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INTENSITY AND CAUSES OF CULLING IN POLISH BLACK-AND-WHITE HOLSTEIN-FRIESIAN COWS

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Abstract

The aim of the study was to determine the intensity of culling in Polish Black-and-White Holstein-Friesian cows and to analyse specific causes of culling. The analysis was conducted on 868 cows from a farm in the Wielkopolska region that were culled in the years 2002–2007. The intensity of culling cows in the analysed period was 30.79%. The mean lifespan, length of productive life and number of milking days in these cows were 1791, 1020 and 900 days, respectively. Among 33 reasons for culling, cows were eliminated from the herd most frequently due to sterility (29.15%) and natural deaths (8.87%), with the third cause being mastitis (7.26%), and with lameness ranking fourth (5.53%), dyspepsia and low productivity fifth and sixth (4.61% each), inflammation of joints seventh (3.80%) and other casualties eighth (3.00%). For the other 25 causes the culling rate ranged from 2.88 to 0.23%. It was shown that cause of culling had a significant effect on the cows' lifespan and length of productive life. Cows culled due to sterility lived longest (1905 days) and had the longest productive lives (1136 days), while for cows culled due to lameness these periods were shortest (1709 and 926 days, respectively). When analysing productivity of animals per day of life it was shown that the cause of culling had a significant effect on milk yield ($P<0.01$) and the yields of fat and FCM ($P<0.05$). When investigating performance of cows per day of productive life, significant effects of the causes of culling were observed on milk, protein and FCM yields ($P<0.01$) as well as on fat yield ($P<0.05$). Analysis of productivity of cows per day in milk showed that the cause of culling had significant effects on milk yield ($P<0.01$) and FCM ($P<0.05$). The most advantageous values of the analysed milk performance traits were recorded for cows eliminated from the herd due to death.

Key words: Polish Holstein-Friesian cows, causes of culling, lifetime performance

A need for coupling production quota with relatively high yields per cow forces breeders and dairy farmers to constantly improve the functional traits, as this approach may significantly reduce milk production costs. The effect of functional traits on profitability of breeding increases with the productivity. It is desirable that herds have animals characterized by high persistency of lactation and high lifetime

performance. Jakobsen et al. (2003) found an adverse genetic correlation between lactation persistency and susceptibility to diseases at various stages of lactation. At present, lifetime performance of cows is the most important trait among numerous traits included in modern selection indices (Brzozowski et al., 2003).

In the opinion of many authors a measure of effectiveness of a breeding programme in a dairy herd is both genetic progress in terms of production traits and a reduced incidence recorded for major diseases, resulting in an increased length of productive life of cows.

Lifespan and the length of productive life are closely related with the cause of culling. An association was found between the health state of animals and the intensity of involuntary culling. It is believed that in order to obtain constant selection response in commercial herds the annual rate of culling should be approximately 20%.

Results of numerous studies indicate that a considerable increase in milk yields may still result in many negative responses, e.g. metabolic diseases, problems with reproduction, udder inflammations, increased feeding costs and poorer nutritive value of milk. Most probably intensive selection towards an increase of milk yield results in reduced genetic resistance to diseases and causes an increased risk of culling, leading to decreased profitability of dairy farming (Harder et al., 2006). Causes of culling may also be random in character, e.g. when they are not directly connected with the genetic capability of an animal to reach a specific production or breeding level.

The aim of the study was to determine the intensity of culling in Polish Black-and-White Holstein-Friesian cows and to analyse specific causes of culling.

Material and methods

The study was conducted in a herd of Polish Black-and-White Holstein-Friesian cows belonging to the "Hodowla Roślin Szelejewo Sp. z o.o." farm. Analyses included 868 cows culled in the years 2002–2007.

Annual stocking in the period of analysis ranged from 447 (2005) to 487 animals (2002). Cows were kept in two free-stall barns representing a loose-box system with straw-littered resting area. Manure was mechanically removed daily, using a telescopic manure loader. Animals used a shelter being an extension of the barn, where they had access to a covered yard and a feeding bunk. Cows were milked twice daily in a diagonal milking parlour (2 × 12) by FARMTEC with a crowd gate and rapid exit facilities.

