NUTRITIONAL AND MANAGEMENT STUDIES ON THE PIGEON:
ESTIMATE OF PROTEIN REQUIREMENTS.

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ABSTRACT

An experiment was conducted to estimate requirements crude protein (CP) and its effects on productive and reproductive performance of Local Baladi squabs and Pigeons under Egyptian conditions. A total number of 60 pair of squabs Baladi pigeons (28 days – age at onset of egg production), were involved in the first experimental (Exp.1) growing period, While it was 32 pairs of Baladi pigeons (6 or 7 months old) were distributed according to its consistent mating systems (sex ratio of pigeons 1:1) in the second experimental (Exp.2) laying period. At the beginning of each experiment squabs and pigeons were divided randomly into equal four treatments containing 15 pairs (3 replicates of 5 pairs each) in the growing period (Exp.1) and 8 paris (4 replicates of 2 pairs each) each in the laying period (Exp.2).The dietary CP levels were 14, 16, 18 and 20%. The diets were isocloric (2700+31.2 ME Kcal/ kg diet). Diets were formulated in mash form and with vitamin and mineral premix. Birds were maintained on a 14 hours of lighting regimen along the experimental period. Feed and water were given ad libitum along the experiment.

Results obtained are summarized as follows:

1- Exp. 1 (growing period). Differences in live body weight, and feed intake during 1and 2 months were not significant ($P<0.05$) affected when dietary CP levels increased. While, differences in weight with male and female and feed intake during 3, 4, 5 and 6 months were significantly ($P<0.05$) increased as the level of CP increased from 14 to 20%. Protein intake were significantly ($P<0.05$) increased as the level of protein increased during experimental period.

2- Exp. 2 (laying period). Final body weight, total egg number per pair, total fertility, total hatchability, hatchability in fertile eggs percentages and mortality rate were not significantly ($P<0.05$) affected when dietary CP levels increased. While, egg cycle significantly ($P<0.05$) decreased by the increase of dietary CP levels. Egg weight was significantly ($P<0.05$) increased as the level of CP increased from 14 to 20% CP of diet.

Feed intake and protein intake significantly ($P<0.05$) increased by the increase of dietary CP levels with or without squabs. Also, number of squabs per pair, weight of squabs in entire period and livability percentage were significantly ($P<0.05$) increased as dietary CP levels increased from 14 to 20%. Relative growth rate (RGR) recorded the highest values at the first days but RGR declined gradually to reach the minimum value at the last days of the experimental period. Body weight gain during 8 to 14 days of age was higher compared with other periods. While the weight gain from 21 to 28 days of age was very poor. BWG was significantly ($P<0.05$) increased as dietary CP levels increased from 14 to 20%.

In conclusion. The highest CP level of pigeon (20% CP) was the best s compared with other CP levels (18, 16 and 14% CP). The diet containing 14% CP levels were suggested to be suitable requirement and no adverse effects on productive and reproductive performance of Local Baladi squabs and Pigeons under Egyptian conditions

INTRODUCTION

Archaeological records suggest that both pigeons and doves trace their domestication back to around 5000 BC. Greek and Roman writings refer to the selective breeding and housing of pigeons in dove cotes (Levi, 1969),

They have been raised for centuries, especially in North Africa and the Middle East. Dovecotes are a good source of both squab and garden manure, and they continue to be used, especially in Egypt. Many breeds have been developed for meat production. They produce squab that grow quicker and have larger breast than unselected birds (Levi, 1969). The pigeons are distinguished apparently than all other birds in that when hatch they are fed upon a semi digested substance from their parents' crop known as crop milk (Levi, 1974).

There is alack of information is about the nutrient requirements and feeding for pigeon. Sales and Janssens (2003) showed that squabs have an extraordinary high rate of maturing (0.1466 to 0.1945 g/ d) in comparison to other domesticated avian species such as poultry (0.0450 g/d) and quail (0.077 to 0.097 g/d). This growth rate was achieved by regurgitation of a holocrine substance (crop milk) by both parents, formed in response to prolactin secretion and triggered by brooding. Aggrey and Cheng (1993) indicated that the maximal weight gain of squabs was observed during 8-14 days of age, while weight gain by the squab between days 21 and 28 days was minimal. In fact, some squabs actually lost weight during this period. Essam (1997) showed that the highest growth rate of squabs was obtained during feeding on the crop milk and the lowest was during seed feeding.

