Comparison of Some Herd Life and Reproductive Parameters of Anatolian Black and Culture Breed Cows

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SUMMARY

In this study, it was aimed to evaluate some breeding parameters and herd life of some cattle breeds raised at the research ınstitute conditions. This study was carried out on Holstein Friesian (HF, n=74), Brown-Swiss (BS, n=75), Simmental (SIM, n=34), and Anatolian Black (AB, n=41) cattle born between 2005-2021 in Lalahan Internationa Center for Livestock Research and Training in Ankara, Türkiye. The characteristics of these animals such as herd participation, calving rate, calving age, lifespan, breeding time and herd life were investigated. During this period, 195 of the 224 animals that left the herd in the farm reached breeding age, and 143 of these animals gave birth. First calving ages of HF, BS, SIM and AB cows were 948 days, 1104 days, 988 days and 1169 days, respectively. The average number of calves per cow in the farm was determined as 2.29, 2.31, 3.04 and 4.50, respectively (P=0.007). Of the 224 animals, 38.9% were voluntary and 61.9% were compulsorily left from the herd. Herd life was determined as 1419 days, 1641 days, 1690 days and 2241 days (P=0.001), while productive life was determined as 788 days, 957 days, 1121 days and 2057 days (P=0.001) in HF, BS, SIM and AB cows respectively. Productive life was found to be 947 days in cultured cows calving before 912 days (30 months) and 2197 days in Anatolian Black. The negative correlation between age at first calving and productive life in culture breeds demonstrates the importance of giving birth to animals before 912 days of age. It is thought that the higher values of locally adapted AB cattle breed in terms of herd life and reproduction data are because of less reproductive and metabolic problems due to their low yield characteristics.

KEY WORDS

Culture breed cow, Anatolian Black, herd life, productive life, calving age.

INTRODUCTION

For many years, it has been tried to increase milk production in animals due to the selection indices applied for dairy cows around the world[1]. As a result of intensive selection applied to animals, the increase in milk yield has led to a decrease in fertility and herd life, and an increase in health problems[2]. Producers try to minimize production costs while optimizing the balance between maximum production to ensure the sustainability of their income. One of the biggest challenges for experts working in this field is to understand the biology of low-fertility cows and develop strategies to improve their fertility[3]. To overcome these difficulties, it is important to know the characteristics of a cow such as herd life, calving age and number of calves. The natural lifespan of a cow is about 20 years, but its average lifespan is much less than the natural life[4]. The production life of dairy cows is less than 3-4.5 years[5].

Longevity and reproductive lifespan are features of special interest for farms and special assisted reproductive techniques are used for this[6,7]. Cows that cannot reach the desired yield can be removed from the herd to gain high income in the herd[8]. Low productivity of cows and sale for breeding purposes are the main reasons for their exit voluntary from the herd, on the other hand, factors such as reproductive defects, physical defects, illness, death, disability and old age can be said to be the reasons for exit compulsory[9,10]. In addition, even if diseases such as mastitis and lameness are treated, it leads to decreases in fertility and estrus[11]. Choosing the criteria that determine the economic life of cows can improve dairy farms economically[12]. By extending the reproductive life of dairy cows, compulsory herd removal can be reduced[13].

In order to conserve domestic animal genetic resources, a herd of Anatolian Black cattle was established in 1997 in the institution where the study was carried out. As of this year, the number of Anatolian Black cattle in the farm continued by increasing. There are some studies examining the growth, development and characteristics of this breed[14-17]. However, literature could not be found on subjects such as the herd participation rate, calving rate and herd life of the Anatolian Black breed. Animals that do not reach the breeding age in the herd, reach and do not become pregnant or calve, cause significant economic losses in the farms. Therefore, it is important to know such parameters in the farms.

In this study, it was aimed to determine and compare some cha-

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racteristics such as herd participation rate, calving rate, reasons for expulsion, herd life and reproductive life span in Holstein Friesian, Brown-Swiss, Simmental and Anatolian Black breeds, bred in the Livestock Research Institute.

