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The age at first calving and the longevity of beef cows in Hungary

Abstract

The length of time beef cows spend in production is an important component of the rentability of beef cattle husbandry. In spite of this fact, very few publications have dealt with this trait, either in Hungary or abroad. Therefore the aim of the present study was to evaluate some of the age parameters of beef cows related to the production period. A database of 2115 cows belonging to five breeds (Hungarian Grey, Hereford, Aberdeen Angus, Limousin, Charolais) and two crossbred genotypes (Simmental x Hereford F_1, Simmental x Limousin F_1) born between 1977-1992 was evaluated. Age at first calving (AFC), age at culling (ACU), moreover longevity (LONG) were studied. Longevity is defined as the number of years from first calving to culling. The mean values of AFC, ACU and LONG obtained were 2.71, 9.47 and 6.77 years, respectively. Breed/genotype and birth year had significant influence ($P<0.01$) on each evaluated trait, whereas birth month statistically affected only the AFC. Ages at first calving of the different breeds and genotypes were: 3.51, 2.08, 2.76, 2.82, 3.02, 2.03, 2.62 years, respectively. Hereford crossbred and purebred cows were the youngest, whereas Hungarian Grey cows were the oldest at first calving. Ages of culling of the evaluated breeds and genotypes were as follows: 12.42, 11.09, 11.03, 10.61, 10.89, 12.73, 8.15 years, respectively. The longest life span was reached by Hereford crossbred and Hungarian Grey and the shortest by Limousin crossbred cows. This trait shows a decreasing trend (from 15.35 years to 5.91 years) from the birth year of 1977 to 1992. The longevity values of the mentioned breeds and genotypes were: 8.59, 9.08, 8.29, 7.81, 7.91, 10.79, 5.55 years, respectively. Hereford crossbred and purebred cows had the longest, Limousin crossbred cows the shortest productive lives. This trait also shows a decreasing trend (from 12.45 to 3.31 years) in the case of cows born between 1977 and 1992.

Key Words: beef cattle breeds, age at first calving, age at culling, productive life, longevity

Zusammenfassung

Titel der Arbeit: **Erstkalbealter und Nutzungsdauer von Fleischrindrassen in Ungarn**

Die Nutzungsdauer von Fleischrindrassen stellt einen bedeutenden Rentabilitätsfaktor dar. Trotz dieser Tatsache finden sich relativ wenige in- bzw. ausländische Veröffentlichungen zu dieser Thematik. Daher war es das Ziel dieser Studie, Merkmale wie Nutzungsdauer, und Lebensalter von Fleischrindrassen in Ungarn retrospektiv zu analysieren. Einbezogen wurden Daten von 2115 Kühen aus den Jahren 1977 bis 1992 der Rassen Ungarisches Steppenrind (1), Hereford (2), Aberdeen Angus (3), Limousin (4), Charolais (5) sowie Kreuzungstiere aus Ungarischen Fleckvieh x Hereford (6) und Ungarisches Fleckvieh x Limousin F_1 (7). Untersucht wurden die Merkmale Erstkalbealter (EKA), Alter der Merzung sowie die Nutzungsdauer, als dem Alter zwischen der ersten Kalbung und der Merzung in Jahren. Die Durchschnittswerte der untersuchten Merkmale aller Tiere betrugen für EKA 2,71, MA 9,47 und 6,77 Jahre. Sowohl die Rasse bzw. der Genotyp und das Geburtsjahr haben signifikant alle Merkmale, der Geburtsmonat lediglich das Erstkalbealter beeinflusst. Das Erstkalbealter betrug für die Populationen 1-7 3,51; 2,08; 2,76; 2,082; 3,02; 2,03 bzw. 2,62 Jahre. Die Hereford bzw. Hereford x Kreuzungskühe erreichten das früheste, die Ungarischen Steppenrinder das späteste Erstkalbealter. Das Merzungsalter betrug für die Populationen 1-7 12,42; 11,09; 11,03; 10,61; 10,89; 12,73 bzw. 8,15 Jahre. Die Hereford-Kreuzungskühe und die Ungarischen Steppenrinder erreichten die längste, die Limousin-Kreuzungskühe die kürzeste Lebensdauer. In den Jahren 1977 bis 1992 verringerte sich das Merzungsalter im Durchschnitt aller Populationen von 15,35 auf 5,91 Jahre. Das Nutzungsalter betrug für die Populationen 1-7 8,9; 9,08; 8,28; 7,81; 7,91; 10,79; bzw. 5,55 Jahre. Dieses Merkmal zeigte eine abnehmende Tendenz (von 12,45 zu 3,31 Jahren) im Untersuchungszeitraum.