A large number of research has been reported on protein requirement; of young meat lyre pigeons to maximize weight gain (Pelzer 1990 a, b) as well as the feed conversion ratio (Rizmayer, (1969) Waldie *et al.*, (1991) indicated that experiments are necessary for determining the nutritional requirements of pigeons wheel is difficult because of several characteristics features of these birds such as: 1) Young pigeons continuously stay in the nest and are dependent on their parents for feed intake; 2) Initially, the parents feed the squabs with a special feed so- called “crop milk”; and 3) Parents are strictly monogamous, and the pair remain together throughout their live. No nutritional requirements for pigeons were included in the summary for poultry published by the National Research Council (1994). Frank (1951) and the USDA (1960) indicated that feeding of pigeons differ radically from the feeding of other poultry species. Pigeons can not be fed mash or green diet .The protein required is ranges from 13.5 to 15 %, carbohydrate 60 to 70 %, fat 2 to 5 % and fiber not more than 5 %. Waldie *et al.*, (1991) reported that 16 % crude protein was sufficient for pigeons without adversely affecting egg production or number of young pigeons produced. However, Meleg *et al.*, (1999) reported that dietary crude protein level 12,14,16,18 and 20 % at a ME concentration of 11.8 to 12.1 MJ/Kg failed to affect the length of the egg cycle (28.9 days), annual egg production (21.4), egg weight (21.7g),hatchability of eggs laid (62.2%) hatchability of fertile eggs (65.5%) and mortality of squabs up to weaning (31.1%). However

increasing of crude protein content increased the weaning weight from 502.6 to 532.3 g of squabs at 8 days and annual production per pair from 4.1 to 5.4 Kg. Furthermore,

Bottcher *et al.*, (1985) showed that increasing CP content from 12, 14, 15, 16, and 18 % of the diet did not influence annual squabs production per breeding pair. Wolter *et al.*, (1970) fed diet containing 12 to 26 % crude protein to parents and found that 18 % dietary crude protein caused an optimal growth of squabs (from 19 to 430 g over 28 days). Morley (1974) indicated that a mixture of good quality whole grains is the standard diet for pigeons and it should contain about 14 % protein and not over 5 % fiber.

In Egypt very limited information is available concerning performance of Baladi pigeons. Thus the present study aimed to study the effect of diets with different CP levels (14, 16, 18 and 20%) on the productive performance during the growing and laying period under Egyptian conditions

MATERIALS AND METHODS

The experimental work was carried out at Gimmizah Production Sector and Gimmizah Poultry Research Farm, Agriculture Research Center, Ministry of Agriculture; during the period from June, 2007 up to June, 2008. This experiment was designed to estimate protein requirements. This study included two experiments. A total number of 60 pair of squabs Baladi pigeons (28 days – age at onset of egg production), were involved in the first experimental (Exp.1) growing period, While it was 32 pairs of Baladi pigeons (6 or 7 months old) were distributed according to its consistent mating systems (sex ratio of pigeons 1:1) in the second experimental (Exp.2) laying period. At the beginning of each experiment squabs and pigeons were divided randomly into equal four treatments containing 15 pairs (3 replicates of 5 pairs each) in the growing period (Exp.1) and 8 paris (4 replicates of 2 pairs each) each in the laying period (Exp.2). The birds were housed in an environmentally controlled home, all pairs were randomly collocated to wire poultry cages 100 x 70 x 40 cm high, The fronts of the cage batteries were modified to suspend feed and water, Feed and water were supplied ad-libitum. In each breeding cage, five squab pairs were allowed unsexed on a random basis in the growing period (Exp.1), while the second laying period (Exp.2) two male and two female pigeons (Baladi pigeons) were allowed to form couples on a random basis. In each breeding cage the parents were able to feed their squabs up to the age of 28 days, the weaning stage. At this age squabs were ready and in prime condition for slaughter or were transferred to be reared further. The pigeons were maintained on a 14 h. light regimen.

Four mash ration low and high protein level (14, 16, 18 and 20%) were compared during the whole test period. The diets were isocloric (2700+31.2 ME Kcal/ kg diet). The compositions of the expermintal diets are shown in Table 1.

During the Exp. 1 (growing period) and Exp.2 laying period the following measurements were performed or calculated initial body weight,

final body weight, changes in body weight in male and female squab, daily feed intake per pair, total feed intake per pair (during 6 month), daily protein intake per pair, totl protein intake per pair (during 6 month) and sexual maturity of squabs in each treatment. Since the sexual maturity was determined at the first egg laying. In addition, determine egg cycle, egg number, egg weight, fertility, hatchability, squabs production per pair, squabs growth during 28 day, relative growth rate (RGR) in squabs during 28 day, body weight gain (BWG) in squabs during 28 day, squabs mortality rate and livability at Exp.2.

Data were analyzed according to one- way analysis of variance. To estimate the significant differences between treatments and Duncan's (1955) Multiple range test were calculated by using SPSS (1997) computer program.

Table 1: Composition and chemical analyses of the basal diets.