MATERIAL AND METHODS

Animal and Management

The animal material of the study consisted of cows that were born in the "International Center for Livestock Research and Training Institute" (39°97 N, 33°10 E; elevation 826m) in Ankara, Türkiye between 2005-2021 and spent their entire lives in this period, and then left the herd for various reasons. Within the scope of the study, herd management information of a total of 224 females, including Holstein Friesian (HF, n=74), Brown-Swiss (BS, n=75), Simmental (SIM, n=34) and Anatolian Black (AB, n=41) cows was used. Females born as twins were not included in the study because their reproductive activities were defective.

While milking is done twice a day in culture breeds in the farm, it is not done in Anatolian Black. In culture breeds, calves are separated from their dams immediately after birth and housed in individual calf pens for 3 months. Anatolian Black calves, on the other hand, are raised with their dams from birth and they are allowed to suckle their dams freely. Both culture and Anatolian Black cows are fed twice a day with concentrated feed and ad libitum roughage. The nutrition of the culture breeds is made according to the milk cow ration specified in NRC[18]. Anatolian Black cows are given 80% barley straw and 20% dry meadow grass as roughage.

Estrus monitoring in culture breed cows in the institute is done by caretaker and technicians. If the estrus is determined, artificial insemination is carried out by technician. In the AB cattle breed, however, natural insemination is carried out by being sheltered as a group of 4 cows and 1 bull, without estrus monitoring.

Data Set

Using the records in the herd registration system of the farm; a data file containing the ear number, breed, date of birth, date and reason of leaving the farm, calving age and number of calves of each animal was created. Then, definitions in Table 1 were calculated[4,19].

Statistical Analysis

Minitab package program was used in the statistical analysis of the data obtained in the study. All values are calculated in days. The data were analyzed using the Linear Model procedures of the Minitab package program. The breed factor was added to the model in calculating the number of CN, FCA, HL, BT and PL. In addition, FCA values were divided into two groups as less than 912 days and more than 913 days, and CN, HL and PL values of culture and AB breeds were calculated separately. Differences between statistically significant groups were analyzed with the Tukey Multiple Comparison test. Relationships between CN, FCA, HL and PL values were made using the basic correlation analysis of the Minitab program. The properties expressed as a percentage (%) were determined by taking the arithmetic averages.

RESULTS AND DISCUSSION

In this study, parameters such as herd life and reproduction were determined in Anatolian Black breed cows, which have been widely raised in Anatolia for centuries but whose numbers have decreased recently, and some cultured cows that are used extensively for animal product production in the world. The data obtained were compared with other studies on the subject in the world.

Herd participation rate

In this study, of the 224 female calves whose herd records were examined, 195 (87.1%) reached the age of 550 days (18 month) and were considered as breeders in the herd. 29 of the cows (12.9%) were expelled before reaching the age of 550 days. While the rate of removal from the herd before reaching the breeding age in AB breeds was 19.5%, this value was found to be higher than that of culture breeds. As it is known, herd survival rate is a parameter that should be followed in herd management[19] and it is essential for profitable livestock to show the economic life and performance of animals. This value was found to be lower than the 27.5% value found in BS, HF and East Anatolian Red (EAR) breed animals in the study conducted by Kaya and Akbulut[19]. In the farm, the rate of those who could not calve despite reaching the breeding age and being used for breeding was found to be higher in BS (34.8%) and ABs (33.3%) than in other breeds. This rate is lower in HFs (21.5%) and SIMs (10.7%). Culture-breed calves are separa-

Table 1 - Herd Life-Related Terms, Their Abbreviations and Definitions

Terms	Abbreviations	Signification
Herd participation rate	-	Every animal that joins the herd from birth
Breeders' rate	-	The rate of cows that gave birth at least once after the age of 550 days (18 months)
Evaluation rate as a cow	-	(Number of cows that gave birth at least once in the herd / rate of joining the herd) x 100
Calving number	CN	Number of births a cow has had during her stay in the herd
First calving age	FCA	The age at which a cow in the herd calves first
Herd life	HL	The period from the birth of the animal until it leaves the herd
Breeding time	BT	The period from the age of 550 days (18 months) until the cow leaves the herd
Productive life	PL	The period from the first calving to the age until the cow leaves the herd.

ted from their mothers immediately after birth and subjected to special care in separate calves compartments. In AB breed, calves are raised freely with their dams and no extra milk is provided. Calves that cannot get the necessary milk from their dams or cannot reach the feed decrease the viability of the calves. In addition, because AB calves are housed with the whole herd during the growth phase, they can sometimes be prevented from being fed by large and strong cows due to the herd hierarchy. For the reasons stated, it is thought that this value may be higher in ABs than in culture breeds.

