J. Agric. Sci. Mansoura Univ., 29 (12): 6809 - 6828, 2004

EFFECT OF FEED RESTRICTION DURING THE REARING PERIOD ON SUBSEQUENT PERFORMANCE OF CAMPBELL AND DOMYATI DUCKS

Tag El-Din, T.H.; M.A. Ali; F. S. A. Ismail; H.A.M. Gad* and A.M. El-Shahat.*

Department of Poultry Production, Faculty of Agriculture, Mansoura University.

***Animal Production Research Institute, Ministry of Agriculture, Giza.**

ABSTRACT

The present study was conducted to study the effects of both breed and different systems of feed restriction during the rearing period from 10 up to 22 weeks of age on growth and laying performance of Campbell and Domyati ducks. At 10 weeks of age, 180 ducklings (144 females and 36 males) from each breed were randomly assigned to 6 feeding systems up to 22 weeks of age; where the first group (control) was fed *ad libitum* throughout the experimental period (AL), the second and third groups were fed on 80 and 60% of the intake of AL group (80 and 60% AL), the 4th group was fed 80% AL mixed with 20% fine sawdust (DL) and the 5th and 6th groups were fed *ad libitum* daily except that feeding was skipped for one or two days per week (W1 and W2), respectively. During the laying period from 22 to 46 weeks of age, however, all groups were fed on *ad libitum* basis.

The criteria of response were live body weight, flock uniformity, age at sexual maturity, feed intake, feed conversion, laying rate, egg weight, egg mass, viability percentage, eggs fertility and hatchability percentage, egg quality (shape index, shell thickness and yolk index), and some blood constituents (plasma calcium, inorganic phosphorus and progesterone), and costs, returns and economic efficiency. The obtained results can be summarized as follows: Significant breed differences were observed between the two breeds in live body weight at 22 weeks of age, flock uniformity, age at sexual maturity, daily feed intake, egg weight , egg mass, level of plasma progesterone (except at 30 weeks of age) and viability. However, feed conversion, laying rate, eggs fertility and hatchability percentages, egg quality and levels of plasma calcium and inorganic phosphorus were not affected by breed. The application of feed restriction during the growing period (10–22 weeks of age) reduced body weight at 22 weeks of age, delayed age at sexual maturity, and improved eggs fertility and hatchability percentages. Feed restriction also significantly affected flock uniformity, laying rate (in favour of DL and W2 groups), egg mass (in favour of 60% AL, DL and W2 groups), viability, egg quality and blood constituents, while daily feed intake, feed conversion and egg weight were not affected by feed restriction. Due to the application of feed restriction during the growing period (10-22 weeks of age) the feeding costs were decreased, and generally, this resulted in achieving greater results and economic efficiency; especially with the 60% AL and W1 groups.

Keywords: Domyati and Campbell ducks, feed restriction systems, subsequent performance, fertility and hatchability, egg quality, blood constituents.

INTRODUCTION

Feed restriction has been used during the rearing period of chickens to regulate rate of growth, reduce the incidence of obesity and to control age at sexual maturity in replacement pullets. This practice has been led, but in

consistently, to other benefits such as reduced mortality and increasing egg production during the subsequent laying period. At the onset of egg production, egg weight is actually not large enough for commercial purpose. Delay of sexual maturity in birds by feed restriction programs aims to obtain large eggs, at least, during the early laying period (Lee et al., 1971b). The proportion of abnormal eggs laid by hens was substantially reduced by feed restriction during the rearing period (Johnson et al., 1984). The peak of egg production was higher for pre-laying feed-restricted birds compared with *ad libitum*-fed hens, but age at peak production was similar for both (Robbins et al., 1986). One disadvantage of *ad libitum* feeding during the growing period is that the birds tend to consume more feed than do the feed-restricted birds, making it more difficult to maintain uniformity under commercial type conditions (Bennett and Leeson, 1989). Uniformity of pullets can be judged by their peak of egg production. High peak of egg production have been shown to be an indicator of flock uniformity (Gous and Stielau, 1976).

In general, feed restriction for birds during the growing period could be carried out by restricting total feed intake, dilution of the ration, feed withdrawal for one or two days weekly, reducing the daily photo-or feeding period, restricting the daily energy or protein intake, restricting the daily allowances of some amino acids, some vitamins or trace elements, adding unpalatable compounds to the ration, or using a combination of some of these methods.

In recent years, there has been a considerable interest in the use of feed restriction for growing replacement stock of ducks in order to improve their productive and reproductive performance during the subsequent laying period, and to decrease the production costs. Much of the research on nutrient requirements of laying hens has been carried out on chickens, but little is known about those of ducks.

The present study was undertaken to determine the effects of using some selected methods of feed restriction during the rearing period (10-22 weeks of age) on growth and subsequent productive and reproductive performance of Domyati and Campbell ducks. In addition, an economic evaluation was made.

MATERIALS AND METHODS

The present study was conducted at El-Serw Poultry Research Station, El-Serw, Damietta, belonging to Animal Production Research Institute, Agricultural Research Center, Egypt.

Two breeds of ducks (Domyati and Campbell) were used in this study. Domyati ducklings were obtained from the El-Serw Poultry Research Station, while those of Campbell ducklings were purchased from a Baladi Hatchery at Sharkia Governorate.

Birds were fed a starter ration from one-day old to 6 weeks of age and a grower ration from 6 to 22 weeks of age. During the laying an ordinary layer ration was used from 22 to 46 weeks of age. Composition and chemical

analysis of all rations are shown in Table (1). Rations were offered to birds in a dry-mash form. Fresh and clean water was available all the time.

Table 1. Composition and chemical analysis of the rations offered to the ducks throughout the experiment.

Ingredients (%)	Experimental Diets		
	Starter; 0-6 weeks	Grower; 6-22 weeks	Layer; 22-46 weeks
Yellow corn	65.00	63.00	66.00
Soybean meal (44%)	30.45	15.50	21.50
Wheat bran	0.65	17.78	2.74
Limestone	1.40	1.80	7.60
Dicalcum phosphate	1.80	1.25	1.50
Vit. + Min. premix*	0.30	0.30	0.30
Salt (NaCl)	0.30	0.30	0.30
D L-Methionine	0.10	0.07	0.06
Total	100.00	100.00	100.00
Calculated analysis:**			
M E (Kcal/kg)	2864	2686	2725
Crude protein (%)	19.13	15.04	15.56
Crude fiber (%)	3.72	4.48	3.32
Ether extract (%)	2.73	2.56	2.66
Calcium (%)	1.03	1.04	3.41
Total phosphorus(%)	0.72	0.72	0.64
Methionine (%)	0.15	0.11	0.10
Lysine (%)	0.11	0.09	0.09

*** Contents per 3 kg permix: Vit. A 10000000 IU, Vit. D_3 1000000 IU, Vit. E 10g, Vit. K_3 1 g, Vit. B_1 1g, Vit. B_2 4 g, Nicotinic acid 20 g, Vit. B_6 1.5g, Pantothenic acid 10g, Vit. B_{12} 10g, Folic acid 1g, Biotin 50 mg, Choline chloride 500 g, Zinc 45 g, Copper 3 g, Iodine 0.3 g, Iron 30g, Selenium 0.1g and Manganese 40g.**

**** According to NRC (1994).**

Experimental design:

At 10 weeks of age, 180 ducklings (144 females and 36 males) from each breed were randomly chosen, leg banded and divided into 6 equal groups, each of which was assigned to one of 6 feeding systems. The ducklings of each group were subdivided to three replicates of 10 birds each (8 females and 2 males). All replicates had nearly equal means of live body weight.

During the growing period from 10 to 22 weeks of age, the experimental groups were fed according to the following feeding regimes: Birds of the first treatment were fed *ad libitum* (AL) and served as a control. Birds of the 2nd and 3rd groups were fed at a level of 80 or 60% of the intake of AL group; denoted as 80% AL and 60% AL, respectively. The birds of the 4th group (DL) were fed at a level of 80% AL mixed with 20% fine sawdust (wt/wt). The birds of the 5th and 6th groups were fed *ad libitum* daily except that feed was withdrawn for one or two days weekly; designated as W1 and W2, respectively. The amount of feed offered to the restricted groups was

determined on the basis of the amount of feed consumed by the *ad libitum* group during the preceding day.

