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Research Article

EVALUATION OF DOMESTICAND IMPORTED SEMENS INFLUENCING THE REPRODUCTIVE EFFICEINCY IN HOLSTEIN DAIRY COWS OF ISFAHAN

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ABSTARCT
This study was conducted to evaluate the effects of domestic and imported semens on some reproductive traits in the Holstein dairy cow's population of the Isfahan dairy farms. A data set containing 99012 records and 3007 semen samples was analyzed by a linear animal mixed model with fixed effects of parity of the dam and herd - year – season and random effects of the direct additive genetic effect of animal, the permanent environmental effect of animal and residual effects. The traits were calving interval, age at first calving, the period from calving to first insemination, service per conception. The overall means of calving interval, days from calving to first insemination, number of services per conception, period of gestation and first calving age were 390.43, 63.64, 2.2, 277.27 and 758.54, respectively. Result from this study showed that the heritability for calving interval, days from calving to first insemination, number of services per conception, period of gestation and first calving age were 0.01 ± 0.01, 0.01 ± 0.01, 0.10 ± 0.01, 0.15 ± 0.01, 0.01 ± 0.01, respectively. These data indicate that reproductive traits have low heritability. Although, there were significant differences in frequency of the 10, 50 and 100 top semens for the most reproductive traits, but the differences between average breeding values for domestic and imported semenswere not significant (P>0.05). Thus, due to low heritability estimated for reproductive traits and selection semen based on production traits in dairy farms in Isfahan, the mean of breeding values for most of the reproductive traits were low and there was not any significant differences in domestic and imported semen groups.

Keywords: *Domestic and importedsemens**,** Calving interval, Gestation length, Age at first calving, Holstein dairy cow*

INTRODUCTION
The improvement of livestock production which has been so remarkable in many industrialized countries, particularly in the last two decades, is due to the integrated effect of rapid developments in several fields of the industry. Increased feed production, improved animal health, better husbandry, and the breeding of animals with the necessary genetic potential for improved performance are the most important of these developments. In developing countries, however, parallel improvements in livestock production have generally been inadequate, and one of the principal limiting factors has been the lack of genetically improved animals (Powell and Wiggans, 1998). The reproductive activity of cows in dairy operations is an important factor in dairy cows and milk production. An effective way to increase milk production is to breed dairy cattle using artificial insemination (A.I). Genetics are available through modern methods of reproduction, which will guarantee the quality of offspring. Artificial insemination is a powerful mean for propagating both genetic improvement and the breeds which are most advantageous at a given time. It is a fact that the data are often old, and their accuracy varies from country to country. Thus, the USA provides statistics only for semen doses sold. It has been estimated that the number of cows inseminated annually in the world is 100 million (Kamdasamy *et al.,* 1993). Genetic gains and advances in management have increased individual milk yields by more than 2 % a year (Raheja *et al.,* 1989). Thus, in order to maintain the milk production of each herd within the limits authorized, dairy farmers have been forced to reduce