Table 2 presents the herd participation rates of animals on the basis of breeds and the birth rates of animals considered as breeding reaching the age of 550 days. In a herd of cattle, the female animal reaching the age of 550 days is the breeding animal that is a candidate for procreation. In the study, 73.3% of 195 animals reaching the age of 550 days were evaluated as breeders by calving in the herd. This value was found to be higher than the value reported which calving of 43.6% of the herd, by Kaya and Akbulut[19]. In the study, the reason why the rate of reaching breeding age and leaving the herd is high in ABs may be due to the morphological elimination of this breed from the herd after reaching adult age. As the AB cattle breed was raised at the institute in the scope of conservation herd, animals that do not show morphological breed characteristics are removed from the herd before the age of 550 days.

Calving number (CN)

The calving numbers during a stay in the herd of the cows that gave birth are presented in Table 3. In this study, the rate of calving with 3 or more in cows was found to be 45.5%, while this value was reported as 61.4% by Kaya and Akbulut[19]. While this rate was found to be the highest in SIM cows with 60%, it was determined as 41.1% in HF and 35.5% in BS cows. The same rate was determined 59% in AB cows. In addition, in this study, HFs gave birth at most 5 times, BSs 6, SIMs 7 and ABs 8 times. In cattle, fertility is an essential activity for herd continuity. These values indicate that the SIM and AB cows in the herd are long-lived and give offspring at a later age.

First calving age (FCA)

In the study, the mean FCA values according to the breeds are presented in Table 4. The FCA in cows ranged from 660 to 2757 days, it was determined significant the differences between breeds (P=0.038). When the culture breeds were examined, FCA was determined as a minimum of 702 days and a maximum of 1992 days. On the other hand, FCA was determined as a minimum of 660 days and a maximum of 2757 days in AB cows. The mean of FCA was found 988 days in SIMs and 1104 days in BSs, but this value in HFs was lowest with 948 days. This value was found to be higher with 1169 days in ABs than in culture breeds. The reason why the FCA values were found to be higher in ABs than the culture breeds, may be because AB breed reach maturity about 24-30 months of age thus the first insemination in heifers is later than the culture breeds and also AB cattle does not have a commercial milk yield and is not expected to enter early lactation.

The FCA value found in this study was found to be higher than the values reported between 815 days (approximately 26.8 months) and 1009 days in various culture breeds in the literature[6,19-22]. In addition, this value was reported as 895 days in

Table 2 - Herd Participation Rates by Breeds, Birth Rates of Those Joining the Herd as Breeders and Rate of Evaluation as a Cow

Breed	Herd Participation Rate					Birth Rate					Rate of Evaluation as Cow
	Total	Reachable Breeder		Unreachable Breeder		Total	Calving		Not Calving		
	n	n	%	n	%	n	n	%	n	%	%
HF	74	65	87.8	9	12.2	65	51	78.5	14	21.5	68.9
BS	75	69	92.0	6	8.0	69	45	65.2	24	34.8	60.0
SIM	34	28	82.4	6	17.6	28	25	89.3	3	10.7	73.5
AB	41	33	80.5	8	19.5	33	22	66.6	11	33.3	53.7
Total	224	195	87.1	29	12.9	195	143	90.7	52	9.3	63.8

Table 3 - Calving Number of Cows

CN	Total		HF		BS		SIM		AB	
	n	%	n	%	n	%	n	%	n	%
1	47	32.8	17	33.3	20	44.4	7	28.0	3	13.6
2	31	21.7	13	25.5	9	20.0	3	12.0	6	27.3
3	29	20.3	12	23.5	6	13.3	8	32.0	3	13.6
4	16	11.2	7	13.7	5	11.1	1	4.0	3	13.6
5	11	7.7	2	3.9	2	4.4	3	12.0	4	18.2
6	5	3.5	0	0	3	6.7	1	4.0	1	4.5
7	3	2.1	0	0	0	0	2	8.0	1	4.5
8	1	0.7	0	0	0	0	0	0	1	4.5
Total	143	100	51	100	45	100	25	100	22	100