Schlüsselwörter: Fleischrindrassen, Erstkalbealter, Merzungsalter, Nutzungsdauer, Langlebigkeit

Introduction

The age at first calving, the life span and the longevity of cows have great importance in cattle husbandry, especially in beef cow husbandry. The cost of raising weaned calves depends largely on how early cows calve and how long they remain in production. If cows are productive extendedly and raise more progeny, specific costs of raising per calf decrease proportionally.

In the case of cattle, natural death is by the present time nearly unknown, since the animals are culled at a relatively early age, out of necessity or on a voluntary basis. This is all the more true for beef cows, as after a late winter/spring calving period empty cows are usually culled in the fall. The natural life span of the species is estimated as 30-35 years, but significantly higher longevities have also been recorded. According to CSUKÁS (1954), cows may live for as long as 40 years.

Longevity (in the ordinary sense of the word) is a decidedly weakly heritable trait, whose manifestation is deeply influenced by environmental factors and keeping, feeding and breeding conditions. NAGY and TAKÁCS (1978) report a heritability of 0.2-0.4, similar to the value described by HORN (1995) (0.2-0.3) and SZABÓ (1998) (0.1), whereas ROGERS et al. (2004) determined a value of 0.14. According to several authors, there may also be certain differences between the individual breeds.

Due to the low heritability the longevity is affected by several environmental, management factors and breeds of cattle (SZABÓ, 1980; RÁKI and SZAJKÓ, 1986; ESSL, 1988; NAGY and TŐZSÉR, 1988; VARGA, 1990; ARTHUR et al., 1993; GÁSPÁRDY et al., 1993; SZABÓ, 1993; GOYACHE et al., 2003; JAKUBEC et al., 2003; ROGERS et al., 2004.

As age at first calving, age at culling and the time elapsing between the to events, have a great effect on beef production of a population and the economic results of beef husbandry, it is important to evaluate and look for improving of these traits. In spite of this fact, very few publications have dealt with this trait, either in Hungary or abroad.

Based the above mentioned facts, the aim of this study was to collect data in different beef herds belonging to different breeds, and evaluate the age at first calving, culling and longevity and that of the year, season, breed effect on them. The present work summarizes the results of the work in this field.

Materials and methods

The present study is founded on a database containing pedigrees as well as calving data, made available to us by the breeders' associations. In the study the pedigrees of cows born between 1977 and 1992 were used, thus even the youngest individual studied could theoretically have been in production for at least 12 years.

Data of altogether 2115 cows of the following breed distribution: Hungarian Grey, 254; Hereford, 98; Aberdeen Angus, 83; Limousin, 491; Charolais, 521; Simmental x Hereford crossbred, 635; Simmental x Limousin crossbred, 33 were analyzed. All crossbreds were of the F_1 generation from mating a Simmental sire and a cow from the given breed.

Only individuals already culled and with complete data sets were included in the analysis. Cows of the population studied were culled between 1982 and 2002. Animals could also have been culled before 1982 and the distribution of age at culling in the different years could have been slightly modified by the data of these animals; however, the original database did not contain the data of these animals.