the number of cows per herd. There are growing markets for semen in developing countries. For a few decades in Iran, Holstein and Brown Swiss semen had been used for crossbreeding and grading up programs with native cattle. Holstein breed has been constituted by unremitting importation of animals and semen from Canada, USA, and some European countries especially Germany and the Netherlands. The poor cows in a herd have been inseminated for crossbreeding, contributing to an intensification of the selection of dairy cows. The lack of surveillance and difficulty of handling the animals make it difficult to conduct A.I. in suckling herds and have hampered the development of A.I. as a breeding method, despite its low cost. Consequently A.I. has come to be used more for spreading genetic gains acquired through selection programmers. In spite of the efforts made to introduce large-scale A.I. breeding services in several developing countries, growth in the use of A.I. has generally not been very strong, although there have been notable exceptions. Reviews of the development of A.I. are hampered by the scarcity of statistics on the extent to which it is used and of information on the technical results of A.I. services in individual countries. However, some estimates of the global application of A.I. give an idea of its use in developing countries (Nilforooshan and Edriss, 2007). The calving interval should not be longer than 1 year for obtaining lower costs, profitability and optimum viability of the dairy enterprise (Kamdasamy *et al.,* 1993; Makuza *et al.,* 1996). In several studies some antagonistic genetic and phenotypic correlations between reproductive performance and lactation yield were reported (Berger *et al.,* 1981). To obtain a simultaneous improvement in productive and reproductive traits by overcoming this antagonism, it will be useful to use a practical measure that combines these traits and shows the overall efficiency of a cow (Dong *et al.,* 1989, Tekerlu and Gundogan, 2005). Gestation length, the period from effective fertilization until calving, is a reproductive trait that significantly affects cattle breeding and production. The cow's age is the key environmental factor influencing gestation length. Gestation length is shorter in heifers than in older cows (Przysucha and Grodzki, 2009). In dairy cattle, female reproduction problems lead to prolonged calving intervals, increased insemination and veterinary costs, higher culling rates, and thus increased replacement costs. Several studies using field data (Janson and Roxstrom *et al.,* 2001) found unfavorable genetic correlations between milk yield and female fertility traits. Importance of fertility in dairy cattle is well known, both in functionality and the farm economy (Pryce *et al.,* 2004). Age at first calving is the period between birth and first calving and influences both the productive and reproductive life of the female, directly through its effect on her lifetime calf crop and milk production and indirectly through its influence on the cost invested for upbringing (Kelay, 2002). Calving interval is the period between successive parturitions and is a function of the postpartum anestrous period from calving to first estrus, service period first postpartum estrus to conception and gestation length (Tewodros, 2008).Number of services preconception is the number of services per conception, which is defined as the number of services natural or artificial required for a successful conception, depends largely on the breeding system used, the reproductive health status of the animal, the management and feeding practices in a farm and the semen quality of artificial insemination or natural service bulls (Tewodros, 2008). Knowledge of factors and their influence on cattle performance are important in the formulation of management and selection decisions (Goyache *et al.*, 2003). It would be highly desirable to identify factors associated with reproductive performance; such information could be beneficial and developing management techniques for maximizing the performance in the breeding herd. The main indicators that would be considered in assessing reproductive performance are age at puberty, age at first calving, calving interval, days open and number of services per conception (Aynalem *et al.*, 2011; Demissu *et al.*, 2013). Therefore, centers for artificial insemination often import semen of elite bulls for planned insemination of Holstein bull dams, or borrow young bulls from abroad (waiting bulls) whose semen is used for insemination of the main population. The objective of this study was to estimate genetic parameters and a genetic comparison of Iranian and imported sire groups for calving interval, days from calving to first insemination, number of services per conception,period of gestation and first calving age. Also the knowledge of these investigated might also be applied and be useful in herd management practices.

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MATERIALS AND METHODS

Records of reproductive traits (99012 records of cows and 3007 semens) such as calving interval, days from calving to first insemination , number of services per conception, period of gestation and age at first calvingin the Holstein breed collected by Vahdat Agriculture and Dairy Cooperative Company in Isfahan, Iran dairy farms during 1987-2012 were used in this study. Mother's age at calving was obtained by subtracting the date of their birth and calving date of them. Gestation period was obtained by subtracting of inoculation resulted in pregnancy and calving date. The source of semen used by farms was determined and the percentage of domestic and imported semens was calculated (Table 1).

Table 1: Percentages of Frequency Domestic and Imported Semens

Traits	Semen	
	Domestic	**Imported**
Calving interval	22.8	77.2
Days from calving to first insemination	23	77
Number of services / conception	22.35	77.65
Period of gestation	26.5	73.5
First calving	22.5	77.5

Statistical Analysis

Data were arranged by Fox pro and excel (2011) programs. To identify none genetic sources of variation used the GLM procedure of SAS (2003) for the multivariate least squares method under below the model.

$$y_{ijk} = \mu + (HYS)_i + P_j + e_{ijk}$$

Where y_{ijk} = Each observation of reproductive traits, μ =Overall mean, $(HYS)_i$= ithHerd-Year-Season, P_J = jth parity and e_{ijk} = Residual effects.

The Wombat program was used (Meyer, 1991; Meyer, 2007)to estimate the genetic parameters and predict BLUP breeding values of considered traits under following model.

$$\mathbf{y} = \mathbf{Xb} + \mathbf{Z_1u} + \mathbf{Z_2pe} + \mathbf{e}$$

Where **y**= vector of observations, **b**= vector of fixed effects, **u**= vector of random animals for direct genetic effects, **pe**= vector of permanent environmental effects, **e**= vector of residual , **X**= incidence matrix for fixed effects. $\mathbf{Z_1}$ and $\mathbf{Z_2}$= incidence matrix for direct genetic and permanent environmental effects respectively.

The mean values of BLUP breeding values were calculated for type of semen and compared with the t - test procedure.

RESULTS AND DISCUSSION

Results

The descriptions for all of the traits are shown in Table 2. The result showed that the means of calving interval, days from calving to first insemination, number of services per conception, period of gestation and first calving age were 390.43, 63.64, 2.2, 277.27 and 758.54, respectively. According to the standard deviation and coefficient of variation, traits studied are in good dispersion coefficient.

