

UTERINE AND FETUS TRAITS IN TWO DIVERGENT LINES SELECTED ON UTERINE EFFICIENCY IN RABBITS

A. CLIMENT, M.A. SANTACREU, M.J. ARGENTE, A. BLASCO
Universidad Politécnica de Valencia. Departamento de Ciencia Animal. P.O. Box 22012. Valencia 46071.
Spain.

SUMMARY

A total of 114 females from generation 1 (G1) and 2 (G2) of a divergent selection experiment on uterine efficiency (UE+ and UE- lines) were used. All females were slaughtered in the 5th gestation, G1 females (49) at 18 days after mating and G2 females (65) at 25 days of gestation. Number of corpora lutea (CL), total number of fetuses (TF), live number of fetuses (LF), number of implantation sites (IE), fetal survival (FS=LF/IE), prenatal survival (PS=LF/CL), individual fetus weight (FW), individual fetal placenta weight (FPW) and maternal placenta weight (MPW) were studied. The functional uterine horn was weighed full (FUW) and empty (EUW) at 25 days of gestation. Length of full uterine horn (FUL) and empty uterine horn (EUL) were also recorded at the same time. No differences in fetal survival were found between UE+ and UE- either at 18 or 25 days of gestation. UE+ had heavier live fetuses, but these advantages are lost at 25 days, and UE- fetuses weight more. However, fetal placenta seems to be more developed in line UE+ either at 18 and 25 days of gestation. The higher weight of placenta and dead fetus at 25 days in EU+ suggest an earlier death in EU-. No differences between lines were found in uterus length and weight.

INTRODUCTION

Uterine length and weight seems to be related with prenatal survival, at least in late states of gestation in intact sows (Wu *et al.*, 1987). Fetal survival also depends on the development of the fetal placenta (Adams, 1960; Hafez, 1972; Bruce and Abdul-Karin, 1973). Competence for the uterus space and nutrients has been suggested as a main cause of fetal mortality (Adams, 1960; Hafez, 1972). The objective of this paper is to examine uterus, fetus and fetal placenta development in two divergent lines selected on uterine efficiency. Uterine efficiency is measured as litter size in unilateral ovariectomized females (Bolet *et al.*, 1994). The remaining ovary duplicates its ovulation rate leading to an overcrowding of the corresponding uterine horn, since there is no embryo transmigration in rabbits.

MATERIAL AND METHODS

Two lines of rabbits were selected to increase (UE+) and decrease (UE-) litter size on unilateral ovariectomized females. 25 females from the UE+ line and 24 from the UE- of the first generation of selection (G1), and 37 from the UE+ and 28 from the UE- of the second generation (G2) were used. All the females were slaughtered in the 5th gestation, G1 females at 18 days after mating and G2 females at 25 days after mating. Number of corpora lutea (CL), total number of fetuses (TF), live number of fetuses (LF), and number of implantation sites (IE) were recorded. Fetal survival (FS=LF/IE) and prenatal survival (PS=LF/CL) rates were calculated. Individual fetus weight (FW) and individual fetal placenta weight (FPW) were also recorded. Maternal placenta weight (MPW) were only recorded at 25 days of gestation. The functional uterine horn was weighed full (FUW) and empty (EUW) at 25 days of gestation. Length of full uterine horn (FUL) and empty uterine horn (EUL) were also recorded at the same time.

G1 and G2 were analyzed separately. Least squares means (LSM) were estimated on a model with line as a fixed effect. Fixed effect of female (within line) and fetus status (live or dead) were added to the model in the analyses of the fetus and placenta weight. IE was used as a covariate in the analysis of length and weight of the uterus as well as in the analysis of number of live embryos.

RESULTS

Table 1 shows the LSM for CL, IE, TF, LF and survival rates. Although there are differences in LF at 18 days of gestation, these differences disappear when the covariate IE is introduced in the analyses (8.05 ± 0.30 for UE+ and 7.86 ± 0.31 for UE-), showing that LF only depend on preimplantation phenomena. No differences in fetal survival were found either at 18 or 25 days of gestation.

Table 2 shows the least square means for fetus and placenta weight. UE+ has heavier live fetuses, but these advantages are lost at 25 days, and UE- fetuses weight more. Fetal placentae of live fetus seem to be more developed in line UE+ either at 18 and 25 days of gestation. Maternal placentae are more developed in line UE+ at 25 days of gestations. Correlation between fetus and fetal placenta weight was 0.78. Weight of placenta and dead fetus is higher in UE+, at least at 25 days of gestation.

Table 3 shows the least square means for uterine length and weight at 25 days of gestation. No differences between lines were found in uterus length and weight. Both traits showed high coefficients of correlation (around 0.9) with TF.

DISCUSSION

The results of the selection for LS on unilateral ovariectomized females have been published by Santacreu *et al.* (1994). Lines diverged in 1.28 rabbits in G1 and 0.71 rabbits in G2. Changes in CL and IE with selection have been discussed in Santacreu *et al.* (1994). No differences in fetal survival were found, which agrees with the results for fetal survival at birth in the same lines.

The correlation between fetus and fetal placenta weight is high and similar to the value given by Garcia (1982). Despite this high correlation, live fetuses are heavier in line UE- at 25 days but their fetal and maternal placentae are, as an average, less developed than placentae in line UE+. When the uterus is overcrowded, Adams (1962) related a higher fetal mortality to a lower fetal placenta development. Besides, he observed that the remaining live fetuses and placentae grew showing a normal development. Birth weight has been found to be the same in unilaterally ovariectomized and in intact females (García-Ximénez and Vicente, 1993).

