Egyptian J. Anim. Prod., Vol. 31, Supplement Issue, Nov. (1994): 419-432.

CONCEPTUS DEVELOPMENT AND RELATED REPRODUCTIVE CRITERIA IN EGYPTIAN GIZA WHITE RABBITS IN RELATION TO ENVIRONMENTAL CONDITIONS

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SUMMARY

This work was carried out to disintegrate the effect of Egyptian summer condition on reproductive performance of rabbits. The studied conditions were; hot climate, long day-light and dry roughage feeding in contrast to the opposite conditions in winter.

A total of 34 adult does of Giza White rabbits were used to study the conceptus development under different environmental conditions. Animals were fed on concentrate ration plus green berseem (Trifolium alexandrinum) or berseem hay as experimentally designed. Drinking water was freely accessible.

Does were randomly assigned into six groups under different environmental conditions. The first group (Control, G1) was kept under natural climatic condition of winter season fed on green berseem while the second group (Hay fed, G2) was kept under the same climatic condition as G1 while replacing green berseem by berseem hay (50 g/day). The third group (Lighted group, G3) had similar condition as G1 except that day light-length was extended artificially to be 14 hours daily. The fourth group (Heat and light, G4) was exposed to artificial ambient temperature fluctuating daily from 24 °C by night to 30 °C through the day for five months as artificial simulation of summer climate, followed by natural winter temperature condition throughout 20 days post-coitum. The fifth group (Sudden heat stress, G5) was kept under the natural winter condition as G1 for

five months before exposure to ambient temperature of 35°C during the 20 days of pregnancy while the sixth group (Adapted to heat stress, G6) was exposed to summer, like environmental condition as G4 within five months followed by 35°C throughout the 20 days post-coitum.

Twenty days post coitum, does of all groups were slaughtered for genitalia examination. The main results were:

The highest number of corpora lutea per doe was observed in G6 with the lowest average weight of single CL. While hay fed group(G2) had the least number per doe with the highest weight of single CL.

Only (44.6%) of the shaded ova in G5 were developed to viable embryos. On the contrary, the highest percentage (85.7) of ova delivering viable embryos was obtained from G6.

The highest percentage(28.9) of degenerated embryos was recorded in G4 compared to other groups. G5 showed the highest percentage (44.6) of embryos lost before placentation.while G6 had the lowest percentage(4.8). G6 had the highest number of viable embryos per doe. On the contrary, the least number was obtained from G5.

Location of embryo within the uterine horn had no effect on embryos degeneration rate. The location sequence showed obvious effect since implantation occurred in the highest percentage (25.9%) in location beside the cervix with gradual decrease towards the utero-tubal junction. Similar trends were observed concerning weights of conceptus and weight maternal placenta.

Keywords: Rabbits, conceptus development, reproductive criteria, environmenal conditions

INTRODUCTION

Rabbit production during hot months of the year is very poor since environmental conditions (high ambient temperature, diurnal light and feed type and quality) during summer months affect negatively kids crop (Shafie et al., 1984; Trammel et al., 1989 and Abd-El-Moty et al., 1991). Many research works studied the effect of season on does reproductivity but rare works considered the effect of conditions on embryonic development.

High environmental temperature or heat stress decreases conception rate (Manchisi et al., 1988), increases embryonic mortality (El-Fouly et al., 1977) and retards embryonic growth (Johanson, 1985). Role of day light length obtained from the pervious investigations on does reproductivity showed contradictory results. While Shafie et al. (1984) reported that increasing day light length up to 14 hrs has no significant effect on reproductive activity of rabbit does, Mady et al. (1989) found that long day-light (14 hrs) had negative effect on does receptivity to mating. Summer feeding in Egypt without green fodder) depress reproductive performance of does (Shafie et al., 1984) which may be due to the deficiency of vitamins A and/or E (Ismail et al., 1992).

The present work aimed at studying the summer environmental factors (temperature, light and feed) on the embryonic growth to determine which factor is the most critical and to elucidate why does rabbit show poor reproductive performance during summer in Egypt.

MATERIALS AND METHODS

a- Experimental animals and management

A total of 34 adult does of Egyptian Giza White rabbits were used in this study executed in Animal Production Department, Faculty of Agriculture, Cairo University during winter months (November through March). Mating was achieved by eight bucks with good fertility record. Animals were fed ad. lib. on concentrate ration composed of 50% barely, 10% yellow corn and 40% wheat bran. Sodium chloride was added at the rate of 0.5 kg/100 kg ration. Rabbits of all groups, except the hay fed group, were offered 150 g green berseem (Trifolium alexandrinum) per head daily, as substitute to green berseem the hay fed group was offered 50 g hay/head/day. Drinking water was freely accessible.

