

## INFLUENCE OF ENVIRONMENTAL TEMPERATURE AND RELATIVE HUMIDITY ON SEMEN CHARACTERISTICS IN MALE RABBIT (*Oryctolagus Cuniculus*) OF LOCAL ALGERIAN POPULATION

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### ABSTRACT

The aim of the present study was to evaluate the effect of the season (summer and spring) on sexual activity and quantitative and qualitative semen characteristics of local male rabbit. Two groups of eleven male rabbits each (11 months-old) were exposed to summer (THI index mean value: 29.6) and to spring (THI index mean value: 20.2) conditions. Initial live weights were similar: 3234 ± 242g and 3152 ± 210g (P>0.05) respectively for rabbits reared in summer and spring. During 9 weeks for each season, 188 and 166 ejaculates were collected respectively in summer and spring groups. In the summer season, the daily feed intake of rabbit was significantly lower (96.8 g/d vs. 114.8 g/d; P<0.001). In contrast, rabbit live weight gain measured between the first week and the 9th week was not affected by the season (201.8 g vs. 179.6 g; P>0.05). Besides, both of rates of ejaculates obtained, useful ejaculates, ejaculates without gel and urine were lower in rabbits reared in summer than those collected in spring, but the values were not significantly different (P>0.05) between the 2 groups. Except the pH, all parameters performed by rabbits reared in spring and summer conditions were different. In summer, the male rabbit libido (time until ejaculation) was significantly altered (14.8 vs. 7.2 seconds, P<0.001). Sperm volume without gel, spermatozoa mobility, viability and concentration by ejaculate decreased significantly respectively by 22 % (P<0.001), 25 % (P<0.05), 26.7 % (P<0.001) and 29 % (P<0.001). The rate of total anomalies of sperm cells was significantly increased in summer period (18.8 %, P<0.001). In conclusion, sexual activity and semen quality were significantly altered in local rabbits exposed to the Algerian summer conditions.

**Key words:** Libido, rabbit, season, semen characteristics.

### INTRODUCTION

A previous study was conducted to evaluate sexual activity and semen quality in male rabbits of local Algerian population exposed to the comfort zone ambient temperature. In these rearing conditions, local rabbit showed acceptable reproductive traits compared to data found in literature (Boulbina *et al.*, 2012). However, it seems important to determine the reproductive performance in local male rabbit reared during summer, where the Temperature Humidity Index (THI) exceeds a value of 30°C considered as a severe heat stress (Nizza *et al.*, 2003).

The negative effects of high ambient temperatures on reproductive traits of rabbit bucks are well known, and several works using different breeds reported their susceptibility to heat stress that produces drastic changes in their biological functions (Marai *et al.*, 2002; Theau-Clément *et al.*, 2009). Indeed, high ambient temperatures decrease semen production and affect fertility by increasing semen pH values and morphological alterations, and also induce a change in sperm motility and libido (Nizza *et al.*, 2003; Safaa *et al.*, 2008).

In Algeria, the high ambient temperature is one of major constraints of animal productivity, and these detrimental effects limit the breeding season of rabbits to the period between September and May. To improve knowledge on this matter, the objective of the present study was to investigate the

reproductive performance, particularly sexual activity and semen quality, in local rabbits exposed to high ambient temperatures of Algerian summer conditions.

## MATERIALS AND METHODS

### Location, animals, treatments and experimental design

The present study was conducted on the experimental rabbit hutch of the High National Veterinary school of Algiers in north of Algeria, during two periods of 9 weeks each: the first one from July to the mid-September and the second one from mid-March to May. During each period, eleven local male rabbits 10-11 months old were used and exposed to summer and to spring natural conditions. In spring one rabbit was died during experimentation. Initial live weights were similar:  $3234 \pm 242\text{g}$  and  $3152 \pm 210\text{g}$  ( $P > 0.05$ ) respectively for rabbits reared in summer and for rabbits reared in spring season.

Rabbits were housed in individual cages, equipped with a feed hopper and an automatic watering system with nipples. They were watered and fed *ad libitum* with commercial rabbit pellets.

