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# PRODUCTIVE AND REPRODUCTIVE PERFORMANCE OF DOE RABBITS AS AFFECT BY FEEDING TYPE AND SEASON OF KINDLING UNDER EGYPTIAN CONDITIONS

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*Thirty two does and eight males of New Zealand White (NZW) rabbits, five months old, with nearly equal in live body weight were used in each of the seasons of the year. The mentioned number was randomly allotted to four treatment groups (8 does and 2 bucks each) according to feeding types. The first group fed the basal diet according to NRC (1984) requirements (control) and the other three groups were fed different formulated diets to contain 120% of requirements from protein (HP) or energy (HE) or 120% of both (HP + HE). Production performance and the economical efficiency were measured during the different seasons of the year. The results showed that the heaviest doe body weight was obtained with HP diet which reared in spring season .Number of services pre conception, gestation length and litter size were significantly affected due to the feeding levels. The interaction effect between season and feeding levels were significant on litter size at weaning. The does which were fed the HP plus HE diet showed significantly the heaviest litter weight at 21 and 28 days of age. Litter weight at birth was significantly (P<0.01) affected by season of kindling. Doe rabbits fed HP+HE dial significantly recorded the highest values of milk yield and spring season. From the results, it could be recommended to use diets containing 20% of energy and protein more than the recommended requirements to alleviate the summer heat stress effects on productive and reproductive performance of doe rabbits under Egyptian conditions.*

**Key words:** Productive & reproductive performance, does, feeding types, season of kindling.

The rabbits are very sensitive to high environmental temperature when exceeds the zone of thermal neutrality (Nichelmann, 1972). At high ambient temperatures, rabbits feed intake and the consequent energy and protein decreases result in impairment of the productive and reproductive performance of rabbits. This is probably the main problem for rabbit production in hot countries (Fernandez Carmona *et al.*, 1995 & 1998; Al-Sobayil and Khalil, 2002; Zeidan *et al.*, 2003 and Marai *et al.*, 2008).

Alleviation of heat stress effects by nutritional means can help in keeping the animals near their thermo-neutral state (Ames *et al.*, 1980; Xiccato, 1996; Nasr, 1998; Bassuny, 1999 and Soliman *et al.*, 2007).

There are many inconsistent reports in the literature about how much dietary energy and or protein is necessary for bucks and lactating does under such conditions, although such studies are scanty.

The aim of the present work was to study the effects of heat stress on doe rabbits performance and its alleviation by using different improved formulated diets during the different seasons of the year under Sharkia Governorate of Egypt conditions.

## MATERIALS AND METHODS

The present study was conducted at the Rabbitary Farm, Faculty of Agriculture, Zagazig University, Zagazig, Egypt, during the period from June 2000 till May 2001.

### Experimental animals:

Thirty two does and eight males of New Zealand White (NZW) rabbits, five months old, with nearly equal in live body weight were used in each of the seasons of the year. The mentioned number was randomly allotted to four treatment groups (8 does and 2 bucks each) according to feeding types.

### Experimental design:

The first group was fed the basal diet (17.27% CP and 2640 kcal DE/kg diet) according to requirements of NRC (1984), while the second group was fed the high protein and normal energy diet (HP) (21.46% CP and 2620 kcal DE/kg diet). The third group was fed the high energy and normal protein diet (HE) (17.14% CP and 3060 kcal DE/kg diet). The fourth group was fed the high protein and high energy diet (HP+HE) (21.70% CP and 3060 kcal DE/kg diet). The rabbits were fed the experimental diets in pelletted form. The formulation and chemical composition of the experimental diets (which were analyzed according to (1980)) are presented in Table 1. All rabbits were fed *ad libitum* and water was available all times in each experimental group.

### Management and housing:

The rabbits were housed in batteries (60 ×55 ×40 cm) provided with feeders and automatic drinkers. The batteries were located in a conventional

**Table 1. Formulation and chemical composition of the experimental diets**

| Items | Control | HP | HE | HP-HE |
|---|---|---|---|---|
| **Ingredients:** | | | | |
| Clover hay | 36.00 | 00.00 | 00.00 | 00.00 |
| Soybean meal | 11.00 | 34.00 | 29.00 | 31.00 |
| Wheat bran | 23.00 | 30.00 | 00.00 | 00.00 |
| Yellow corn | 00.00 | 18.00 | 35.00 | 29.00 |
| Barley | 28.00 | 00.00 | 00.00 | 00.00 |
| Navagras | 00.00 | 00.00 | 08.00 | 07.00 |
| Corn gluten (60%) | 00.00 | 00.00 | 00.00 | 07.00 |
| Wheat Straw | 00.00 | 13.00 | 23.00 | 21.00 |
| Molasses | 00.00 | 03.00 | 03.00 | 03.00 |
| Limestone | 01.00 | 01.00 | 01.00 | 01.00 |
| Methionine | 00.20 | 00.20 | 00.20 | 00.20 |
| Sodium chloride salt | 00.50 | 00.50 | 00.50 | 00.50 |
| Vit. and Min. Premix[1] | 00.30 | 00.30 | 00.30 | 00.30 |
| **Total** | **100.0** | **100.0** | **100.0** | **100.0** |
| **Chemical composition on[2] DM basis :** | | | | |
| OM | 90.31 | 90.89 | 91.89 | 91.79 |
| CP | 17.27 | 21.46 | 17.14 | 20.70 |
| EE | 02.53 | 02.54 | 11.46 | 09.60 |
| CF | 16.63 | 11.04 | 12.01 | 11.16 |
| NFE | 52.83 | 55.85 | 51.28 | 50.33 |
| Ash | 09.69 | 09.11 | 08.11 | 08.21 |
| DE (Kcal/Kg DM)[3] | 2640 | 2620 | 3060 | 3060 |