At 22 weeks of age, however, all ducks of all treatments were fed *ad libitum* on the ordinary layer ration to the end of the experiment at 46 weeks of age. All birds were kept under the same managerial and hygienic conditions.

Parameters estimated:

Growing period (10-22 weeks):

The birds were individually weighed at 10 and 22 weeks of age. Uniformity of the ducklings (defined as the percentage of ducklings having live weight values ranked in the range of ±10% around the average weight of the treatment) was calculated according to North (1984). Viability percentage was calculated throughout the rearing period from 10 to 22 weeks of age.

Laying period (22-46 weeks):

Age at sexual maturity was considered as the age of ducks at the time of laying the first egg in each pen. Also, records on daily feed consumption, egg weight, egg production rate (expressed as hen-day and hen-housed bases), feed conversion and total egg mass were maintained. Viability rate was calculated throughout the laying period from 22 to 46 weeks of age.

On 30, 38 and 46 weeks of age, 3 batches of hatching eggs (30 eggs per treatment within each breed) were incubated. Eggs fertility was examined at the 7^{th} day of incubation. Hatchability percentage (% of fertile eggs) was also calculated. On 30 and 46 weeks of age, 10 eggs were taken randomly from each treatment within each breed to determine some parameters of egg quality (egg shape index, shell thickness and yolk index).

Blood constituents:

Blood samples were collected at 22 weeks of age (the end of the growing period), 30 weeks of age (the peak of egg production; 85-90% egg production) and 46 weeks of age (the end of the experiment) from the wing veins of 6 female ducks per treatment. Some blood constituents were estimated in the laboratories of Animal Production Research Institute, Dokki, Cairo; using commercial kits for the determination of levels of plasma total calcium (Moorhead and Biggs, 1974), inorganic phosphorus (Fiske and Subbarow, 1925) and Progesterone (Blight and White, 1983).

Costs and returns:

Production costs were estimated on the basis of the prevailing market prices of feeds, eggs and day-old ducklings during the experimental period.

Statistical analysis:

Obtained data were subjected to analysis of variance (ANOVA) as described by Gomez and Gomez (1984).

RESULTS

Growth performance:

The effects of breed and feed restriction program on live body weight and flock uniformity are shown in Table 2. Campbell ducklings had significantly ($P \leq 0.01$) heavier live body weight at 10 and 22 weeks of age than Domyati ones by 32.4 and 40.7 %, respectively. Feed restriction significantly ($P \leq 0.01$) reduced live body weight of ducklings at 22 weeks of age, particularly in the 60% AL-group compared with the AL group (control). The breed x feeding system interaction for live body weight was not significant. Domyati ducks had significantly ($P \leq 0.01$) higher values of flock uniformity than Campbell ones by 26.0 and 4.7% at 10 and 22 weeks of age, respectively. The highest value of flock uniformity (%) was recorded for the 80% AL-group, and the worst one was exhibited by the 60% AL-group. The breed x feeding system interaction for flock uniformity was significant ($P \leq 0.01$) at 10 weeks of age, while it was not significant at 22 weeks of age. Viability percentage of ducklings during the rearing period was 100%. This may indicate that neither breed nor feed restriction system had any effect on viability percentage of ducklings during the rearing period.

Laying performance:

The results of the effects of breed and feed restriction system; that was practiced during the growing period, on the subsequent productive performance of ducks during the laying period (from 22 to 46 weeks of age) are summarized in Table 3. Campbell ducks recorded significantly ($P \leq 0.01$) higher values for age at sexual maturity, daily feed intake, egg weight, egg mass, and viability than did Domyati ones. No breed difference were detected, however, in egg production rate or feed conversion.

The application of feed restriction during the rearing period (from 10 to 22 weeks of age) significantly delayed the age at sexual maturity of ducks in comparison with the AL-fed group (control). It was observed that the W2-group was the latest one to reach sexual maturity. Due to the effete of feed restriction, to which ducklings were subjected during the rearing period, significant differences ($P \leq 0.01$) were observed later in egg production, egg mass, and viability ($P \leq 0.05$) of laying ducks, were as feed intake, feed conversion and egg weight were not affected. the highest value of egg production rate was achieved by the DL-group, and the lowest one was attained by the 80% AL-group. Total egg mass ranged from 7026 g (80% AL-group) to 7308 g (W2-group). The best value of ducks' viability (100%) was exhibited by the 80% AL-group, while the lowest one (91.8%) was recorded for the W2-group. Significant breed by feeding system inter actions ($P \leq 0.01$) were observed only for age at sexual maturity, laying rate, and viability percentage.

Table 2: Effect of breed and feed restriction system on live body weight of ducklings and flock uniformity during the growing period (10 to 22 weeks of age).

Treatments	live body weight (g)		Uniformity %.	
	10 Weeks old	22 Weeks old	10 Weeks old	22 Weeks old
Breeds (A)				
Camp.	1613.0±11.5 ^{a}	2358.0±20.8 ^{a}	71.8±3.3 ^{b}	72.3±3.8
Domt.	1218.0±6.4 ^{b}	1676.0±12.7 ^{b}	90.5±2.5 ^{a}	75.7±2.7
Significance level	**	**	**	NS
Feeding systems (B)				
AL	1411.5±31.8	2062.0±60.8 ^{ab}	86.1±5.2 ^{a}	75.0±5.7 ^{ab}
80% AL	1416.2±32.7	1986.0±50.7 ^{bc}	88.9±2.8 ^{a}	86.8±4.9 ^{a}
60%AL	1418.0±34.1	1938.2±57.7 ^{c}	80.6±6.7 ^{ab}	62.1±4.3 ^{b}
DL	1429.0±32.1	2029.0±62.3 ^{ab}	71.5±3.1 ^{b}	63.2±4.9 ^{b}
W_1	1407.0±34.2	2089.0±50.4 ^{a}	71.5±3.2 ^{b}	84.1±4.3 ^{a}
W_2	1412.0±33.3	1999.0±62.3 ^{bc}	88.2±2.8 ^{a}	73.0±6.1 ^{ab}
Significance Level	NS	**	**	**
Interaction A x B				
Camp. AL	1613.0±21.8	2433.0±46.0	79.2±6.4	72.2±12.1
Camp. 80% AL	1622.0±22.9	2315.0±24.7	86.1±5.6	91.7±8.3
Camp. 60%AL	1605.4±34.7	2243.3±67.8	66.7±4.8	60.3±6.0
Camp. DL	1616.0±27.7	2376.0±62.6	70.8±4.2	62.5±10.5
Camp. W_1	1603.0±35.2	2396.0±39.7	50.0±4.8	79.2±2.4
Camp. W_2	1618.0±27.1	2383.0±47.7	77.8±5.6	68.2±5.1
Domt. AL	1210.0±11.4	1691.0±32.7	93.1±6.9	77.8±2.8
Domt. 80% AL	1210.4±13.1	1657.1±22.1	91.7±0.0	82.0±5.0
Domt. 60%AL	1229.6±21.7	1632.0±146.6	94.5±2.8	63.9±7.4
Domt. DL	1242.0±20.1	1683.0±38.3	72.2±5.5	63.9±2.8
Domt. W_1	1210.4±13.8	1782.0±24.1	93.1±3.7	88.9±2.8
Domt. W_2	1206.0±10.4	1615.0±27.5	98.6±1.4	77.8±5.5
Significance level.	NS	NS	**	NS

a-c : Means in the same column, for each criterion, having different superscripts differ significantly.
NS = not significant ; * = significant at p≤0.05 ; ** = significant at p≤0.01.

Fertility and hatchability percentages:

The effects of breed and feed restriction system; that was applied during the rearing period, on eggs fertility and hatchability percentages are shown in Table 4.

No significant breed differences were detected in eggs fertility or hatchability percentages at all ages investigated. On the other hand, the application of feed restriction during the rearing period (10-22 weeks of age) resulted in significant improvements in eggs fertility (%) at 30, 38 and 46 weeks of age compared with that of the control (AL-group). Within feeding systems, the improvements in eggs fertility percentage over the control group at 30 weeks of age were 7.8, 24.1, 36.2, 30.2 and 34.7 % in the groups of 80% AL, 60% AL, DL, W_1 and W_2, respectively. Whereas the corresponding figures of improvement in egg fertility were 29.4, 46.8, 39.2, 23.2 and 46.6 %

at 38 weeks of age and 11.0, 20.1, 19.3, 6.9 and 23.3% at 46 weeks of age, in the same previously mentioned order for groups, respectively.

