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ADAPTIVE AND REPRODUCTIVE PERFORMANCE OF RABBITS. 3- ROLE OF VITAMIN "E" IN ENVIRONMENTAL ADAPTATION

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SUMMARY

Thirty adult does [15 New Zealand White, NZW and 15 Egyptian Baladi Red, BR] were used to study the effect of vitamin E suppl. On adaptive and reproductive performance of female rabbits under summer conditions (4 months). These does were divided into three equal groups, each composed of 10 does(5 NZW and 5 BR). One group was given 30 mg/head /day vit. E, the second group was given 50 mg/head/day and the third group was untreated with vit. E (control). Does average age and body weight were 9 months and 3.0 Kg resp. The animals were maintained under normal nutritional status. Vitamin E suppl. improved the adaptive response and reproductive performance of both NZW and BR rabbits than control group. But NZW rabbits responded to vit. E suppl. more than BR.In addition the differences in adaptive response due to vit.E suppl. were negligible between the doses used (30 and 50 mg/head/day). Suppl. with 50 mg vit. E, NZW had higher respiration rate, Hb, PCV, RBCs count and the levels of T_3 and T_4 than BR rabbits. Progesterone levels,litter size, survival rate ,milk yield and bunny body weight gain were increased in the two breeds due to vit. E suppl. BR had higher P_4 levels,litter size and mortality rate than NZW under vit.E suppl. The effect of vit.E need extensive study from the physiological point of view and the economic impact.

Keywords: Rabbits, vitamin E, adaptation, reproduction, hormones

INTRODUCTION

In addition to the great numbers of vit.E functions as found by many workers (Pappu et al., 1978; Scott et al.,1982; McDowell,1989; Ismail et al.,1992 b and c), several research works proved that vit.E suppl. produces favorable adaptive and reproductive responses, either in thermoneuteral condition or exposed to heat stress. Vit. E suppl. ranging between 25 and 50 (mg/d/doe) had many effects as follow : respiration rate increased by 5 to 10/min from control, however there was no obvious effects on body temperatuer (Ghaly, 1988). Litter size in Bouscat rabbits was larger than control group (9.7 vs 7.4) (Ghaly, 1988, Ismail et al., 1992 a). Ismail et al. (1992 c) found that the average litter size in NZW rabbits was higher in treated group than control group by 35 and 46.6 % during first and second parity, resp.. Preweaning growth of offspring and weaning weights were higher in treated groups (Ghaly, 1988 and Ismail et al., 1992 c). Lang (1981) stated that when increased levels of vit. E were fed to does throughout life, the number of young born, number of young weaned and mortality in does and youngsters were increased. He also, reported that the minimum requirement of vit. E for rabbits is 0.32 mg/day/kg body weight. The recommendations for vit. E suppl. in rabbits ranged between 20-40 mg/kg diet (BASF, 1984).

The present work was executed to examine the vit. E potency in diminishing the effect of summer stress on adaptive and reproductive performance of two rabbit breeds, one Egyptian native (BR) and one exotic (NZW).

MATERIALS AND METHODS

Thirty adult does, 15 New Zealand White (NZW) and 15 Baladi Red (BR) were used to study the effect of vit. E suppl. on adaptive and reproductive performance of females under summer conditions (4 months). These does were divided into three equal groups, each composed of 10 does(5 NZW and 5 BR).One group was given 30 mg/head/day vit. E, the second group was given 50 mg/head/day and the third group was untreated with vit. E (control).

The does average age and body weight were 9 months and 3.0 Kg resp. The animals were maintained under normal nutritional status, hay and standard pelleted concentrate. Body temperature and respiration rate were recorded simultaneously once daily for each doe at morning (8-9 a.m.). Air temperature and relative humidity were recorded simultaneously with measuring physiological responses. The average body weight of the offspring was recorded by weighing the animals collectively for the litter three times a week, until 4 weeks of age. The daily milk yield of each doe was measured three times weekly till 30 days post-partum by the weight of the litter before and after suckling. Blood samples were collected at morning (8-9 a.m.) from each doe at three times, one week before mating, at 15 days post-coitum and one week after parturition. RBCs ($10^6/mm^3$), Hb (g/100 ml) and PCV (%) were determined. Progesterone (P_4), Triiodothyronine (T_3) and Thyroxine (T_4) were determined by using RIA technique (Pantex, santa Monica, U.S.A.).

