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Full Length Research Paper

Analysis of productivity, longevity and culling causes of Jersey and Polish holstein-friesian (PHF) cows

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The analyzed population comprised 970 Polish holstein-friesian cows (PHF) and 372 Jersey cows. The database provided pedigree information on dams and their productivity. Differences between breeds in terms of longevity and culling reasons were investigated. For the group of PHF cows, the average age of culling was 5.2 years, while for Jersey cows, it was 4.81 years. In the PHF group, for the main cause of culling, about 39.5% of all cases, was classified as "other", that is unspecified causes. In the group of Jersey cows, very similar levels were recorded for four culling reasons: "sterility and reproductive system disfunction" and "infectious diseases"; each at about 17%, "low yields" at 16.5% and "metabolic disorders and diseases of the alimentary tract" at 15.6%.

Key words: Longevity, lifetime production, Jersey cows, Polish holstein-friesian cows.

INTRODUCTION

For the last 20 years, the population size of dairy cows in Poland and in the entire European Union has dropped considerably. At the same time, higher concentration and specialization of large farms have been observed. Farmers have focused mainly on keeping and breeding cattle of specific performance profile (Lipińska and Gajda, 2006). The reduction in the population of dairy cattle in Poland has not meant decrease in milk production, since because of animal welfare improvement and intensive breeding work, there has been a considerable increase in productivity (Nienartowicz-Zdrojewska et al., 2006). However, intensive selection for yield maximization is desirable from the economic point of view; it is not always advantageous to breeders, as it may result in shorter productive lifespan of cows. It reduces lifetime productivity of cows, making it impossible to reimburse the costs of their rearing and herd replacement. It also means lower number of lactations and the same time, lower number of calves produced both for herd replacement and for slaughter, which reduces additional income (Sawa et al., 2007).

The aim of this study was to analyze culling causes in two breed groups, that is, Jersey cows and Polish holstein-friesian black-and-white cows (PHF). Differences between breeds were also investigated in terms of culling reasons, longevity, milk productivity and milk components yield.

MATERIALS AND METHODS

The material used for analysis was provided by Symlek database, and it included both pedigree data and information on productivity of 1342 individuals, of which 372 were Jersey cows (that is, approximately 10% of this breed population in Poland) and 970 were Polish holstein-friesian black-and-white cows. The first lactation completed was recorded for all cows. The observed animals, born between 1994 and 2005 were kept in five herds in the Wielkopolska region, and were culled within the period of 1997 to 2007. Data were collected on longevity (in days), lifetime

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Table 1. Code symbols for CR and their percentages in the analyzed populations.

Culling reason (CR)	Percentage (%)
Sold for further rearing	1.5
Low productivity	6.0
Udder diseases	11.1
Sterility and diseases of reproductive system	18.8
Infectious diseases	5.8
Old age	0.6
Leukemia	0.3
Casualties	2.4
Metabolic diseases and diseases of the alimentary tract	3.9
Diseases of the motor system	2.9
Others	39.5
Wastage	4.5
Sold for slaughter	2.4

productivity and lactation performance, milk fat and protein yields and contents, while FCM (4% Fat corrected milk) and protein: butterfat ratios were calculated. The database also contained information on culling reasons (CR). Code symbols for CR and their percentages in the analyzed populations are given below (Table 1). Basic statistics were calculated, then the significance of mean value differences for traits and culling reasons in both breeds was estimated using the analysis of variance (GLM) with LSD test (SAS/IINC, 2004). In order to determine differences among means, a multivariate analysis of variance and LSD significance tests were applied for the following traits: lifespan in days, yields of milk and its components [actual, daily and for 4% fat corrected milk (FCM)]. The following models were used:

Model 1-basic

$$Y_{ijklm} = \mu + HYS_i + R_j + S_{jk} + PB_l + e_{ijklm}$$

Where, Y_{ijklm} is the lifespan in days, yields of milk and its components, lifetime yield or 4% fat corrected milk; μ is the expected value; HYS_i is the effect of i-th herd-year-season of birth; R_j is the effect of j-th breed; S_{jk} is the genetic effect of k-th sire in j-th breed; PB_l is the effect of culling reason; e_{ijklm} is the random error.