Feeding plan followed IZ-INRA recommendations (1997). Cows were fed total mixed rations (TMR) using six technological groups that were formed according to the stage of lactation-reproduction cycle. Throughout the entire period of analysis animals were fed similarly with feeds produced on the farm. The primary forages were maize silage, alfalfa haylage, and grass haylage. Moreover, ensiled maize kernels, ensiled pressed sugar beet pulp and straw were used. Concentrate, depending

on the technological group, was fed at 0.7 to 11 kg per cow. Cows were dried off at 6 weeks before calving under antibiotic protection. Two weeks before the expected calving date cows were transferred to calving pens.

Source data on culled cows were from the farm documentation, i.e. heifer-cow cards, milk recording reports as well as veterinary recordings.

The following reasons for culling were identified: agalactia, metabolic diseases, locomotor system diseases, diseases of the udder, cysts on both ovaries, intrauterine tumours and adhesions, sterility, placental retention with complications, uterine haemorrhage, lameness, paresis, indigestion, respiratory failure, failure of the alimentary tract, low productivity, acute cardiovascular failure, death, miscarriage, displaced abomasum, rupture of the pubic symphysis, old age, damaged pelvis, damaged inguinal ligament, placental retention, metritis, inflammation of joints, mastitis, atrophic foetus, rupture of limb ligaments, tendon rupture, hepatic degeneration, other casualties and other causes.

Culled cows were characterized on the basis of the following parameters: lifespan, length of productive life, the number of days in milk, age at first calving, lifetime performance, as well as lifetime performance per day of life, per day of productive life and per day in milk. Lifetime productivity of cows was expressed in kgs of milk, 4% fat corrected milk (FCM), fat and protein.

Lifespan referred to the period from the date of birth to the date of culling, while the length of productive life was the period from the date at first calving to the date of culling.

In this study the rate of culling in the years of observations was determined, the frequency of specific causes of culling was analysed and the effect of four most important causes of culling (with frequency exceeding 5%) on milk performance traits of cows was investigated.

In the calculations, the MS Excel spreadsheet and the SAS® ver. 9.13 (2007) statistical package were applied. The multivariate analysis of variance was used that accounted for the following effects: genotype (percentage of HF genes), cause of culling and age at first calving as a covariate. The least significant difference (LSD) test was applied to calculate the significance of differences. Procedures applied in the computations included MEANS, FREQ and GLM.

Results

Figure 1 presents the intensity of culling in the years 2002–2007. The value of annual culling rate was relatively high, amounting to over 30% (except for the years 2002 and 2003). The largest number of animals (38.78%) was culled in 2007. The limited number of cows culled in the years 2002 and 2003 could have been caused by the quota reference year lasting from 1 April 2002 to 31 March 2003, during which culling was probably reduced in order to be granted a higher milk quota in the forthcoming years. The mean culling percentage for the period of six years was too high and most likely made it difficult to obtain a permanent production progress in the herd.

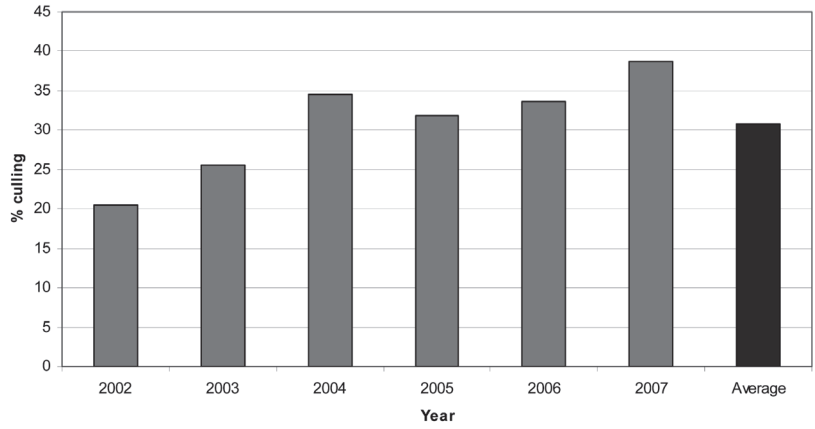

Figure 1. Annual rate of cow culling in the years 2002–2007

The mean lifespan of cows in the analysed population was 1791 days. The mean length of productive life and the number of milking days were 1020 and 900 days, respectively (Figure 2).