1. Vit. and Min. mixtures: supplied of diet, Vit. A, 12,000 IU; Vit. $D_3$, 2,000 IU; Vit. E, 10 mg; Vit. $K_3$ 2mg; Vit. $B_1$, 1mg; Vit. $B_6$, 1.5 mg; Vit. $B_{12}$ , 10 mg; Vit. $B_2$, 4mg; Pntothenic acid, 10mg; Nicotinic acid, 20 mg; Folic acid, 1mg; Botin, 50 ?g; Choline chloride, 500 mg; Copper 10 ppm; Iodine, 1 ppm, iron, 30 ppm; Manganese, 55 ppm; Zinc, 35 ppm; Selenium, 1 pp.
2. Analyzed according toA.O.A.C(1980)..
3. Calculated according to N. R. C. (1984).

HP = High protein, HE = High energy, HP-HE = High protein and high energy.

confined and windowed building not heated and naturally ventilated, side electric fans were used. All rabbits were kept under the same managerial, hygienic and environmental conditions.

Does in the same experimental group were assigned for bucks which fed on the same tested ration which given to the does. Mating was carried out in the morning after two or three days of kindling. Each doe was transferred to buck's cage from the same feeding treatment to be mated and returned to it's own cage after being bred, and pregnancy was diagnosed by abdominal palpation at the tenth day after mating. Does were failed to conceive, immediately returned after palpation to the same mating buck for another service. At 27[th] day of pregnancy, the nest boxes were supplied with straw letter to provide a comfortable and warm nest for the kindling bunnies. After 12 hours of kindling, bunnies were examined and weighed, and after 28 days of kindling bunnies were weaned.

Estimation of milk yield began from kindling up to weaning (7[th], 14[th], 21[st] and 28[th] days of age), by weighing the pups before and after suckling. The pups were deprived of suckling for 12 hours by separation between the doe and pups, and then allowed to suckle, according to Davis *et al.* (1964) and Zarrow *et al.* (1965).

Data collected for does were: doe live weight at kindling, number of services per conception, gestation length (days), litter size and litter weight at birth, 21 days and at weaning (28 days) and weekly milk yield up to 4 weeks. Economical efficiency was calculated, where:

*Price of one kg of weanling was 12 (L.E.)

*Net return= Selling cost of the total weight of the weaned pups - Cost of total feed consumed.

*Economical efficiency=(Net return/ Cost of Total feed consumed) x 100

**Statistical analysis**

The analysis of variance of the obtained data was based on factorial design (4 Feeding types x 4 Seasons) as the following model:

$Y_{ij} = ? + F_i + S_j + FS_{ij} + e_{ijk}$

Where: $Y_{ijk}$ = An observation, ? = Overall means, $F_i$ = Feeding level effects (1, 2… 4), $S_j$ = Season effects (1, 2… 4), $(FS_i)_j$ = The interaction effect due to feeding types and seasons (1 ….. 16) and $e_{ijkl}$ = Random error.

The data were analyzed according to Snedecor and Cochran (1982), by using SPSS system (1998). Values of percentage were transformed to Arc-sin values before being statistical analyzed and retransformed to the original scale after analysis. The differences between means were tested by using Duncan New Multiple Range Test (Duncan, 1955).

## RESULTS AND DISCUSSION

**Doe weight at kindling, number of services per conception and gestation length:**

The obtained results showed that doe live body weight was significantly (P<0.01) affected by the different feeding levels. The doe rabbits which were fed diet contained (HP) level showed the heaviest live weight. The present results were similar to those obtained by Nagda Omar *et al.* (1997) who found that during gestation or lactation periods, change in doe body weight was either due to change in dietary protein level, energy level or energy /protein ratio; which tended to be in positive balance. On the other hand, Parigi-Bini *et al.* (1990) and Gad- Alla *et al.* (2002) reported that live body weight was insignificantly affected by protein or energy level.

The doe live body weight was significantly ($P<0.01$) affected by different seasons of the year. The doe rabbits which reared under spring season showed the heaviest ($P<0.01$) live weight when compared with those of the other seasons (Table 2). Similar results were obtained by Yamani *et al.* (1991).

