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Genetic Parameters of Productive Traits in Montbeliarde and Sarabi Cows

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Abstract: In order to survey effective factors on economic traits in Montbeliarde and Sarabi cows this study was done. Traits were studied in research include Milk Production (MP), Days In Milk (DIM) and Calving Interval (CI) in Montbeliarde and Sarabi cows. Factors that were putted as variable in models for each trait proportionally include the effect of sire, dam within sire groups, month, season, the year of the calving, lactation number, days open and dry period. Least squares method was used because of unequal observations in subgroups. Model fitting was carried out using restricted maximum likelihood with DFREML. Heritability was estimated for milk production of Montbeliarde and Sarabi cows 0.23±0.07 and 0.28±0.09 for Montbeliarde and Sarabi cows days in milk 0.16±0.05 and 0.13±0.06 and for calving interval in Montbeliarde and Sarabi cows was calculated 0.12±0.03 and 0.10±0.04, respectively. Repeatability for milk production in Montbeliarde and Sarabi cows was estimated 0.39 and 0.32, respectively.

Key words: Heritability, genetic correlation, dairy cattle, repeatability, internal, Iran

INTRODUCTION

Dairy cattle's breeding has improved markedly during the last decade. In most countries, the primary selection objective in dairy cattle breeding has been milk production. Recently, other important traits such as reproduction and health traits have received increased focus because of biological, economical, ethical reasons and animal welfare concerns too. The objective of most animal breeding programs is to improve the benefit of the animal. This often includes simultaneous improvements in multiple traits. The genetic correlations between female fertility and milk production are antagonistic (Andersen-Ranberg *et al*., 2005).

In other words, selection for increased milk yield is expected to result in genetic decline in female fertility, implying that selection for fertility is necessary to genetically stabilize or improve female fertility. In recent years however, economic attention has highly focused on improving the health aspects of (dairy) products. The length of the life of a cow is related to decision by the individual farmer through voluntary culling of low producing animals. However, diseases, injuries and poor fertility may also force him or her to cull a cow. This involuntary culling will often be related to decrease animal welfare and high costs. Economic losses are considerable and associated with reduced milk yield, discarded milk and reduction in milk price. Selection has focused on production traits. Aggregated 305 days yields have been used as the breeding goal in dairy cattle traditionally but these kinds of traits may be affected by various factors like temporal environmental effects that are difficult to estimate in animal models because of the lack of sufficient information. Breeding is costly and it is very important for farmers to secure the most profitable selection strategy by choosing either animals or breeds. However, several models were developed to analyze the data.

Genetics and environmental parameters were estimated at different stages of lactation in these models. Some studies have found that when small datasets are used, daily variances and heritabilities at the beginning and the end of lactation could be unreasonably high and genetic correlations between yields at the opposite ends of lactation could be negative (Misztal *et al*., 2000). Results indicated that the use of large amounts of data is necessary for obtaining reliable estimation (Jamrozik *et al*., 1998; Zavadilov *et al*., 2005). Several researches (Janson and Andreasson, 1981; Bulter and Smith, 1989) have argued that interval traits such as calving interval and days open are not good measures of cow fertility because of teir large influencing by management through preferential husbandry.

The breeding of cows can be intentionally delayed due to high yield, bST use, embryo transfer or seasonal factors (Luna-Dominguez *et al*., 2000; Rajala-Schultz and Frazer, 2003). Sarabi breed is one of the Iranian traditional cows breeds but Montbeliarde cows have imported to

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Iran from France between 1965 and 1970 and now there is only one herd of Montbeliarde cows in Iran. The objective of this study was to estimate genetic parameters for milk production, days in milk and calving interval in Montbeliarde and Sarabi cows. A further aim was to determine effective environmental and genetic factors on these traits.

MATERIALS AND METHODS

Data: The Montbeliarde cows data was collected from Montbeliarde exclusive herd that was located in Bojnourd city at the northern part of Khorasan Province. The Sarabi cows data was collected from Sarabi cattle research center that was located in Sarab city at the eastern part of Azarbaijan Province. Used data in this study were recorded from years 1995-2004.

