RESULTS

The cows were characterized by the milk yield of 2825 and 7795 kg respectively for the first 100 and 305 days of lactation ([tab. 1](#)). The fat and protein yields remained in proportion to the milk yield for 100 days (respectively: 125,7 and 88,0 kg) and for 305 days lactation (342,4 and 260,6 kg). The milk fat and protein content during 100 days of lactation averaged 4,46 and 3,11% and for the whole lactation: 4,41 and 3,35%. The difference between milk fat and protein contents (RTB) equaled 1,06% and protein to fat ratio (SBT) was 0,77. In relation to the whole lactation, the share of milk, fat and protein yields obtained in the first 100 days of lactation (respectively: 36,4; 36,8 and 33,8%) showed, that the pattern of lactation curve was very even.

Table 1. Milk yield for 100 and 305 days of lactation of primiparous Black-White cows imported from Holland

Trait	\bar{x}	sd	Minimum	Maximum
<i>100 days of lactation:</i>				
Milk yield, kg	2825	410	1846	3968
Fat yield, kg	125.7	27.3	84.0	267.0
Protein yield, kg	88.0	13.9	58.0	138.0
Fat content, %	4.46	0.71	3.21	7.54
Protein content, %	3.11	0.17	2.75	3.54
Max. daily milk yield, kg	30.7	4.2	23.0	50.3
<i>305 days lactation:</i>				
Milk yield, kg	7795	1190	5018	12818
Fat yield, kg	342.4	61.0	214.0	556.0
Protein yield, kg	260.6	38.3	160.0	427.0
Dry matter yield, kg	603.0	94.4	404.0	983.0
Fat content, %	4.41	0.52	2.86	5.77
Protein content, %	3.35	0.14	3.03	3.71
SBT ¹	0.77	0.09	0.58	1.15
RTB ² , %	1.06	0.48	-0.42	2.22
FCM, kg	8255	1313	5667	13467
FCM/100 kg body weight	1294.5	180.7	807.3	1689.0
Relative milk yield (100 days : 305 days lactation), %	36.4	2.8	28.9	42.8
Relative fat yield (100 days : 305 days lactation), %	36.8	4.6	25.5	49.6
Relative protein yield (100 days : 305 days lactation), %	33.8	2.5	27.8	40.3
Sanders index ³	254	18.2	196.0	281.0

¹SBT = ratio of protein to fat content; ²RTB = difference between fat and protein content in milk; ³Sanders index = 305 days lactation yield /max. daily milk yield

As shown in [table 2](#), the cows were tall (height at withers and sacrum - respectively: 135,5 and 140,8 cm), long (oblique length of trunk - 166,2 cm) with a broad (47,9 cm) and deep (74,6 cm) chest and relatively heavy (636,6 kg). These values documented the large body capacity of animals imported from Holland.

Table 2. Body weight and body measurements of cows

Trait	\bar{x}	sd	Minimum	Maximum
Body weight, kg	636.6	47.1	520.0	742.0
Height at withers, cm	135.5	3.0	128.0	141.0
Height at sacrum, cm	140.8	2.8	136.0	148.0
Width at shoulders, cm	48.8	2.8	40.0	58.0
Width of chest, cm	47.9	3.1	39.0	57.0
Depth of chest, cm	74.6	3.4	59.0	80.0
Width at hips, cm	54.9	2.0	50.0	58.0
Width at pins, cm	37.7	1.6	34.0	42.0
Width at trochanter bones, cm	55.5	2.1	51.0	61.0
Length of rump, cm	54.8	1.8	50.0	58.0
Chest girth, cm	198.4	5.1	186.0	209.0
Thigh spiral circumference, cm	180.6	5.5	165.0	193.0
Cannon bone girth, cm	19.5	0.8	18.0	22.0
Oblique length of trunk, cm	166.2	5.0	156.0	177.0