The interaction effects between feeding types and season of kindling on doe live weight were significant ($P<0.01$). The heaviest value (3532.73 gm) was obtained with doe rabbits which fed diet containing (HP) during spring season compared with the other feeding levels during the other seasons of kindling (Table 3). However, the lowest value (2737 gm) was observed in doe rabbits fed diet containing (HE+HP) during summer season. These differences between the obtained values were significant ($P<0.01$). The results showed that the diets containing (HP) improved doe live body weight during summer season.

The decrease in number of services per conception under high environmental temperature is due to a complex set of events which are expressed in significant reduction in total young born and in increase in percentage of young born dead. Exposure of adult female rabbits to severe heat stress affected adversely their reproductive rates (Marai *et al.*, 2001), although Lebas *et al.* (1986) clarified that the lower prolificacy of does reared in hot climates (30 – 31 C$^{o}$) would appear to be due to a reduction in body weight and not so much to the temperature itself.

Similar results were obtained by Yamani *et al,* (1991) and Mahrose (2000) who found that no significant effects due to seasons of kindling in number of services per conception. On the other hand, Asker (1999); Bassuny (1999) and Marai *et al.* (2006) reported that the number of services per conception was significantly affected by seasons of kindling, whereas the conception rate increased in winter and spring than summer and autumn seasons.

It seems that there was insignificant effect on the reported values of number of services per conception and gestation length as affected by kindling season, feeding types and their interaction (Tables 2 and 3). Similar results were obtained by Rahargo *et al.* (1986), Gad -Alla *et al.* (2002) and Marai *et al.* (2006) who found no significant differences in gestation length due to feeding levels or month of kindling.

**Table 2. Means ($\overline{X}$) ± S.E. of doe weights at kindling (g), number of services per conception and gestation length (Days) for doe NZW rabbits as affected by feeding types and seasons.**

| Items | Doe weight (g) | Number of services per conception | Gestation length (days) |
|---|---|---|---|
| **Feeding type:** | | | |
| Control | $3065.00 \pm 56.83^{bc}$ | 1.34±0.07 | 31.11±0.11 |
| HE | $3168.95 \pm 56.33^{b}$ | 1.42±0.11 | 30.84±0.12 |
| HP | $3298.79 \pm 31.00^{a}$ | 1.50±0.07 | 31.08±0.15 |
| HE +HP | $3031.61 \pm 46.74^{c}$ | 1.45±0.13 | 31.29±0.14 |
| **Sig.** | ** | **NS** | **NS** |
| **Kindling season:** | | | |
| Winter | $3186.98 \pm 68.44^{b}$ | 1.36±0.08 | 30.85±0.12 |
| Spring | $3324.47 \pm 53.38^{a}$ | 1.40±0.04 | 31.19±0.14 |
| Summer | $2965.37 \pm 31.86^{c}$ | 1.41±0.09 | 31.19±0.12 |
| Autumn | $3163.94 \pm 28.82^{b}$ | 1.53±0.10 | 31.06±0.16 |
| **Sig.** | ** | **NS** | **NS** |

A, b, c…. Means in the same column in each classification bearing different letters differ significantly (P <0.05). NS = Not significant and **=P<0.01

**Table 3. Means($\overline{X}$) ± S.E. of doe live body weight at kindling, number of services per conception and gestation length due to the interaction effects between feeding types and kindling seasons.**

| Items | | Doe weight (g) | Number of services per conception | Gestation length (days) |
|---|---|---|---|---|
| **Interaction effect:** | | | | |
| **Control** | x Winter | $2951.00 \pm 147.30^{cd}$ | 1.40±0.13 | 31.00±0.21 |
| | x Spring | $3297.89 \pm 093.40^{b}$ | 1.22±0.10 | 31.26±0.21 |
| | x Summer | $2938.21 \pm 056.05^{cd}$ | 1.36±0.13 | 31.07±0.20 |
| | x Autumn | $3043.17 \pm 028.62^{c}$ | 1.42±0.19 | 31.08±0.29 |
| **HE** | x Winter | $3378.89 \pm 142.80^{b}$ | 1.56±0.24 | 30.89±0.20 |
| | x Spring | $3430.71 \pm 183.92^{ab}$ | 1.14±0.14 | 31.14±0.34 |
| | x Summer | $2961.88 \pm 043.59^{cd}$ | 1.38±0.20 | 30.88±0.22 |
| | x Autumn | $3131.82 \pm 085.76^{c}$ | 1.55±0.21 | 30.55±0.21 |
| **HP** | x Winter | $3441.67 \pm 043.30^{ab}$ | 1.33±0.13 | 30.53±0.26 |
| | x Spring | $3532.73 \pm 029.34^{a}$ | 1.64±0.15 | 30.91±0.37 |
| | x Summer | $3048.42 \pm 050.33^{cd}$ | 1.53±0.14 | 31.58±0.22 |
| | x Autumn | $3300.18 \pm 025.80^{b}$ | 1.53±0.12 | 31.12±0.33 |
| **HE +HP** | x Winter | $3095.00 \pm 065.50^{c}$ | 1.11±0.11 | 31.00±0.24 |
| | x Spring | $3071.50 \pm 070.99^{c}$ | 1.70±0.26 | 31.40±0.27 |
| | x Summer | $2737.00 \pm 174.32^{e}$ | 1.20±0.20 | 31.00±0.01 |
| | x Autumn | $3103.57 \pm 057.49^{bc}$ | 1.71±0.36 | 31.71±0.36 |
| **Sig.** | | ** | **NS** | **NS** |

A, b, c Means in the same column bearing different letters differ significantly (P <0.05)
NS = Not significant and **=P<0.01.