Data were statistically analyzed after SAS (1990).

RESULTS AND DISCUSSION

A- Adaptive Response

1. Body temperature (BT)

Body temperature in NZW rabbits was almost the same at all stages of first parity. During the second parity vit.E suppl. caused drop in BT, to a greater extent in case of 30 mg/head/day (Table 1). The effect was more clear significantly at 1st week of gestation and 2nd week of lactation in the second parity. In BR, Vit.E suppl. did not induce any change in BT than control during first and second parities except in the 4th week of lactation in the first parity. Ghaly (1988) found that, in Bouscat rabbits, vit. E suppl. group (50 mg/day) showed no obvious difference in BT than the control group.

2. Respiration rate (RR)

In NZW rabbits during first and second parities 50 mg/head/day vit. E suppl. group had the highest RR followed by 30 mg/head/day vit. E suppl. group and control group (Table 1). Vit. suppl. groups showed

faster RR, around 37/min and 14/min than the control group. BR rabbits, during first parity, showed the same trend like NZW rabbits. During the second parity 50 mg/ head/ day vit. E suppl. group had significantly higher RR than both control and 30 mg suppl. group. The differences from control were 16.3 % in barren status and 20.5, 30.7, 30.5 and 29.1 % during the successive 4 weeks of gestation. Also during lactation period 50 mg vit. E had the highest RR. While 30 mg vit. E suppl. group had higher RR than control group during gestation and lactation periods in second parity. Ghaly (1988) found that vit. E suppl. (50 mg/day) in Bouscat does had faster RR than the unsuppl. groups under two temperature environments (winter temperature 21°C and continous heat stress temperature 30°C).

Table 1. Overall mean of body temperature (BT) and respiration rate (RR) NZW and BR rabbits in two consecutive parities during one week before gestation (B.G), gestation (G.) and lactation (L) as affected by vit.E supplementation (30 & 50 mg /head/day) (Means)

Items	Breed	Stat.	con.	30 mg	50 mg	Change from con.%	
						30mg	50mg
BT	NZW	B.G	39.3	39.2	39.3	-0.38	0.13
		G.	39.4	39.3	39.4	- 0.25	0.13
		L.	39.6	39.3	39.6	- 0.63	0.13
	BR	B.G	39.2	39.2	39.3	0.13	0.26
		G.	39.3	39.2	39.3	- 0.13	0.13
		L.	39.3	39.2	39.4	- 0.13	0.38
RR	NZW	B.G	166.2	183.5	192.2	10.60	15.90
		G.	188.5	200.6	212.7	6.45	12.90
		L.	193.3	203.2	217.9	5.12	12.70
	BR	B.G	181.1	187.9	200.1	3.80	10.50
		G.	178.8	199.4	215.7	11.65	20.90
		L.	178.6	188.0	208.8	5.26	16.95

3. Hematological response

There was always, in the two breeds at all stages, increase in PCV % due to vit. E suppl. being more with

50 mg suppl. This trend was exact in case of RBCs count and Hb g/dl (Table 2). This effect of vit. E suppl. denotes excess in general metabolism due to the increased capacity of O_2 intake by blood, this is expected to be assessed by faster respiration rate (Table 1) and augmented by the rise in T_3 and T_4 hormones (Table 3) with this suppl. It deserve notice, and further investigation, that the body temperature, which is expected to be raised by this rise in metabolic rate, is on the contrary reduced (Table 1).

