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The Effect of Some Factors on Stillbirth in Primiparous and Multiparous Holstein Cattle in Iraq

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Abstract - A total of 9691 records of calves belonged to 3076 Holstein cows and 58 sires were analyzed from 1995 to 1999 , at Nasr Dairy Cattle Station. The aim of the research is to evaluate sires geneticelly by using best linear unbiased prediction (BLUP) according to the stillbirths of their daughters after adjusting for fixed effects and to estimate heritability, phenotypic trend for the mentioned trait. Data were analayzed by using General Linear Model within SAS program to investigate the effectof some fixed factors (season and year of calving, parity sex of calf) on the stillbirths. Components of variance for the random effects in the employed mixed model were estimated by the Minimum Variance Quadratic Unbiased Estimation (MIVQUE) method. The Harvey program was also used to estimate BLUP values for sires. The overall mean of stillbirths was **11.19%** in primiparous, **8.69%** in multiparous and **9.49%** in both of them.The effect of all fixed factors was significant ($P < 0.01$) . Heritability of direct effect estimated for stillbirth rates in primiparous and multiparous and in both of them were 0.03 , 0.007 , 0.02 respectively ,whereas corresponding estimates of heritability of maternal effects were 0.04 .0.02 ,0.03 respectively .

Keywords : *Stillbirths, genetic evaluation, Herita - bility, Phenotypic trend.*

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Abstract - A total of 9691 records of calves belonged to 3076 Holstein cows and 58 sires were analyzed from 1995 to 1999 , at Nasr Dairy Cattle Station. The aim of the research is to evaluate sires geneticelly by using best linear unbiased prediction (BLUP) according to the stillbirths of their daughters after adjusting for fixed effects and to estimate heritability, phenotypic trend for the mentioned trait. Data were analayzed by using General Linear Model within SAS program to investigate the effect of some fixed factors (season and year of calving, parity sex of calf) on the stillbirths. Components of variance for the random effects in the employed mixed model were estimated by the Minimum Variance Quadratic Unbiased Estimation (MIVQUE) method.
The Harvey program was also used to estimate BLUP values for sires. The overall mean of stillbirths was **11.19%** in primiparous, **8.69%** in multiparous and **9.49%** in both of them.The effect of all fixed factors was significant ($P < 0.01$) . Heritability of direct effect estimated for stillbirth rates in primiparous and multiparous and in both of them were 0.03 , 0.007 , 0.02 respectively ,whereas corresponding estimates of heritability of maternal effects were 0.04 .0.02 ,0.03 respectively .

Phenotypic trend of stillbirths in primiparous was positive and non significant (**0.19%** / year) whereas negative and non-significant ($P < 0.05$) (- **0.11%**/year) in multiparous and in both of them (- **0.07%**/year). Minimum and maximum BLUP values of sires for stillbirths were **7.33** and **10.33%** respectively.

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I. Introduction

Stillbirths is a trait that needs more attention especially because its rates have increased with Holstein population (Harbers *et al.,* 2003;Meyer *et al.,*2000;Berglund *et al.,*2003; Hansen *et al.,*2004). Berglund (1996) reported an increase in stillbirths in Sweden with the importation of semen from North American bulls. The cost of stillbirths to the US dairy industry has been estimated to be $ 132 million per year (Thompson *et al.,*1981). Meyer *et al.,*(2000) has revealed that each year about 7% of Holstein calves in United State die within 48 h of birth with unknown cause of death and the replacement of stillborn calves represent a substantial cost to the dairy industry at more than $125.3 million per year.

Stillbirths are defined as a calf that dies just prior to, during,or within 24 to 48 h of parturition with at least 260 days of gestation.(Philipsson *et al.,*1979; Chassange *et al.,* 1999).

Dystocia, difficulty of birth, has been implicated as the major cause of stillbirths; however, about 50% of stillborn calves were from unassisted births (Philipsson 1996).

In recent years, many studies have found stillbirths to be separate trait in primiparous (heifers) and multiparous (cows) Holstein cattle.(Meyer *et al.,*2000;Hansen, 2005; Steinbock *et al.,* 2006).

The genetic variation exists in stillbirths which consist of two parts:Direct effects (genetic variation in the calf) and maternal effects (genetic variation in the dam).The direct effects of stillbirths describe the calf's ability to survive birth.This trait is closely related to the size of the calf.The maternal effects of stillbirths describe the cow's ability to give birth to a living calf. Hence Hansen, (2005) recomonded to take in to acount the two effects when analysing stillbirths data.

Sires evaluation are almost exclusively based on field data, which are highly affected by large array of environmental factors. For this reason, Togashi *et al.,*(2004) reported the importance to adjust for environmental effects in order to accurately estimates of genetic merit of sires.