The breed x feeding system interactions for eggs of fertility percentage were significant (P≤ 0.05) at 38 weeks and (P≤ 0.01) at 30 and 46 weeks of age.

As for the effect of feeding system on eggs hatchability percentage, the differences between the six feeding systems were statistically significant (P≤ 0.05) at 30, 38 and 46 weeks old. It is noteworthy, however, that all feed-restricted groups had better values of eggs hatchability percentage than the control group (AL) , at all ages investigated. The breed x feeding system interaction for eggs hatchability percentage was significant (P≤ 0.01) only at 38 weeks of age.

Table 3: Effects of breed and feed restriction system (10 – 22 weeks of age) on the productive performance of ducks from 22 to 46 weeks of age.

Treatments	Age at sexual maturity (days)	Daily feed consumption (g)	Feed conversion (g feed /g egg mass)	Laying rate %	Egg weight (g)	Egg mass (g)	Viability %
Breeds (A)							
Camp.	171.4±1.5 ^{a}	175.5±1.6 ^{a}	3.58±0.43	67.1±1.1	73.4±0.3 ^{a}	8274±34.1 ^{a}	98.0±0.7 ^{a}
Domt.	167.7±1.5 ^{b}	156.1±1.2 ^{b}	3.44±0.35	68.2±0.7	66.5±0.3 ^{b}	7619±25.3 ^{b}	95.9±1.2 ^{b}
Significance Level	**	**	NS	NS	**	**	**
Feeding systems (B)							
AL	164.2±0.9 ^{c}	166.1±2.9	3.58±0.42	66.6±1.6 ^{b}	69.8±0.7	7807±39.4 ^{bc}	98.0±1.4 ^{ab}
80% AL	169.8±1.1 ^{b}	165.9±4.0	3.63±0.60	65.0±2.1 ^{b}	70.8±0.8	7695±19.8 ^{c}	100.0±0.0 ^{a}
60%AL	167.5±4.0b	161.7±4.7	3.48±0.37	66.7±0.4b	69.7±0.7	7810±52.3a	96.0±1.8b
DL	170.2±2.2 ^{b}	167.3±2.9	3.36±0.55	71.2±1.5 ^{a}	70.0±0.7	8379±62.7 ^{b}	98.0±1.4 ^{ab}
W_1	167.3±0.8 ^{b}	166.0±2.8	3.56±0.92	67.1±1.8 ^{b}	69.7±0.8	7877±49.8 ^{c}	91.8±2.4 ^{c}
W_2	178.3±1.7 ^{a}	168.0±4.7	3.44±0.63	70.2±0.7 ^{a}	69.8±0.7	8228±63.2 ^{a}	98.0±1.4 ^{ab}
Significance level	**	NS	NS	**	NS	**	*
Interaction A x B							
Camp. AL	165.7±0.9	174.3±1.5	3.7±0.0.81	63.7±2.0	74.0±0.8	7920±55.5	96.0±2.3
Camp. 80% AL	167.3±0.3	176.5±4.0	3.92±0.99	60.3±0.1	74.7±0.8	7567±28.2	100.0±0.0
Camp. 60%AL	176.3±0.3	171.9±6.3	3.58±0.70	66.1±0.1	72.7±0.9	8073±66.6	100.0±0.0
Camp. DL	174.0±2.9	174.9±3.2	3.3±0.97	72.3±2.9	73.3±0.7	8903±54.5	96.0±2.3
Camp. W_1	165.7±0.3	173.9±2.7	3.37±1.01	70.5±0.8	73.2±0.8	8670±65.4	96.0±2.3
Camp. W_2	179.7±3.2	181.7±4.0	3.61±2.15	69.4±1.3	72.9±0.9	8500±17.4	100.0±0.0
Domt. AL	162.7±0.9	157.9±2.8	3.45±0.44	69.5±0.8	65.9±0.6	7694±29.1	100.0±0.0
Domt. 80% AL	172.3±0.3	155.3±3.2	3.34±0.90	69.7±0.4	66.8±0.5	7822±49.7	100.0±0.0
Domt. 60%AL	158.7±0.3	151.4±3.9	3.38±0.42	67.2±0.6	66.7±0.7	7530±35.9	92.0±0.0
Domt. DL	166.3±0.3	159.7±1.8	3.42±0.75	70.0±0.7	66.8±0.7	7856±45.8	100.0±0.0
Domt. W_1	169.0±0.6	158.2±1.8	3.75±0.74	63.7±2.2	66.2±0.8	7084±41.9	87.7±2.6
Domt. W_2	177.0±1.7	154.4±2.8	3.26±1.87	71.0±0.4	66.7±0.5	7956±10.1	96.0±2.3
Significance level.	**	NS	NS	**	NS	NS	**

a.c : Means in the same column, for each criterion, having different superscripts differ significantly.

NS = not significant ; * = significant at p≤0.05 ; = significant at p≤0.01 .**

Table 4: Effects of breed and feed restriction system (10-22 weeks of age) on fertility and hatchability percentages of eggs produced by ducks at 30, 38,and 46 weeks of age . .

Treatments	Fertility percentage			Hatchability percentage		
	30 weeks old	38 weeks old	46 weeks old	30 weeks old	38 weeks old	46 weeks old
Breeds (A)						
Camp.	80.4±2.7	83.7±3.3	86.5±2.1	79.6±3.3	81.4±2.7	81.4±2.9
Domt.	81.6±3.3	85.7±2.9	87.1±2.2	77.4±2.8	79.0±2.6	81.3±3.8
Significance level	NS	NS	NS	NS	NS	NS
Feeding systems (B)						
AL	66.3±7.5^{b}	60.9±5.8^{c}	76.5±4.5^{c}	68.5±4.9^{b}	65.4±4.2^{c}	76.3±6.1^{ab}
80% AL	71.5±5.2^{b}	78.8±5.7^{ab}	84.9±5.2^{abc}	76.5±5.1^{ab}	73.9±4.7^{ab}	88.8±4.0^{a}
60%AL	82.3±5.6^{a}	89.4±3.1^{a}	91.9±2.3^{a}	74.0±5.5^{ab}	76.4±6.1^{ab}	79.4±5.2^{ab}
DL	90.3±2.0^{a}	84.8±3.3^{ab}	91.3±2.5^{ab}	87.5±5.5^{a}	79.4±4.4^{ab}	87.9±3.3^{a}
W_1	86.3±2.1^{a}	75.0±7.2^{b}	81.8±2.2^{bc}	79.3±5.4^{ab}	82.6±4.9^{a}	69.3±8.7^{b}
W_2	89.3±3.0^{a}	89.3±3.4^{a}	94.3±2.6^{a}	85.3±4.2^{a}	84.0±2.6^{a}	86.5±4.3^{a}
Significance Level	**	**	**	*	*	*
Interaction A x B						
Camp. AL	88.2±3.2	56.8±9.5	83.5±5.0	74.3±7.1	95.2±3.1	71.8±11.5
Camp. 80% AL	60.8±7.5	62.5±6.0	75.2±8.5	78.3±7.6	81.2±6.9	93.3±4.2
Camp. 60%AL	66.7±5.8	83.3±4.7	91.2±3.4	68.7±10.5	65.2±8.1	70.2±6.7
Camp. DL	92.5±2.8	90.2±2.4	90.5±2.9	82.7±10.7	72.3±6.4	85.5±6.3
Camp. W_1	90.0±2.8	66.3±9.5	83.3±3.3	88.0±5.3	90.7±3.4	81.8±4.9
Camp. W_2	84.3±4.3	83.2±5.1	95.3±3.3	85.8±6.3	83.7±3.3	85.8±4.5
Domt. AL	44.3±6.7	65.0±7.2	69.5±6.7	62.7±6.5	75.7±5.4	80.7±6.8
Domt. 80% AL	82.2±4.2	95.0±1.6	94.7±2.6	74.7±7.4	65.5±4.8	84.2±6.8
Domt. 60%AL	97.8±2.2	95.5±2.2	92.7±3.5	79.3±3.4	87.7±6.8	88.7±6.4
Domt. DL	88.2±2.8	79.3±5.6	92.0±4.2	92.3±3.1	86.5±4.9	90.3±2.3
Domt. W_1	82.5±2.4	83.7±10.4	80.2±3.0	70.7±8.4	74.5±8.2	86.8±15.7
Domt. W_2	94.3±3.2	95.5±3.1	93.3±4.2	84.8±6.2	84.3±4.4	87.2±7.7
Significance level.	**	*	**	NS	**	NS

a-c : Means in the same column, for each criterion, having different superscripts differ significantly.
NS = not significant ; * = significant at p≤0.05 ; ** = significant at p≤0.01 .