Table 2. Hematological parameters, Hb (g/dl), PCV (%), RBCs (10^6/mm^3) in NZW and BR rabbits at one week before gestation (BG), midterm of 1st & 2nd gestation (G) and one week after parturition (AP) as affected by vit.E suppl. (30 & 50 mg/head/d), (Means± SE)

Items	Breed	Treatment	BG	1stG	2ndG	AP
Hb	NZW	Control	9.7 ±0.2	9.6 ±0.3	9.5 ±0.1	9.5 ±0.1
		30 mg	10.5 ±0.1	10.7 ±0.0	10.6 ±0.1	10.6 ±0.3
		50 mg	10.6 ±0.2	10.7 ±0.1	10.8 ±0.1	10.8 ±0.2
	BR	Control	10.3 ±0.2	9.3 ±0.1	9.6 ±0.2	10.4 ±0.3
		30 mg	10.7 ±0.2	10.1 ±0.2	9.7 ±0.1	10.4 ±0.1
		50 mg	10.8 ±0.1	10.4 ±0.3	9.8 ±0.0	10.5 ±0.0
PCV	NZW	Control	29.4 ±0.3	28.9 ±0.7	28.5 ±0.1	28.7 ±0.5
		30 mg	31.2 ±0.5	32.1 ±0.6	31.8 ±0.5	32.0 ±0.3
		50 mg	32.0 ±1.0	33.1 ±1.0	32.4 ±0.7	33.5 ±0.8
	BR	Control	30.7 ±0.5	30.0 ±0.3	30.7 ±0.3	31.1 ±1.0
		30 mg	32.2 ±1.0	30.0 ±0.8	30.7 ±0.7	32.0 ±0.7
		50 mg	32.4 ±0.9	31.5 ±1.1	33.4 ±1.2	34.3 ±1.2
RBCs	NZW	Control	3.48 ±0.0	3.47 ±0.0	3.54 ±0.0	3.30±0.0
		30 mg	3.67 ±0.0	3.53 ±0.0	3.50 ±0.0	3.62±0.0
		50 mg	3.70 ±0.0	3.64 ±0.0	3.56 ±0.0	3.78±0.0
	BR	Control	3.40 ±0.0	3.10 ±0.0	3.25 ±0.0	3.43±0.0
		30 mg	3.54 ±0.1	3.40 ±0.0	3.46 ±0.0	3.56±0.0
		50 mg	3.56 ±0.1	3.50 ±0.0	3.33 ±0.0	3.70±0.0

4. Thyroid activity

T_3 concentration in 50 mg vit.E suppl. group of NZW rabbits had higher level than control group by 65.3 % in the week before gestation (BG), 28.6, 35.0 % at midterm in the first and second gestations (G) and 29.7 % in the

Table 3. T_3, T_4, T_4/T_3 ratio and P_4 (ng/ml) in NZW and BR rabbits at one week before gestation (BG), midterm of 1st & 2nd gestation (G) and one week after parturition (AP) as affected by vit. E suppl. (30 & 50 mg/head/day), (Means± SE)