Differences in fetal placenta weight were higher for the UE+ line at 18 days of gestation but lower at 25 days, probably due to competence between fetuses. However, no differences in fetal survival were found in G1 and G2 and no differences in fetal survival to birth have been found in four generations of selection of these lines (Santacreu *et al.*, 1994). Some differences in fetal placenta weight do not seem to be correlated with further success of the fetuses. The large differences in dead fetus weight and the differences in development of the fetal placenta would support the hypothesis of an earlier death in line UE-. It is difficult to assess the relevance of the differences between UE+ and UE- in fetus and placenta weight to determine fetal survival.

A high correlation (0.86) between number of fetuses and uterus length has also been found in pigs by Wu *et al.* (1987). As our lines have the same TF at 25 days, no differences between lines were expected.

Acknowledgements: We are very grateful to ERASMUS student Katja Thaesler for her collaboration. This work has been supported by the CAYCIT, GAN90-0632.

REFERENCES

- ADAMS, C.E., 1960. *J. Endocrin.* 19: 325-344.
 ADAMS, C.E., 1962. *J. Endocrin.* 24: 471-490.
 BOLET, G., SANTACREU, M.A., ARGENTE, M.J., CLIMENT, A., BLASCO, A. 1994. 5th WCGALP. Guelph 8-12 August 1994
 BRUCE, N.W., ABDUL-KARIN., R.W. 1973. *J.Reprod. Fert.* 32:15-24.
 GARCÍA, F. 1982. Tesis Doctoral. UPV.
 GARCÍA-XIMÉNEZ, F., VICENTE, J.S. 1993. *Rep. Nut. Dev.* 33:69-73.
 HAFEZ, E.S.E. 1972. In mammalian fertilization and implantation. Chpt 11: 296-342.
 SANTACREU, M.A., ARGENTE, M.J., CLIMENT, A., BLASCO, A., BOLET, G. 1994. 5th WCGALP. Guelph, 8-12 August 1994.
 WU, M.C., HENTZEL, M.D , DZIUK, P.J. 1987. *J. Anim. Sci.* 65:762-770.

Table 1: Least Square Means (LSM) and standar errors (SE) for number of corpora lutea (CL), implantation sites (IE), total fetuses (TF), live fetuses (LF), fetal survival (FS) and survival from ovulation to slaughter time (PS) at 18 days in generation 1 and at 25 days in generation 2. Lines selected to increase (UE+) and decrease (UE-) litter size.

	GENERATION 1-					GENERATION 2				
	UE+		UE-		Sig.	UE+		UE-		Sig.
	LSM	SE	LSM	SE		LSM	SE	LSM	SE	
CL	14.80	0.56	15.35	0.58	N.S	15.24	0.45	13.96	0.49	N.S
IE	11.28	0.56	8.52	0.59	*	10.58	0.46	10.44	0.52	N.S
TF	9.68	0.50	7.13	0.52	*	8.60	0.49	8.44	0.55	N.S
LF	8.92	0.47	6.91	0.49	*	8.03	0.46	7.59	0.53	N.S
FS	0.81	0.40	0.81	0.40	N.S	0.77	0.03	0.72	0.03	N.S
PS	0.62	0.03	0.45	0.03	**	0.55	0.04	0.56	0.04	N.S

P ≤ 0.05 =*; P ≤ 0.01= ** N.S: no significant

Table 2: Least Square Means (LSM) and standar errors (SE) for weight (g) of live fetus (FW), fetal (FPW) and maternal (MPW) placentae. LF: live fetuses. DF: dead fetus at 18 days of gestation (generation 1) and 25 days of gestation (generation 2). Lines selected to increase (UE+) and decrease (UE-) litter size.

		GENERATION 1					GENERATION 2				
		UE+		UE-			UE+		UE-		
		LSM	SE	LSM	SE	Sig.	LSM	SE	LSM	SE	Sig.
LF	FW	1.62	0.01	1.49	0.02	**	20.41	0.20	21.60	0.26	**
	FPW	1.46	0.02	1.33	0.03	N.S	4.43	0.06	4.15	0.08	**
	MPW	--	--	--	--	--	1.67	0.02	1.54	0.03	**
DF	FW	0.71	0.07	0.39	0.22	**	9.71	0.71	4.99	0.70	**
	FPW	0.83	0.09	0.62	0.17	N.S	2.87	0.21	2.10	0.21	*
	MPW	--	--	--	--	--	1.27	0.07	1.30	0.07	N.S

$P \leq 0.05 = *$; $P \leq 0.01 = **$. N.S: no significant

Table 3: Least Square Means (LSM) and standar errors (SE) for full (FUL) and empty (EUL) uterus lenght (cm) and for full (FUW) and empty (EUW) uterus weight (g) at 25 days of gestation (generation 2). Lines selected to increase (UE+) and decrease (UE-) litter size.

	UE+		UE-		
	LSM	SE	LSM	SE	Sig.
FUL	39.6	1.69	35.1	1.69	N.S
FUW	325	17.2	333	21.6	N.S
EUL	36.5	2.27	35.1	2.50	N.S
EUW	39	1.6	39	1.8	N.S

N.S: no significant