**Litter size:**

The effects of feeding types on litter size at birth, 21 and 28 days of age (weaning age) are presented in Table 4. In view of the results, it seems that doe rabbits fed different levels of feeding showed no significant differences on litter size at all ages studied. Similar results were obtained by Nagda Omar *et al.* (1997) and Gad- Alla *et al.* (2002) who found insignificant effects of energy levels on litter size at birth, 21 or 28 days of age.

However, Carregal and Zinsly (1981); Abd El-Malak (2000) and Gad-Alla *et al.* (2002) noticed that doers fed high dietary protein levels showed significant ($P<0.05$) higher values of litter size at birth, 21 or 28 days of age than those fed low dietary protein levels.

Spring and winter born litter size at 28 days of age were significantly ($P<0.05$) higher in litter size at 28 days than those born in the other two seasons.

The present results were similar to those obtained by Ayyat *et al.* (1995) and Bassuny (1999) who found that season of kindling significantly ($P < 0.01$) affected litter size at weaning, which was higher in winter and lower in summer season which may be a result to the drastic changes in biological functions caused by heat stress (Marai *et al.*, 1994).

On the other hand, no-significant differences of season of kindling on litter size at birth and 21 days of age were obtained by Nasr (1998).

It is evident from the results that the interaction effects between feeding levels and seasons of kindling were significant ($P<0.01$) in litter size at weaning, while there were insignificant difference in litter size at birth or 21 days of ages (Table 5).

The lowest values of litter size at weaning (4.57) were obtained with doe rabbits fed the control diet during summer season compared with other feeding levels during different seasons (Table 5), however, the highest values of litter Size at weaning (6.47) was obtained with doe rabbits fed control diets during spring season.

**Litter weight:**

Litter weight at 21 and 28 days of age were significantly ($P<0.01$) affected by feeding types of their dams (Table 6). The highest values ($P < 0.01$) of litter weight at 21 and 28 days of age were born by does fed diets containing (HE+HP) levels. On the other hand, the lowest value of litter weight was obtained for does which were fed the control diet compared with the other feeding types (Table 6).

The present results were similar to those obtained by Nagda Omar *et al.* (1997) who found that the average weight of litter significantly ($P<0.05$) improved with increasing digestible energy levels. The same trend was

**Table 4. Means ($\overline{X}$) ± S.E. of litter size at different ages in doe rabbits as affected by feeding types, kindling seasons.**

| Items | Litter size at Birth | 21 days | 28 days |
|---|---|---|---|
| **Feeding type:** | | | |
| Control | 7.20±0.20 | 5.57±0.20 | 5.55±0.21 |
| HE | 7.33±0.23 | 5.58±0.17 | 5.40±0.19 |
| HP | 6.87±1.61 | 5.71±0.12 | 5.50±0.13 |
| HE +HP | 6.84±1.83 | 5.56±0.20 | 5.56±0.20 |
| **Sig.** | NS | NS | NS |
| **Kindling season:** | | | |
| Winter | 7.55±0.23 | 5.71±0.18 | 5.58±0.15[a] |
| Spring | 7.09±0.23 | 5.81±0.17 | 5.78±0.16[a] |
| Summer | 6.87±0.23 | 5.57±0.18 | .37±0.21[ab] |
| Autumn | 6.74±0.21 | 5.40±0.18 | 5.13±0.20[b] |
| **Sig.** | NS | NS | * |

A...c Means in the same column in each classification bearing different letters differ significantly (P<0.05). NS = Not significant and *= (P<0.05).

**Table 5. Means($\overline{X}$ ± S.E.) of interaction effect between feeding types and kindling season for litter size at different ages in rabbits.**