In the course of the analysis, three traits were evaluated: (1) age at first calving (AFC), (2) age at culling (ACU) and (3) longevity (LONG), all of which can be expressed in days, months or years. In order to facilitate comparisons, it were calculated ages in years. The age at first calving is the period of time elapsed between the date of birth and the date of the first calving; the age at culling is, naturally, the length of time elapsed between the date of birth and the date of culling, whereas longevity is the period of time elapsed from the date of first calving to the date of culling.
The data were prepared for analysis with the help of the MS Office Excel program and statistical analyses were carried out using SPSS for Windows 11.5. In addition to evaluating the basic statistical parameters (mean, standard error of the mean, standard deviation, maximum and minimum values). The effect of various influencing factors on the variables was represented by generalized linear modelling (GLM).
It were also seeked to determine whether or not the month and the year of birth have a statistically significant effect on age at first calving, age at culling and longevity, and to what extent these traits are influenced by breed. The model incorporates as fixed effects the year of birth (yob), the month of birth (mob) and the breed or genotype (b/gen), same as JAKUBEC et al. (2003) and GOYACHE et al. (2003) reported.

The model is described by the following equation:

$$Y_{ijk} = \mu + f_i + e_j + h_k + \varepsilon_{ijk}$$

where

μ is the mean of the population
f is the fixed additive effect of the i-th breed/genotype
e is the fixed additive effect of the j-th year of birth
h is the fixed additive effect of the k-th month of birth
ε is other effects (e.g. the error of the model)

Results

The results of the inclusive analysis of the entire database are summarized in Table 1. The average age at first calving for all breeds and genotypes was 2.59±0.65 years, whereas the average age at culling was 10.24±4.08 years. The earliest age heifers could be introduced to breeding was 1.70 years and the latest. 4.98 years. The oldest cow culled was 21.81 years old and the youngest. 2.28 years old. The average longevity was 7.65±4.04 years; the minimal value of this parameter was 0 years and the maximal value 17.87 years.

Table 1
The mean values of the evaluated traits (Durchschnittswerte der untersuchten Merkmale)

Traits	no	mean	std.error	std.deviation	minimum	maximum
Age at first calving	2115	2.59	0.01	0.65	1.70	4.98
Age at culling	2115	10.24	0.08	4.08	2.28	21.81
Longevity	2115	7.65	0.08	4.04	0	17.87

Statistical analysis of the raw data revealed that the differences between the groups obtained by classification on the ground of breed/genotype and year of birth were significant ($P<0.01$) for all three traits studied, whereas in the case of groups formed

according to month of birth, statistically significant differences were observed only in the case of age at first calving. The results of the analysis are shown in Table 2.

Table 2
Reliability of the effects influencing age data (Zuverlässigkeit der das Alter beeinflussenden Effekte)

Traits	effects		
	breed	year of birth	month of birth
Age at first calving	**	**	**
Age at culling	**	**	ns
Longevity	**	**	ns

** $p<0.01$

The contribution of the individual factors, i.e. breed, year of birth and month of birth to total variance is presented in Table 3. According to the data in the table, breed/genotype was the most determinant factor in the case of age at first calving, its contribution to total variance was 97.85%, but played a much less important role in the case of the other two traits; its contribution was 31.56% and 45.83%, respectively.
Total variance was affected by the year of birth in the opposite way: its contribution was only 1.45% for age at first calving but 68.43% for age at culling and 54.66% for longevity. Age at first calving was influenced the least by the month of birth, with a contribution of 0.68% to total variance. In the case of age at culling and longevity it became clear at an early stage of statistical analysis that the differences between the individual groups are independent of the month of birth and may therefore not contribute to total variance.

Table 3
Distribution of variance components (Verteilung der Varianzkomponenten)

Effects	traits		
	age at firs calving	age at culling	longevity
Breed and genotype	97.85	31.56	45.33
Year of birth	1.45	68.43	54.66
Month of birth	0.68	-	-

Values of life span for the different *breeds/genotypes* are summarized in Table 4. Data of *age at first calving* reveal that Hungarian Grey cows took the longest time to raise (3.51 years), followed by Charolais (3.02 years), Limousin (2.82 years), Angus (2.76 years), Limousin crossbred (2.62 years), Hereford (2.08 years) and Hereford crossbred (2.03 years).
Based on the results of data processing, *age at culling* is the highest for Hereford crossbred cows (12.73 years), slightly preceding Hungarian Grey cows (12.42 years). Hereford (11.09 years) and Angus (11.03 years) are next with nearly identical values, followed by Charolais (10.89 years) and Limousin (10.61 years).