Model 2

$$Y_{ijklmn} = \mu + HYS_i + R_j + S_{jk} + PB_l + M_m + e_{ijklmn}$$

Where, Y_{ijklmn} is the lifespan of cow in days; HYS_i, R_j, S_{jk}, PB_l, e_{ijklmn}: is as in Model 1; M_m is the effect of m-th yield class of selected trait (lifetime production of milk, butterfat, protein, or class of lifetime production of 4% fat corrected milk).

RESULTS

The research indicates downward trends in cow longevity in the analyzed populations. For example, for PHF breed, the mean culling age was 10.5 years in 1997, while in 2005, it was only 5.9 years. In the case of the Jersey breed, culling age dropped from 6.4 to 2.8 years in 10 years. The more rapid decrease in longevity was observed for the Jerseys, with their milk production increasing with each successive year. As it could have been expected, yields of milk and its components were higher for the PHF group; however, the protein: butterfat ratio (FPF) was higher for the Jersey breed (Table 2).

The FPF was high and stable in the following years with a slight upward trend for this value. This trend was observed for both Jersey and PHF cows. Contrary to expectations, in the analyzed population, better FPF was observed in the PHF group, that is, over 0.8, while in Jersey cows it was 0.74 on average. As far as the FPF was concerned, it had been expected to be better for Jersey cows, and so it was, as in fact, it is typical for their milk to have better component concentration. Apart from the effects of herd, year and season of calving, as well as breed, the research has been concerned with the productivity of cows within a specific age range. Yields of milk and its components affect profitability of production and should be crucial when making decisions on culling. After calculating yields of milk, butterfat and protein per 1 day of cow's life, it was found that as far as the productive life longevity is concerned, there was no significant difference between PHF and Jersey cows. The Holsteins, however, predominated in all age classes in terms of milk yield per day of life. The protein: butterfat ratio (FPF) was better for younger cows and it was observed both for PHF and Jersey cows, which shows the effectiveness of breeding work, aiming at increasing protein content, and at the same time at reducing butterfat content in milk.

Another factor analyzed was culling reasons for individual animals (Table 3). The biggest number of animals, that is, 39.5%, was removed from the herd due to "other" culling causes (11) that is for unspecified reasons. This may indicate a rather haphazard data recording in cow files, particularly in farms where PHF cows were kept (41.7%). In the group of Jersey cows

Table 2. Lifetime milk and milk components yield for both breeds.

Parameter	Breed							
	PHF				Jersey			
	Minimum	Maximum	Mean	SD	Minimum	Maximum	Mean	SD
Days of life	895	5217	1897.55*	662.92	901	4241	1758.50*	777.07
Years of life	2.5	14.3	5.20*	1.81	2.5	11.6	4.81*	2.13
Lifetime milk yield	1002	116310	21730.38**	15677.59	1124	49948	11665.55**	9104.15
Milk kg per 1 day	0.81	32.67	10.39**	4.87	0.98	13.20	5.88**	2.24
Lifetime fat yield kg	170	4347	912.47**	641.89	96	2280	630.74**	475.31
Fat kg/day	0.01	1.32	0.44**	0.21	0.08	0.64	0.32**	0.11
Lifetime protein yield	240	3504	716.36**	511.32	56	1598	437.57**	327.56
Protein kg/1 day	0.02	1.70	0.34**	0.17	0.05	0.44	0.22**	0.08
Protein:butterfat ratio FPF	0.13	1.43	0.79*	0.10	0.34	1.04	0.70*	0.07

The means marked in lines with (**) describe differences highly significant at P < 0.01;* differences significant at P < 0.05.

Table 3. Culling reasons (%) for the different breeds.