| Items | | Litter size at Birth | 21 days | 28 days |
|---|---|---|---|---|
| **Interaction effect:** | | | | |
| **Control** | x Winter | 7.45±0.32 | 5.90±0.38 | 5.90±0.26[b] |
| | x Spring | 7.53±0.33 | 6.47±0.31 | 6.47±0.19[a] |
| | x Summer | 6.93±0.38 | 5.14±0.48 | 4.57±0.57[f] |
| | x Autumn | 6.58±0.38 | 5.08±0.47 | 4.75±0.52[f] |
| **HE** | x Winter | 7.56±0.50 | 5.78±0.40 | 5.67±0.41[c] |
| | x Spring | 6.71±0.71 | 5.57±0.30 | 5.14±0.46[e] |
| | x Summer | 7.50±0.32 | 5.88±0.30 | 5.81±0.29[bc] |
| | x Autumn | 7.27±0.51 | 5.00±0.33 | 4.73±0.33[f] |
| **HP** | x Winter | 8.00±0.47 | 5.93±0.23 | 5.67±0.21[c] |
| | x Spring | 6.55±0.45 | 5.45±0.28 | 5.36±0.24[cd] |
| | x Summer | 6.32±0.32 | 5.53±0.23 | 5.42±0.26[cd] |
| | x Autumn | 6.71±0.32 | 5.88±0.26 | 5.53±0.29[cd] |
| **HE +HP** | x Winter | 7.00±0.53 | 5.44±0.38 | 5.44±0.44[d] |
| | x Spring | 7.10±0.57 | 5.50±0.37 | 5.50±0.37[cd] |
| | x Summer | 6.80±0.86 | 6.00±0.55 | 6.00±0.55[b] |
| | x Autumn | 6.29±0.52 | 5.43±0.37 | 5.43±0.37[cd] |
| **Sig.** | | NS | NS | ** |

A...c Means in the same column bearing different letters differ significantly (P<0.05).
NS = Not significant and **=P<0.01.

**Table 6. Means ($\bar{X}$) ± S.E. of litter weight (g) at different ages as affected by feeding types, kindling season or parity in NZW rabbits.**

| Items | Litter weight at | | |
|---|---|---|---|
| | Birth | 21 days | 28 days |
| **Feeding type:** | | | |
| Control | 406.95±11.81 | 1213.89±051.12$^{c}$ | 1799.74±065.91$^{c}$ |
| HE | 394.15±15.51 | 1741.44±071.03$^{b}$ | 2390.12±076.84$^{b}$ |
| HP | 403.93±16.11 | 1682.10±054.40$^{b}$ | 2258.79±062.89$^{b}$ |
| HE +HP | 425.90±19.76 | 2189.23±092.19$^{a}$ | 2789.06±096.87$^{a}$ |
| **Sig.** | **NS** | ** | ** |
| **Kindling season:** | | | |
| Winter | 459.61±15.41$^{a}$ | 1770.64±078.77$^{a}$ | 2335.09±083.05$^{a}$ |
| Spring | 394.79±13.89$^{b}$ | 1543.72±071.60$^{bc}$ | 2165.96±070.51$^{ab}$ |
| Summer | 347.55±13.30$^{c}$ | 1506.22±079.12$^{c}$ | 2069.37±096.13$^{b}$ |
| Autumn | 439.29±13.90$^{a}$ | 1676.04±075.88$^{ab}$ | 2320.17±087.48$^{a}$ |
| Sig. | ** | ** | * |

A...c Means in the same column in each classification bearing different letters differ significantly (P<0.05). NS = Not significant, *=P<0.05 and **=P<0.01.

observed with Partridge *et al.* (1982) and Gad Aalla *et al.* (2002) who reported that high litter weights at 21 and 28 days of age were recorded for does which fed high protein level diet.

However, litter weight at the different ages studied was significantly (P<0.05 and 0.01) affected by seasons of kindling (Table 6). Doe rabbits reared under autumn and winter seasons conditions produced high litter weight at different ages studied than those reared under summer conditions. The same trend was obtained by Mahrose (2000) and Marai *et al.* (2006) who reported that litter weight at birth was lower during summer than in winter. Ayyat *et al.* (1995); Radwan (1998) and Marai *et al.* (2006) also found that the lightest litter weight recorded was during the summer season.

Moreover, the litter weight at weaning was also found to be significantly affected by season of kindling (El-Sheikh and El-Bayomi (1994); Bassuny, (1999); Barakat (2001) and Marai *et al.* (2006).

The adverse effect of high ambient temperature during summer on litter weight at different ages may be due to a decrease in feed consumption, milk yield of does, dehydration of animals, tissue catabolism (Abo El-Ezz *et al.,* 1984) as well as to the low metabolizable energy left for growth, since more energy is consumed by the increase in respiratory frequency that occurs in hot ambient temperature (Habeeb *et al.*, 1999).

The interaction effects on litter weight showed that the doe rabbits fed diets containing (HE+HP) during summer season had the best values of litter weight at birth, 21 and 28 days of age when compared to the other feeding types during the same season (Table 7). Such results supported the adverse effect of high ambient temperature during summer on litter weight at all ages studied.

**Milk yield:**

Means of milk yield at 1st, 2nd, 3rd and 4th weeks of lactation as affected by different feeding levels are shown in Table 8.