Table 4 - Average Values of First Calving Ages in Cows and Number of Calves Per Cow

Breed	First Calving Age				Number of Calves Per Cow
	n	Min	Max	Mean	Mean
General	143	660	2757	1057.8±29.5	2.79±0.141
HF	51	702	1875	948.2±46.3	2.29±0.221
BS	45	714	1992	1104.1±49.3	2.31±0.235
SIM	25	744	1281	988.5±66.1	3.04±0.315
AB	22	660	2757	1169.0±70.6	4.50±0.336
P Value				0.026	0.007

The means within columns with different superscripts are significantly different at P<0.05

the EAR breed[19]. Nilforooshan and Edriss[20] indicated a positive effect of reducing age at first calving on milk yield and productive life. Therefore, to reduce costs, cows should be bred for the first time at the age of 420-450 days (14-15 months), so that they can perform their first calving at approximately 700-730 days (23-24 months). However, the first calving time of the cows should be determined according to the climate and breeding needs of the country where they are located.

Number of Calve Per Cow

In the study, average CN values per cow by breed are also presented in Table 4. CN value was found to be the highest in AB breed with 4.50 and the lowest in FH and BS breeds with 2.29 and 2.31. The mean CN value per cow was found to be 2.79 in the herd, and the interracial differences were found to be significant (P=0.007). As the number of calving increases in cows, the breeding period will increase, this value high is a positive indicator for herd management. While Kaya and Akbulut[19] reported the average CN per cow as 3.30 in the herd, these values were calculated as 3.69 in EAR, 3.04 in BS and 2.30 in HF. This value was reported between 2.23-3.4 in HF[6,23,24]. In both this study and the study reported by Kaya and Akbulut[19], the fact that the BS value was found to be higher in native breeds than in culture breeds is thought to be due to the lack of production pressure such as milk and fertility on native breeds.

Reasons for Exiting Animals

In the study, the reasons for leaving the herd on the basis of breed are presented in Table 5. Of the 224 animals whose records were examined, only 6 of them were sold as breeding, and 81 of them were removed from the herd as reformed. Of the 137 cows that were compulsorily removed from the herd, 75 were removed from the herd due to slaughter, 29 due to compulsory slaughter and 33 due to death. In the study, in HFs the ratios of the other 4 factors were found to be close to each other, except for those that were sold as breeder sales. BS and SIMs were mostly removed from the herd as reformed sales and ABs as reformed slaughter. Cows sold as reformed sales were generally animals that do not keep offspring, fattened and can be used as stocker in the herd. The age of the reformed slaughter animals is generally older than the other groups, and these animals were removed from the herd due to old age, infertility, decrease in milk yield and foot and udder problems. Compulsory slaughtered animals were animals that have health problems in the herd and are no longer used for breeding. Due to death, they were generally animals that leave the herd at either calf age or old heifer age. Yaylak[9] reported that 43.7% of the cows in the herd were optionally removed from the herd, and 56.3% were forced out of the herd. Kara et al.[10] reported the voluntary and obligatory ratio of animals removed from the herd as 50-50%. While Koç[22] determined the rate of those who were voluntarily removed from the herd as 33.51%, the rate of those who were compulsory removed from the herd as 47.87%, the rate of those whose reason for removal from the herd was unknown as 18.62%. In this study, voluntary and compulsory herd exit rates were generally close to the literature reports.