Items	Breed	Treatment	BG	1stG	2ndG	AP
T_3	NZW	Control	1.223^{a}± 0.0	1.959^{a}± 0.0	2.056^{a} ±0.1	1.930^{a} ±0.0
		30 mg	1.359^{a}± 0.0	2.477^{b}± 0.0	2.501^{ab}±0.1	2.334^{ab}±0.0
		50 mg	2.022^{b}± 0.0	2.520^{b}± 0.0	2.331^{ab}±0.0	2.503^{b} ±0.0
	BR	Control	2.022^{a}± 0.0	1.700^{a} ± 0.1	1.995 ±0.1	2.113 ±0.0
		30 mg	1.113^{a}± 0.0	2.110^{ab}± 0.1	2.070 ±0.1	2.132 ±0.0
		50 mg	1.357^{b}± 0.0	2.350^{b} ± 0.0	2.355 ±0.1	2.400 ±0.1
T_4	NZW	Control	3.687^{a}± 0.1	4.640 ± 0.0	4.170^{a} ±0.0	4.071 ±0.0
		30 mg	3.690^{a}± 0.1	4.940 ± 0.0	5.753^{b} ±0.0	4.332 ±0.0
		50 mg	4.980^{b}± 0.0	5.158 ± 0.1	5.768^{b} ±0.0	5.002 ±0.0
	BR	Control	3.067 ± 0.0	4.011 ± 0.0	4.357^{a} ±0.1	3.993^{a} ±0.0
		30 mg	3.423 ± 0.0	4.397 ± 0.0	4.900^{ab}±0.0	4.522^{ab}±0.0
		50 mg	3.530 ± 0.1	4.650 ± 0.0	5.660^{b} ±0.0	4.990^{b} ±0.0
T_4/T_3	NZW	Control	3.00	2.40	2.00	2.10
		30 mg	2.70	2.00	2.30	1.90
		50 mg	2.50	2.00	2.10	2.00
	BR	Control	3.00	2.40	2.20	1.90
		30 mg	3.10	2.10	2.40	2.10
		50 mg	2.60	2.00	2.40	2.10
P_4	NZW	Control	0.32 ± 0.0	7.54 ^{a} ± 0.1	10.07 ^{a} ±0.0	0.40 ^{a} ±0.0
		30 mg	0.30 ± 0.0	6.96 ^{a} ± 0.1	10.95 ^{ab}±0.1	0.27 ^{b} ±0.0
		50 mg	0.35 ± 0.0	9.03 ^{b} ± 0.0	12.53 ^{b} ±0.2	0.43 ^{a} ±0.0
	BR	Control	0.39 ± 0.1	9.37 ^{a} ± 0.0	10.52 ±0.3	0.33 ±0.0
		30 mg	0.35 ± 0.0	10.20 ^{ab}± 0.0	11.31 ±0.4	0.33 ±0.0
		50 mg	0.41 ± 0.0	12.13 ^{b} ± 0.2	11.41 ±0.1	0.34 ±0.0

a,b P<0.05.

week after parturition (AP). Also 30 mg suppl. group had higher level of T_3 than control group, however by less extent 11.1, 26.4, 21.6 and 20.8 % at the same stages, resp., (Table 3). BR showed similar response as that of NZW, however with lower concentration and less extent of change. T_4 concentration in 50 mg vit. E suppl. group of NZW and BR had the highest level followed by 30 mg suppl. and control group (Table 3). Hoch (1974) found that the increased metabolic activities resulting from

thyroid hormones stimulation increases the demand for coenzymes and their vitamin precursors, thyroid hormones control the synthetic pathways by which vitamins function as coenzymes. Thyroid index (T_4/T_3) ng/ml in NZW rabbits was higher in control group compared with 30 and 50 mg vit. E suppl. groups. But at midterm in the second gestation T_4/T_3 was the highest in 30 mg vit. E followed by 50 mg vit. E and control group. In BR thyroid index as a general average was of higher level in 30 mg vit. E than 50 mg and control groups by 4.45 % and 2.9 % resp. (Table 3). It is seems that Vit.E accelerate transformation of T_4 to the more potent T_3 hormone, thus the ratio drop down by Vit. E suppl.

B- Reproductive Performance

1. Progesterone (P_4) level

Basal levels of P_4 didn't differ between the two breeds, NZW and BR, being on the average 0.32 and 0.38 ng/ml, resp. (Table 3). BR rabbits had higher P_4 level during pregnancy than NZW (10.6 ng/ml vs 7.8 ng/ml). Concerning the effect of vit. E suppl., 30 mg vit.E didn't affect significantly P_4 level at the 15th day of gestation in the two consecutive parities in the two breeds. Meanwhile, the elevation of vit. E suppl. to 50 mg increased P_4 levels in the 1st and 2nd gestation significantly in NZW, the increase in case of BR was significant only in the 1st parity. P_4 level after one week of parturition dropped to level near to that level before gestation, anyhow the value was slightly higher in NZW. This denotes that milk secretion and suckling is not related with progesterone.

2. Litter size (LS)

Litter size (LS) was of higher value in 30 and 50 mg vit. E suppl. groups than control group in NZW rabbits during the first and second parities (Table 4). The LS in 30 mg suppl. group was higher than control group by 33.3 % and 20.6 % in first and second parity, resp.. The 50 mg suppl. group had respective values of 38.3 % and 27.6 %. In BR rabbits LS was higher in 30 mg suppl. group than control group by 12.1 % and 45 % during first and second parity, resp.. The 50 mg suppl. group had respective values of 15.5 % and 50 % (Table 4). The increase in LS by vit. E suppl. is a second product that induced rise in ovulation, thus increase in corpora

lutea number and in serum progesterone during gestation than in the control (unsuppl.) does (Table 3).