The genetic variation of stillbirths can be expressed by evaluated sires using Best Linear Unbiased Prediction (BLUP) after adjustting to environmental effects.

The aim of the present study is to evaluate sires using BLUP, estimate heritability for direct and maternal effects of stillbirths, and to determine the phenotypic trend of the previous trait in Holstein cattle in Iraq.

II. Material and Methods

Stillbirths data consist of 9691 records for the period from1990 to1999 which represent progeny of 58 Holstein sires were used in this study in Nasr Dairy Cattle Station United Company for Animal Resources Ltd. This station was established in 1987 in Al-Soueira (50 km south of Baghdad) Iraq. The herd was imported

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as 1200 pregnant Holstein heifers from the United States of America. All calves were the outcome of an artificial insemination. Records without information on season of birth, year of birth, sex of calf and parity were not included in the analyses .Records where the calf was not the result of single born were excluded. After these edits, the final data set included information on stillbirths was 9691.In this study, we defined calves as stillborn if they were recorded dead at birth or dead within 24 to 48 h after births, whereas the others were considered live-born. We assigned the value 0 for live-born and 1 for stillborn calves.

III. Statistical Analysis

General Linear Model (GLM) within SAS program was used by using three models: the first one was used to investigate the effect of season and year of calving, parity and sex of calf on the stillbirths in primiparous and multiparous cows. In addition to use the same model after excluding the data of primiparous cows to investigate the effects of the previous factors on multiparous cows.

$$Y_{ijklm} = \mu + E_i + R_j + P_k + S_l + e_{ijklm}$$

Where Y_{ijkm} is any trait considered in this study, μ is the overall mean, E_i the fixed effect of i^{th} calving season (i= 1 – 4), R_j the fixed effect of j^{th} calving year (j=1990-1999), P_k the fixed effect of k^{th} parity (k=1 – 6), S_l the fixed effect of l^{th} sex(l=1 – 2), e_{ijk} is the residual effect.

The second model used all factors in the first model but the data for parity from 2 to 6 were excluded to study the effect of the factors on stillbirths in primiparous only.

$$Y_{ijkl} = \mu + E_i + R_j + S_k + e_{ijkl}$$

Third model was used to estimate component of variance for the random effects using the Minimum Variance Quadratic Unbiased Estimation (MIVQUE) method (Rao, 1971).

$$Y_{ijklmo} = \mu + E_i + R_j + P_k + S_l + D_m + e_{ijklmo}$$

Where Dm the random effect of sires.

Heritability of direct effect (h^2a) was estimated by paternal half sibs, whereas heritability for maternal effect was estimated by submitting the following equations (Cameron, 1997):

$\sigma^2P = \sigma^2a + \sigma^2m + \sigma^2E$
$\sigma^2S = ¼\ \sigma^2a$
$\sigma^2a = 4\ \sigma^2S$
$\sigma^2D = ¼\ \sigma^2a + \sigma^2m$
$\sigma^2D = \sigma^2S + \sigma^2m$
$\sigma^2m = \sigma^2D - \sigma^2S$
$\sigma^2E = \sigma^2e - 2\ \sigma^2S$
$h^2\ m = \sigma^2m / \sigma^2P$

Where σ^2P = Phenotypic variance, σ^2a = Additive variance, σ^2m = Maternal variance, σ^2E = Variance due to permanent environment, σ^2S = Variance due to sire, σ^2D = Variance due to dam, σ^2e= Residual variance.

BLUP of sires was estimated by Harvey program (1990).Regression of phenotypic value of stillborn calves on their birth year was used to estimate stillbirth phenotypic trend (Galbraith, 2003).

IV. Results and Discussion

The overall mean of stillbirths for cows (primiparous and multiparous) was 9.49% (Table 1), the present estimation is within range obtained from many researches 4.55 – 11.8% (Agerholm *et al.*,1993; Chassagne *et al.*,1999; Meyer *et al.*,2000; Heins *et al.*,2005), whereas overall mean of multiparous was 8.69 % (Table 2), and 11.19 % for primiparous (Table 3).This finding was supported by Aurant (1972) who reported that rate of stillbirths was 50 % higher in primiparous compared with multiparous and Bar-Anan *et al.*,(1976) revealed that stillbirths percentage was 9.1% and 4.1% in primiparous and multiparous respectively.

The results of stillborn heifers, cows, and of both of them are presented in Tables 4, 5 and 6.

The effect of calving season on stillbirths for all traits was significant ($P < 0.01$). The highest estimates were in summer calving being 14.60% in heifers, 10.71% in cows and 11.36% in both, but the lowest estimates were in winter calving. These results were supported by many researches (Bar-Anan *et al.,* 1976; Lindstrom and Villa 1977; Martinez *et al.,* 1983;Erf *et al.,*1990; Meyer *et al.,* 2001).The cause of differences as a result of calving season may attribute to variation in temperatures, diseases and nutrition.