During the experimental period (Winter), natural air temperature averaged 21.0°C with relative humidity of 56% and day light-length of 10 hrs. During matings, bucks were transferred to does, under the applied treatments. No forced mating was executed, the buck was allowed to mate the doe for two times in average. The does were mated after 24 hrs from starting the

treatment.

b- Experimental procedure

The does were divided into six groups (5-6 does/group) exposed to different environmental conditions in separated equipped rooms. The first group (Control, G1) was kept under the natural climatic condition of winter season fed on green berseem, while the second group (Hay fed, G2) was kept under the same climatic conditions as G1 while replacing green berseem by berseem hay. The third group (Lighted group, G3) had similar conditions as G1 except that day light-length was extended artificially to be 14 hrs daily (similar to summer light). The fourth group (Heat and light, G4) was exposed to artificial ambient temperature fluctuating daily between 24°C by night to 30°C through the day for five months before decreasing it to natural winter temperature conditions throughout 20 days post-coitum. The fifth group (short period of heat stress, G5) was kept under the natural winter conditions (temperature, and light-length) as G1 for five months before increasing the ambient temperature to 35°C during the 20 days of pregnancy while the sixth group (continuous heat stress, G6) was exposed to summer-like environmental conditions, as G4, before increasing the temperature to 35°C throughout the 20 days post-coitum.

The does of all groups gave two consecutive parities under their particular environmental conditions before starting the anatomical study of the genitalia, in the third parity. In that last parity the does of each group were mated and at the 20th day of pregnancy they were slaughtered. Reproductive organs were exposed via a mid ventral cut. Corpora lutea of each ovary were counted, separated and weighed. Numbers of viable and degenerated embryos were recorded. Maternal placenta, fetal placenta, (membranes and fluids) and viable embryos were weighted. Each uterine horn was arbitrary divided into six location/ sequences starting from cervix (location one) to utero-tubal junction (location six), where the characteristics of the conceptus in each sequence were recorded.

C- Statistical analysis

Data was analyzed by general linear model of SAS (User's Guide, 1982).

RESULTS

A- Effect of environmental conditions on reproductive performance

Numbers of pregnant and non pregnant rabbit does are presented in Tables (1 & 2). All the does exposed to treatments of G4 (summer-like temperature, 24-30°C daily) and that of G5 under winter natural conditions followed by 20 days continuous heat stress (35°C) got pregnant while 2 or 3 does in the other groups failed to be pregnant (Table 1). Anyhow these non-pregnant does showed ovulation CL (Table 2). In all treatments, of course, the characteristics of ovarian and conceptus are studied in the number of pregnant does at 20 days post-coitum.

Effect of environmental condition treatments on number of corpora lutea (ovulation activity) and its related criteria are presented in Table (1). The highest number of corpora lutea per pregnant doe was observed in G6 with the lowest average weight of single CL. While hay fed group (G2) had the least number per doe with the highest weight of single CL.

Only (44.6%) of the shaded ova in G5 (that exposed to sudden heat stress) following rearing under winter temperature (21°C) for 5 months were developed to viable embryos. On the contrary, the highest percentage (85.7%) of ova delivering viable embryos was obtained from G6 that exposed to fluctuating summer-like temperature (24-30°C) followed by heat stress (35°C) (Table 1). This seems to be due to adaptation to repeated hot exposition in G6.

The highest percentage (28.9%) of degenerated embryos was recorded in G4 (Summer-like temperature) compared to other groups. It is interesting to notice that, G5 (sudden heat stress) showed the highest percentage (44.6%) of embryos lost before placentation, obviously due to failure of implantation. While G6 had the lowest percentage (4.8) and G4 (8.9). G6 had the highest number of viable embryo per doe. On the contrary, the least number was obtained from G5 that of sudden heat stress (Table 1).

Percentage of embryo to total weight of conceptus (Table 1) indicates that embryo represent about 46% of the conceptus. Embryos of G2 had the highest percentage

Table 1. Percentage of viable embryos (VE) to total number of corpora lutea (CL), degenerated embryos (DE), embryos loss before placentation, number of viable embryos (VE)/doe and embryo weight to total weight of conceptus in groups under different environmental conditions

Treatment groups	Does No.	No. of pregnant does	Total No. of CL	No. CL/doe	CL (gm)	% of viable embryos of total CL	% of degenerated embryos	% of embryos lost before placentation	No. VE/doe	%of embryo weight to conceptus
G1	5	3	30	10.0	18.8±2.9	76.7	6.7	16.6	7.7±1.7	46.1
G2	6	3	26	8.7	25.1±2.4	61.5	0.0	38.5	5.3±1.7	48.2
G3	6	4	37	9.3	21.5±2.6	67.6	0.0	32.4	6.3±1.6	43.4
G4	5	5	45	9.0	19.5±2.6	62.2	28.9	8.9	5.6±1.6	44.7
G5	6	6	56	9.3	18.5±2.4	44.6	10.8	44.6	4.2±1.4	47.8
G6	6	4	42	10.5	14.1±2.8	85.7	9.5	4.8	9.0±1.7	45.5

compared to the other groups, which may be due to the little weight of fetal membrane and fluids.