Table 2: Descriptive statistics of the studied traits

Traits	**Unit**	**Means**	**Standard deviation**	**Coefficient of variation**
Calving interval (day)	Day	390.43	58.88	15.08
Days from calving to first insemination	Day	63.46	21.28	33.53
Services / conception (number)	No	2.22	1.59	71.62
Period of gestation (day)	Day	277.27	6.16	2.22
First calving (day)	Day	758.54	59.31	7.81

The results of the heritability coefficients for considered traits are in Table 3. As result relevant form this table the heritability for calving interval, days from calving to first insemination, number of services per conception, period of gestation and first calving age were 0.01 ± 0.01,0.01 ± 0.01,0.10 ± 0.01,0.15 ± 0.01,0.01 ± 0.01, respectively. These data indicate that reproductive traits have low heritability.

Table 3: The heritability of the studied traits

Traits	h^2
Calving interval (day)	0.01 ± 0.01
Days from calving to first insemination	0.01 ± 0.01
Services / conception (number)	0.10 ± 0.01
Period of gestation(day)	0.15 ± 0.01
First calving(day)	0.01 ± 0.01

The average BLUP breeding value of reproductive traits for domestic and imported semen were compared in Table 4. According to data from Table 4 the differences between average breeding values for domestic and imported semen for all of reproductive traits were none significant (P>0.05). It means there were no significant differences between the average breeding value of reproductive traits in domestic and imported smens. As specified in the above information, average breeding values for all traits except the period of gestation and first calving only in domestic sperm samples were negative; this is probably that the choice was only for production traits such as milk production and reproductive traits that they had low heritability.

Table 4- The mean values for domestic and imported semens of reproductive breeding

Traits	**Domestic**		**Imported**	
	No	**Average breeding value**	**No**	**Average breeding value**
Calving interval (day)	255	-0.0146±0.0282[a]	855	-0.00086±0.0172[a]
Days from calving to first insemination	289	-0.0358±0.0291[a]	968	-0.00368±0.00773[a]
Services / conception (number)	307	-0.1160±0.0269[a]	1067	-0.1107±0.0168[a]
Period of gestation(day)	177	0.0814±0.0569[a]	491	-0.0144±0.0338[a]
First calving (day)	293	0.0346±0.0968[a]	1009	-0.0520±0.0535[a]

After determining the best semens for breeding value in different traits, the top 10, 50 and 100 semens were collected and were analyzed. As result relevant from table 5, all characters and all categories were statistically significant differences between the frequencies of top semens except for a period of gestation trait on 10 top semens group.

Table 5- Percentage of frequency domestic and imported top semens

Traits	100 Topsperm		50 Topsperm		10 Topsperm	
	Domestic	Imported	Domestic	Imported	Domestic	Importe d
Calving interval	17^{b}	83^{a}	12^{b}	88^{a}	10^{b}	90^{a}
Days from calving to first insemination	26^{a}	74^{b}	24^{b}	76^{a}	30^{a}	70^{b}
Number of services /conception	12^{b}	77^{a}	06^{b}	94^{a}	0^{b}	100^{a}
Period of gestation	31^{a}	69^{b}	34^{a}	66^{b}	50^{a}	50^{a}
First calving	22^{b}	78^{a}	22^{b}	78^{a}	40^{a}	60^{b}

Discussion

Van Doormaal *et al.,* (2004) reported preliminary results for four fertility traits, that is, age at first service in heifers, non-return rate to 56 d in heifers and cows, and the interval from calving date to first insemination date for Canadian dairy breeds. Jamrozik *et al.,* (2005) found that service per consumption for first parity and older Holstein cows in Canada was 1.64 ± 1.09 and 2.14 ± 1.50, respectively. The average of calving interval in this study was (390.43 days) which it was close to the average calving interval reported in Iranian Holstein dairy cows (396.6 days), and it was more than the average reported for England Holstein dairy cows (387 days).