With the exception of the negative relation between the depth of chest and milk protein content ($r = - 0,39$; $P \leq 0,01$) and milk fat content ($r = - 0,27$), the obtained values of correlation coefficients between conformation traits and milk performance of cows were low and statistically not significant ([tab. 3](#)). The lactation milk yield was poorly related to the following body measurements: width at trochanter bones ($r = 0,16$), depth of chest ($r = 0,15$), width at pins ($r = 0,13$), cannon bone girth ($r = 0,10$). The values of correlation coefficients with the other conformation traits were close to a zero. The whole lactation fat yield was related positively to the width at shoulders ($r = 0,22$) and negatively to the height at withers ($r = - 0,16$). Similarly, the whole lactation protein yield was related to the cannon bone girth ($r = 0,20$), width at trochanter bones ($r = 0,19$) and at the pin bones ($r = 0,15$). The length of rump was related negatively to the milk protein yield ($r = - 0,11$). Associations between the milk fat content and the width at hip bones ($r = 0,10$) and at the trochanter bones ($r = 0,10$) were positive while, the associations with the depth of chest ($r = - 0,27$), height at withers ($r = - 0,17$) and height at sacrum ($r = - 0,14$) were negative. The correlations found between the milk protein content and the depth of chest ($r = - 0,39$; $P \leq 0,01$), the length of rump ($r = - 0,17$), body weight ($r = - 0,14$), chest girth ($r = - 0,14$) and the height at withers ($r = - 0,11$) were negative, except for the cannon bone girth ($r = 0,27$).

Table 3. Correlation coefficients between body weight and body measurements and milk performance traits for 305 days lactation of primiparous cows

Trait	Yield of:			Milk content of:	
	milk	fat	protein	fat	protein
Body weight	0,04	0.04	-0.01	0.02	-0.14
Height at withers	-0,04	-0.16	-0.07	-0.17	-0.11
Height at sacrum	0,04	-0,07	0.03	-0.14	-0.02
Width at shoulders	0,01	-0,01	0.00	-0.05	-0.05
Width of chest	-0,01	0.00	-0.03	0.01	-0.08
Depth of chest	0,15	-0.07	0.02	-0.27	-0.39**
Width at hips	0,00	0.06	0.02	0.10	0.03
Width at pins	0,13	0.05	0.15	-0.08	0.04
Width at trochanter bones	0,16	0.22	0.19	0.10	0.07
Length of rump	-0,05	-0.01	-0.11	0.06	-0.17
Chest girth	0,04	0.04	-0.01	0.02	-0.14
Thigh spiral circumference	0,09	0.05	0.07	-0.03	-0.06
Cannon bone girth	0,10	0.06	0.20	-0.07	0.27
Oblique length of trunk	-0,05	-0.06	-0.07	-0.01	-0,06

** P ≤ 0,01

DISCUSSION

The milk yield for 305 days' lactation of the primiparous Black-White cows of the Dutch origin was high and surpassed the milk production performance of native population of milk recorded cows [5, 6, 14] and of the cows imported from the other European Union countries [1, 2, 11, 12].

When compared to the average value obtained by milk recorded cows in 1999, the milk yield of the imported animals (primiparous cows) for the 305 days of lactation, was higher by 2768 kg of milk, 0,29% of the milk fat content and 0,10% of the milk protein content [5]. The cows in the present study also surpassed in yield the population of milk recorded native primiparous Black-White cows with a high share of HF genes (76 - 99%) by 2345 kg of milk, 0,29% fat content and 0,14% of the milk protein content [6]. In the research of Wójcik and Czaja [14] primiparous cows with udder score from 46 to 50 points averaged in 305 days' lactation 6470 kg of milk at 4,10% fat and the 3,20% protein contents. The values of SBT and RTB indices, obtained in the present study, were in the range of the other published in Poland data [6]. The efficiency of milk production, as FCM, estimated in the present study at 1294 kg per 100 kg of body weight was significantly higher (+ 449 kg) when compared to the Black-White cows imported from Germany [1]. As estimated in the present study, the ratio of milk yield in the period of the first 100 days of lactation to the whole 305 days' lactation (36,2%) was more favorable to the ratio stated in the population of Red-White x HF hybrid cows [9, 10]. Pawlina

et al. [9, 10] showed that Red-White cows with a different share of HF genes produced 40 - 43% of total milk yield during the first 100 days of lactation and 32 - 34% in the next hundred days.