The percentage of stillbirths differ significantly by year of calving which is in agreement with some studies (Berglund, 1996; Meyer *et al.,* 2001; Hansen *et al.,* 2004).This finding was interpreted to be a reflect of differences in management among years.

Parity has a significant effect on stillbirths. This corresponds well with what has been recorded by two separate studies in Holstein submitted in the United States of America: the first one was by Martinez *et al.,* (1983) who reported that the stillbirths in the first, the second and the third calving were 10.5, 5.5 and 5.7% respectively, and the second was by Meyer *et al.,* (2000) who revealed that stillbirths were 11% in the first calving and 5.7% in the second calving.

Sex of calf had a significant effect on stillbirths percentage. Female calves had lowest estimates being 5.51% in heifers, 5.42% in cows and 7.54% in both. On the other hand the corresponding estimates of male were 12.48, 15.15 and 12.76% respectively. The results of the present study were similar to some other results obtained by Aurant, (1972), Martinez *et al.,* (1983) and

Eriksson *et al.,* (2004).The sex of calf may cause a variation in stillbirths percentage especially in cows with large body size like Holstein, which is in general, calved a large size calf and so the probability of dystocia increased and consequently the stillborns increased also, due to the high correlation between the two traits (Lindstrom and Vilva, 1977).

Estimates of heritability of stillbirths are given in Table 7.In general, all estimates were low. They reflect the importance of environment effects as an essential source in phenotypic variation of the studied traits.

The heritability of direct effect (h^2a) for stillbirths was 0.03 in heifers which is within range of 0.00 – 0.05 reported by many researches (Philipsson *et al.,* 1979; Eriksson *et al.,* 2004; Hansen, 2005; Steinbock *et al.,* 2006), whereas the h^2a in cows was 0.007 and also comes within range of 0.00 – 0.02 (Philipsson *et al.,* 1979; Eriksson *et al.,* 2004; Hansen, 2005).On the other hand h^2a of both heifers and cows was 0.02. As shown in this study, heritability of stillbirths is very low, particularly in cows (0.007); therefore, direct selection against stillbirths would relatively be ineffective. Many advantages could be provided if we selected other traits which were correlated genetically with stillbirths and had higher heritability.

The heritability estimates of maternal effects (h^2m) for stillbirths were 0.04 in heifers, 0.02 in cows and 0.03 in both of them, which were similar to estimates reported by Hansen, (2005) and Steinbock *et al.,* (2006).

Genetic evaluation of sires for stillbirths in heifers and cows using BLUP values was done and sires were ranked in descending order. The lowest and highest values are 7.33% and 10.33% respectively. This result states that there is a little genetic variation in the trait, and most variations belonged to environment effects. A similar result was obtained from Harbers *et al.,* (2000) who reported that transmitting ability of sires for stillbirths was between -3% and 3%.

Phenotypic trend of stillbirth rates in heifers for the period from 1990 to 1999 was positive and not significant (0.19% / year), negative and not significant for cows (- 0.11% / year) and both of them (- 0.07% / year) (Table 8).This finding was not supported by many researchers (Harbers *et al.,* 2000; Meyer *et al.,* 2000: Hansen, 2005) who reported positive and significant phenotypic trend in stillbirth rates.

V. Conclusion

1- Highly significant effects ($P < 0.01$) on stillbirths were found for several environmental variables including calving year, calving season, parity and calf sex. Therefore, the effects of environmental must be taken into consideration by adjusting data for these variables to provide the best estimates of genetic values and heritability.
2- Heritability estimates for stillbirths obtained for Holstein population in this study were low which were pointed to the low role of additive variation in total variation of stillbirths.
3- The phenotypic trend of stillbirths in this study was non-significant. This suggested low efficiency of animal evaluation procedures used in the herd studied.
4- Further investigation of relationship between stillbirth rates and other calving traits (dystocia, calving ease) is needed to develop a more complete understanding of biological processes resulting in the loss of calves at birth.

VI. Acknowledgements

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Table 1 : Least squares means ± S.E for some factors affecting stillbirths in heifers and cows.