CR (%)	1	2	3	4	5	6	7	8	9	10	11	12	13
PHF	1.4	5.4	11.5	18.9	5.1	0.7	0.1	2.1	3.2	2.7	41.7	4.6	2.5
Jersey	2.4	16.5	5.3	17.1	17.4	1.2	3.2	6.8	15.6	6.5	2.4	4.1	1.8
Total	1.5	6.0	11.1	18.8	5.8	0.7	0.3	2.4	3.9	2.9	39.5	4.5	2.4

"other" reasons accounted for only 2.4%. Other culling reasons included: "sterility and diseases of the reproductive system" (18.8%), "udder diseases" (11.1%), and "low yields", being 6% of all culling causes. The lowest numbers of animals were culled for "old age" (0.6%) and "leukemia" (0.3%). Within the Jersey breed subclass, the following culling causes predominated: "low yields" (2), 16.5%, "sterility and diseases of the reproduction system" (4) and "infectious diseases" (5), each at 17%, and "metabolic diseases and diseases of the alimentary system" (9) at 15.6%. In turn, in the PHF group, 19% cases were associated with "sterility and diseases of the reproductive system" (4), and 11.5% were related to udder diseases (3). The longest lifespan was recorded for cows culled due to old age (10.22 years in the PHF and 10.76 years in the Jersey breed), and those individuals also had high milk production per day of life, reaching over 3.7 kg. High-producing cows were sold for further rearing at a young age (slightly over 4 years). Cows suffering from leukemia were also characterized by high milk yields and lived relatively long, over 7 years (Figure 1).

For PHF cows removed from the herd as "sold for further rearing" (1), values of analyzed traits were several times higher than those for Jersey cows. Differences between breeds were highly significant, except for the FPF index, where it was only significantly higher for PHF cows. Within the "low yield" subclass (2), the mean culling age for PHF cows was 5 years, while for Jersey cows it was 3 years. For cows culled due to udder diseases (3), high milk production per day of life and high lifetime yields of milk and its components were recorded. Cows were culled at different ages, with the mean age at culling of approximately 5 years. No significant differences between breeds were found in terms of age of culled cows, lifetime yields of butterfat and protein. Milk yield per day of life and lifetime milk productivity however were highly significantly higher in the PHF group (Figure 2). Dysfunctions of the reproductive system and sterility (4) eliminated younger cows more often than those suffering from udder diseases (3). For those culling reasons, yields of milk and its components, as well as longevity of cows, were highly significantly higher in the Holstein group, as compared to Jersey cows. No statistical differences were found for the protein: butterfat ratio value between the two breeds. Animals eliminated due to infectious diseases (5) did not differ in age in both groups. Significant differences were observed for yields of protein and butterfat per day of life, and they were highly significant for the PHF group, showing higher level of lifetime production of milk, butterfat and protein. "Old age" (6) was the culling reason for cows over 10 years of age (both PHF and Jersey), that at the same time were highly productive. The group of PHF cows exceeded Jersey cows in terms of all analyzed yield traits in a highly significant manner. Leukemia (7) was a marginal problem, concerning 0.3% of all culled cows in the analyzed population. They were eliminated from the herd at the average age of 7.5 years, and in that group, Jersey cows were significantly older than PHF cows. Lifetime