### Climate variable

During the study, the lighting was natural and the diurnal air temperature ( $^{\circ}\text{C}$ ) and relative humidity (%) inside the rabbit hutch were recorded three times a day and the mean daily were calculated. Temperature-humidity index (THI) was estimated from the following equation reported by Marai *et al.* (2002) for rabbits:

$$\text{THI: } T - [(0.31 - 0.31(\text{RH})) (T - 14.4)]$$

Where T = the temperature ( $^{\circ}\text{C}$ ) and RH = relative humidity percentage (%)

### Ejaculate collection and evaluation

Ejaculate collection was performed during the morning using an artificial vagina once a week. For each collection two successive ejaculates per day with an interval of 10 to 20 min between them, were obtained. So, during the experimental period, 188 and 166 ejaculates were collected respectively for summer and spring group. The percentages of ejaculates obtained (EO), of useful ejaculates (UE), of ejaculates without gel (EWG) and of ejaculates without urine (EWU) were calculated.

Libido was estimated by the time between introduction of the female into the male's cage and ejaculation. Immediately after collection semen was kept in a water bath at  $37^{\circ}\text{C}$ . The pH, volume of ejaculate without gel (VE), sperm motility (SM; scale of 0 to 4), percentage of live normal spermatozoa (LNS) were estimated according to the methods described by Alvarino (1993). Concentration was estimated using a Thomas-Zeiss cell counter (final dilution 1:50) and the total number of spermatozoa per ejaculate (NSE) was calculated. In final, proportion of abnormal sperm (AS) was microscopically (40X) evaluated using Eosin-Nigrosin dye (Baril *et al.*, 1993). Semen was discarded when volume is lower than 0.1 ml, contaminated by urine or blood.

### Statistical analysis

Statistical analysis was performed using analysis of variance (ANOVA1) to determine the effect of season on the studied parameters. Analyses were performed using the program StatView (Abacus Concepts, 1996, Inc., Berkeley, CA94704-1014, United Kingdom). The significance level is 5%.

## RESULTS AND DISCUSSION

The estimated temperature-humidity index (THI) values were 20.2 during the spring and 29.6 in the summer period (Table 1), indicating absence of heat stress in the first period and exposure of rabbits to severe heat stress in the second one (Marai *et al.*, 2002).

**Table 1:** THI index, daily feed intake and live weight gain in males rabbit during experiment (Means  $\pm$  Standard Error)

Season	THI index	N	Daily feed intake (g/d)	Live weight gain (g)
Summer	29.6 (min 27.3. max 32.1)	11	96.8 $\pm$ 13 <sup>a</sup>	179.6 $\pm$ 43 <sup>a</sup>
Spring	20.2 (min 18.2. max 22.3)	11	114.8 $\pm$ 15 <sup>b</sup>	201.8 $\pm$ 40 <sup>a</sup>
<i>P value</i>			<0.001	NS

<sup>a, b</sup> Different superscripts indicate significant difference at the 5% level

During summer, the average daily feed intake was significantly lower ( $P < 0.001$ ) than in the spring season (96.8 g/d vs 114.8 g/d). However, no significant difference ( $P > 0.05$ ) between rabbits reared in both season was found for the live weight gain (201.8 g vs 179.6 g) (Table 1). Similar effect of high ambient temperature on feed consumption was obtained in Egypt by Habeeb *et al.* (1993) and Marai *et al.* (2002) using White Californian and New Zealand rabbits. However, in contrast with our results, Marai *et al.* (1994) showed that high ambient temperature decreased live weight gain of rabbit.

Rates of ejaculates obtained, useful ejaculates, ejaculates without gel and ejaculates without urine were lower in rabbits subjected to summer ambient conditions compared to spring group. However, the differences (3.3% on average) were not significant (Table 2;  $P > 0.05$ ). Nevertheless, the negative effect of the summer season on the rate of ejaculates obtained and useful ejaculates was reported by Nizza *et al.* (2003) on commercial rabbit Hyla, with an important reduction of about 11 %. Our results suggest a better response of the local rabbit subjected to the chronic heat stress compared to commercial rabbit.