Table 2. Number of corpora lutea and weight of corpus luteum in non-pregnant does in the treated groups

Treatments	No. of non-pregnant does	No. of ovulated does	No. of CL	CL (mg)
G1	2	2	14	6.3±3.2
G2	3	3*	24	11.2±3.1
G3	2	1	10	12.6±4.2
G4	-	-	-	-
G5	-	-	-	-
G6	2	1	8	14.6±5.7

* Does which had CL without successful implantation.

Among treated groups, G2 and G6 had the lowest average weight of viable embryos, conceptus and maternal placenta (Table 3). The weight of embryos was significantly correlated (P>0.05) with both fetal membrane and fluid (0.45) and maternal placenta (0.43).

Table 3. Least square means±SE of weights (gm) of maternal placenta (MP), viable embryo (VE), fetal membrane and fluids (M&F) and conceptus for does groups under different treatments

Treatments	No. of does	MP	VE	M & F	Conceptus
G1	3	2.5^{a} ±0.3	3.0^{ab}±0.3	3.5^{ab} ±0.4	6.5^{ab}±0.6
G2	3	1.7^{ab} ±0.3	2.7^{ab}±0.3	2.9^{b} ±0.4	5.6^{b} ±0.6
G3	4	2.1^{ab} ±0.2	3.3^{a} ±0.2	4.2^{a} ±0.4	7.5^{a} ±0.5
G4	5	1.9^{abc}±0.2	3.1^{ab}±0.2	4.0^{ab}±0.4	7.0^{ab}±0.5
G5	6	2.1^{ab} ±0.2	3.3^{a} ±0.2	3.6^{ab} ±0.3	6.9^{ab}±0.4
G6	4	1.3^{c} ±0.2	2.5^{b} ±0.2	3.0^{b} ±0.4	5.5^{b} ±0.5

Values by the same letter superscript are not significantly different (P>0.05).

The number of viable embryos was positively correlated (0.54) with number of croproa lutea per doe. The correlation was negative (-0.44) between number and weight of embryos.

B- Effect of embryo location sequence on conceptus development.

Hay fed (G2) and lighted (G3) groups didn't shows degenerated embryos (Table 1).

Embryos are implanted in high frequency (25.9%) in the first location (beside cervix), the frequency decreased gradually towards the utero-tubal junction (Figure 1) to reach the lowest percentage (5.5%) in location no. 6. No certain trend was observed concerning the effect of location on embryo degeneration ratio. In locations 1, 3, 4 and 5 degeneration percentage ranged between 14.8 and 16.7%, while it was about 10% in the other two locations (Table 4).

Table 4. Total number of viable and degenerated embryos in uterus location sequence at 20 days post-coitum in groups under different environmental conditions

Treatment groups	No. of pregnant does		% of viable embryos	Ratio of degenerated embryos to total embryos in uterus location sequence					Total
G1	3	92.0	1/6	0/5	0/5	0/4	0/3	1/2	2/25
G2	3	100.0	0/6	0/4	0/3	0/3	--	--	0/16
G3	4	100.0	0/8	0/7	0/4	0/2	0/2	0/2	0/25
G4	5	68.3	3/10	3/10	4/10	2/7	1/4	--	13/14
G5	6	80.7	2/9	1/8	1/6	1/4	1/4	0/3	6/31
G6	4	90.0	1/8	0/8	1/8	1/7	1/6	0/3	4/40
Total	25	88.5	7/47	4/42	6/36	4/27	3/19	1/10	25/181
%Placentation in loci/total			25.9	23.2	19.9	14.9	10.5	5.5	
%Degen. embryos/total			14.9	9.5	16.7	14.8	15.7	10.0	13.8

It obvious from Table (5) that the weight of placenta and embryo was the highest in the first location with gradual decrease in weight in successive loci towards the last one (Location no. 6). This clear phenomenon needs further study to elucidate the probable effect of several factors i.e. endometrium condition in the

different loci (histological pattern and circulatory feeding). The priority of fetal implantation is of particular consideration.