Herd Life (HL)

In the study, HL durations were calculated in all animals that gave birth and did not give birth, and these values are presented in Table 6. HL value found in the study was found to be close to each other in culture breeds, and the HF breed had the lo-

Table 5. The Reasons and Rates of Exit of the Animals from Herd

Reason for Exit		Total		HF		BS		SIM		AB	
		n	%	n	%	n	%	n	%	n	%
Voluntary	Breeder sale	6	2.7	1	1.3	3	4.0	2	5.9	0	0
	Reformed sale	81	36.2	19	25.7	41	54.7	14	41.2	7	17.1
	Subtotal	87	38.9	20	27.0	44	58.7	16	47.1	7	17.1
Compulsory	Reformed slaughter	75	33.5	22	29.7	18	24.0	10	29.4	25	61.0
	Compulsory slaughter	29	12.9	17	23.0	6	8.0	5	14.7	1	2.4
	Death	33	14.7	15	20.3	7	9.3	3	8.8	8	19.5
	Subtotal	137	61.1	54	73.0	31	41.3	18	52.9	34	82.9
Total		224	100	74	100	75	100	34	100	41	100

Table 6 - Average HL, BT and PL Values in Cows

Breed	Herd Life				Breeding Time				Productive life			
	n	Min	Max	Mean	n	Min	Max	Mean	n	Min	Max	Mean
General	224	4	5775	1748.2±73.79	195	247	5225	1733.4±76.09	143	0	4265	1231.0±68.81
HF	74	16	2948	1419.5±120.8	65	247	2398	1186.7±119.5	51	0	2061	788.5±108.0
BS	75	4	3916	1641.6±120.0	69	321	3366	1511.1±127.2	45	5	2542	957.0±115.0
SIM	34	12	3714	1690.0±178.2	28	349	3164	1559.6±170.6	25	1	2599	1121.1±154.3
AB	41	8	5775	2241.8±162.3	33	464	5225	2676.4±181.9	22	145	4265	2057.4±164.5
P Value	0.001	0.001	0.001									

The means within columns with different superscripts are significantly different at P<0.05

west value with 1419 days. On the other hand, this value was found to be higher in ABs than the culture breeds with 2242 days. HL value was generally found to be 1748 days, and the interracial differences were found to be significant (P<0.001). In various studies, the HL value has been reported between approximately 1540 days and 2229 days in the SA breed [6,20-22,24,25]. In another study, this value was calculated as 1130 days in BSs, 810 days in HF and 1333 days in EAR breeds[19]. In this study, the values found in culture breeds were found to be generally compatible with the literature reports, while the values of ABs were found to be higher than those reported in the literature.

Breeding Time (BT)

The mean BT values of the cows in the herd are presented in Table 6 in detail according to the breeds. The mean BT of the cows was 1733 days, and the differences between the breeds were found to be statistically significant (P<0.001). These values were found to be lowest in HFs and highest in ABs. In this study, the age at breeding was found to be the lowest in HFs and highest in ABs. When the literature data is examined, BT values have been reported between 740 days and 1236 days in culture breed cows[10,22,24,26]. The fact that the values found in this study are higher than the values reported in the literature may be due to the high FCA values of the cows in the herd. In cattle breeding, 4 years is considered ideal as the breeding period of cows in the herd[10]. Because at this time, a sufficient number of breeding heifers can be obtained to replace the emerging cow in the herd[23]. In this study, the BT values found in other breeds except HF cows for more than 4 years may be an indication that the necessary care, feeding and welfare conditions are provided to the cows in the herd.

Productive life (PL)

The time elapsed from the first calving to the removal of the cows from the herd is indicated as PL. In the study, the PL values are presented in Table 6 in detail on the basis of breed. These values of the cows were found to be 1231 days on average in all breeds. When the culture breeds were examined, it was lowest in HF cows with 788 days, while it had a higher value in BS and SIM cows with 957 days and 1121 days. On the other hand, in AB cows, these values were found to be higher than the culture breeds with 2057 days. It was statistically significant (P<0.001) among breeds. This value, Nilforooshan and Edriss[20] reported as approximately 915 days in HF, Kaya and Akbulut[19] as 3723 days in BS, 2355 days in HF and 3133 days in EAR. Gavrila et al.[25] found this value in the range of 1066 days to 1590 days in five HF herds. Kucevic et al.[6] reported approximately 1220 days in HF cows.