Egg quality traits:

The effects of breed and feed restriction system on some parameters of egg quality are shown in Table 5.

The two breeds (Domyati and Campbell ducks) had nearly similar values of egg shape index, eggshell thickness and yolk index at 30 and 46 weeks of age, with no significant breed differences. Differences in egg shape index and shell thickness; that attributed to the effect of feeding system, were significant (P≤ 0.01) at 30 weeks of age and not significant at 46 weeks of age. Also, there were significant differences in yolk index due to the effect of feeding system at 30 (P≤ 0.01) and 46 (P≤ 0.05) weeks of age. Within feeding systems, at 30 weeks of age, the W_2-group had significantly thinner

egg shells than that of the control (AL) by 8.9%, however, the other feed-restricted groups had nearly similar values of egg shell thickness to that of the control. The feed restriction resulted in improving yolk index of eggs as compared to that of the control group at 30 and 46 weeks of age. The breed × feeding system interactions were not significant for all egg quality traits examined.

Blood constituents

The results of the effects of breed and feed restriction systems applied during the rearing period (10-22 weeks of age) on levels of plasma calcium, inorganic phosphorus and progesterone in the experimental ducks at different ages, are summarized in Tables 6 and 7.

Table 5: Effects of breed and feed restriction systems on some parameters of egg quality of experimental ducks. .

Treatments	Shape index (%)		Shell thickness (mm)[1]		Yolk index (%)	
	30 weeks old	46 weeks old	30 weeks old	46 weeks old	30 weeks old	46 weeks old
Breeds (A)						
Camp.	70.5±0.7	71.7±0.5	0.379±0.004	0.378±0.003	51.0±0.5	44.0±0.4
Domt.	70.8±0.6	74.8±0.4	0.389±0.004	0..375±0.003	50.8±0.5	45.0±0.5
Significance level	NS	NS	NS	NS	NS	NS
Feeding systems (B)						
AL	74.1±1.1[a]	73.1±0.8ab	0.392±0.007a	0.380±0.007	48.8±0.9c	43.1±0.5b
80% AL	74.4±0.7[a]	72.1±1.0b	0.405±0.007a	0.384±0.006	50.4±0.7bc	44.4±0.7ab
60%AL	66.1±0.9[b]	73.0±0.9ab	0.390±0.007a	0.388±0.005	53.1±0.9a	45.1±0.6ab
DL	73.3±1.0[a]	74.0±0.8ab	0.395±0.005a	0.391±0.005	50.5±0.9bc	43.8±0.9ab
W_1	68.4±0.6[b]	72.8±1.0ab	0.391±0.008a	0.376±0.006	50.3±0.8bc	44.8±0.7ab
W_2	67.7±0.5[b]	74.6±0.6a	0.360±0.007b	0.388±0.006	52.5±0.9ab	45.7±0.7a
Significance level	**	NS	**	NS	**	*
Interaction A x B						
Camp. AL	73.2±2.0	70.8±1.1	0.391±0.011	0.392±0.012	49.1±1.2	43.1±0.7
Camp. 80% AL	74.3±1.1	71.2±1.1	0.403±0.011	0.397±0.008	50.9±0.9	43.7±0.5
Camp. 60%AL	66.1±1.4	71.6±1.2	0.384±0.003	0.390±0.007	54.6±1.6	45.5±0.8
Camp. DL	74.0±0.9	72.5±0.9	0.395±0.007	0.401±0.004	51.6±1.1	43.0±1.4
Camp. W_1	68.7±0.7	69.6±1.1	0.397±0.006	0.383±0.009	48.9±0.9	43.9±0.7
Camp. W_2	66.8±0.7	74.2±0.9	0.361±0.007	0.401±0.008	50.8±1.2	44.6±1.0
Domt. AL	75.0±0.9	75.3±0.8	0.392±0.008	0.369±0.008	48.5±1.3	43.0±0.9
Domt. 80% AL	74.5±1.0	72.9±1.6	0.406±0.008	0.370±0.008	49.8±1.0	45.1±1.4
Domt. 60%AL	66.0±1.2	74.3±1.2	0.396±0.007	0.387±0.007	51.6±0.7	44.6±0.9
Domt. DL	72.5±1.9	75.5±1.1	0.396±0.008	0.381±0.008	49.4±1.4	44.6±1.2
Domt. W_1	68.0±0.9	76.0±0.9	0.385±0.016	0.369±0.009	51.6±1.1	45.7±0.9
Domt. W_2	68.5±0.7	74.9±0.7	0.360±0.012	0.375±0.008	54.1±1.0	46.7±0.9
Significance level.	NS	NS	NS	NS	NS	NS

a-c : Means in the same column, for each criterion, having different superscripts differ significantly.
NS = not significant ; * = significant at p≤0.05 ; ** = significant at p≤0.01 .

There were no significant breed differences in plasma calcium or inorganic phosphorus levels at all ages examined. At the end of the growing period (22 weeks old) and 30 weeks of age the two breeds had nearly equal

levels of plasma calcium, yet its concentration in the Campbell ducks exceeded that of Domyati ones by about 16.0% at the end of the experiment (46 weeks of age), with no significant breed difference. Significant differences were detected , however, in plasma calcium concentration due to the effect of feeding system only at the end of the growing period (22 weeks of age) and at the end of the experiment (46 weeks of age), but at 30 weeks of age no significant differences were observed in that respect. Within feeding systems, the W_2-group had the highest level of plasma calcium at all ages, except at 46 weeks of age. The breed x feeding system interactions for plasma calcium concentration were not significant at all ages examined. The plasma level of inorganic phosphorus in the AL-group mediated all groups at the end of growing period (22 weeks of age) and at 30 weeks of age, but it recorded the highest value at the end of the experiment (46 weeks of age). The breed x feeding system interactions for plasma phosphorus concentration were significant only at the end of the growing period (22 weeks of age).

Table 6: Effects of breed and feeding system on plasma calcium and inorganic phosphorus concentrations of ducks at 22,30,and 46 weeks of age.

Treatments	Plasma Ca (mg/dl)			Plasma inorganic P (mg/dl)		
	22 weeks old	30 weeks old	46 weeks old	22 weeks old	30 weeks old	46 weeks old
Breeds (A)						
Camp.	12.7±0.9	39.3±1.7	34.9±2.2	5.38±0.44	7.82±0.57	6.25±0.37
Domt.	12.5±0.9	39.4±2.0	30.0±2.1	5.82±0.46	8.11±0.50	6.30±0.36
Significance Level	NS	NS	NS	NS	NS	NS
Feeding systems (B)						
AL	12.6±1.3^{b}	39.3±2.2	40.8±4.8^{a}	5.37±0.45^{ab}	8.5±0.55^{ab}	7.16±0.57^{a}
80% AL	8.4±0.8^{c}	40.6±3.9	34.1±3.6^{ab}	4.14±0.77^{b}	7.70±1.02^{ab}	6.86±0.78^{a}
60%AL	12.2±1.0^{b}	35.4±3.1	26.4±2.8^{b}	5.25±0.51^{ab}	9.55±1.34^{a}	5.87±0.63^{ab}
DL	8.1±0.7^{c}	40.5±3.2	34.4±4.6^{ab}	6.38±1.03^{a}	5.55±0.22^{b}	6.70±0.63^{a}
W_1	11.4±0.4^{bc}	36.8±3.7	29.8±2.7^{ab}	5.57±0.76^{ab}	8.63±1.07^{a}	6.26±0.41^{ab}
W_2	20.2±2.0^{a}	43.6±2.8	29.2±2.4^{ab}	6.88±0.90^{a}	8.29±0.55^{ab}	4.80±0.57^{b}
Significance Level	**	NS	**	*	*	*
Interaction A x B						
Camp. AL	13.8±0.8	39.0±0.9	44.8±0.2	4.23±0.51	7.78±0.53	6.82±0.42
Camp. 80% AL	8.6±1.4	38.5±4.1	35.6±6.0	5.48±1.29	6.04±0.98	6.03±1.27
Camp. 60%AL	12.3±1.5	41.3±4.8	32.0±1.6	4.40±0.14	10.42±2.29	7.04±1.03
Camp. DL	7.7±1.0	41.8±3.9	35.0±7.3	4.48±0.79	5.56±0.37	7.25±1.06
Camp. W_1	11.2±0.6	38.2±6.7	31.4±5.3	5.56±1.26	8.70±1.65	6.10±0.40
Camp. W_2	20.0±3.0	37.2±3.7	30.2±4.0	8.13±1.44	8.39±0.87	4.24±0.38
Domt. AL	11.5±1.9	39.6±3.8	36.8±7.6	6.52±0.53	8.31±0.92	7.50±1.00
Domt. 80% AL	8.2±0.7	42.1±7.0	32.6±4.4	2.79±0.45	9.35±1.60	7.69±0.90
Domt. 60%AL	12.1±1.3	29.6±2.5	20.7±4.3	6.10±0.92	8.68±1.56	4.69±0.38
Domt. DL	8.5±1.1	39.2±5.5	33.8±6.4	8.29±1.60	5.51±0.28	6.15±0.72
Domt. W_1	11.6±0.7	35.3±3.9	28.2±1.4	5.58±0.97	8.57±1.51	6.42±0.74
Domt. W_2	20.5±3.0	50.0±2.0	28.2±2.9	5.64±0.92	8.20±0.76	5.35±1.08
Significance level.	NS	NS	NS	**	NS	NS