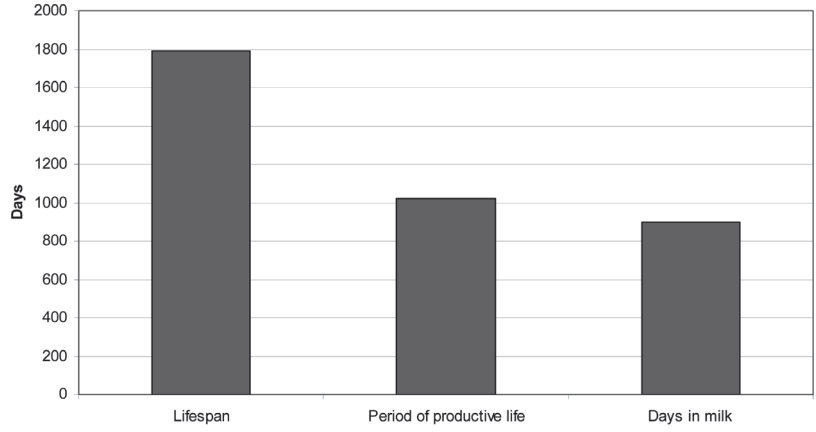

Figure 2. Lifespan, length of productive life and days in milk of culled cows

Table 1 presents the intensity of culling of cows depending on the cause of culling. A total of 33 causes are listed. Most frequently animals were removed from the herd due to sterility (29.15%), deaths (8.87%), and mastitis (7.26%), with lameness ranking fourth (5.53%), dyspepsia and low productivity fifth and sixth (4.61% each), inflammation of joints seventh (3.80%) and other casualties eighth (3.00%). For the other 25 causes of culling the culling rate ranged from 2.88 to 0.35%.

Table 1. Causes and intensity of culling in the investigated cows

Cause of culling		N	% total
Code	Item		
1	Sterility	253	29.15
2	Death	77	8.87
3	Mastitis	63	7.26
4	Lameness	48	5.53
5	Dyspepsia	40	4.61
6	Low productivity	40	4.61
7	Inflammation of joints	33	3.80
8	Other casualties	26	3.00
9	Placental retention with complications	25	2.88
10	Hepatic degeneration	24	2.77
11	Damaged inguinal ligament	22	2.54
12	Udder diseases	22	2.54
13	Failure of alimentary tract	21	2.42
14	Diseases of locomotor system	20	2.30
15	Displaced abomasum	19	2.19
16	Metabolic diseases	17	1.96
17	Postpartum retention	17	1.96
18	Acute cardiovascular failure	14	1.61
19	Intrauterine tumours and adhesions	12	1.38
20	Agalactia	11	1.25
21	Metritis	10	1.15
22	Old age	9	1.03
23	Damage to pelvis	7	0.81
24	Respiratory failure	6	0.69
25	Tendon rupture	6	0.69
26	Rupture of pubic symphysis	5	0.58
27	Rupture of limb ligament	5	0.58
28	Other causes	4	0.45
29	Ovarian cysts	3	0.35
30	Paresis	3	0.35
31	Miscarriage	2	0.23
32	Atrophic foetus	2	0.23
33	Uterine haemorrhage	2	0.23
Total		868	100.00

A considerable proportion among the causes of culling was made by deaths and mastitis. Dyspepsia and low yields were the next causes of culling, with the proportions of animals eliminated from the herd due to these reasons being identical. A considerable group of causes for culling of dairy cows is made up of “other casualties”.