Longevity is the highest in the case of Hereford crossbred cows (10.79 years), followed by the group comprising Hereford purebred (9.08 years), Hungarian Grey (8.95 years) and Angus (8.28 years). The longevities of Charolais and Limousin were close to 8 years (7.91 and 7.81 years. respectively), whereas that of Limousin crossbreds was below six years (5.55 years).

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Table 4
Evaluated traits according to breed and genotype (Untersuchte Merkmale nach Rassen bzw. Genotypen)

Traits	Breed	no	Age and life-span (year)				
			Mean	Std.error	Std.deviation	Minimum	Maximum
Age at first calving	Hungarian Grey	254	3.51	0.03	0.57	2.05	4.98
	Hereford	98	2.08	0.04	0.21	1.75	3.96
	Aberdeen Angus	83	2.76	0.04	0.66	1.70	4.71
	Limousin	491	2.82	0.02	0.39	1.94	4.61
	Charolais	521	3.02	0.02	0.35	1.77	4.89
	Hereford crossbred F_1	635	2.03	0.03	0.07	1.78	2.98
	Limousin crossbred F_1	33	2.62	0.06	0.24	2.13	3.08
Age at culling	Hungarian Grey	254	12.42	0.20	4.99	2.28	21.81
	Hereford	98	11.09	0.34	2.91	2.75	14.88
	Aberdeen Angus	83	11.03	0.36	2.53	3.39	13.67
	Limousin	491	10.61	0.16	4.42	2.31	19.13
	Charolais	521	10.89	0.16	3.02	2.32	18.32
	Hereford crossbred F_1	635	12.73	0.15	3.25	3.03	19.76
	Limousin crossbred F_1	33	8.15	0.53	3.13	2.53	12.65
Longevity	Hungarian Grey	254	8.95	0.20	4.91	0	17.87
	Hereford	98	9.08	0.34	2.86	0.85	10.93
	Aberdeen Angus	83	8.28	0.36	2.67	1.20	11.71
	Limousin	491	7.81	0.16	4.39	0	16.48
	Charolais	521	7.91	0.15	3.06	0	15.45
	Hereford crossbred F_1	635	10.79	0.15	3.25	1.04	17.81
	Limousin crossbred F_1	33	5.55	0.53	3.14	0	10.38

Data of age and life span arranged *as a function of the year of birth* are presented in Table 5. The *age of first calving* is relatively independent of the year of birth and the data show little variation, with the lowest value recorded for cows born in 1981 (2.54 years) and the highest for those born in 1977 (2.96 years). In the case of the *age at culling*, a tendency to decrease is observed with the progress of years. The highest age was reached by the animals born in 1978 (15.41 years), whereas those born in 1992 had the shortest lives (5.91 years). The same decrease can be observed in the values of *longevity*: the 1978 generation spent an average of 12.71 years in production, whereas the average value of the same parameter is only 3.31 years for the 1992 age group. For cows born later than 1992 the period studied was of course shorter, but in the case of those born in 1992 there still remained 12 years between birth and the end of data collection. This value, however, is well above the average age at culling 5.91 years. In the group of cows born in 1992 even the cow culled at the latest age was less than 10 years old.

Table 5
Evaluated traits according to year of birth (Untersuchte Merkmale nach Geburtsjahren)