Effects of feeding levels on milk yield at different stages of lactation were highly significant ($P< 0.01$). The doe rabbits fed diet containing (HE + HP) recorded the highest values ($P<0.01$) of milk yield (77.73, 133.95, 279.53 and 148.35 gm) at 1st, 2nd, 3rd and 4th weeks of age, respectively (Table 8). The lowest values ($P<0.01$) of milk yield (57.32, 102.84, 189.20 and 100.69 gm) ... the same ages studied were recorded by the doe rabbits which were fed the control diet. The increase in crude protein intake may increase milk production and consequently increase the weanlings' body weight (Shemin *et al.*,1991). The energy deficient caused by milk production is may be responsible for intense body mobilization and reduced reproductive performance. This situation is exacerbated in primiparous rabbit does since their feed intake capacity is not fully developed and their growth is not complete (Fortune–Lamothe, 2006). However, Xiccoto *et al.* (1992) found that the protein level did not influence milk yield of the does fed diets containing CP at level 16.5 or 18.6 (%). Moreover, the same authors added that the different lactation length obviously influenced both total milk production and total feed intake, during lactation and dry period.

Seasons of kindling significantly ($P<0.01$) affected milk yield at different lactation periods, where the highest values were obtained for does reared under spring season (73.05, 124.54, 265.62 and 136.29 gm at all stages studied), while the lowest values were found for doe rabbits reared under summer season (52.62, 101.42, 198.74 and 98.97 gm at the same weeks, respectively) when compared to other seasons of kindling during all lactation periods studied.

The same trend was observed by Habeeb *et al.* (1993) and El-Sayiad (1994) who reported that doe's milk yield was found to be significantly($P<0.05$) lower in summer than the other seasons of kindling. The daily milk yield was found to be lower by nearly 10 % during the hot period of the day (Maertens and De Groate, 1998) when the temperature rose above 20 C° (Rafai and Papp, 1984).

The interactions between feeding types and kindling season were significant on milk yield at all stages of lactation (Table 9). Doe rabbits fed

**Table 7. Means($\overline{X}$ ±S.E.) of interaction effect between feeding types and kindling seasons of litter weights (g) at different ages in NZW rabbits.**

| Items | | Litter weight at | | |
|---|---|---|---|---|
| | | Birth | 21 days | 28 days |
| **Interaction effect:** | | | | |
| **Control** | x Winter | 467.70±15.20 | 1270.00±056.30 | 1909.75±073.01 |
| | x Spring | 410.06±16.66 | 1625.79±053.32 | 1951.32±056.03 |
| | x Summer | 308.78±22.83 | 0937.86±131.76 | 1376.79±178.38 |
| | x Autumn | 415.33±26.57 | 1360.25±176.17 | 1869.83±212.09 |
| **HE** | x Winter | 464.36±35.57 | 1865.00±211.46 | 2575.00±202.28 |
| | x Spring | 330.10±42.23 | 1475.71±108.75 | 2174.29±166.51 |
| | x Summer | 352.51±18.63 | 1654.06±078.69 | 2287.81±090.48 |
| | x Autumn | 438.03±33.94 | 1936.55±157.74 | 2525.00±180.58 |
| **HP** | x Winter | 492.13±38.41 | 1664.67±116.73 | 2273.33±136.95 |
| | x Spring | 407.05±33.63 | 1557.73±119.01 | 2083.18±129.36 |
| | x Summer | 359.95±26.02 | 1637.11±117.48 | 2212.11±137.14 |
| | x Autumn | 453.48±23.51 | 1828.24±074.53 | 2411.76±084.76 |
| **HE +HP** | x Winter | 382.70±36.27 | 2408.33±137.84 | 3055.00±131.88 |
| | x Spring | 397.60±31.21 | 2104.00±194.81 | 2659.00±191.10 |
| | x Summer | 393.11±22.70 | 2127.20±266.69 | 2767.20±312.93 |
| | x Autumn | 447.86±48.80 | 2073.57±160.39 | 2648.57±174.73 |
| **Sig.** | | **NS** | **NS** | **NS** |

NS = Not significant

**Table 8. Means ($\overline{X}$) ± S.E. for milk yield (g) at different ages as affected by feeding types, kindling season or parity in NZW rabbits.**

| Items | Milk yield at | | | |
|---|---|---|---|---|
| | 1st Week | 2nd Week | 3rd Week | 4th Week |
| **Feeding type:** | | | | |
| Control | 57.32±1.05$^d$ | 102.84±1.28$^d$ | 189.20±02.25$^d$ | 100.69±2.15$^d$ |
| HE | 64.05±1.66$^c$ | 117.94±2.01$^c$ | 229.85±03.17$^c$ | 115.05±1.87$^c$ |
| HP | 71.82±2.13$^b$ | 127.48±2.68$^b$ | 260.05±10.98$^b$ | 126.22±1.11$^b$ |
| HE+HP | 77.73±2.34$^a$ | 133.95±2.23$^a$ | 279.53±08.97$^a$ | 148.35±8.66$^a$ |
| **Sig.** | ** | ** | ** | ** |
| **Kindling Season:** | | | | |
| Winter | 63.96±1.04$^b$ | 118.51±2.41$^c$ | 215.84±03.99$^c$ | 115.56±2.14$^c$ |
| Spring | 73.05±1.64$^a$ | 124.54±2.15$^a$ | 265. 62±09.35$^a$ | 136.29±6.73$^a$ |
| Summer | 52.62±1.69$^c$ | 101.42±1.99$^d$ | 198.74±04.35$^d$ | 098.97±2.76$^d$ |
| Autumn | 71.71±2.33$^a$ | 121.69±2.75$^b$ | 234.94±08.20$^b$ | 123.33±2.20$^b$ |
| **Sig.** | ** | ** | ** | ** |