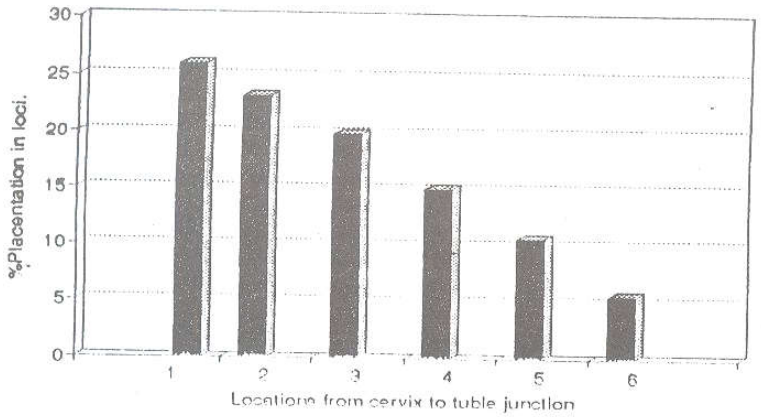

Fig. 1. Total number of placentation in uterus location sequence at 20 d.post-coitum.

Table 5. Least squares means ±SE of weights (g) for viable embryo, placenta, conceptus and fetal membranes and fluid as affected by uterus location sequence of embryos

Location	No.	Embryo	Maternal placenta	Fetal membranes& fluids	conceptus
1	40	5.5 ± 0.3^{a}	3.9 ± 0.2^{a}	6.5 ± 0.4^{a}	12.0 ± 0.6^{a}
2	38	4.9 ± 0.3^{ab}	3.0 ± 0.2^{b}	5.4 ± 0.4^{ab}	10.3 ± 0.6^{ab}
3	30	4.3 ± 0.3^{bc}	2.5 ± 0.2^{bc}	5.5 ± 0.5^{ab}	9.8 ± 0.7^{ab}
4	23	4.0 ± 0.3^{bcd}	3.4 ± 0.3^{bc}	4.8 ± 0.5^{abc}	8.8 ± 0.7^{abc}
5	16	3.4 ± 0.4^{cd}	2.2 ± 0.3^{bc}	3.9 ± 0.6^{bc}	7.3 ± 0.9^{bc}
6	9	3.0 ± 0.6^{d}	1.9 ± 0.5^{c}	3.4 ± 0.9^{c}	6.4 ± 1.3^{c}

DISCUSSION

The low number of viable embryos obtained from G5 (short period of heat stress) compared to long period of heated group (G6) might be attributed to suddenly effect of heat stress with less adaptation ability.

Ovulation rates in G1 (natural winter condition) (10) and G6 (summer-like conditions) (10.5) were higher than that reported by El-Fouly et al. (1977) 6.4 and 5.4 for winter and summer seasons, respectively, this is most probably due to intensified.

High ovulation rate of sustained heat stress (G6, 10.5) or short period of heat stress (G5, 9.3) is in agreement with Saeed (1994) who reported that heat stress has no effect on ovulation rate. On the other hand, Marie et al. (1991) stated that heat stress caused a marked decline in ovulation rate.

Low weights of conceptus and viable embryos and low number of viable embryos of hay fed group (G2) could be attributed, mostly to the deficiency in vitamin E. Ismail et al. (1992) showed that vitamin E decreased embryonic mortality and increased litter size. Similar case was found in G6 (long term hot condition) expected to be due to other causes; increased number of viable embryos in this group and/or the inhibitory effect of high temperature on thyroid activity (Trammel et al., 1989 and Saeed, 1994) and low feed intake.

Light treatment (G3) has no effect on ovulation rate and other criteria of conceptus development. Similar results were obtained by Shafie et al. (1984) but adverse effect were observed by Boyd (1986) and Mady et al. (1989). Boyd (1986) reported that long day light length causes gonadal regression. Reduction of light period (10 hrs) after rearing for 5 m in hot and long light period (14 hrs) before mating (G4) has no effect on ovulation rate and embryonic development although it possessed the highest number of embryo degeneration.

The high percentage of embryo degeneration may elucidate the small litter size obtained in autumn (Khalil and Mansour, 1987). This finding raise a question about the effect of transitional period between seasons on the response of rabbits reproductive system.

Sudden exposure to severe heat stress ($^{\circ}$C, G5) caused a deleterious effect on embryos by a high rate of degeneration, thus expected small litter size. This

result is very important in rearing rabbits during summer, the does must be protected from occasionally exceptional hot spells. Several managerial approaches has to be tested biologically and economically.