Table 2. Lifetime productivity depending on cause of culling

Trait	Significance of effect	Cause of culling							
		sterility		death		mastitis		lameness	
		$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
Lifespan (days)	*	1905 a	647	1774	695	1824	781	1709 a	767
Days of productive life	*	1136 a	633	1017	684	1058	778	926 a	769
Days in milk	NS	992	543	928	531	987	579	868	633
Lifetime productivity									
Milk (kg)	NS	22875	14049	25872	18601	25421	1555	21802	15692
Fat (kg)	NS	961.9	609.9	986.3	610.0	1026.0	665.6	891.7	633.5
Protein (kg)	NS	770.9	461.7	817.4	473.32	852.3	515.4	732.7	530
FCM (kg)	NS	23563	14691	25144	16167	25558	1609	22096	15732
Yield per day of life									
Milk (kg)	**	11.08 A	3.84	12.61 A	5.07	12.07 a	4.26	10.31 a	5.05
Fat (kg)	*	0.46	0.17	0.49 a	0.17	0.48 b	0.18	0.42 ab	0.21
Protein (kg)	NS	0.37	0.13	0.41	0.13	0.40	0.14	0.35	0.17
FCM (kg)	*	11.37	4.03	12.32 a	4.33	12.01	4.25	10.44 a	5.11
Yield per day of productive life									
Milk (kg)	**	19.95Aa	4.69	23.03 A	5.51	21.55 a	5.20	21.06	7.15
Fat (kg)	*	0.83 a	0.20	0.89 a	0.19	0.85	0.19	0.84	0.23
Protein (k)]	**	0.68 A	0.15	0.74 A	0.14	0.72	0.16	0.70	0.22
FCM (kg)	**	20.43 A	4.73	22.55 A	4.56	21.33	4.66	21.01	6.06
Yield per day in milk									
Milk (kg)	**	24.68 A	4.60	27.11 Ab	5.87	25.59	5.35	24.95 b	6.85
Fat (kg)	NS	1.03	0.20	1.05	0.19	1.01	0.20	1.00	0.24
Protein (kg)	NS	0.84	0.15	0.88	0.13	0.86	0.16	0.83	0.21
FCM (kg)	*	25.25	4.50	26.54 a	4.53	25.34	4.73	24.99 a	6.02

** $P<0.01$; * $P<0.05$.

NS – Non-significant ($P\geq0.05$).

A, B, a, b – means with identical letter differ significantly: capital letters – $P<0.01$, small letters – $P<0.05$.

Table 2 contains results concerning lifespan and lifetime productivity of cows eliminated from the herd due to the most frequent causes. Statistical analysis showed that the cause of culling had a significant effect on the cows' lifespan and length of productive life. Cows culled due to sterility lived longest (1905 days) and had the longest productive lives (1136 days), with the periods being shortest for cows culled due to lameness (1709 and 926 days, respectively). The lifespan and the length of productive lives for cows culled due to sterility differed at $P<0.05$ from the figures concerning animals eliminated from the herd due to lameness or other causes. When analysing the number of days in milk and lifetime productivity of cows culled for other causes expressed in kgs of milk, fat, protein and FCM, no significant differences were found between the analysed groups of animals. Table 2 contains also results concerning lifetime productivity of cows culled for selected causes in terms of day of life, day of productive life and milking day. When analysing productivity of animals per day of life it was shown that the cause of culling had a significant effect ($P<0.01$) on milk yield and on the yields of fat and FCM ($P<0.05$). Cows eliminated from the herd due to death were characterized by the highest yields of milk (12.61 kg), fat (0.49 kg) and FCM (12.32 kg). The mean milk yield recorded for this group of animals differed at $P<0.01$ from identical milk performance traits of cows culled due to lameness or sterility. Significant differences were also found in terms of means for milk yields per day of life between cows culled due to lameness and mastitis. When taking into consideration yields of fat and FCM per day of life, higher values for the above mentioned milk performance traits were observed for cows which died in comparison to those culled due to lameness. The conducted analysis for milk yield showed that cows culled due to mastitis differed in terms of this trait at $P<0.05$ from those culled due to lameness.

When analysing productivity of cows per day of productive life, significant effects at $P<0.01$ were found for the cause of culling on the investigated milk performance traits, except for kgs of fat, for which the effect was significant at $P<0.05$. The highest yields of milk (23.03 kg), fat (0.89 kg), protein (0.79 kg) and FCM (22.55 kg) were recorded for cows eliminated from the herd due to death, while the lowest values for the analysed traits were found for cows culled due to sterility (19.95 kg, 0.83 kg, 0.68 kg and 20.43 kg, respectively). In terms of milk performance traits significant differences at $P<0.01$ were found between these groups of cows, except for kgs of fat, for which the means differed at $P<0.05$.

When investigating productivity of cows per day in milk it was shown that causes of culling had significant effects ($P<0.01$) on milk and FCM yields ($P<0.05$). Cows eliminated from the herd due to death produced the largest amounts of milk (27.11 kg) and FCM (26.54 kg). Analysis of milk yields per day in milk showed that means for this trait recorded for cows eliminated from the herd due to death and culled as a result of sterility differed at $P<0.01$, while the difference between cows which died natural deaths and those culled due to lameness was significant at $P<0.05$. Cows which died and those culled due to lameness differed in terms of yields of FCM per milking day ($P<0.05$).

