SECRETION OF 17 Beta-ESTRADIOL AT MATING TIME IN RABBIT DOES ACCORDING TO THE SEASON, THE RECEPTIVITY, THE PHENOTYPE AND THE LITTER SIZE

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ABSTRACT

This study was carried on Algerian local population rabbit does, white dress with red eyes (albino) and colored dress with black eyes, raised in natural conditions, natural mating and semi-intensive rhythm. The aim of this study was to determine under these conditions, the plasmatic rates of 17β-estradiol (E2) and seasonal variations in rabbit does which accept or refuse mating. At each season, blood samples were taken from 24 does, just after the presentation to the buck, half accepting mating and half refusing it. The further litter size at birth was registered from females witch accept mating. Our results over one year, show that the colored does which accept mating have an estradiol rate significantly higher than those which refuse it (21.83 *vs* 14.84 pg/ml respectively, P<0,001). The season significantly influences estradiol secretions with a maximal rate in winter and minimal in autumn (22.89 *vs* 15.90 pg/ml respectively, P<0.05). Colored does have higher variations of plasmatic estradiol. These results evidence the relationship between the estradiol rate, sexual receptivity and the phenotype of does; they show too the influence of environmental conditions, particularly the season, on the rate of plasmatic estradiol and consequently on the rabbit does sexual receptivity. It doesn't appear any significant correlation between rate of E2 at the moment of mating and the further litter size at birth.

Key words: 17β-estradiol, rabbit does, phenotype, season, litter size

INTRODUCTION

Rabbit breeding in Algeria remains for the most part, as small farms conducted in unconditioned buildings with no selected animals and a large phenotypic heterogeneity due to different origins and crossovers, explaining the low productivity of rabbits (Daoud-Zerrouki, 2006). Consequently, the reproductive performances of rabbits are strongly depressed under natural climatic conditions especially in the summer (Marai *et al*., 2002). Ovarian function of rabbits is under the control of endogenous and exogenous factors. The 17β-estradiol is an endogenous regulator of reproductive function through its action on follicular maturation itself and on the hypothalamic-pituitary centers (Monniaux *et al*., 2009). Al Aissa (2011) shows that changes of hematological constituents can be reflected on the activities, performances and fetus of pregnant rabbits in relation with the environment. So to better understand the variations in reproductive performances of the local Algerian population rabbits, the objective of this study was to correlate plasma levels of 17β-estradiol (E2) to environmental factors (season), phenotype of rabbits (color of the dress), the receptivity at the time of presentation to the male and the litter size at birth.

MATERIALS AND METHODS

Farming conditions

The reproductive performance of 232 rabbits does and 50 males of Algerian local population were studied in the farm of the ITMAS (Agricultural Technical Institute) of Tizi-Ouzou (Algeria). Rabbit does were mated; the theoretical reproduction rhythm was 42 days. The animals were housed individually in wire cages arranged in flat-deck on one level. They were equipped with feeders (filled manually) for food and an automatic watering system. The animals were fed a commercial feed containing 16.6% crude protein and 12.3% cellulose. Feed and water were given *ad libitum*. The light, temperature and humidity were naturals; animals were then subjected to seasonal variations.

Experimental protocol

Blood samples were collected in the middle of each calendar season from 24 rabbit females divided into two groups according to the phenotype: 12 with white dress and red eyes (albino type) and 12 with colored dress and dark eyes (colored type). In each group, 6 females have accepted the mating (receptive: R+) and 6 have refused it (non-receptive: R-). These does were weighted before being presented to the male. Litter size at birth (total born, born alive) were registered for fertile females (18 albino and 20 colored).

Blood samples

Blood was collected immediately after the presentation of the female to the buck, in a dry tube, at the ear marginal vein. These tubes were transported to the central laboratory of Biochemistry of the University Hospital of Tizi-Ouzou. Samples were centrifuged at 1000 rpm during 2 minutes, and then the level of 17β-estradiol was determined in the plasma by the method ECLIA on the analyzer Elecsys 1010 from Roche.

Statistical Analysis

The weight of the rabbits does, plasma concentration of E2 at the moment of presentation and the further litter size (if kindling), were analyzed using analysis of variance (ANOVA on STATISTICA 6.0) including the fixed effect of the phenotype (2 levels: albinos or colored), receptivity (2 levels: receptive (R+) or non-receptive (R-)), season (4 levels: winter, spring, summer, autumn) and the interactions taken 2 by 2. For fertile does, the relation between E2 concentrations with the further litter size was studied using correlation test. Differences were considered significant at 5%.

RESULTS AND DISCUSSION

The average weight of total rabbits does at mating was 3.452 ± 0.435 kg (table 1), the weight varied significantly only according to the season with lower values in summer (3.204 *vs* 3.564, 3.576 and 3.464 kg in winter, spring and autumn, respectively, $P< 0.0001$). This result is in agreement with Marai and *al*., (2002). The weight decreased in hot conditions because rabbits reduce food intake to regulate body internal temperature. The absence of any significant difference in the weight of females at mating depending on the phenotype or whether they accept or reject mating, suggests that there is no connection between body condition or genetic factors and receptiveness.

The mean E2 plasma concentration was 18.74 ± 5.94 pg/ml (Table 1), similar to that reported by Ubilla and Rebollar (1994) and slightly higher than that found by Marongiu (2009) in non-lactating does. There were seasonal variations, as the higher level of E2 was observed in winter (22.89 *vs* 18.57, 17.56 and 15.90 pg/ml in spring, summer and autumn, respectively, $P<0.05$). The highest level in winter could be explained by the fact that blood samples were taken when days are getting longer (Boyd, 1986); it should be noted that the sampling was done during the middle period of each season. Similar variations have been observed on some other rabbit hematological parameters due to different adaptation abilities of animal species against temperature changes (Çetin *et al.*, 2009; Al-Eissa, 2011).

