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Survival Curves to Evaluate Age of End of Lactation in Dairy Cows from Different Genotypes

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ABSTRACT --- ***Lactancies were analysed in four dairy genotypes:Holstein (H), Canadian Jersey (F1), F1x Brown Swiss (P) and F1x Guernsey (G) between the years 2007 and 2011. The cows were fed on pasture, with the supplementation of concentrated fodder and they were handled in the same milking premises. Survival function was estimated through Kaplan and Meier [10] and the differences between functions were assessed by a Wilcoxon [24] test. Significant differences were found among the survival curves of all the groups in the four lactancies. In all the genotypes cows have a 50 % probability of ending their first lactancy before they are 1100 days. It is 80% probable that the cows end their second lactancy from their 1500, 1600, 1700 or 1900 days, depending on their genotype: G, P, F1 or H respectively. The probability for F1, G and P cows to end their third lactancy before their 1900 days is 80 % whereas for H, it is 20 %. Half the H cows are at least 2600 days by the end of their fourth lactancy, while the same proportion of G and P cows end with less than 2250 days and F1 do it with less than 2400 days. In the system under consideration and for the years assessed, the four genotypes showed different results as regards the age when they ended their lactancies. The H cows are more likely to end their lactancies at an older age and with a wider dispersion in time when compared with the F1 cows and –specially the G and P cows. Besides, the F1, G and P cows are more likely to get a third or fourth lactancy than the H cows.***

Keywords --- Dairy genotypes, crossing, lactancies, survival, pasture systems

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1. INTRODUCTION

In Argentina, mainly during the 1990s and the first decade of 2000, it was commonly observed a strong tendency for local rodeos to engross Argentinian Holstein by American Holstein genetics, selected and improved in regions where the handling and feeding conditionsare really different - and generally speaking, much more controlled than those seen in pasture systems in our region, which is why the efficiency of these animals was not at its highest potential, considering reproductive problems and a low productive life as well [16]. The selection which prevailed during this period, widely based on individual cow production, had a consequence on other aspects of rodeos, such as a decline in cows longevity [11], which –in our country- was estimated in 2.4 lactancies for the cows included in the Argentinian Association of Argentinian Holstein Breeders by the year 2005 [16].

In different milking regions of the world, an important sector of dairy producers use crossings between milking breeds in order to reduce those adaptation problems and achieve faster progress as regards productive, reproductive and economic efficiency of their rodeos [14, 15, 22]. InArgentinaand Uruguaythese crossings have particularly intensified and widened in the last years [12]. However, the election of the breed and the crossing is closely connected to the rest of the productive system adopted, where the feeding resources, its salubrity and handling must be in harmony with the animal genotype, since the advantages of one genotype or another depend on the environment provided [15]. The genetic potential of animals is shown as long as the environment conditions permit that; and even though these do not directly modify the genetic constitution of the animal, they do determine the extension to which many characteristics are shown and, by being measured in different environments, some of them might be considered as different characteristics but genetically correlated [6]. It is stated that the combination of genetic plus non genetic factors, as well as their interaction, directly affect productive behavior, reproduction and survival, and therefore, different genotypes must be kept in a same environment when assessing the genetic component in particular [13].

Survival, as characteristic of longevity of dairy cows, also combines aspects related to the subjective selection that producers make about the rodeo, making it necessary to analyses separately the environment and handling effects [1]. The survival analysis is recognized as an appropriate method to estimate the longevity or productive life [5] and it is included within the merit rates in countries members ofInterbull, as it is a characteristic which can considerably affect the rentability of dairy companies [2, 3]. On the other side, when considering longevity through the survival analysis, it is possible to find genetic differences among animals in traits other than production such as health, fertility, structure and old age [19]. In this sense the crossing in dairy production is an option to improve these indicators, since the differences between breeds are bigger than those presented within the group and further benefits can be obtained due to the hybrid component [4, 8].

For this, it is stated the objective of evaluating the behaviour of cows as regards ages at the beginning and at the end of their four first lactancies in different dairy genotypes, in a pasturing system with strategic supplementation, typical of the milking region of Entre Rios, Argentina.

2. MATERIALS Y METHODS

In a dairy commercialcenter located in the mid-west of the province of Entre Rios (32º 00´ South y 59° 34´ West), retrospective data was analysed (years 2007 to 2011) in cows belonging to four different dairy genotypes Holstein (H), Canadian Jersey (F1), F1x Brown Swiss (P) and F1x Guernsey (G), whose numbers are presented in Table 1.