Discussion

According to Kuczaj (1997) the annual culling rate usually falls within the 10 to 25% range. In a study by Antkowiak and Kliks (1998) the reported lifespan for cows with a various proportion of HF genes in their genotype ranged from 4.24 to 5 years. Dorynek et al. (2006) found a higher mean length of productive life (1319 days) and a higher number of milking days (996 days) in Black-and-White cows with a high proportion of Holstein-Friesian genes.

Results of studies conducted by many authors (Reklewski et al., 2004; Varisella et al., 2007; Kuczaj et al., 2008) confirmed the hypothesis that sterility is the major cause of culling of cows in Poland. Similar results were reported in other countries by Esslemont and Kossaibati (1997), Seegers et al. (1998), Bascom and Young (1998). In recent numerous papers their authors stated that reproductive performance of dairy cows has been deteriorating. Most probably this has been the effect of a disadvantageous genetic correlation (ranging from –0.37 to –0.74) between milk yield and different fertility traits. Smith et al. (2000) stated that the high-producing herds reported more cows leaving due to reproduction, mastitis, and feet and leg diseases. In the opinion of some authors fertility disorders are genetically determined in only 10% ($h^2 = 0.10$), whereas the remainder (90%) depends on environmental factors, of which the most significant is feeding. It is believed that an inadequate balance of energy and protein in the feed ration leads to the deterioration of reproductive indices, particularly in high-producing herds. It is also known that fertility is reduced when the coefficient of inbreeding increases. The most frequent disorders and diseases of the reproductive system in Holstein-Friesian cows include metritis, ovarian cysts, retained placenta, miscarriage and silent heat. In this study 10 cows (1.15%) were culled due to metritis, while postpartum complications accounted for 2.88% of all culling cases. When investigating the incidence of reproductive disorders in early lactation Ayrshire cows, Gröhn et al. (1994) found that cows which calved during the cold months with a short daylight period were more susceptible to diseases of the reproductive system in comparison to animals in which parturition occurred at other times of the year. These authors also showed that high milk yield in early lactation resulted in the incidence of ovarian cysts in 6.6% and silent heat in 5.4% cases. Similar results were reported by Rajala and Gröhn (1998). In the opinion of Seegers et al. (1998), special priority should be given to reduce culling for reproductive problems, because it is the most costly reason.

According to Gröhn et al. (1997) mastitis is a significant factor for culling cows. In the investigations conducted by Samore et al. (2003) genetic correlation between the risk of being culled and somatic cell score (SCS) was estimated to be 0.31. In a paper by Czaplicka et al. (2002) they reported an average proportion of cows culled due to mastitis to be 7.9%, while Sobek et al. (2005) in their study found 6% culling cases as due to that cause. Rajala-Schultz and Gröhn (1999) stated that the largest effect on the risk of culling, among fifteen diseases, was observed for mastitis, damaged teats or lameness. Gröhn et al. (1995) showed that high milk yield does not constitute a risk for the incidence of potential diseases eliminating cows from the herd,

whereas the only such cause is mastitis. Ptak et al. (2009) suggested that shallower and narrower udders are associated with lower SCS.

Another important problem in cattle management and breeding is connected with hoof and leg diseases. Recent studies did not confirm closer genetic relationships between the verticality of hind legs and the length of productive life of cows. The evaluation of the hock joint as an indicator of bone quality may be of certain importance in this respect. In case of hooves their steepness and shorter soles may be genetically connected with a lower frequency of lameness. In this study a total of 61 cows (9.32% of the entire population) were culled jointly due to lameness and joint inflammation. In the opinion of Twardoń et al. (2001) the largest number of problems connected with limbs is caused by injuries. Their frequency increases with the growing popularity of floor management in the housing of cattle. Booth et al. (2004) showed that the survival rate of cows decreased when diseases of limbs occurred in the first half of lactation.

Sawa and Maciejewski (2000) showed a downward trend for the culling rate due to low milk yields, from 20% in the early 1990s to 6.8% in 1998. Other causes of cow removal from the herd, unintended by the breeder, have an adverse effect on the rate of breeding progress. Sobek et al. (2005) and Dorynek et al. (2006) hold that a high level of culling due to these causes may indicate a generalization of this term, replacing all the other causes of elimination of animals from the herd. In a study by Dorynek et al. (2006), no differences were shown between lifespan of cows culled for different reasons, whereas these animals differed in terms of the length of their productive lives and the number of days in milk. Nienartowicz-Zdrojewska et al. (2009) reported that the cows culled for health problems showed the highest lifetime milk yields. According to Żarnecki and Jagusiak (2003), the cows surviving longer (≤72 months) had higher breeding values for milk production than cows culled at an earlier age.