Traits	Year of birth	n	Age and life-span (year)				
			Mean	Std.error	Std.deviation	Minimum	Maximum
Age at first calving	1977	27	2.96	0.07	0.44	2.99	4.96
	1978	37	2.75	0.06	0.57	2.69	4.94
	1979	27	2.77	0.07	0.52	2.78	4.92
	1980	86	2.93	0.05	0.53	2.20	4.98
	1981	127	2.54	0.04	0.47	2.12	4.18
	1982	94	2.71	0.04	0.75	1.82	4.84
	1983	153	2.69	0.03	0.76	1.84	4.93
	1984	107	2.71	0.04	0.67	1.77	4.16
	1985	157	2.59	0.03	0.56	1.84	4.08
	1986	143	2.62	0.03	0.54	1.83	4.12
	1987	137	2.63	0.03	0.54	1.82	4.00
	1988	179	2.67	0.03	0.64	1.81	4.89
	1989	245	2.64	0.02	0.55	1.75	4.71
	1990	264	2.64	0.02	0.56	1.83	4.27
	1991	159	2.61	0.03	0.52	1.70	4.52
	1992	173	2.64	0.03	0.53	1.82	4.45
Age at culling	1977	27	15.35	0.61	5.39	4.86	21.81
	1978	37	15.41	0.53	4.58	6.35	20.80
	1979	27	15.01	0.62	4.69	4.07	19.80
	1980	86	12.72	0.35	4.86	3.11	20.16
	1981	127	13.39	0.31	4.60	2.28	19.46
	1982	94	13.52	0.33	1.91	10.27	19.76
	1983	153	12.07	0.26	3.64	3.32	18.72
	1984	107	11.78	0.31	3.76	2.61	17.78
	1985	157	9.82	0.25	3.27	2.79	16.85
	1986	143	10.22	0.26	3.15	2.31	16.28
	1987	137	9.45	0.27	2.74	2.93	14.90
	1988	179	8.66	0.24	2.93	2.53	14.13
	1989	245	8.13	0.21	2.73	2.73	13.07
	1990	264	7.67	0.20	2.28	2.32	12.03
	1991	159	6.71	0.25	2.02	2.67	11.10
	1992	173	5.91	0.25	1.74	2.74	9.97
Longevity	1977	27	12.45	0.61	5.59	0.95	17.84
	1978	37	12.71	0.53	4.58	2.40	17.87
	1979	27	12.29	0.62	4.75	0	16.79
	1980	86	9.85	0.35	4.79	0	15.34
	1981	127	10.88	0.31	4.47	0	16.48
	1982	94	10.85	0.33	2.15	6.51	17.81
	1983	153	9.43	0.26	3.73	0.58	16.81
	1984	107	9.13	0.31	3.88	0.13	15.81
	1985	157	7.28	0.25	3.49	0.32	14.92
	1986	143	7.63	0.26	3.13	0	13.81
	1987	137	6.87	0.27	2.95	0	12.81
	1988	179	6.03	0.24	3.18	0	11.81
	1989	245	5.52	0.21	2.84	0	10.81
	1990	264	5.07	0.21	2.38	0	9.81
	1991	159	4.12	0.25	2.22	0.16	8.88
	1992	173	3.31	0.25	1.87	0.18	7.83

Data of age and life span *as a function of the month of birth* are listed in Table 6. As mentioned above a statistically significant difference linked to the time of birth was established only in the case of age at first calving. Individuals born in the spring and summer months usually calved at an earlier age than did those born in the fall and

winter months. For instance, cows born in April calved at an average age of 2.59 years, whereas those born in December did at an average age of 2.77 years. The difference is 0.18 years, i.e. 2.16 months.

Table 6
Evaluated traits according to month of birth (Untersuchte Merkmale nach Geburtsmonat)

Traits	Month of birth	no	Age and life-span (year)				
			Mean	Std.error	Std.deviation	Minimum	Maximum
Age at first calving	1.	91	2.75	0.04	0.48	2.20	4.61
	2.	224	2.64	0.03	0.42	2.13	4.21
	3.	488	2.67	0.02	0.67	1.77	4.98
	4.	825	2.59	0.02	0.55	1.83	4.96
	5.	177	2.66	0.02	0.69	1.75	4.90
	6.	92	2.61	0.03	0.98	1.93	4.22
	7.	69	2.64	0.04	0.23	1.99	3.53
	8.	38	2.77	0.06	0.32	2.05	3.84
	9.	17	2.74	0.08	0.63	2.25	4.08
	10.	24	2.77	0.07	0.61	1.75	4.52
	11.	31	2.73	0.06	0.51	1.70	4.12
	12.	39	2.77	0.06	0.31	1.94	3.38
Age at culling	1.	91	11.07	0.35	4.46	2.28	21.00
	2.	224	11.01	0.24	4.41	2.53	20.87
	3.	488	10.14	0.17	4.51	2.31	21.81
	4.	825	10.96	0.17	3.57	2.75	20.77
	5.	177	11.10	0.25	4.02	2.67	20.63
	6.	92	10.64	0.33	4.83	3.29	20.58
	7.	69	10.47	0.39	3.79	2.73	16.93
	8.	38	11.29	0.51	3.52	2.93	18.49
	9.	17	10.87	0.74	4.06	3.16	15.57
	10.	24	10.77	0.63	2.84	4.34	13.75
	11.	31	11.53	0.57	3.16	3.24	13.69
	12.	39	10.51	0.51	2.67	2.88	15.35
Longevity	1.	91	8.31	0.35	4.43	0	17.75
	2.	224	8.36	0.24	4.39	0	17.78
	3.	488	8.47	0.18	4.39	0	17.87
	4.	825	8.36	0.17	3.54	0	17.77
	5.	177	8.43	0.25	3.88	0	16.88
	6.	92	8.04	0.33	4.68	0	16.96
	7.	69	7.82	0.39	3.84	0	14.26
	8.	38	8.57	0.51	3.52	0	15.89
	9.	17	8.12	0.74	4.22	0.67	13.26
	10.	24	7.99	0.63	2.81	0.62	11.23
	11.	31	8.79	0.57	3.29	0.16	10.70
	12.	39	7.73	0.51	2.71	0.39	12.53