Table 1. Number of Animals (N) Analysed through Genotype and Lactancy

GENOTYPES	LACTANCIES				
	First	Second	Third	Fourth	TOTALS
H	52	70	108	136	366
F1	634	707	646	446	2433
P	327	134	97	42	600
G	486	340	109	28	963
TOTALS	1499	1251	960	652	4362

During the period in consideration, all the cows were handled in the same milking premises and were fed on similar pastures and grazing areas, with similar assignment of fodder and concentrated food. Rain during the period in consideration was highly irregular, as were the days with thermal stress for dairy cows, that is when the combination of temperature and environment humidity or "Temperature – Humidity Index ITH" is over 74 [21]. Table 2.

A multinomial logistic regression model was used, through the statistical programme SPSS for Windows® (SPSS Inc., Chicago, IL, version 13.0), being the following variables considered: number of lactancies reached by each cow and genotype and age (in days), as these were the only ones which provided significant data for the model under use. The interpretation of the model was carried out based on the Odds Reasons estimated.

The study of the variable "time till the end of lactancy" for each genotype was carried out through an analysis of survival where the Kaplan Meier method was applied [10]. Then, it was assessed whether there existed significant differences among survival functions for the different genotypes applying the Wilcoxon Test [24].

Table2. WeatherVariables for the Period under Consideration (2007-2011)

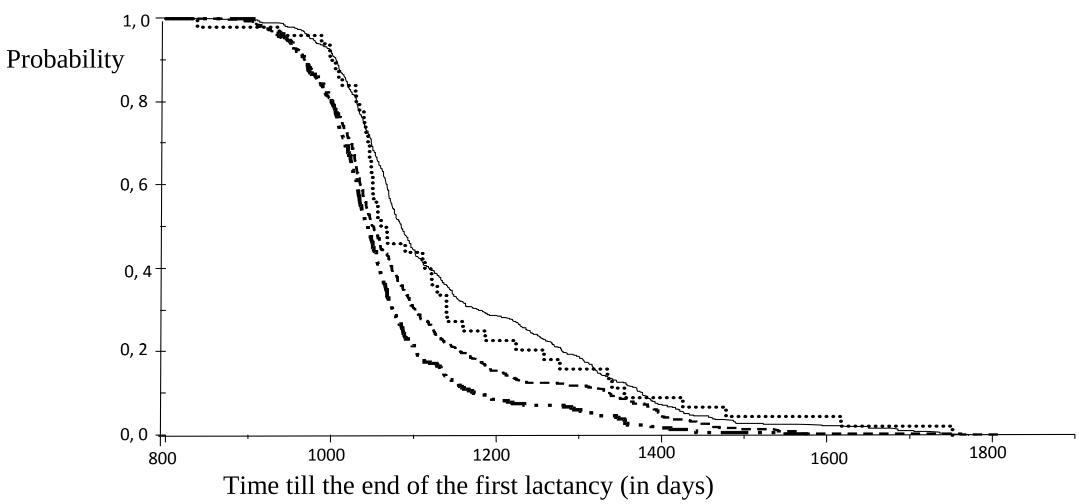
VARIABLE	YEARS				
	2007	2008	2009	2010	2011
Rain (mm)	1365	648	1465	1244	1037
Dayswith ITH over 74	43	55	60	48	41

3. RESULTS

Survival analysis.

Figure 1 shows the survival curves [10]as regards the end of the first lactancy for each genotype. It can be seen that 50 % of the cows belonging to the four genotypes reach the end of their first lactancy before they get to 1100 days old. There is an 90 % of probability that P cows finish their first lactancy before they get 1200 days old, while the G, F1 and H cows require 150 more days in order to get to the same point and reach the end of their first lactancies with at least 1350 days. The differences among survival functions for the different genotypes are statistically significant ($p \leq 0{,}001$).