Evaluation Calves Number, Herd Life and Productive Life According to First Calving Age

BS, HL and PL values are calculated according to FCA groups and shown in Table 7. In the study, 912 days (30 months) was accepted as the limit for grouping the FCA values of the cows, and they were divided into two groups less than 912 days and more than 913 days. As a result of the analysis made according to early or late calving values, calving numbers were found to be very close to each other in culture breeds. Although the number of cows that gave birth after 913 days was higher in ABs, the difference was found to be statistically insignificant As FCA values increased in cows, HL increased in both cultured breeds and ABs. However, as FCA values increased, PL values dec-

Table 7 - CN, HL and PL Values by FCA Groups

Character	n	CN	HL	PL
Culture Breeds				
Less 912 days	58	2.47±0.199	1766.4±93.78	946.7±90.45
Over 913 days	63	2.44±0.191	2089.0±89.98	883.8±86.79
P-Value	0.939	0.014	0.620	
Anatolian Black				
Less 912 days	7	3.20±0.74	2973.0±535.5	2197.1±446.7
Over 913 days	15	4.14±0.51	3344.6±365.8	1992.2±305.2
P-Value	0.307	0.573	0.709	

The means within columns with different superscripts are significantly different at P<0.05

Table 8 - Correlation Coefficient Values Between FCA, CN, HL and PL

	FCA	CN	HL
Culture Breeds			
CN	-0.046		
HL	0.318***	0.847	
PL	-0.065	0.910***	0.926***
Anatolian Black			
CN	0.054		
HL	0.587**	0.752***	
PL	0.224	0.880***	0.920***

***(P<0.001) **(P<0.01)

reased in cows in the herd. In other words, the productivity times of the cows that gave birth after the 913th day decreased in the herd. These findings were consistent with the values reported by Nilforooshan and Edriss[20] that milk yield and PL decreased in HF cows when the age of first calving passed 730 days. Similarly, the study findings by Haworth et al.[27] reported that longevity gradually decreases as PL decreases in HF. Brickell et al.[28] reported that cows calving at a relatively younger age have a long and productive life span, whereas lifetime productivity is significantly lower. Zavadilova and Stipkova[13] found that high FCA was associated with short PL. Ciela et al.[29] determined that cows calving for the first time at 912 days and older have a longer lifespan, but have a significantly shorter productive lifespan than other FCA groups. Kucevic et al.[6] reported that the productive life of cows calving older than 29 months (about 882 days) decreased gradually with the increase of FCA.

Phenotypic Correlation Values

The correlation coefficient values between FCA, CN, HL and PL values are presented in Table 8. Accordingly, while the relationship between FCA-CN and FCA-PL was negative in culture breeds, it was found to be positive in AB. Associations between FCA-HL, CN-HL, CN-FCA, and HL-PL were positively correlated in all breeds. The prolongation of FCA in cultured breeds makes the animals fat, which shortens the HL of these animals. In the AB breed, the fact that the cows were not put under any pressure for reproduction may have caused this correlation value to be positive. A positive correlation (0.32, 0.052) between FCA and life expectancy in HF has been reported in some studies[20,21]. It is an important finding that this relationship is found as a positive phenotypic correlation in herds. Because the length of life consists of first calving age and productive life.

CONCLUSION

In conclusion, the rates of reaching the breeding age and the calving rates of the cows reaching the breeding age were found to be higher in culture breeds than in AB. However, HL, BT and PL values were found to be higher in AB breed. The negative correlation between age at first calving and reproductive life span in culture breeds reveals the importance of giving birth to the first calving before 912 days of age. For this, the breeding cows in the herd should be made pregnant between 450-550 days (15-18 months), the first calf should be born between 730-820 days (24-27 months), and care should be taken that this period does not exceed 912 days (30 months).

It can be said that the reason why locally adapted AB cattle have higher HL and PL values than culture breeds is that there are fewer problems in their reproductive performance and metabolic diseases are much less common due to their low yield characteristics. It also reveals that cattle with high yield characteristics are left from the herd earlier. In addition, AB cattle breed was raised in a system close to its natural environment and was not subject to the selection process in terms of features that have economic importance such as milk. That is, it can be said that the Anatolian Black breed has not been directly genetically interfered. In addition, it can be considered that transferring some of the superior adaptive characteristics of Native breed cattles to cultural breeds by using technological opportunities will add value to these breeds.

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Conflict of interest

The authors declare that there is no conflict of interest.

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