Significant improvements in milk performance of dairy cows in EU countries have been observed in the recent years. Puchajda et al. [11] estimated that primiparous cows of the French origin surpassed in milk yield (+ 244 kg) contemporaries of the German origin imported to Poland. When compared to the cows imported from France, the cows imported from Germany were characterized by the higher fat content (+0,06%) but the lower milk protein content (- 0,04%), however these differences were insignificant. Dymnicki and Reklewski [2] reported that cows imported from Holland produced in the first lactation 5665 kg of milk with 4,04% fat and 3,20% protein and surpassed cows imported from Germany by 744 kg of milk, 25,9 kg of fat and 24,6 kg of protein. The same authors noted similar differences between the Dutch and the Polish groups of cows. The recorded differences were statistically highly significant. When compared to their contemporaries of the German origin, the cows of the Dutch origin had the lower milk fat content by 0,09% but when compared to the cows of Polish origin, higher by 0,04%. Milk protein content did not differ between these three groups. Slightly higher variability in milk yield and composition was reported by Sawicka [12], who found that primiparous cows imported from Holland surpassed contemporaries of the French origin by 348 kg of milk and 42 kg of milk fat, these of the German origin by 516 kg of milk and 3 kg of fat, the Polish origin animals by 1092 kg of milk and 72 kg of fat and of the Danish origin by 1163 kg of milk and 73 kg of fat. The highest milk fat and protein contents were reported for primiparous cows of the Dutch origin (consequently: 4,54 and 3,39%) while the lowest values were reported for cows of the French origin (consequently: 4,10 and 3,10%).

Basing on the results of the present study it is possible to conclude, that the young stock of the Dutch origin is characterized by the larger body frame than the native Black-White primiparous cows [15] and imports from France and Germany [11]. When compared to the native population of Black-White primiparous cows with high share (87,5 - 100%) of HF genes [15] the animals described in this study were slightly taller (+ 0,5 cm at withers and + 1,7 cm at sacrum) with the longer trunk (+ 9,5 cm), wider and deeper chest (respectively: + 4,9 and + 3,3 cm) and heavier (+ 65,4 kg). Puchajda [11] reported that the cows imported from Germany were taller (+ 3,2 cm at withers and + 2,9 cm at sacrum) and longer (+ 0,7 cm) but more narrow in the chest (- 3,1 cm) and with less depth of the chest (- 1,9 cm) when compared to their contemporaries of the French origin. When compared to the native Polish Black-White cows [1] and these imported from Germany, the primiparous cows in the present study were heavier (ca + 77 kg).

The results of the present study on relations between milk performance and body build were similar in values to the data cited by Puchajda et al. [11]; who found that values of correlation coefficients between milk traits and body conformation traits were low, except for the relation between the fat yield and width at pin bones in cows of German origin ($r = 0,38$). Other authors [3, 7] reported stronger and positive relations between the conformation and milk traits. Nowicki et al. [7] found the strongest relations between the milk yield and the width of chest ($r = 0,35$), chest girth ($r = 0,34$), and height at withers ($r = 0,30$). Positive and significant correlations between the length and width of the rump and milk production of cows ($r = 0,31$ and $r = 0,28$) were shown by Guliński and Litwińczuk [3]. On the opposite, in the population of Red-White cows Pawlina [8] found negative relations between the length and width of rump and the milk yield (respectively: $r = - 0,02$ and $- 0,05$).

CONCLUSIONS

1. Young cows of the Dutch origin were characterized by the proper body conformation and a very high milk yield during the first 305 days of lactation.
2. Correlation coefficients between milk performance traits and body conformation traits had quite low values. The only significant relation was stated between milk protein content for the 305 days of lactation and the depth of chest ($r = - 0,39$; $P \leq 0,01$).
3. The obtained results may be useful for selecting and breeding within the native Black-White cattle population while transformed into more specialized dairy type.

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