a-c : Means in the same column, for each criterion, having different superscripts differ significantly.

NS = not significant ; * = significant at p≤0.05 ; ** = significant at p≤0.01

Table 7: Effects of breed and feed restriction system on Plasma progesterone level of ducks at 22,30 and 46 weeks of age .

Treatments	Plasma progestron (ng/ml)		
	22 weeks old	30 weeks old	46 weeks old
Breeds (A)			
Camp.	0.074±0.006 [b]	0.493±0.049	0.158±0.036 [b]
Domt.	0.109±0.012 [a]	0.466±0.048	0.395±0.070 [a]
Significance level	*	NS	**
Feeding systems (B)			
AL	0.108±0.032	0.327±0.070	0.116±0.037[b]
80% AL	0.096±0.018	0.357±0.550	0.122±0.030[b]
60%AL	0.072±0.009	0.536±0.076	0.291±0.119[b]
DL	0.098±0.013	0.526±0.089	0.167±0.031[b]
W_1	0.075±0.011	0.577±0.082	0.335±0.114[b]
W_2	0.102±0.014	0.555±0.106	0.627±0.142[a]
Significance level	NS	NS	**
Interaction A x B			
Camp. AL	0.056±0.009	0.289±0.085	0.052±0.015
Camp. 80% AL	0.064±0.006	0.386±0.090	0.085±0.036
Camp. 60%AL	0.071±0.009	0.679±0.075	0.132±0.041
Camp. DL	0.106±0.022	0.470±0.115	0.105±0.031
Camp. W_1	0.049±0.006	0.489±0.105	0.064±0.014
Camp. W_2	0.102±0.021	0.646±0.188	0.507±0.146
Domt. AL	0.160±0.058	0.366±0.119	0.180±0.065
Domt. 80% AL	0.129±0.031	0.329±0.700	0.159±0.046
Domt. 60%AL	0.074±0.017	0.393±0.109	0.450±0.224
Domt. DL	0.089±0.016	0.581±0.142	0.228±0.041
Domt. W_1	0.101±0.013	0.662±0.126	0.606±0.165
Domt. W_2	0.103±0.020	0.464±0.106	0.746±0.247
Significance level.	NS	NS	NS

a-b : Means in the same column, for each criterion, having different superscripts differ significantly.
NS = not significant ; * = significant at p≤0.05 ; ** = significant at p≤0.01 .

Plasma progesterone level:

At the end of the growing (feed restriction) period (22 weeks old) and at the end of the experiment (46 weeks old), it was observed that Domyati ducks had significantly higher levels of progesterone than that of Campbell ones by 47.3 and 25.0%, respectively. On the other hand, both the two breeds had nearly equal levels of plasma progesterone at 30 weeks of age. Significant differences were observed in the level of plasma progesterone due to the effect of feeding system only at the end of the experiment (46 weeks of age). Within feeding systems, although the progesterone level in plasma of the AL-group was the highest at the end of the growing (feed restriction) period (22 weeks of age), the opposite trend was found at the other two ages (30 and 46 weeks of age). At 30 weeks of age and at the end of the study (46 weeks of age), it was observed that feed-restricted groups had higher levels of plasma progesterone than those of the AL-group

(control). The breed x feeding system interactions for plasma progesterone concentration were not significant at all ages examined.

Costs and returns:

The results of the effects of breed and feed restriction system on costs, net returns and economic efficiency are summarized in Tables 8 and 9. Campbell ducks had higher feeding cost at 10-22, 22-46 and 10-46 weeks of age than Domyati ones by 28.1, 12.4 and 15.9%, respectively. Also, Campbell ducks had higher total productive costs, and egg cost at 10-46 weeks of age than the Domyati ones by 15.8 and 17.5%, respectively.

The net return and economic efficiency; on the basis of egg selling, were higher in Campbell ducks than those of Domyati ones by 120.2 and 90.1%, respectively. On the basis of selling hatched ducklings, Campbell ducks had higher net return than that of Domyati ones by 11.9%, however Domyati ducks had higher economic efficiency than that of Campbell ones by 3.5%.

Application of the feed restriction during the growing period (10-22 weeks of age) decreased the feeding cost. When the feed-restricted birds were put on full feeding (22-46 weeks of age), no tendency was observed for consuming more feed during the subsequent laying period, therefore the feed costs at 22-46 weeks of age were nearly similar for all groups. The total feeding costs (LE/duck) from 10 up to 46 weeks of age for feed-restricted groups were decreased by 5.9, 14.8, 4.5, 4.1 and 7.5% for 80% AL, 60% AL, DL, W_1 and W_2 groups, respectively, in comparison with that of the control (AL-group). The egg cost was nearly similar in all groups.

Table 8. Effects of breed and feed restriction system on costs of production of experimental ducks from 10 up to 46 weeks of age.

	Feed consumption / duck (10-22 wk)		Feed consumption / duck (22-46 wk)		Total feed consumption / duck (10-46 wk)		Total* productive costs (LE)	Egg cost LE/egg
	Amount (kg)	Cost (LE)	Amount (kg)	Cost (LE)	Amount (kg)	Cost (LE)	/ duck (10-46 wk)	(10-46 weeks)
Camp.	9.81	6.29	29.48	19.72	39.29	26.01	40.64	0.40
Domt.	7.66	4.91	26.22	17.54	33.88	22.45	35.08	0.34
AL	10.99	7.04	27.91	18.67	38.90	25.71	40.17	0.38
80% AL	8.79	5.64	27.87	18.64	36.66	24.28	37.94	0.38
60% AL	6.59	4.23	27.17	18.17	33.76	22.40	35.00	0.34
DL	8.79	5.86	28.11	18.80	36.90	24.60	38.53	0.35
W_1	9.42	6.04	27.99	18.65	37.30	24.69	38.98	0.39
W_2	7.85	5.04	28.23	18.88	36.08	23.92	37.38	0.32

* The constant costs were considered to be 36% from the total costs according to Fattari *et al.* (1991).

On the basis of egg selling, the net return and economic efficiency were improved by 36.7 and 56.9% in the 60% AL-group and by 35.4 and 29.9% in the DL-group, respectively, in comparison to the AL-group. On the basis of selling hatched ducklings, the net return was increased in the feed-

restricted groups (80% AL, 60% AL, DL, W_1 and W_2) by 249.4, 504.5, 710.5, 256.1 and 645.9%, respectively, in comparison to the AL- group (control). In the same order, the economic efficiency was improved by 264.0, 594.0, 745.2, 270.8 and 701.8%, respectively.

Table 9. Effects of breed and feed restriction system on returns and economic efficiency (EE) of experimental ducks from 10 up to 46 weeks of age.