Table 4. Average of litter size (LS), birth weight (BW), weaning weight (WW) mortality rate (MR%), No. of weaned bunnies/ litter (NW) and meat yield/ litter at weaning (MY) in NZW and BR rabbits during two consecutive parities as affected by vit. E suppl. (30 & 50 mg/head/day)

Breed	Parity	Treatment	LS	BW	WW	MR	NW	MY
NZW	1st	Control	6.0	59.0	395.0	39.3	3.6	1422
		30 mg	8.0	59.7	393.3	26.7	5.9	2320
		50 mg	8.3	58.2	419.2	22.4	6.4	2683
	2nd	Control	6.5	54.7	339.2	26.5	4.8	1628
		30 mg	8.0	55.5	379.9	22.9	6.2	2355
		50 mg	8.7	55.0	393.5	20.5	6.9	2715
BR	1st	Control	5.8	47.0	352.6	40.0	3.5	1234
		30 mg	6.5	52.7	376.7	33.4	4.3	1620
		50 mg	6.7	53.5	387.9	27.8	4.8	1862
	2nd	Control	6.0	47.7	329.6	25.0	4.5	1483
		30 mg	8.7	43.1	326.0	22.4	6.8	2217
		50 mg	9.0	41.7	336.7	20.0	7.2	2424

3. Mortality rate (MR %)

Vit. E suppl. caused reduction in mortality rate in the two breeds, with more effect in the 1st parity (Table 4). These findings are in agreement with Ghaly (1988) and Ismail et al.(1992 a and b), these authors found that vit.E suppl. caused increase in litter size and great reduction in mortality rate. The effect of vit. E in reducing MR is attributed to disease resistance by protecting leukocytes and macrophages during phagocytosis and increasing immunity responses (Reddy et al., 1987 and McDowell, 1989). In addition vit. E enhances synthesization of ascorbic acid (Scott et al., 1982).

4. Daily milk production (DMP)

DMP at first parity in NZW rabbits was higher in 50 mg vit. E suppl. group followed by 30 mg vit. E and control groups. The 50 mg vit.E group had higher DMP than control group by 7.5, 20.0, 13.8 and 34.4 % at 1st, 2nd, 3rd and 4th week of lactation. DMP in 30 mg vit. E group was in between, but the differences were not significant

(Table 5). During second parity 50 mg vit. E suppl. induced more increase than in the first parity, being 19.5, 20.4, 20.8 and 24.8% in the four weeks, significantly in the last three weeks (Table 5). DMP in BR rabbits during the first and second parities was of higher value in 50 mg vit. E suppl. group followed by 30 mg and control group. The differences being not significant at all stages (Table 5). The increased DMP in 50 mg vit. E group followed by 30 mg vit. E group attributed to increase in number of weaned bunnies per litter and increased weight of weaned animal, thus collective economic benefit. Ghaly (1988) cleared that in Bouscat rabbits, the vit. E suppl. does (50 mg/day) had more milk production under two temperature environments (21°C and 30°C) than unsuppl. group by 46 % and 65.5 %, resp.. Yamani et al. (1991) found that the increase in total milk yield in NZW was 1134 g (from 2266 to 3400 g) when the number of litter size changed (from 4 to 7).