**Table 2:** Frequency of qualitative semen traits

Season	EO	UE	EWG	EWU
Summer	96.7 <sup>a</sup>	92.6 <sup>a</sup>	59.6 <sup>a</sup>	92.6 <sup>a</sup>
Spring	100 <sup>a</sup>	96.0 <sup>a</sup>	62.9 <sup>a</sup>	97.1 <sup>a</sup>

EO: % of ejaculates obtained; UE: % of useful ejaculates; EWG: % of ejaculates without gel plugs; EWU: % of ejaculates without urine

In our conditions, rabbits exposed to summer ambient conditions had lower libido and a gel-free volume of ejaculate ( $P < 0.001$ ) compared to those subjected to spring ambient conditions (Table 3). Many authors confirmed this effect using various types of rabbit under variable summer ambient conditions (Finzi *et al.*, 2000; Nizza *et al.*, 2003; Safaa *et al.*, 2008; Garcia-Tomás *et al.*, 2008). The decrease in the volume induced by summer ambient temperatures could be related to changes of secreted testosterone levels (El-Sherry *et al.*, 1980; El Masry *et al.*, 1994).

**Table 3:** Libido, production and qualitative semen traits (Means  $\pm$  Standard Error)

Season	N	Libido (s)	pH	VE (ml)	SM (%)	LNS (%)	NSE (10 <sup>6</sup> )	AS (%)
Summer	188	14.8 $\pm$ 1.05 <sup>a</sup>	7.2 $\pm$ 0.03 <sup>a</sup>	0.67 $\pm$ 0.03 <sup>a</sup>	3.37 $\pm$ 0.07 <sup>a</sup>	58.6 $\pm$ 1.53 <sup>a</sup>	441.3 $\pm$ 25.3 <sup>a</sup>	18.59 $\pm$ 0.50 <sup>a</sup>
Spring	166	7.2 $\pm$ 0.22 <sup>b</sup>	7.3 $\pm$ 0.03 <sup>a</sup>	0.86 $\pm$ 0.03 <sup>b</sup>	3.57 $\pm$ 0.06 <sup>b</sup>	80.0 $\pm$ 0.84 <sup>b</sup>	621.8 $\pm$ 31.7 <sup>b</sup>	15.08 $\pm$ 0.48 <sup>b</sup>
<i>P value</i>		<0.001	NS	<0.001	<0.05	<0.001	<0.001	<0.001

<sup>a, b</sup> Different superscripts in a same column indicate significant difference at the 5% level.

VE: Volume of ejaculate without gel plugs; SM: Sperm motility; LNS: Live normal sperms; NSE: number of spermatozoa per ejaculate; AS: Abnormal sperms

In our experimental conditions, except the pH, we found a significant negative effect of high ambient temperature on sperms motility, live normal sperms, concentration per ejaculate and total abnormal sperms (Table 3). This heat-induced reductions were also reported by previous studies (Battaglini *et al.*, 1992 ; Marai *et al.*, 2002 ; Roca *et al.*, 2005 ; Safaa *et al.*, 2008 ; Theau-Clément *et al.*, 2009) and could be explained by the degeneration of the germinal epithelium and to the partial atrophy of seminiferous tubules (Marai *et al.*, 1991). Moreover, our results revealed a very significant effect of the summer ambient temperature on the abnormal sperms rate (+3.5 points;  $P < 0.001$ ). Marai *et al.* (1991) attributed the increase of the abnormal sperms rate in the summer ambient conditions to defects of the spermatogenesis, particularly in the last stage of differentiation of spermatids.

## CONCLUSIONS

In conclusion, our results suggest that sexual activity and ejaculate parameters of local rabbit reared in ambient summer conditions were significantly depressed as compared to spring conditions. Additional variables related to quality of spermatozoa and to physiological functions could be considered in further studies.

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