Discussion

The conclusions of the analysis in some cases generally support the results of earlier studies and practical observations. Namely, the study demonstrates that, in addition to the breeders' decisions, the age and longevity of beef cows are also significantly affected by the breed/genotype and by the environmental effects manifesting themselves in intergenerational differences.

As compared the data of ages at first calving results to the data of performance tested beef cows, published by National Herd-book Societies in Hungary (*NIAQC*, 2004) and the results of twelve investigated purebred and crossbred populations, there are

differences but the rank of the breeds almost the same. According to the latter data, based on the age at first calving of altogether 13651 first-calf cows recorded in the course of the six evaluated years, Hungarian Grey cows calved at the latest age (3.82 years) and Hereford (2.23 years). Hereford crossbred (2.29 years), Galloway (2.30 years), Angus (2.35 years) and Red Lincoln cows (2.44 years) at the earliest age. The ages at first calving of Belgian Blue (2.60 years), Simmental (2.64 years), Charolais (2.87 years), Limousin (2.90 years), Limousin crossbred (2.99 years) and Blonde d'Aquitaine (2.88 years) are intermediate between those of Hungarian Grey and British breeds. The results reveal that there are considerable differences between the individual breeds and genotypes as regards the age at first calving.

As for the culling age and longevity there are some differences and similarities between the results obtained and that of published in literature. Longevity of Simmental x Hereford (F_1 generation) was reported to be 5.6 years (NAGY and TŐZSÉR, 1988). VARGA (1990) studied culling data of the year 1988 of the registered beef cow population and found that the average ages at culling of Hereford, Limousin, Charolais and Hungarian Grey cows were 8.5, 5.9, 7.9 and 10.1 years, respectively. Limousin crossbred cows were removed from breeding at the age of 7.8 years and Hereford crossbreds at the age of 7.0 years. According to SZABÓ (1993), Hereford and Angus cows were culled at the age of around 8 years. The average period between first calving and culling of purebred Hereford, crossbred beef cow and crossbred dairy cow populations was reported as 4.2 years by ARTHUR et al. (1993).

As a consequence of differences between ages at fist calving and between ages at culling, differences in longevity also exist. Among the breeds and genotypes studied in this work, the longevity of cows of Hereford was the highest, followed by Hungarian Grey, Angus, Charolais and, finally, by animals of Limousin.

The ages of culling and longevities of the populations studied exhibit a decreasing tendency over the years. The reason for this tendency is not biological. The explanation for the latter results is that the size of the Hungarian beef cow population has also decreased during the period studied. Owing to the unfavorable economic position of beef cow husbandry breeders reduced their herds and culled animals that they would most probably have retained in a situation of boom and expansion.

It is important to one more stress that, values of the age at introduction to breeding and the age at culling, consequently longevity are predominantly determined by conditions of raising, keeping, feeding and tending as well as by the breeders' decisions. The results should therefore be considered only as tendencies and they hold only for the populations kept under the conditions studied.

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