Table 5. Average daily milk production (DMP, g/wk), bunny Body weight gain (BWG, g/wk) and total yield (TY) in NZW and BR rabbits during two consecutive parities as affected by vit.E suppl.(30 & 50 mg /head/day)

Item	Breed	Treatment	1st	2nd	3rd	4th	TY
DMP	NZW	Control	84.3	111.7	122.8	92.0	410.8
		30 mg	86.1	122.5	134.2	104.2	447.0
		50 mg	95.4	134.2	143.9	119.1	492.6
	BR	Control	83.3	102.0	121.4	87.0	393.7
		30 mg	87.1	104.3	126.8	97.7	415.9
		50 mg	95.4	120.5	135.1	103.9	454.9
BWG	NZW	Control	61.9	79.0	91.4	77.9	310.2
		30 mg	58.3	74.2	99.4	97.2	329.1
		50 mg	60.2	75.2	110.1	104.3	349.8
	BR	Control	58.9	71.3	85.9	77.7	293.8
		30 mg	58.9	69.6	88.9	86.1	303.5
		50 mg	56.8	71.3	94.9	91.8	314.8

5. Growth of offspring

Vit.E suppl., by any of the used levels, did not induce effect on the body weight gain of bunnies throughout the first two weeks of suckling. The effect of suppl. appeared in the 3rd week and was more clear in

the 4th week. The response of NZW was more apparent (Table 5). The NZW litters showed faster increase in weight than the BR, in spite of the larger litter size of NZW (Table 5). This difference in growth rate is a genetical character, anyhow more milk production in NZW furnish for this faster growth. These results are in agreement with Afifi et al. (1977), Khalil et al. (1987), Ismail (1988) and Ismail et al. (1992 c). The latter authors concluded that the weaning weight is more affected by litter size than by vitamin suppl.

It is of great interest to notice that vitamin suppl. improved the adaptive response of both BR and NZW rabbits, towards hot condition, keeping efficient metabolic activities, this study proved that 30 or 50 mg/head/day vit. E suppl. was accompanied by high thyroid activity and hematological parameters, however the response did not show considerable differences between the two levels of suppl. From economic point of view Vit.E suppl. was successful in increasing litter size and reducing mortality rate up to weaning. Moreover it increased the weaning weight. Thus the productive capacity was elevated to give greater crop. The economic feasibilty needs further studies under different climatic conditions, housing facilities, feed quality and managerial procedures.

The action of vit. E needs extensive study from the physiological point of view.

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كفاءة التأقلم والتناسل فى الأرانب ٣- دور فيتامين "هـ" فى التأقلم للظروف البيئية

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أستخدم فى هذه الدراسة ثلاثين من إناث الأرانب التامة النمو (١٥نيوزيلندى أبيض و١٥ بلدى أحمر) لدراسة تأثير تناول الأرانب فيتامين هـ على كفاءة التأقلم والتناسل فى إناث الأرانب تحت ظروف الصيف لمدة ٤ شهور مستمرة وكان متوسط عمر الأمهات ٩ شهور ومتوسط اوزانها ٣كجم وتمت رعايتها وتغذيتها طبقا للنظام المعتاد بالمزرعة.وتم تقسيم هذه الإناث الى ثلاث مجموعات متساوية كل منها مكون من عشرة إناث (٥ من النيوزيلندى و٥ من البلدى الاحمر). وتم إعطاء المجموعة الاولى ٣٠ ملجم للأم يوميا بينما المجموعة الثانية أعطيت ٥٠ ملجم للأم يوميا ولم تتم معاملة المجموعة الثالثة بالفيتامين (الكنترول). وفيما يلى أهم النتائج التى تم التوصل اليها:-

تناول فيتامين "هـ" أدى إلى تحسن فى إستجابة التأقلم وكفاءة التناسل فى كلا السلالتين عن المجموعة الغير معاملة.كانت الإستجابة لتناول فيتامين "هـ" أكثر وضوحا فى النيوزيلندى عن البلدى . زاد عدد الخلفة فى البطن ونسبة الخلفة الحية من الميلاد حتى الفطام وإنتاج اللبن والزيادة فى وزن الصغار فى كلا السلالتين. لم يحدث تناول فيتامين هـ بمعدل ٥٠ ملجم اثرا واضحا عن تناوله بمعدل ٣٠ ملجم سواء من إستجابة الأقلمة أو فى الظواهر التناسلية.أوضحت هذه الدراسة الجدوى العملية الإقتصادية من تناول فيتامين هـ مع الحاجة الى العديد من الدراسات المكثفة من وجهه النظر الفسيولوجية وكذلك من ناحية تقييم العائد الإقتصادى.