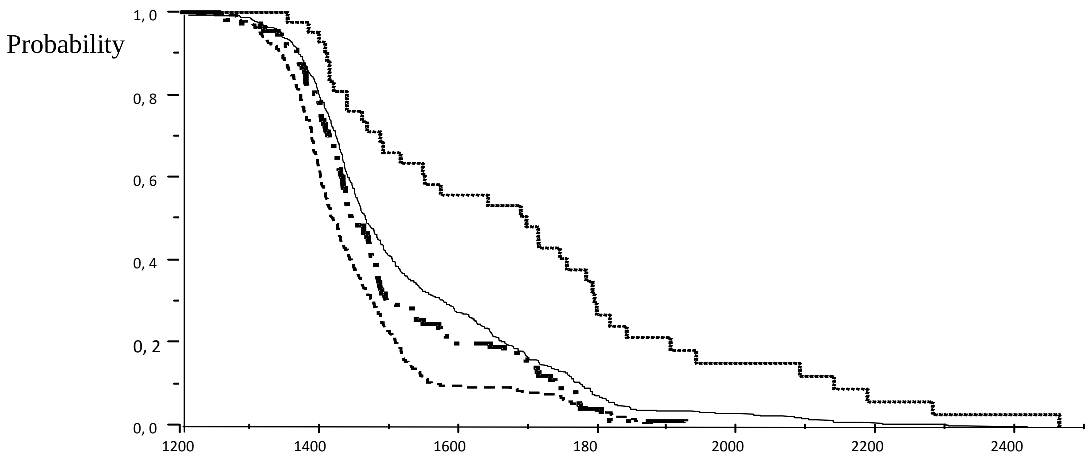
Figure 1. Survival Analysis till the end of the First Lactancy.



References: H...... F1 ____ G - - - - P __ . .

When analysing the survival curves for the second lactancy (Figure 2), it is observed that the H cows require at least 1700 days in order to get a 50 % of probability to reach the end of lactancy, whereas the 3 other genotypes get it within 1450 and 1500 days. For any time considered there is a minor probability that the H cows finish their second lactancy in relation to the other genotypes.The G and P cows are still the genotypes with more important gradients in the survival curves, which means they concentrate their second lactancies between the 1300 and 1900 days, a much smaller interval than the H (situated between 1350 and 2450 days). The F1 finish their second lactancies in an intermediate range, between 1300 and 2300 days. These differences are statistically significant ($p \leq 0{,}001$) among the genotypes as regards the survival function of time till the end of the second lactancy.

Figure 2. Survival Analysis till the end of the



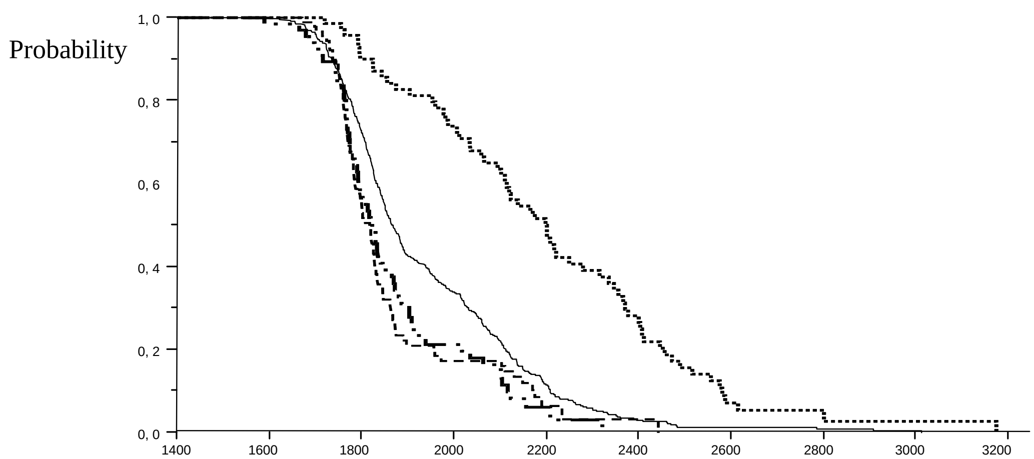
Time till the end of the second lactancy (in days)

References:H....... F1 —— G - - - - P — . .

SecondLactancy.

Figure 3 shows the survival curves as regards the end of the third lactancy for each genotype, and it can be seen that the H cows have a greater probability to end their third lactancy at an older age, regardless the moment that they are compared with the other genotypes.

Figure3. Survival Analysis till the end of the Third Lactancy.



Time till the end of the third lactancy (in days)

References:H....... F1 —— G - - - - P — . .