Table 1: Weight and plasma concentration of E2 of rabbit does at mating time, according to the season, the sexual receptivity and the phenotype (means± se)

Factors	*N*	Weight (kg)	E2 (pg/ml)
AVERAGE	*96*	3,452±0,435	18,74±5,94
SEASON	*96*	P<0,01	P<0,05
Winter	*24*	3,564±0,460[a]	22,89±5,23[a]
Spring	*24*	3,576±0,430[a]	18,57±6,47[ab]
Summer	*24*	3,204±0,400[b]	17,56±5,73[b]
Autumn	*24*	3,464±0,364[a]	15,90±3,93[b]
RECEPTIVITY	*96*	NS	P<0,001
Positive (R+)	*48*	3,529±0,397	21,04±5,32
Negative (R-)	*48*	3,375±0,462	16,42±5,65
PHENOTYPE	*96*	NS	NS
Albino	*48*	3,437±0,397	19.13±5,39
Colored	*48*	3,468±0,745	18,34±6,46
Season*Receptivity	*96*	NS	NS
Season*Phenotype	*96*	NS	P=0,05
Receptivity*Phenotype	*96*	NS	P<0,05

Means with different letters on the same column differ significantly
NS: not significant

The receptive does had estradiol concentrations significantly higher than non-receptive (respectively 21.04 *vs* 16.42 pg/ml, P <0.001). However, this difference was not significant in female albino (Figure 1). The difference between the concentration of E2 in R+ and R- (4.62 pg / ml) was lower than that found by Lefèvre and Caillol (1978) in the follicular fluid from females in estrus and those at 1 day and 4 days of diestrus (65 *vs* 46.7 pg / ml, respectively). As previously reported by Stoufflet and Caillol (1988) and by Theau Clément (2008), present results evidence a close relationship between elevated levels of E2 and the expression of sexual receptivity of does. But variation in E2 plasma level depends also on phenotype, being more marked in colored rabbit does, as well as on season (Figure 2). Compared to others seasons, the E2 plasma level of colored does was significantly higher in winter.

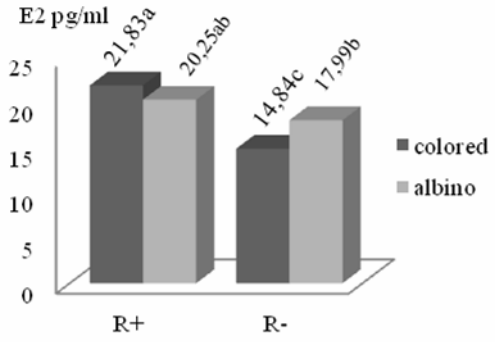

Figure 1: Rate of E2 in both phenotypes according to receptivity

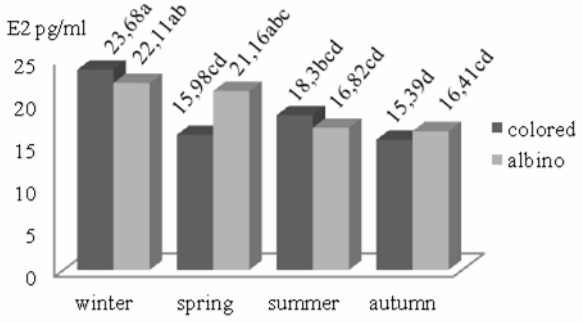

Figure 2: Rate of E2 in both phenotypes according to the season

Consequently, these interactions suggest a greater variability of estradiol in colored than in albino does according to the receptivity and season. It would be premature to infer a genetic relationship, direct or indirect, between coloration genes and secretion of estradiol, but this hypothesis has to be studied.
In the fertile rabbit does (kindling observed), the litter size at birth registered was compared to E2 plasma concentration and weight at mating. Both correlations are not significant (Table 2).

Table 2: Correlation between the litter size at birth, E2 plasmatic level and the weight of kindling does rabbit

Litter size	*n*	Means ± SE	R	
			E2 (21,12 ± 5,45 pg/ml)	**Weight** (3,50 ± 0,41 kg)
Total Born	38	6,68 ± 2,28	-0,200	0,363
Born Alive	38	5,97 ± 2,41	-0,132	0,243
Stillborn	38	0,71 ± 1,43	-0,096	0,170

This absence of correlation between litter size and E2 rate at mating, suggests that prolificacy is not directly depending on the fluctuations of E2 produced by preovulatory follicles, at that time, but rather on ovulation and implantation rate and embryo survival as reported by Theau-Clément (2005). Our results are in agreement with those evidenced by Meunier *et al.* (1983) who found no correlation between gonadotropins LH-FSH levels and prolificacy of rabbit does, knowing that these hormones are responsible for the secretion of E2. In the same way, the litter size is not correlated to the weight (Table2) and could be, consequently, independent of the body conditions at mating.

CONCLUSION

This study highlights the relationship between plasma levels of estradiol with the expression of sexual receptivity in the rabbit, and the influence of environmental conditions. The season influences plasma estradiol and thus sexual receptivity of does. However, the importance of this relationship varies with the phenotype of does. These results suggest that genetic effects should be studied. The lack of relation between E2 plasmatic rate at mating and the litter size at birth suggests that other factors determine prolificacy.

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