In summary, the mean intensity of culling of the analysed cows was 30.79%. The value of this parameter showed an increasing trend in the last three years of the study. The mean lifespan, length of productive life and the number of days in milk in cows were 1791, 1020 and 900 days, respectively. Among the 33 causes of elimination of cows from the herd, animals were culled most frequently due to sterility (29.15%), followed by natural deaths (8.87%), mastitis (7.26%), lameness (5.53%), indigestion and low productivity (4.61% each), inflammation of joints (3.80%) and other casualties (3.00%). For the other 25 causes of culling from the herd, the intensity of culling ranged from 0.35 to 2.88%. It was shown that the cause of culling cows for the four major reasons (sterility, natural deaths, mastitis, lameness) had a significant effect on the lifespan and length of productive life of these animals. Cows culled due to sterility lived longest (1905 days) and had the longest productive lives (1136 days), while these periods were shortest for cows culled due to lameness (1709 and 926 days, respectively). When analysing productivity of animals per day of life it was shown that the cause of culling had a significant effect on milk yield ($P<0.01$) and the yields of fat and FCM ($P<0.05$). Analysis of the yields of cows per day of productive life demonstrated significant effects on milk ($P<0.01$) and fat and FCM yields ($P<0.05$). Analysis of productivity of cows per day in milk showed that

causes of culling affected the yields of milk ($P<0.01$) and FCM ($P<0.05$). The highest values of analysed milk performance traits were observed for cows eliminated from the herd by natural death.

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Intensywność i przyczyny brakowania krów rasy polskiej holsztyńsko-fryzyjskiej odmiany czarno-białej

STRESZCZENIE

Celem pracy było określenie intensywności brakowania krów rasy polskiej holsztyńsko-fryzyjskiej odmiany czarno-białej oraz analiza szczegółowych przyczyn ubycia zwierząt ze stada. Analizą objęto 868 krów z jednego z gospodarstw Wielkopolski, wybrakowanych w latach 2002–2007. Intensywność brakowania krów w badanym okresie wyniosła 30,79%. Średnia długość życia, użytkowania oraz liczba dni doju wyniosła u tych krów odpowiednio: 1791, 1020 i 900 dni. Spośród 33 przyczyn usunięć krów ze stada, najczęściej zwierzęta brakowano z powodu jałowości (29,15%), następnie w wyniku padnięć (8,87%), trzecią z kolei przyczyną było zapalenie wymienia (7,26%), czwartą kulawizna (5,53%), piątą i szóstą niestrawność i niska wydajność (po 4,6%), siódmą zapalenie stawów (3,80%) i ósmą inne wypadki losowe (3,00%). Dla pozostałych 25 powodów ubyć zwierząt ze stada wielkość wskaźnika intensywności brakowania wahała się od 2,88 do 0,23%. Wykazano, że powód ubycia krów wpłynął istotnie na długość życia i użytkowania zwierząt. Najdłużej żyły (1905 dni) i były użytkowane (1136 dni) krowy wybrakowane z powodu jałowości, natomiast najkrócej ubyłe w wyniku kulawizny (odpowiednio 1709 i 926 dni). Analizując produkcyjność zwierząt w przeliczeniu na dzień życia wykazano, że powód ubycia miał istotny wpływ na wydajność mleka ($P<0,01$) oraz wydajność tłuszczu i FCM ($P<0,05$). Badając wydajność krów w przeliczeniu na dzień użytkowania stwierdzono istotny wpływ przyczyny brakowania na wydajność mleka, białka i FCM ($P<0,01$), jak również na wydajność tłuszczu ($P<0,05$). Analiza produkcyjności krów w przeliczeniu na dzień doju, wykazała, że przyczyny brakowania miały istotny wpływ na wydajność mleka ($P<0,01$) i FCM ($P<0,05$). Najkorzystniejszymi wartościami analizowanych cech użytkowości mlecznej charakteryzowały się krowy, których przyczyną ubycia ze stada były padnięcia.