G y P cows have similar behaviour and have fewer probabilities to end their third lactancy with over 2200 days. There is high gradient of curves for P and G cows which show the concentration in the age of the third delivery between 1700 and 2200 days (90 % of probability), opposite the dispersion and older age of H cows (90% between 1800 and 2600 days). F1 behaviour is in the middle, closer to the triple crossing though. Differences as regards the time till the end of their third lactancy are significant ($p \leq 0{,}001$) in all the genotypes.

The survival curves for the end oftheir fourth lactancy (Figure 4), also shows important differences in shape and gradient, specially for genotypes G and H, being P and F1 in the middle but more similar to the triple cross cows G. With an 80 % of probability, G cows end their fourth lactancy between 2100 and 2300 days old, whereas, in order to get this 80 %, the H cows require between 2400 and 3000 days.

The H cows have 50 % of probability to reach the end of their fourth lactancy with at least 2600 days of age, while genotypes G and P reach with less than 2250 days and F1 cows with less than 2400 days. All the differences are statistically significant ($p \leq 0{,}001$) among the genotypes as regards the time of delivery till the end of the fourth lactancy.

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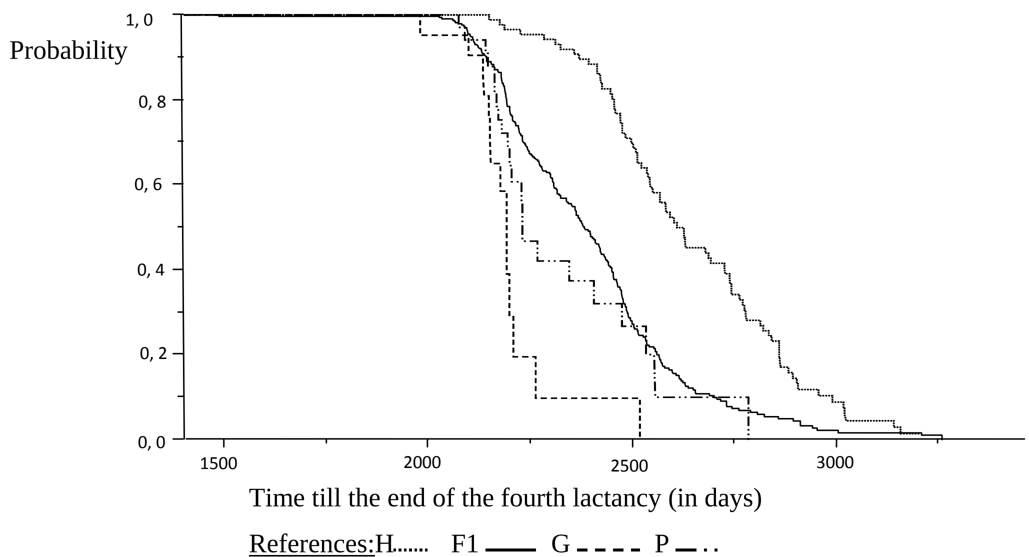
Figure 4. Survival Analysis till the end of the Fourth Lactancy.



Interpretation of the multinomial logistic regression model.

The Odds Reasons were considered in order to interpret the multinomial logistic regression model. The genotypes are compared as regards "2nd lactancy versus 1st lactancy, ending the first lactancy with 1100 days"; " 3rd lactancy vs 2nd lactancy, ending the lactancy by the 1800 days".

Table 3: Some Odds Reasons in the Multinomial Logistic regression Model proposed**.**

Model	Breed	Age (days)	Estimated OR
2nd lactancy vs 1st lactancy	F1 vs H	1100	2.07*
	G vs H		2.14*
	P vs H		4.6*
3rd lactancy vs 2nd lactancy	F1 vs H	1400	1.36*
	G vs H		1.51*
	P vs H		2.42*
4th lactancy vs 3rd lactancy	F1 vs H	1800	4.13*
	G vs H		3.29*
	P vs H		3.65*

References:* significant differences $p \leq 0{,}001$

Some differences were found when comparing H cows with the other genotypes, which can be seen in Table 3. Results show greater probabilities to reach second, third and fourth lactancy for the cows of genotype F1, G and P than H cows. The results of the model "second lactancy vs first lactancy", setting age in 1100 days, show that for cows genotype F1, G and P, the chances to reach a second lactancy are 2.07; 2.14 and 4.6 times bigger respectively than for cows H. In the case "third lactancy vs second lactancy", setting age in 1400 days, the chances to get the third lactancy for F1, G and P cows are 1.36; 1.51 and 2.42 times bigger than for the H cows, respectively. Finally, the model "fourth lactancy vs third lactancy", setting the age in 1800 days, shows that the chances to get to this fourth lactancy are 4.13; 3.29 and 3.65 times bigger for cows F1, G and P than for H respectively.