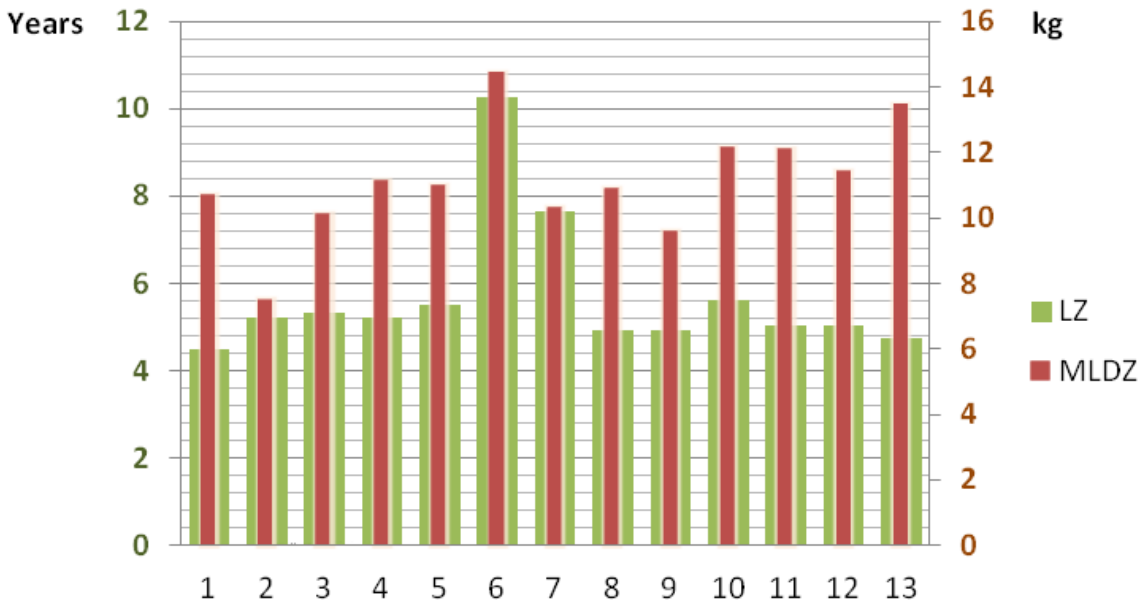

Figure 1. Lifespan (LZ in years of life) and average milk yield per day of life (MLDZ in kg) within classes of culling reasons.

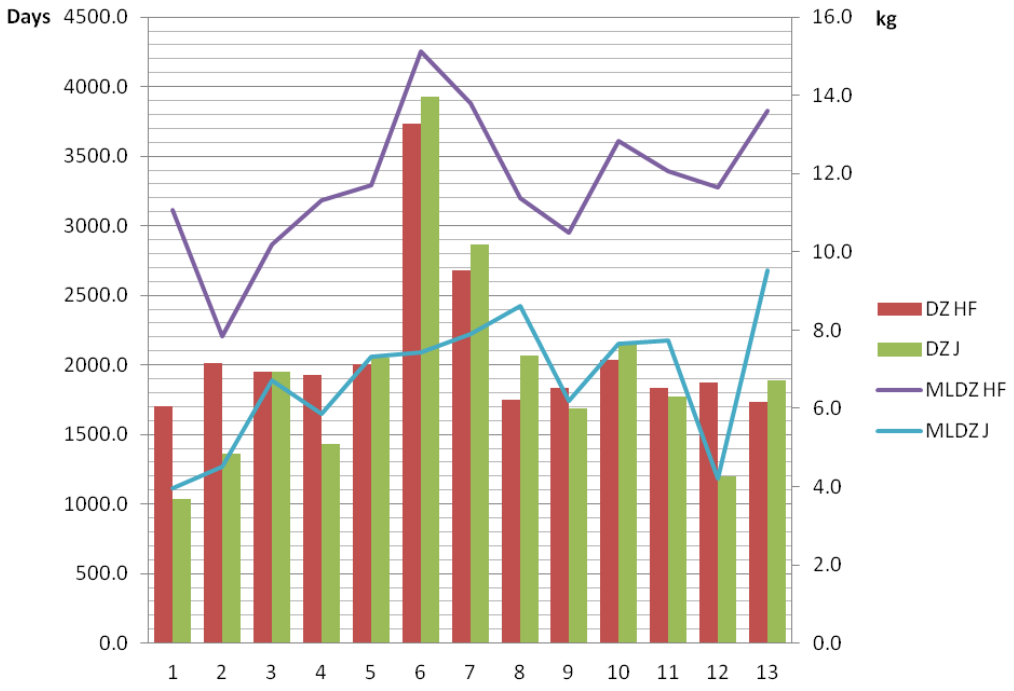

Figure 2. Lifespan (LZ in years of life) and average milk yield per day of life (MLDZ in kg) for different breeds and classes of culling reasons

yields of milk and its components, as well as production calculated per 1 day of life, together with the protein: butterfat ratio, were significantly higher for the PHF group than for the Jersey one. Casualties (8) affected cows at different ages, from 2.5 to 10 years old. Milk production was again significantly higher in the PHF group than in Jersey cows, while no statistically significant differences were observed in butterfat and protein yield within breed subclasses.