	On the basis of egg selling				On the basis of selling hatched ducklings			
	Egg number / duck	Income (LE / duck)	Net return (LE/duck)	EE (%)	Egg number / duck	Income (LE / duck)	Net return* (LE/duck)	EE** (%)
Camp.	100.80	55.44	14.80	36.42	58.95	70.74	20.52	50.49
Domt.	104.50	41.80	6.72	19.16	63.34	63.34	18.33	52.25
AL	104.70	52.35	12.18	30.32	49.21	54.13	4.01	9.98
80% AL	98.90	49.45	11.51	30.34	55.77	61.35	14.01	36.33
60% AL	103.30	51.65	16.65	47.57	62.77	69.05	24.24	69.26
DL	108.70	54.65	15.82	41.06	73.96	81.36	32.50	84.35
W1	100.70	50.35	11.77	30.51	56.75	62.43	14.28	37.01
W2	99.60	49.80	12.42	33.23	69.77	76.70	29.91	80.02

*Net return = Income - total productive costs.
** EE =100 [net return]/[Total productive costs]

DISCUSSION

The aim of this study was to clarify the nature of any production response during the laying period, which could be attributed to the effect of feed restriction during the rearing period of Domyati and Campbell ducks. The study of restricted feeding in the fowl is complicated by interactions of numerous factors, which may hinder straightforward explanations. There is, however, a voluminous literature on feed restriction in poultry, where it is commonly used during the growing period as a husbandry procedure, to control body weight and reduce reproductive problems in meat-type and egg-type breeder chickens. In this connection, even though little research has been carried out on ducks, the comparison between chicken breeds and the experimental breeds of ducks may not lose its validity.

Growing Period:

A significant variation was observed in body weight between the two breeds of ducks (Domyati and Campbell) at 22 weeks of age. The breed is considered to be one of the most important factors affecting live body weight of birds. Similarly, breed differences in body weight of ducks during the rearing period were reported by Kamar and Yamani (1975), Hatzel (1983), Saleh (1985), Mostafa (1989), Tag EL-Din *et al.* (1989), Fattouh (1994) and Ghoneem (1998) dealing with different breeds of duck. The reduction which was observed in body weight of feed-restricted groups of ducks versus the *ad libitum*-fed group at the end of growing period (22 weeks of age) was

expected. Similar observations were reported by Luckham *et al* (1963), dealing with leghorn pullets, Owings and Sell (1980) and Nestor *et al.* (1981) in turkeys, Olver (1984a) and Bartov *et al.* (1988) in Pekin ducks, and Amer *et al.* (1993) and Tag EL-Din (1995) in chickens; who found that the average body weight was significantly lower in the feed- restricted groups than that of the full-fed controls throughout the growing period.

Flock uniformity is one of the best indicators of flock productivity. The better is the uniformity of growing birds, the better is their subsequent performance for production. The best flock uniformity which was achieved with the 80% AL-group in the present study, is in agreement with Bartov *et al.* (1988) and Amer *et al.* (1993); who reported that chicken flock uniformity was significantly increased in feed-restricted growing birds compared with that of their full-fed counterparts of the control. While, Bennett and Leeson (1989) indicated that chicken flock uniformity was unaffected by the restricted feeding. On the contrary, Mandev and Duneva (1989) dealing with chickens, and Renema *et al.* (1994) dealing with turkeys, showed that feed restriction during the growing period reduced the flock uniformity.

Viability percentage of ducklings was 100% during the rearing period from 10 to 22 weeks of age. In contrast, Hatzel (1983) found significant breed differences in viability percentage of ducks during the growing period. In addition, Isaacks *et al.* (1960) and Deaton and Quisenberry (1963) found a significant decrease in viability percentage during the growing period of broiler-type and egg-type replacement stocks, respectively, due to the application of feed restriction.

Laying period:

Significant breed differences were observed in age at sexual maturity, daily feed consumption, egg weight, egg mass, plasma progesterone levels (except at 30 weeks of age) and viability percentage. Similar breed differences were reported by Goher (1968) and Hatzel (1983) in age at sexual maturity; Eswaran *et al.* (1985) and Ghoneem (1988) in daily feed consumption and egg weight; and Hatzel (1983) in viability percentage. Generally, these breed differences are probably due to differences in genetic potential for these traits between the two breeds.

The delay in age at sexual maturity due to the application of feed restriction during the rearing period in the present study is in line with the reports of Singh *et al.* (1979), Olver (1984a and b) and Olver (1995), dealing with ducks. On the other hand, Abd El-Hamid *et al.* (1995) and Lin and Hsu (1995) pointed out that the feed restriction did not alter age at sexual maturity for growing pullets.

The delayed sexual maturity caused by feed restriction during rearing is a major factor in causing a variety of conclusions to be reached concerning the relative productivity of restricted hens compared with *ad libitum*-fed counterparts (Bullock *et al.* 1963). Hocking (1990) has suggested that the optimum degree of restriction is close to that required to result in the minimum body mass and feed intake required for the onset of lay. He also reported that the ducks should be at least 60% of the mass of unrestricted

birds to achieve sexual maturity. This assumption is in keeping with that of Olver (1984b, 1988).

No significant differences were observed in daily feed intake, from 22-46 weeks of age, among the experimental groups of ducks; showing that feed restriction during rearing had no significant effect on feed intake during laying period. Similarly, Olver (1984b) indicated that restricted feeding for Pekin ducklings to 70% of the *ad libitum* consumption up to 20 weeks of age had no significant effect on feed intake from 20 to 60 weeks of age. On the other hand, Gous and Stielau (1976) and Olver (1995) showed that feed restriction during the rearing period decreased lifetime of birds and feed intake.

There are many contradictions in the reports on the effects of feed restriction during the rearing period on the subsequent feed consumption. Part of this is probably due to the duration of the laying period. Some have measured feed intake during the laying period from sexual maturity to a particular age (e.g. Walter and Aitken, 1961) while others have measured intake between two ages (e.g. Lee *et al.*, 1971b). The former measure is dependent upon the definition of sexual maturity; age at 50% production is a better measure than age at first egg in comparing the *ad libitum*-fed with feed-restricted birds because of the higher rate of increase in egg production in the feed-restricted birds. In the present experiment, all birds consumed approximately the same amount of feed during the laying period.

Laying rate was significantly affected by feed restriction during the rearing period. Similar results were obtained by Olver (1984b, 1988), Krastn (1987), Olver (1995) and Mazanowski and Kokoszynski (1998a and b) who showed that this trait is definitely improved by feed restriction. On the other hand, several reports indicated that the restricted feeding of birds seemed to have no effects on the subsequent laying rate (Deaton and Quisenberry, 1963; Lillie and Denton, 1966; Nestor *et al.* 1981; and Bartov *et al.* 1988).

The insignificant differences that were observed in egg weight; due to the effect of feed restriction during the rearing period in the present study, are also in line with those reported by Negm *et al.* (1984b). Bartov *et al.* (1988), Amer *et al.* (1993) and Abd EL-Hamid *et al.* (1995). In contrast to these results, Olver (1984b), Krastin (1987) and Pan *et al.* (1987) illustrated that restricted feeding during the rearing period of birds increased their egg weight during the laying period.

Lee *et al.* (1971a) discussed the difference between the average egg weight at certain age and the average weight of all eggs laid in their experiments with restricted feeding, and concluded that the former was not altered by restricted feeding, whereas the latter may be increased because the feed-restricted birds have commenced their egg production at a later chronological age, and, therefore laid heavier eggs. This conclusion was based on the well known relationships (for example: Williams and Sharp, 1978) between age and egg weight in laying hens.

Lee *et al.* (1971a) found that mortality during the laying period of pullets which were feed-restricted during the rearing period was lower than that of pullets fed *ad libitum*. They also stated that 64 of 92 other studies confirmed this observation. Olver *et al.* (1978) and Olver (1984b, 1988)

reported that mortality decreased in the laying period as the rate of feed-restriction increased during the rearing period.

Eggs fertility (%) of ducks which were subjected to restricted feeding during the rearing period was significantly higher than that of ducks fed *ad libitum*. These results are in line with those of Olver *et al.* (1978) and Olver (1984b, 1988). The lower fertility of the ducks given a free access to feed, may be related to their heavier body weight; which was evident at 22 weeks of age, and this may reflect an increase in body fat content. On the other hand, Moultrie (1983) and Fattori *et al.* (1991) reported that feed restriction during the rearing period had no significant effect on fertility or total hatchability of eggs produced by broiler breeder females. However, in most cases, feed restriction during the rearing or laying periods resulted in an increased fertility but had little or no effect on hatchability (Lee *et al.*, 1971a; Pym and Dillon, 1974; McDaniel *et al.*, 1981; Wilson and Harms, 1984; and Bilgili and Renden, 1985). Negm *et al.* (1984a) reported that the type of feeding program (skip-a-day and 50% of full-fed) significantly reduced egg shape index. Kari *et al.* (1977) concluded that feed restriction did not show any effect on shell thickness.