4. DISCUSSION

In high productive dairy cows, the traits associated to the biological efficiency or "fitness": reproduction and longevity have been worsening despite their importance for the viability of the company itself [18]. With a smaller and smaller profit margin, being able to keep the individual productivity of each cow turns to be a critical duty for a milking company to stay financially sustainable. In that sense, within the system being considered and the period assessed, cows of the four genotypes behave differently as regards the age when they end their lactancies, which gives producers the opportunity to choose those genotypes which function at their best for this trait.

In relation to the first lactancy, despite being differences among the genotypes in the ages they end, the forms and gradients are not as different as those seen in the next three lactancies. From the second lactancy on, the H cows do mark a difference with the other genotypes, with an important dispersion among individuals where only half of the cows end within the 57 months. This implies that, if these animals have a 50% probability to end their first lactancy by their 37 months and two months later they have their second delivery, they were lactating 18 months on average. On the other side crossed cows, with the same probability of ending their first lactancy by their 37 months, end up with the same chance (50%) their second lactancy, but before their 50 months, which means that the average length of such lactancy in those genotypes would be 11 months, 7 months shorter than the H cows.

The tendency to longer lactancies in pure breeds is kept, although not as marked, in the duration of the third lactancy, where H cows get to 14.5 months and the other genotypes 11.5 months. This is consistent with the results found in the pasture production systems which compared the length of lactancies for purebred Holstein cows with the crossbreeds Red Danish and Red Swedish[17]. Another characteristic to be considered in the second and third lactancies assessed, is the high gradient of the curves of G and P, which shows the concentration of ages for succesive deliveries, opposite a dispersion and older age when ending their lactancies for H cows. The F1 cows, on their side, behave in the middle, with gradients closer to the triple crossing cows. In relation to the fourth and lastlactancy assessed, cows of genotypes G and P have a 50 % probability of ending it with 75 months old, which implies that it lasted around 10 months, while for the same chance in cows H, they end it with 87 months, 12 months total length. The F1 behaved in the middle as regards age of ending this lactancy (80 months), but this one lasted almost 15 months, the longest of allgenotypes.

By fixing the average age for ending the first lactancy of the rodeo in 37 months (1100 days) for further analysis, it is clear that the handling of re breeding and the reproductive aspects of cows during first delivery is the appropriate. Something similar occurs with the parameters used to define the average age for the end of the second and third lactancy (47 and 60 months respectively), which highlight the good general reproductive behaviour of the rodeo. However, it is important to point out the smaller probabilities for H cows to end their lactancies by that age when compared with any of the crossbreeds, which reinforces the analysis carried out about the length of lactancies and agrees with the results found by García-Peniche *et al.* [7] when they compared Holstein Cows vs Brown Swiss and Jersey in seven American milking regions, since the two latter ones had greater probabilities to reach a 5th lactancy, trait which could be transmitted to the cows crossed with them. Touchberry [20], when studying the survival of crossbreeds Guernsey x Holstein and purebreed Guernsey and Holstein for 20 years, from 1949 to 1969, observed that 88% of the cross cows survived the first delivery while only 83% of the pure Holstein cows did. Eighty-five per cent of the cross cows had two deliveries, opposite to the Holstein cows with only 77 %. Vesely *et al.* [23] found no differences between cross cows Ayrshire x Holstein and pure Holstein cows as regards the cattle loss from the first to the second lactancy. However, from the first experiment, Hocking *et al.* [9] using the survival analysis, found that the cross cows Ayrshire x Holstein had a longer productive life than the pure Holstein cows. Those findings support the personal comments of the producers from the milking region of Entre Rios (Argentina) who observe better reproductive indicators in their rodeos when using crossbreeds from Holstein.

5. CONCLUSSIONS

The four genotypes under study show different behaviour when analysing the end of their first four lactancies, being the Holstein cows the ones with a higher probability of ending each lactancy at an older age and with a greater dispersion in time, especially when compared to the triple cross cows Swiss Brown and Guernsey

6. ACKNOWLEDGEMENT

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