Models: Genetic parameters of Milk Production (MP), Days In Milk (DIM) and Calving Interval (CI) traits were estimated by the following models, respectively:

Model 1:

$$Mp_{jklm} = \mu + A_j + YE_k + M_l + L_m + \alpha DIM_j + e_{jklm}$$

Model 2:

$$DIM_{jklm} = \mu + A_j + YE_k + M_l + L_m + \alpha MP_j + e_{jklm}$$

Model 3:

$$CI_{jkm} = \mu + A_j + YE_k + L_m + \alpha OD_j + \beta DP_j + e_{jkm}$$

where, μ is an overall mean and A_j, YE_k , M_l, L_m, DIM_j, MP_j, OD_j, DP_j and e_{jklm} are the jth animal, kth calving year, lth month, mth lactation number, days in milk of jth animal, milk production of jth animal, open days of jth animal, dry period of jth animal and residual effect related to each record, respectively.

Statistical analyze: First, all of cows available data such as birth, pregnancy, calving and producing information from registering and recording studies in their research center have moved to computer using JMP software. Then for each model fix, random effects and covariate was determined. After that for each trait model was fitted. In next stage, data and pedigree files was prepared. Finally genetic parameters of the above traits were estimated using Restricted Maximum Likelihood (REML) method via DFREML 2000 software's univariate program.

RESULTS AND DISCUSSION

Milk Production (MP) and Days In Milk (DIM) showed the high genetics correlation so it was concluded that, the milk producing of animals with long lactating period in second and third lactations are usually higher. However, heat stress is an important factor of decreasing the records of MP and DIM in summer because of decreasing Dry Matter Intake (DMI) by animals. Genetic selection for milk production has led to increases in DMI but also has resulted in more negative energy balance during early lactation. It means that cows calved in winter showed higher MP and DIM because they reached to peak of lactation curve after 6-8 weeks in spring without any heat stress. Rincon *et al*. (1982) reported similar results. Production in the 2nd and 3rd lactations is usually higher. As a result, lactation curves should be steeper which leaves space for higher variability and offers a chance for improvement of genetic persistency. Calving interval phenotypic average was equal to 376.21±1.84 and 396.81±4.51 days in Montbeliarde and Sarabi cows, respectively (Table 1 and 2). Optimum calving interval was estimated 12.5-13 months by Spain (1995). In this study, days open had the most important effect on calving interval. Also Anan and Soller (1979) showed that days open had 6-10 times more important than the period of pregnancy time. Days open and pregnancy rate can be analyzed more accurately when information on management of fertility such service period, estrous

Table 1: Some of economic traits in Montbeliarde cow according to the lactation number

Lactation number	Milk production (kg)	Days in milk (day)	Calving interval (day)	Days open (day)	Dry period (day)
1	4050	254	-	-	-
2	4903	261	385	88	76
3	5037	249	389	84	68
4	5149	253	383	80	72
5	5047	242	379	87	70
6	4693	233	370	81	60
7	4763	233	366	67	55
8	3574	140	361	52	64

Table 2: Some of economic traits in Sarabi cows according to the lactation number

Lactation number	Milk production (kg)	Days in milk (day)	Calving interval (day)	Days open (day)	Dry period (day)
1	1448	249	-	-	-
2	1469	217	412	133	148
3	1489	226	388	96	144
4	1695	213	394	94	127
5	1649	210	407	108	165
6	1721	224	398	104	148
7	1477	180	392	105	155
8	1383	192	385	92	168

synchronization and bST are available. Each successful reproductive cycle of the dairy cow results in a calf or calves at the onset of a potentially copious lactation. The remodeling of mammary tissue that occurs during the dry period is critical for animal because of the absence of dry period results in reduced milk production during the lactation. The physiological status of virgin heifers differs from that of milking cows because stress of lactation and calving problems may affect fertility traits (Weigel and Rekaya, 2000; Miller *et al*., 2001). Reports by several researchers (Hansen *et al*., 1983; Van Arendonk *et al*., 1989; Van Raden and Tooker, 2003) also indicated low phenotypic correlations between days open and milk yield.