A...c Means in the same column bearing different letters differ significantly (P<0.05).
** = P<0.01

**Table 9. Means($\overline{X}$ ± S.E.) of interaction effect between feeding types and season on milk yield (g) at different ages in NZW rabbits.**

| Items | Milk yield at | | | |
|---|---|---|---|---|
| | $1^{st}$ week | $2^{nd}$ week | $3^{rd}$ week | $4^{th}$ week |
| **Interaction effect:** | | | | |
| **Control** x Winter | $59.37±01.83^{e}$ | $100.12±01.47^{e}$ | $189.29±03.04^{c}$ | $099.22±2.63^{d}$ |
| x Spring | $61.99±01.28^{e}$ | $108.12±01.28^{d}$ | $197.67±01.89^{dc}$ | $103.74±0.79^{d}$ |
| x Summe | $46.55±01.30^{g}$ | $094.19±02.85^{f}$ | $173.98±04.95^{f}$ | $088.22±3.11^{e}$ |
| x Autumı | $60.20±00.63^{c}$ | $109.55±03.04^{d}$ | $194.72±06.54^{de}$ | $115.63±3.56^{bc}$ |
| **HE** x Winter | $61.26±00.77^{e}$ | $119.42±00.65^{c}$ | $225.71±01.23^{c}$ | $116.37±1.07^{bc}$ |
| x Spring | $69.13±01.05^{d}$ | $125.63±01.46^{bc}$ | $244.67±01.29^{c}$ | $119.20±1.84^{bc}$ |
| x Summer | $54.37±02.32^{f}$ | $104.27±02.94^{d}$ | $210.38±04.91^{cd}$ | $102.81±2.68^{d}$ |
| x Autumn | $76.29±01.42^{c}$ | $130.49±00.88^{b}$ | $250.35±00.90^{c}$ | $128.00±0.83^{b}$ |
| **HP** x Winter | $68.90±01.40^{d}$ | $130.70±00.74^{b}$ | $229.75±09.33^{c}$ | $125.64±1.14^{b}$ |
| x Spring | $81.03±01.50^{b}$ | $135.38±01.71^{ab}$ | $314.42±10.29^{b}$ | $129.44±1.14^{b}$ |
| x Summer | $55.90±10.35^{f}$ | $106.93±10.20^{d}$ | $211.50±16.65^{cd}$ | $119.75±1.14^{bc}$ |
| x Autumn | $61.10±05.70^{e}$ | $097.15±08.25^{e}$ | $200.45±49.95^{de}$ | $110.20±0.01^{c}$ |
| **HE+HP** x Winter | $69.81±00.80^{d}$ | $139.50±01.04^{a}$ | $242.06±00.69^{c}$ | $129.69±0.89^{b}$ |
| x Spring | $87.29±05.58^{a}$ | $139.78±00.99^{a}$ | $335.32±03.15^{a}$ | $198.11±1.64^{a}$ |
| x Summer | $62.40±05.77^{e}$ | $109.86±01.74^{d}$ | $220.50±04.40^{cd}$ | $102.76±1.19^{d}$ |
| x Autumn | $85.83±00.65^{a}$ | $135.67±04.56^{ab}$ | $291.93±14.60^{b}$ | $128.02±2.49^{b}$ |
| **Sig.** | ** | ** | * | ** |

A...c Means in the same column bearing different letters differ significantly (P<0.05).
**=P<0.01

diet containing (HE+EP) showed significantly (P<0.01 or P<0.05) higher values of milk yield at all stages of lactation during spring season of kindling when compared with the other groups. On the other hand, doe rabbits fed the control diets during summer season had the lowest values of milk yield at $1^{st}$, $2^{nd}$, $3^{rd}$ and $4^{th}$ week of lactation than those fed the other feeding types in each kindling season (Table 9).

**Economical efficiency**:

Table 10 showed that using diet containing (HE+HP) recorded higher feed economic efficiency than the other diets, while the contrary was noticed when using control diet led to lower economic feed efficiency. The same conclusion was reported by Bassuny (1999) who using diets differed in energy and protein contents in different production seasons.

***In conclusion***, it could be recommended to use diets containing 20% of energy and protein more than the recommended requirements to alleviate the summer heat stress effects on productive and reproductive performance of doe rabbits under Egyptian conditions.