High frequency of implantation beside the cervix compared to the other locations toward the uterine horn tip agree with Bruce and Abdul-Karim (1973).

In conclusion, heat and light are not the critical factors affecting low reproductive efficiency during summer. Feed quality seems to be the critical factor. Unavailability of green fodder and/or vitamin deficiency would depress the ovarian function and negatively affect does receptivity to male and kids crop.

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التطور الجنيني وعلاقته بالمظاهر التناسلية فى ارانب الجيزة الابيض تحت الظروف البيئية

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اجرى هذا البحث ليحلل تأثير موسم وظروف الصيف البيئية فى مصر على المظاهر التناسلية للارانب ٠ وكانت الظروف التى درست كالاتى:-
المناخ الحار - طول ساعات الاضاءة - التغذية على المادة الجافة على عكس ظروف الشتاء٠ استعملت ٣٤ ام من ارنب الجيزة الابيض لدراسة التطور الجنينى تحت الظروف البيئة المختلفة ٠ الحيوانات غذيت على علقية مركزه +البرسيم الاخضر أو دريس البرسيم كما فى التجارب المصممة لذلك. حيث قسمت الامهات الى ٦ مجاميع تحت ظروف بيئية مختلفة كالاتى :
المجموعة الاولى : (كنترول) حيث وضعت الامهات تحت المناخ الطبيعى للشتاء مع التغذية على البرسيم الاخضر والعلقية المركزة ٠
المجموعة الثانية : (مجموعة الدريس) كمجوعة الكنترول واستعمل للتغذية دريس البرسيم بدلا من البرسيم الاخضر ٠
المجموعة الثالثة : (مجموعة الضوء مثل المجموعة الاولى فيما عدا الاضاءة زادت صناعيا الى ١٤ ساعة يوميا٠
المجموعة الرابعة : (حرارة+ضوء) حيث تعرضت الى حرارة منذ بداية التجربة مابين ٢٤°م فى الليل و ٣٠°م فى النهارلمدة ٥ شهور تلى ذلك الظروف الطبيعية لحرارة الشتاء لعشرين يوما بعد التلقيح ٠
المجموالخامسة : (الاجهاد الحرارى المفاجىء) كانت هذا المجموعة تحت ظروف الشتاء العادى لمدة ٥ شهور قبل التعرض المفاجىء لحرارة ٣٥°م اثناء العشرين يوم من الحمل ٠
المجموعة السادسة : (المجموعة المؤقلمة للاجهاد الحرارى) حيث عرضت الى ظروف بيئية شبيهة بظروف المجموعة الرابع لمدة ٥ شهور ثم تبع ذلك دفع الحرارة الى ٣٥°م خلال العشرين يوم من الحمل ٠
بعد ٢٠يوم من التلقيح ذبحت الامهات فى كل المعاملات لدراسة الجهاز التناسلى ومظاهر الاجنة وكانت اهم النتائج كاتى :
سجل اعلى عدد للاجسام الصفراء لكل ام فى المجموعة السادسة مع تسجيل اقل متوسط وزن للجسم الاصفر ٠ بينما مجموعة الدريس (مجموعة

٢) كانت اقل عدد فى الاجسام الصفراء مع اكبر وزن للجسم الاصفر٠ ٤٤,٦ ٪ فقط من البويضات المفرزة من المبيض فى المجموعة الخامسة تطورت الى اجنة حية بينما على العكس فأن اعلى نسبة (٨٥,٧) سجلت فى المجموعة السادسة٠ اعلى نسبة (٢٨,٩) من الاجنة الغير حيه (الممتصة) سجلت فى المجموعة الرابع مقارنة بكل المجاميع الاخرى٠
المجموعة الخامسة اوضحت اعلى نسبة (٤٤,٦) من الاجنة فقدت قبل تكوين المشيمة٠ بينما المجموعة السادسة اوضحت أقل نسبة (٤,٨)٠ وكانت اعلى نسبة تحصل عليها من الاجنه الحية من المجموعة السادسة ٠ بينما اقل عدد سجل من الاجنة الحية كان بالمجموعة الخامسة٠
موقع الجنين فى قرن الرحم لم يكن له تأثير على معدل امتصاص الاجنة بينما معدل الانغراس كان الاعلى بنسبة (٢٥,٩) فى الموقع بجانب عنق الرحم بينما الانغراس هذه تقل تدريجيا كلما اتجهنا الى اعلى بقرن الرحم ناحية المبيض ٠ وكذلك وضح اتجاه وتأثير مشابه لما سبق لوحظ فيما يتعلق بوزن مكونات الحمل (الجنين - السوائل الجنينية والأغشية) وكذلك وزن المشيمة الامية ٠