Eghbal *et al.,* (2003) showed that the average breeding value for domestic sire's daughters for both milk and fat in every region were negative and they were lesser than the average breeding value for imported sire's daughters. Eghbal Saeed *et al.,* (2009) showed that the average breeding value for domestic sire's daughters in Newzland for both milk production and milk fat in every region (except semi cold areas) were better than the average breeding value for Iranian sire's daughters. Salari *et al.,* (2011) demonstrated that there were significant differences in average milk production (28.50 and 29.84 kg) of domestic and imported sperms on Iranian dairy cows. Pantelic, (2005) established following results in entire lactation:duration of lactation 311 days, milk yield of 5.754 kg, content of milk fat 3.98%, production of milk fat of 230 kg and yield of 4% FCM 5.755 kg. Nilforooshan and Edriss, (2007) showed that the American and European daughters had the highest performances for milk yield. The highest mean for fat yield was related to European daughters. American sires on average had the highest genetic potential for yield traits. Holmann *et al.,* (1990) evaluated the profit of investing in US semen for use in three Latin American countries and concluded that these importations should be used strategically in environments with excellent feed and management, in order to obtain a positive response on the selection of imported genetic material. Powell and Wiggans, (1991) reported that daughters of US Holstein sires produced more milk in Mexican herds than did the daughters of Canadian or Mexican sires. Higher performance of imported sire progeny in Isfahan dairy herds was reported by (Ghaderi, 2002). Most Iranian bulls were sired by Canadian or American sires, otherwise, lower genetic merit would have been observed for Iranian sires than present. In Nilforooshan and Edriss, (2007) study the daughters of Iranian sires had the lowest yield and a negative genetic merit mean in fat percentage, too. Surprisingly, despite the negative genetic correlation between milk yield and fat percentage, Iranian sires had low efficiencies in both. Heravi Mousavi and Danesh Mesgaran, (2009) demonstrated that length of productive life was higher among the daughters of Iranian sires compare with the Canadians sires and sire origin had no effect on age at first calving and first parity. Powell and Wiggans, (1997) reported that daughters of US sires born in 1985 in Mexico were 380 kg superior for breeding value for milk yield than daughters of Canadian sires and 336 kg superior than those of Mexican sires. Also, daughters' milk yield of North American sires in Mexico was higher than those of Mexican sires.

The result of (Heravi Mousavi and Danesh Mesgaran, 2009) study showed that first parity milk performance was similar among the daughters of sire groups ($p>0.05$). Milk production was numerically higher in the imported sire groups. Mackey *et al.,* (2007) also noted that the major cause of poor reproductive performance in Irish dairy herds was the prolonged interval to first service and the poor success rate at first artificial insemination. In this study estimated heritability of gestation period based on the direct effect of sperms was determined in the range of $h^2 = 0.15 \pm 0.01$, whereas much lower values were reported based on the indirect effect (Jamrozik *et al.,* 2005). Toghiani, (2012) demonstrated that most genetic correlations between reproductive performances were found close to zero. Most studies of the association between milk yield and reproductive measures in dairy cattle showed an unfavorable relationship between them. High milk yield per lactation has been associated with longer postpartum intervals to first service (Berger *et al.,* 1981) and longer service period (Hansen *et al.,* 1983). Most estimates of heritability of reproductive traits are less than 0.10 (Hansen *et al.,* 1983). Rust and Groeneveld, (2001) mentioned that reproductive recording is affected by the age structure of the herds and the prevailing environmental and management conditions.Rege and Famula (1993) demonstrated that calving interval has traditionally been the predominant measure of reproduction during the productive life of the animal, particularly in dairy cattle; however, calving interval might not be the most desirable measure of fertility to include in a breeding objective in beef cattle. Cows with a shorter calving interval are often those whose first calves were born later. Selecting these animals or their offspring could result in indirect selection for a later age at puberty. Age at first calving appears to be a crucial trait in the reproductive life of the dam. Selection in a shorter age at first calving would lead to an improvement of calving interval performance. This result shows that the genetic variation in calving interval is very small relative to the variation caused by other factors and, in spite of the justification to eliminate animals with poor reproductive efficiency, the genetic improvement in calving interval will be limited. In various studies, a number of factors have been included in the analyses as main factors or their two or three way interaction either as fixed effects or as continuous effects to account for environmental sources of variation in animals' performance (Wasike, 2006). Cassell, (2001) showed that the calving interval has a very low heritability. Million and Tadelle (2003), reported that, heritability value of 0.03 for first calving interval in Holstein dairy cattle. Due to differences in the genetic base and scale between countries, and genotype by environmental interactions which cause different genetic expressions between environments, direct comparison of animals between countries is not appropriate. The use of foreign semen has produced favorable results in Iran by supplying improved genetics to the Iranian dairy populations; however, using superior genetic materials more suited to the environmental conditions and management systems of the importing country should be considered to achieve optimum benefits.

Conclusion

Genetic evaluation and improvement breeding programs requires knowledge of the genetic parameters for economically important production traits**.** Accurate estimation ofthe genetic parameters requires data to be corrected to accommodate differences in known many effects that influence the production and reproductive performances of livestock. To increase the estimates of these parameters, uniform environment, use of multiple measurements, adjustment of records and accurate measurement of data are the basics needed to be considered. Also due to low heritability estimated for reproductive traits and selection semen based on production traits in dairy farms in Isfahan, the mean of breeding values for most of the reproductive traits were low and there was not any significant differences in domestic and imported semen groups.

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