**Table 10. Economic feed efficiency of doe rabbits**

| Items | HE | HP | HE+HP | CONTROL |
|---|---|---|---|---|
| **Feed consumption kg /group** | | | | |
| Winter | 188.20 | 201.60 | 188.45 | 223.20 |
| Spring | 186.00 | 194.40 | 181.25 | 216.00 |
| Summer | 158.40 | 172.80 | 156.60 | 187.20 |
| Autumn | 186.50 | 195.00 | 186.90 | 218.00 |
| **Cost of one kg feed** | 01.60 | 01.50 | 01.75 | 01.20 |
| **Total cost of feed consumed(L.E.)** | | | | |
| Winter | 301.12 | 302.40 | 329.79 | 267.84 |
| Spring | 297.60 | 291.60 | 317.19 | 259.20 |
| Summer | 253.44 | 259.20 | 274.05 | 224.64 |
| Autumn | 298.40 | 292.50 | 327.08 | 261.60 |
| **Total weight of weaned pups kg** | | | | |
| Winter | 30.97 | 29.28 | 36.14 | 23.49 |
| Spring | 28.53 | 28.11 | 34.14 | 22.62 |
| Summer | 25.39 | 23.94 | 28.79 | 19.14 |
| Autumn | 29.83 | 27.91 | 33.80 | 22.75 |
| **Selling cost of the weaned pups (L.E.)[1]** | | | | |
| Winter | 371.64 | 351.36 | 433.68 | 281.88 |
| Spring | 342.36 | 337.32 | 409.68 | 271.44 |
| Summer | 304.68 | 287.28 | 345.48 | 229.68 |
| Autumn | 357.96 | 334.92 | 405.60 | 273.00 |
| **Net return(L.E.)[2]** | | | | |
| Winter | 70.52 | 48.96 | 103.89 | 14.04 |
| Spring | 44.76 | 45.72 | 92.49 | 12.24 |
| Summer | 51.24 | 28.08 | 71.43 | 05.04 |
| Autumn | 59.56 | 42.42 | 78.52 | 23.40 |
| **Economical efficiency (%)[3]** | | | | |
| Winter | 23.00 | 16.00 | 32.00 | 5.00 |
| Spring | 15.00 | 16.00 | 29.00 | 5.00 |
| Summer | 20.00 | 11.00 | 26.00 | 2.00 |
| Autumn | 20.00 | 15.00 | 24.00 | 9.00 |

1-Price of one kg of weanling was 12 (L.E.)

2-Net return= Selling cost of the total weight of the weaned pups - Cost of total feed consumed

3-Economical efficiency = (Net return/ Cost of Total feed consumed) x 100.

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# الأداء الإنتاجي والتناسلي لإناث الأرانب تحت تأثير نوع التغذية و موسم الولادة تحت الظروف المصرية

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أستخدم فى هذه التجربة ٣٢ أم و٨ ذكور نيوزيلندى الأبيض متماثلة تقريباً فى الوزن والعمر (٥ شهور) قسمت إلى أربعة مجاميع تجريبية (٨ إناث+ ذكرين)، غذيت المجموعة الأولى على عليقة تحتوى الاحتياجات الغذائية طبقاً للمقررات الغذائية الموصى بها NRC ١٩٨٤- وتم تغذية المجموعات الثلاثة الباقية على علائقه تحتوى ١٢٠% من الاحتياجات الغذائية من البروتين (المجموعة الثانية) أو الطاقة (المجموعة الثالثة) أو كلاهما (المجموعة الرابعة).

وقد تم تقدير العديد من الصفات الإنتاجية والكفاءة الاقتصادية على مدى فصول السنة الأربعة.

- أظهرت النتائج أعلى وزن للام مع العليقة الأعلى فى البروتين... وفى موسم الربيع لم يؤثر مستوى التغذية أو المواسم على التلقيحات اللازمة للإخصاب أو طول فترة الحمل.
- أظهر التداخل بين مستوى التغذية والموسم تأثير معنوى على عدد الخلفات عند عمر ٢٨ يوم، أظهر المحتوى العالى من الطاقة والبروتين أعلى وزن الحلقة عند عمر ٢١، ٢٨ يوم ولم يؤثر على وزن الميلاد بينما زاد وزن الخلفة معنويا عند عمر ٢١يوم خلال فصل الشتاء فقط.
- زاد إنتاج اللبن بصورة معنوية بزيادة مستوى التغذية وكانت أفضل النتائج مع العليقة المرتفعة فى كلا من الطاقة والبروتين كما أظهر موسم الربيع أفضل النتائج فى جميع مراحل الإنتاج.
- لم يظهر أية تأثيرات معنوية على معدلات النفوق فى المراحل العمرية المختلفة.
- أظهرت نتائج الكفاءة الاقتصادية أعلى معدل للعائد مع العليقة المرتفعة الطاقة والبروتين بينما أظهرت عليقة المقارنة أقل النتائج.

تظهر النتائج المتحصل عليها من هذه الدراسة أن تغذية ارانب التربية على عليقة تحتوى ١٢٠% من البروتين والطاقة أعلى من الاحتياجات الغذائية الموصى بها حسّنت الصفات الانتاجية والتناسليات تحت الدراسة.... وخاصة خلال فصل الصيف.