Factors	No. of observations	Least squares means ± S.E
Overall mean	9691	9.49 ± 0.30
Calving season		
Winter	2606	6.81 ± 0.66 c
Spring	1907	9.53 ± 0.76 ab
Summer	2457	11.36 ± 0.67 a
Autumn	2721	8.83 ± 0.64 c
Calving year		
1990	329	10.26 ± 1.68 ab
1991	332	8.19 ± 1.66 ab
1992	372	7.88 ± 1.56 ab
1993	681	7.73 ± 1.17 b
1994	871	9.16 ± 1.03 ab
1995	984	11.05 ± 0.97 a
1997	1521	7.23 ± 0.79 b
1998	1743	10.37 ± 0.73 ab
1999	1842	7.82 ± 0.72 ab

Parity		
1	3076	11.35 ± 0.56 a
2	2398	7.59 ± 0.64 b
3	1695	8.59 ± 0.76 b
4	1072	9.58 ± 0.94 b
5	794	8.44 ± 1.19 b
6	656	9.26 ± 1.10 b
Calf sex		
Male	5096	12.76 ± 0.51 a
Female	4595	5.51 ± 0.53 b

Means in the same column with no common superscripts differ significantly (P < 0.01).

Table 2 : Least squares means ± S.E for some factors affecting stillbirths in cows

Factors	No. of observations	Least squares means ± S.E
Overall mean	6615	8.69 ± 0.35
Calving season		
Winter	1679	6.29 ± 0.78 b
Spring	967	10.62 ± 0.99 a
Summer	1903	10.71 ± 0.77 a
Autumn	2066	8.19 ± 0.74 ab
Calving year		
1990	136	8.61 ± 2.49 ab
1991	176	10.82 ± 2.18 ab
1992	259	7.88 ± 1.80 ab
1993	384	8.10 ± 1.48 b
1994	549	9.80 ± 1.24 ab
1995	732	10.81 ± 1.08 a
1996	665	11.51 ± 1.12 a
1997	984	7.58 ± 0.93 b
1998	1308	10.17 ± 0.81 ab
1999	1422	7.21 ± 0.79 b
Parity		
2	2398	7.76 ± 0.64 a
3	1695	8.97 ± 0.76 a
4	1072	9.77 ± 0.94 a
5	794	8.69 ± 1.18 a
6	656	9.57 ± 1.10 a
Calf sex		
Male	3501	12.48 ± 0.48 a
Female	3114	5.42 ± 0.52 b

Means in the same column with no common superscripts differ significantly (P < 0.01).

Table 3 : Least squares means ± S.E for some factors affecting stillbirths in heifers

Factors	No. of observations	Least squares means ± S.E
Overall mean	3076	11.19 ± 0.58
Calving season		
Winter	927	8.97 ± 1.13 b
Spring	940	9.89 ± 1.12 b
Summer	554	14.60 ± 1.43 a
Autumn	655	11.92 ± 1.29 ab
Calving year		
1990	193	13.40 ± 2.34 a
1991	156	8.07 ± 2.58 b
1992	113	9.65 ± 3.02 ab
1993	297	9.10 ± 1.90 b
1994	322	11.05 ± 1.89 ab
1995	252	13.03 ± 2.11 a
1996	351	13.48 ± 1.71 a
1997	537	10.26 ± 1.39 ab
1998	435	12.78 ± 1.55 ab
1999	420	11.63 ± 1.57 ab
Calf sex		
Male	1595	15.15 ± 0.86 a
Female	1481	7.54 ± 0.89 b

Means in the same column with no common superscripts differ significantly (P < 0.01).

Table 4 : Analysis of variance for some factors affecting stillbirths in heifers and cows.

Sources of variation	D.F	Mean square
Calving season	3	8660.00 **
Calving year	9	2638.22 **
Parity	5	4007.48 **
Calf sex	1	126906.16 **
Residual	9672	888.38

*** (P < 0.01)*

Table 5 : Analysis of variance for some factors affecting stillbirths in cows.

Sources of variation	D.F	Mean square
Calving season	3	6969.80 **
Calving year	9	2288.68 **
Parity	4	984.07
Calf sex	1	81873.17 **
Residual	6597	820.41

*** (P < 0.01)*

Table 6 : Analysis of variance for some factors affecting stillbirths in heifers.

Sources of variation	D.F	Mean square
Calving season	3	3957.21 **
Calving year	9	3272.78 **
Calf sex	1	44285.17 **
Residual	3062	1033.38

*** (P < 0.01)*

Table 7 : Heritability estimates of direct effect (h^2a) and maternal effect (h^2m) of stillbirths in heifers, cows and in both.

Trait	h^2a	h^2m
Stillbirths in heifers	0.03	0.04
Stillbirths in cows	0.007	0.02
Stillbirths in heifers and cows	0.02	0.03

Table 8 : Phenotypic trends of stillbirths in heifers, cows and in both.

Trait	Phenotypic trend
Stillbirths in heifers	0.19% / year
Stillbirths in cows	- 0.11% / year
Stillbirths in heifers and cows	- 0.07% / year

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