However, Abd EL-Hamid *et al.* (1995) found that skip-two-days regimen during the rearing period; further decreased the egg shell thickness compared with that of skip-a-day regimen.

Concerning blood constituents, researches on the effect of feed restriction on blood constituents are very limited. Abd EL-Hamid *et al.* (1995) reported that restricted feeding by skipping one or two days weekly significantly increased the level of blood phosphorus. Generally, numerous hormones are directly or indirectly involved in the metabolic responses of feed restriction (Nir *et al.* 1996).

CONCLUSION

From the previous results, it can be concluded that applying feed restriction during the growing period (10-22 weeks of age) may have some positive effects on ducks' performance, eggs fertility and hatchability, and, economic efficiency of duck production.

REFERENCES

Abd El-Hamid, A.M.; Mervat A. Ali; El-Samra H. Abou-Egla; Tork M. Dorra; M.M. Khalifah and P. Merat (1995). Effect of feed restriction and vitamin C supplement on productive performance of mature female and male chickens. Mansoura Univ. J. Agric. Sci., 20(1):181-199.

Amer, M.F.; I. El-Wardany; K.M. Mansour; Y.M. Abdel-Kader and R.G. Teeter (1993). The influence of feed restriction during the growing period on the flock uniformity, body weight, and age at sexual maturity. Mansoura Univ. J. Agric. Sci., 18:2869-2879.

Bartov, I.; S. Bornstein; Y. Lev; M. Pines and J. Rosenberg (1988). Feed restriction in broiler breeder pullets: Skip-a-day versus skip-two-days. Poult. Sci., 67:809-813.

Bennett, C.D. and S. Leeson (1989). Research Note: Growth of broiler breeder pullets with skip-a-day versus daily feeding. Poult. Sci., 68:836-838.

Bilgili, S.F. and J.A. Renden (1985). Relationship of body fat to fertility in broiler breeder hens. Poult. Sc., 64:1394-1396.

Blight, L.F. and G.H. White (1983). I-labeled radioimmunoassay kits for progesterone evaluated use in an *in vitro* fertilization program. Clin. Chem., 29:1024-1027.

Bullock D.W.; T.R. Morris and S. Fox (1963). Protein and energy restriction for replacement pullets. Brit. Poult. Sci.,4: 227-237.

Deaton, J.W. and J.H. Quisenberry (1963). Effects of caloric restriction during the growing period on the performance of egg-type replacement stock. Poult. Sci., 42:618-613.

Eswaran, K.R.; A. Ramakrishnan; C.K. Venugp[lan and G.R. Nair (1985). Comparative performance of Khaki-Campbell and Desi ducks. 2. Egg production, feed efficiency and egg quality. Indian J. Poultry Sci., 20(1):42-45.

Fattori, T.R.; H. R. Wilson; R.H. Harms and R.D. Miles (1991). Response of broiler breeder females to feed restriction below recommended levels. 1. Growth and reproductive performance. Poult. Sci., 70:26-36.

Fattouh, M.H.A. (1994). A study for some production traits in ducks. M.Sc. Thesis, Fac. Agric., Mansoura Univ.

Fiske, C.H. and Y. Subbarow (1925). The colorimetric determination of phosphorus. J. Biol. Chem., 66:375-400.

Ghoneem, A.I.A. (1998). Physiological and productive studies on ducks. M.Sc. Thesis, Fac. Agric., Mansoura Univ.

Goher, N.E. (1968). Effect of crossing on meat and egg production in ducks. M.Sc. Thesis. Fac. Agric., Cairo Univ.

Gomez, K.A. and A.A. Gomez (1984). Statistical Procedures for Agricultural Research. 2nd Ed. John Wiley and Sons, Inc.

Gous, R.M. and W.J. Stielau (1976). Growth and laying performance of light-hybrid pullets subjected to quantitative food restriction. Brit. Poult. Sci., 17:487-498.

Hatzel, D.J.S. (1983). The egg production of intensively managed Alabio and Tegal ducks and their reciprocal crosses. World Review of Animal Production, 19(4):41-46.

Hocking, P.M. (1990). Comparison of the degree of food restriction during rearing on ovarian function at the onset of lay in unselected ducks (*Anas Platyrhynchos)* in a line selected for improved feed efficiency. Brit. Poult. Sci.,31: 351-360.

Isaacks, R.E.; B.L. Reid; R.E. Davies; J.H. Quisenberry and J.R. Couch (1960). Restricted feeding of broiler type replacement stock. Poult. Sci., 39:339-346.

Johnson, R.J.; A. Choice; D.J. Farrell and R.B. Cumming (1984). Production responses of layer strain hens to feed restriction during rearing. Brit. Poult. Sci., 25:369-387.

Kamar, G.A.R. and K.A. Yamani (1975). Studies on duck organs, glands and meat production. Egypt. J. Anim. Prod., 20(1):41-53.

Kari, R.R.; J.H. Quisenberry and J.E. Bradley (1977). Egg quality and performance as influenced by restricted feeding of commercial caged layers. Poult. Sci., 56:1914-1919.

Krastn, V. (1987). Restricted feeding of replacement ducklings. Ptitsevodstvo, 9:29-30.

Lee, P.J.W.; A.L. Gulliver and T.R. Morris (1971a). A quantitative analysis of the literature concerning the restricted feeding of growing pullets. Brit. Poult. Sci., 12:413-437.

Lee, P.J.W.; A.L. Gulliver and T.R. Morris (1971b). Restricted feeding on broiler breeder pullets during the rearing period and its effects on productive and breeding. Brit. Poult. Sci., 12:499-510.

Lillie, R.J. and C.A. Denton (1966). Effect of nutrient restriction on White Leghorn in the grower and subsequent layer periods. Poult. Sci., 45:810-818.

Lin, J.Y. and J.C. Hsu (1995). Effect of feed restriction and dietary protein levels on the sexual maturity and traits of first egg of Taiwan country pullets. J. Chin. Soc. Anim. Sci., 24:373-390.

Luckham, D.G.; S.J. Slinger; I.R. Sibbalnd, and G.C. Asthon (1963). Methods of restricting feed or energy intake of growing Leghorn pullets and their effect on subsequent reproductive performance. Poult. Sci., 42:1285.

Mandev, I. and M. Duneva (1989). Effect of a programme for daily quantitative restriction of feed for growing parents of broiler chickens on flock uniformity and productivity. 1. Flock uniformity on basis of live weight. Zhivotnov dni Nawki, 26:46-50.

Mazanowski, A. and D. Kokoszynski (1998a). Effect of restricted feeding from 7 to 20 weeks of age on duck performance before and during reproduction. Roczniki Naukow Zootechniki, 25:135-145.

Mazanowski, A. and D. Kokoszynski (1998b). Effect of restricted feeding of duck from 7 to 20 weeks of age on their reproductive traits. Roczniki Naukow Zootechniki, 25:147-157.

McDaniel, G.R.; J.Brake and M.K. Eckman (1981). Factors affecting broiler breeder performance. 4. The interrelationship of some reproductive traits. Poult. Sci., 60:1792-1797.

Moorhead, W.R. and H.G. Biggs (1974). 2-amino-2-methyl-1-propanol as the alkalizing agent in an improved continuous flow cresolphthalein complexone procedure for calcium in serum. Clin. Chem. , 20:1458-1460.

Mostafa, M.Y. (1989). Genetical and physiological studies on ducks. M.Sc. Thesis, Fac. Agric., Kafr El-Sheikh, Tanta Univ.

Moultrie, F. (1983).Feeding and lighting trials with broiler breeders-A progress report. Pages 48-54 in:Proc. Arkansas Nutr. Conf., Department of Animal Science, University of Arkansas, Fayetteville, AR.

N.R.C.; National Research Council (1994). Nutrient Requirements of Poultry. 9th Rev. Ed. National Academy Press. Washington, D.C., USA.