Metabolic diseases and diseases of the alimentary tract

(9) were reasons for culling of cows at the average age of 5 years. In this group, higher values of traits were found for PHF cows. Significant differences between breeds were recorded for the protein: butterfat ratio (FPF). Culling coded as "other causes" (11) constituted the highest percentage of all the above mentioned reasons for culling of all cows and also of PHF cows. Lifetime production of milk and its components was statistically highly significantly higher in the PHF group. In turn, in the group described as "wastage" (12), the average age of culling was 5 years for PHF and 3 years for Jersey cows, and lifetime yield was considerably higher in the group of PHF cows. Sales for slaughter (13) pertained to Jersey cows, which were slightly older than PHF cows; the age difference was statistically significant. However, Holstein cows still showed higher yields of analyzed milking traits.

DISCUSSION

In practice, lifespan of cows is closely connected with information on culling (Seegers et al., 1998; Różańska-Zawieja et al., 2008a, b; Varisella et al., 2007a, b). Culling reasons depend on various factors, for example certain diseases or injuries are used as a qualification parameter. These may include infectious diseases or fractures. However, in the case of treatable diseases, only frequent recurrence or lack of response to treatment is the reason for removing an individual from the herd (Callaghan, 2003).

Piech and Tarkowski (2002) in their study on a herd of black-and-white cows from the breeding station based at the Agricultural University in Lublin, recorded still, different results for culling reasons. In that case, sterility predominated, amounting to 37.9% cases. Other reasons included sale for further rearing (16.2%), casualties (12.2%) and leukemia (10%). Sawa et al. (2007) reported sterility as the main reason for culling, and in their investigations, it accounted for as much as 64% of all cases. The desirable productive lifespan of cows is assumed to be six to seven lactations, that is, approximately nine years of life (Varisella et al., 2007a, b). The length of productive life in cows is connected with culling reasons. Breeders may eliminate low-producing individuals, diseased cows or animals with reproductive problems. However, some of the culling reasons belong to the category of random cases and casualties, which may be affected by management conditions of animals.

Theron and Mostert (2004) pointed at the necessity of improving cattle feeding programmes, the standard of production recording and control methods, together with the entire body of factors affecting animal welfare. It particularly concerns high-producing herds, since genetically valuable animals would not show their high productive potential under inadequate environmental conditions. Management conditions should also change together with population changes. Almost 50 years of intensive selection for improving milking performance traits in dairy cattle has resulted in an approximately three-fold increase in production, however with the deterioration of adaptation traits at the same time. The costs of adaptation to the changing environment are becoming too high for demanding high-producing organisms. Thus, in contemporary breeding programs, the focus is on functional traits, such as resistance to disease and reproduction or survival rates (Callaghan, 2003; Nienartowicz-Zdrojewska et al., 2009).

In ealier studies (Nienartowicz-Zdrojewska et al., 2009), it was shown that cows culled for health problems showed the highest lifetime performance at the same time. Dairy cows kept for a shorter period of time were either culled because of milking and behavioral problems or were sold for further breeding.

Conclusion

Summing up, it may be stated once again that the analyzed PHF group differed statistically significantly from the Jersey group in terms of lifespan of cows, as well as the protein: butterfat ratio (FPF), while highly significant differences were recorded for lifetime yields of milk, butterfat and protein and FCM. In all cases, values of these traits were higher for the PHF cows than for Jersey cows. Statistically highly significant differences were observed in longevity of animals culled due to different causes (1 to 13). Extremely high percentage of culling for “other” reasons draws attention to the need of breeding documentation improvement.

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