Therefore, selection for higher yields of dairy cattle has led to a decrease in fertility due to undesirable genetic correlations between yield and fertility (Pryce *et al*., 2004). Waiting for information from later lactations before selecting young bulls may cause a prolonged generation interval which is not desirable because of economic reasons. Compared with other measures of fertility traits such as days from calving to first service, days open or non return rate calving interval is easily measurable between calvings and is less affected by data quality issues than other fertility traits (Pryce *et al*., 2000). However, this trait might not be the most desirable direct measure of reproductive efficiency to be included in a breeding program. In other words, adjustment of milk production records with factors based on the heritability estimaes for the previous days open, previous days dry or current days open was not warranted because those variables are largely related to management decisions not via genetics (Wilton *et al*., 1967; Schaefer and Henderson, 1972; Funk *et al*., 1987). This result promotes the subject that previous dry period length is the effect of a management decision that in turn was affected by many factors. For instance, economic consequences of longer calving interval depend on milk price, production level, value of the calf and feed cost. It is widely accepted in the economic literature that the assumption of optimal policy is related to assuming that the farmer is maximizing his or her benefit.

Genetic parameters: Heritability of milk production in Montbeliarde (MMP) and Sarabi dairy cattle (SMP) were equal to 0.23±0.07and 0.28±0.09, respectively and are in the range of the most research reports. However, Visscher and Goddarad (1995) estimated heritability equals to 0.20 for this trait. Silvestere *et al*. (2005) reported for milk yield, the heritability at 18 day in milk was 0.19 which increased to the maximum estimated value of 0.23 at mid lactation and then decreased. Strabel and Jamrozik (2006) reported that the estimates of heritability for milk production were equal to 0.18, 0.16 and 0.17 for 1st, 2nd and 3rd lactation, respectively. All of their results were lower than the study findings. Heritability of days in milk in Montbeliarde (MDIM) and Sarabi cows (SDIM) were equal to 0.16±0.05 and 0.13±0.06, respectively. In the study, the heritability of all traits decreased with increasing lactation number. This was mainly an effect of increasing residual variances and also due to decreasing genetic variances.

Heritability for 2nd and 3rd lactations showed a positive trend with DIM. Heritability of Calving Interval (CI) in Montbeliarde and Sarabi cows were equal to 0.12±0.03 and 0.10±0.04, respectively. In contrast, other studies have showed lower heritability for this trait. For example, Oseni *et al*. (2004) found various estimation of heritability for days open between 0.03 and 0.06. Dal-Zotto *et al*. (2007) calculated heritability 0.05 for calving interval in Brown Swiss cattle. Haile-Mariam *et al*. (2003, 2004) reported negative genetic correlations between survival in early lactations and calving interval. Repeatability for Montbeliarde cow's milk production and Sarabi cow's milk production were estimated equal to 0.39 and 0.32, respectively.

These findings showed a high repeatability for milk production in Montbeliarde in compare with Sarabi dairy cattle. However, heritability of MMP was higher than SMP, the repeatability of this trait for Sarabi cows was more. It can be related to the higher amount of permanent environmental effect variance in Sarabi cows in contrast to Montbeliarde cows.

CONCLUSION

The results of this study indicate that selection criterion of choice depends on selection goal. We should not expect considerable effects on animal genetic condition about reproductive traits like days open and calving interval with breeding programs and the other genetic methods because heritability's of reproductive characteristics were low. But about traits with average or high heritability like producing traits we can help to genetic improvement of herd by recognize and choosing animals with high genetic performance.

Due to low heritability and late availability of information, trusting exclusively direct selection to reduce calving interval is not advisable. Further investigations of later lactations, persistency measures and other populations are needed as well as multivariate models to study genetic relationships between different production traits. Estimation of economic values of animal traits at the farm level demands a reliable data set. It should cover a large proportion of farmers with economic and genetic data available for several years.

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