Negm, H.M.; G.A.R. Kamar; S.A. Riad and A. Mangood (1984a). Effect of restricted feeding during the growing period on egg quality, reproductive organs, endocrine glands and some internal organs of Ross Tint and Fayoumi laying hens. Egypt. J. Anim. Prod., 24:23-30.

Negm, H.M.; G.A.R. Kamar; S.A. Riad and A. Mangood (1984b). Effect of restricted feeding during the growing period on subsequent performance of Fayoumi and Ross Tint laying hens. Egypt. J. Anim. Prod., 24:31-40.

Nestor, K.E.; A.H. Cantor; W.L. Bacon and K.I. Brown (1981). The influence of body weight restriction during the growing and holding periods on reproduction of turkey females from strains differing in body weight. Poult. Sci., 60:1458-1467.

Nir, I.; Z. Nitsan; E.A. Dunnington and P.B. Siegel (1996). Aspects of food intake restriction in young domestic fowl: metabolic and genetic considerations. World's Poultry Science Journal, 52: 251-266.

North, M.O. (1984). Commercial Chickens Production Manual. 3rd edition. AVI Publishing Company Inc. Westport, Connecticut.

Olver, D.M. (1984a). Qualitative versus quantitative feed restriction in Pekin breeder ducks during the rearing period. South African J. Anim. Sci., 14(2):75-78.

Olver, D.M. (1984b). Quantitative feed restriction of Pekin breeder ducks during the rearing period and its effect on subsequent productivity. South African J. Anim. Sci., 14(2):136-141.

Olver, D.M. (1988). Quantitative feed restriction of Pekin ducks from 3 weeks of age and its effects on subsequent productivity. South African J. Anim. Sci., 18:93-96.

Olver, D.M.; A. Kuyper Margaret and J. Mould Diana (1978). Restricted feeding of Pekin breeder ducks during the rearing period and its effect on subsequent productivity. Agroanamalia, 10:7-12.

Olver, D.M. (1995). Effect of restricted feeding during the rearing period and a "forced moult" at 40 weeks of production on the productivity of Pekin breeder ducks. Brit. Poult. Sci., 36:737-746.

Owings, W.J. and J.L. Sell (1980). Effect of restricted feeding from 6 to 20 weeks of age on reproductive performance of turkeys. Poult. Sci., 59:77-81.

Pan, C.M.; C.Y. Lin; C.L. Kan and B.J. Chen (1987). The study of different restricted feeding method of Brown Tsaiya ducks in growing period. J. Taiwan Livestock Res., 20:45-53.

Pym, R.A.E. and J.F. Dillon (1974). Restricted food intake and reproductive performance of broiler breeder pullets. Brit. Poult. Sci., 15:245-259.

Renema, R.A.; F.E. Robinson, V.L. Melnychuk; R.T. Hardin; L.G. Bagley; D.A. Emmerson and J.R. Blackman (1994). The use of feed restriction for improving reproductive traits in male-line Large White turkey hens. 1. Growth and carcass characteristics. Poult. Sci., 73:1724-1738.

Robbins, K.R.; G.C. McGhee; P. Osei and R.E. Beauchene (1986). Effect of feed restriction on growth, body composition and egg production of broiler females through 68 weeks of age. Poult. Sci., 65:2226-2231.

Saleh, K. (1985). Preliminary results of the effect of crossbreeding on characteristics of ducks. Egypt. Poult. Sci., 5: 164-182.

Singh, C.M.; R.A. Singh; R.K. Sharma and C.K. Aggarwal (1979). Effect of level and duration of feed restriction on reproductive performance of White Pekin ducks. Haryana Agric. Univ. J. Res., 9:378-383.

Tag El-Din; M.M. Ali and T.M.I. Dorra (1989). Growth performance and meat yield of Broiler Domyati and Pekin ducklings. J. Agric. Sci., Mansoura Univ., 14(3):1479-1488.

Tag El-Din, T.H. (1995). Effect of strain, dietary protein level and feeding system on growth performance of two local Egyptian chickens. J. Agric. Sci., Mansoura Univ., 20(4):1353-1367.

Walter, E.D. and J.R. Aitken (1961). Performance of laying hens subjected to restricted feeding during rearing and laying periods. Poult. Sci., 40:345-354.

Williams, J.B. and P.J. Sharp (1978). Ovarian morphology and rates of ovarian follicular development in laying broiler breeders and commercial egg production hens. Brit. Poult. Sci., 19: 387-395.

Wilson, H.R. and R.H. Harms (1984). Evaluation of nutrient specifications for broiler breeders. Poult. Sci., 63:1400-1406.

تأثير تحديد الغذاء أثناء فترة النمو علي الأداء الإنتاجي لبط الكامبل والبط الدمياطي

تاج الدين حسن تاج الدين ، مرفت عطية علي ، فوزي صديق عبد الفتاح إسماعيل ،حاتم عبد السلام محمد جاد* ، عبد الغني محمد الشحات*

قسم انتاج الدواجن -كلية الزراعة -جامعة المنصورة

معهد بحوث الإنتاج الحيواني- وزارة الزراعة - الجيزة

أجريت هذه الدراسة لبحث تأثير كل من السلالة ونظم مختلفة لتحديد الغذاء أثناء فترة النمو (١٠-٢٢ أسبوع) على المظاهر الإنتاجية اللاحقة لبط الكامبل والبط الدمياطي. تم تقسيم عدد ١٨٠ بطة عمر ١٠ أسابيع (١٤٤ أنثى + ٣٦ ذكر) من كل سلالة إلى ٦ مجموعات تجريبية.غذيت المجموعة الأولى (المقارنة) تغذية حرة حتى الشبع. وغذيت المجموعة الثانية والثالثة بمستوى ٦٠ ، ٨٠% من حد الشبع لمجموعة المقارنة.و غذيت المجموعة الرابعة على ٨٠% من حد الشبع لمجموعة المقارنة مضافا إليها باقي حد الشبع (٢٠%) نشارة خشب ناعمة. وغذيت المجموعة الخامسة و السادسة بحرية حتى الشبع مع التصويم لمدة يوم او يومين أسبوعيا لكل منها على الترتيب. تم تغذية كل المجموعات بحرية حتى الشبع خلال فترة إنتاج البيض (٢٢-٤٦ أسبوع). أخذت القياسات عن كل من وزن الجسم وتجانس القطيع والعمر عند النضج الجنسي واستهلاك العلف والتحويل الغذائي ومعدل إنتاج البيض ووزن البيض وكتلة البيض الكلية ونسبة الحيوية ونسبة الخصوبة ونسبة الفقس وبعض معايير جودة البيض وبعض مكونات الدم والكفاءة الاقتصادية . ويمكن تلخيص النتائج المتحصل عليها كالأتي:

وجدت فروق معنوية بين السلالتين في كل من وزن الجسم عند عمر ٢٢ أسبوع وتجانس القطيع والعمر عند النضج الجنسي واستهلاك العلف اليومي ووزن البيض وكتلة البيض الكلية ومستوى هرمون البروجسترون في البلازما (فيما عدا عند عمر ٣٠ أسبوع) وكذلك نسبة الحيوية. بينما لم يتأثر بالسلالة كل من معدل إنتاج البيض و التحويل الغذائي ونسبة الخصوبة ونسبة الفقس وجودة البيض ومستويات الكالسيوم والفسفور في بلازما الدم .

أدى تطبيق نظم تحديد الغذاء أثناء الفترة من ١٠ إلى ٢٢ أسبوع إلى خفض وزن الجسم عند ٢٢ أسبوع وتأخر النضج الجنسي وكذلك تحسين نسبة الخصوبة ونسبة الفقس للبيض. كما كان هناك تأثير معنوي لتحديد الغذاء على كل من تجانس القطيع ومعدل إنتاج البيض (خصوصا المجموعة الرابعة و السادسة) وكتلة البيض الكلية (خصوصا المجموعة الثالثة و الرابعة والسادسة) وحيوية الطيور وجودة البيض ومكونات الدم . بينما لم يؤثر تحديد الغذاء على كل من استهلاك العلف اليومي والتحويل الغذائي وكذلك وزن البيضة. وعموما فإن تحديد الغذاء خلال فترة النمو (١٠-٢٢ أسبوع) أدى إلى الحصول على كفاءة اقتصادية أفضل خاصة مع المجموعة الثالثة و الخامسة.