Ingredients (%)	Diet 1 14%cp	Diet 2 16%cp	Diet 3 18%cp	Diet 4 20%cp
Yellow corn	65.30	62.5	60.00	62.00
Soybean meal, 44 %CP	15.50	21.50	27.50	30.00
Wheat bran	15.00	12.00	8.40	0.00
Gluten 62%CP	0.00	0.00	0.00	3.50
Limestone	1.60	1.50	1.50	1.50
Bone meal	2.00	1.90	2.00	2.40
Common salt (NaCl)	0.30	0.30	0.30	0.30
Vit. & Min. mix.*	0.30	0.30	0.30	0.30
Total	100	100	100	100
Calculated values:**				
Crude protein, %	14.21	16.20	18.12	20.32
ME,Kcal/kg	2727.10	2729.12	2732.11	2746.75
Crude fiber,%	4.27	4.32	4.31	3.62
Ether Extract,%	3.22	3.05	2.86	2.62
Calcium, %	1.34	1.226	1.27	1.314
Available phosphorus, AP %	0.436	0.419	0.422	0.431
Lysine, %	0.694	0.846	0.995	1.027
Methionine,%	0.277	0.288	0.314	0.317
Methionine + cysteine %	0.509	0.565	0.619	0.619

***Vit.& Min. mix:. each 1kg diet contains: 10,000 IU Vit. A; 2,000 IU Vit D_3 10 mg Vit. E;1mg Vit. K; 1mg Vit. B1; 5mg Vit. B2; 1,5mg Vit B6; 0.1mg Vit. B12; 0.3mg; Niacin, 10 mg ; Panatothenic acid, 0.5 mg, Biotin; I mg Folic acid;250 mg choline chloride; 60 mg manganese; 30 mg iron; 50 mg zinc; 4 mg copper;0.3 mg iodine; 0.1 mg Seleinium and 0.1mg cobalt.**

**** Calculated according to NRC (1994).**

RESULTS AND DISCUSSION

Body weight and changes in body weight of the squabs and young squabs (Exp. 1):

Effects of CP levels on the performance of birds during the growing period from 28 days till the age at onset of egg production are presented in (Table 2) Mean data showed that the live body weight (LBW) and weight

gain at different ages studied were not significantly affect by the dietary protein levels, except LBW at end of first month. The squab pigeons fed diet containing (14 % CP) recorded a significantly (P≤0.05) the lowest body weight compared to those fed either 16, 18 or 20% CP diets at the end of the first month. Also, the highly significant difference in LBW between male and female were observed with increasing of dietary protein level in the diet during all periods. The results showed that the weight gain from 29 to180 days of age (sexual maturity) was very poor.

Table 2: Body weight and changes in body weight of the squabs (Exp.1):

Measurements	Level of CP				Sig.
	14%	16%	18%	20%	
Initial body weight (gm/bird).					
Males	225.50±0.42	225.37±0.59	225.25±0.56	226.00±0.71	NS
Females	204.00±0.27	204.00±0.60	203.75±0.30	204.75±0.31	NS
Mean	214.75±2.78	214.67±2.79	214.50±.2.79	215.37±2.76	NS
Body weight (gm/bird) at end of 1st month .					
Males	237.25±0.72c	239.00±0.70bc	242.75±2.42b	248.50±2.16a	*
Females	220.50±1.02e	224.75±1.11d	228.25±0.49d	228.75±1.02d	*
Mean	228.87±2.24b	231.87±1.95ab	235..50±2.22ab	238.50±2.82a	*
Body weight (gm/bird) at end of 2nd month					
Males	255.00±0.71b	250.75±0.56c	255.00±1.36b	261.25±0.31a	**
Females	226.50±0.42e	232.00±0.46d	232.00±0.80d	234.75±0.30d	**
Mean	240.75±3.70	241.37±2.44	243.50±3.06	248.00±3.42	NS
Body weight (gm/bird) at end of 3rd month					
Males	261.00±0.70c	263.00±1.49bc	265.25±1.26b	273.00±1.41a	**
Females	230.50±0.62f	236.50±0.68e	236.75±0.72e	242.00±0.71d	**
Mean	245.75±3.96	249.75±3.51	251.00±3.75	257.50±4.07	NS
Body weight (gm/bird) at end of 4th month					
Males	269.00±1.41c	272.50±1.26b	277.25±0.86a	279.50±1.57a	**
Females	233.50±0.63f	238.00±0.59e	239.50±1.19e	247.00±0.70d	**
Mean	251.25±4.64	255.25±4.50	258.37±4.89	263.25±4.28	NS
Body weight (gm/bird) at end of 5th month					
Males	278.50±1.35b	280.75±1.17b	284.25±1.23a	285.00±1.28a	*
Females	237.00±0.71e	241.25±0.40d	241.75±041d	247.50±0.42c	**
Mean	257.75±5.41	261.00±5.13	263.00±5.52	266.25±4.88	NS
Body weight (gm/bird) at end of 6th month					
Males	287.75±1.49c	288.00±2.03c	295.25±1.47b	299.00±1.69a	**
Females	240.25±0.56e	247.25±0.56d	247.75±0.67d	249.50±0.42d	*
Mean	264.00±6.18	267.62±5.35	271.50±6.18	274.25±6.44	NS
Changes in body weight(gm).					
Males	84.25±1.41b	82.00±1.51b	88.00±1.44a	91.00±1.03a	*
Females	58.00±0.84d	63.50±0.98d	56.00±0.27d	56.75±1.52c	*
Mean	71.12±3.45	72.75±2.54	72.00±4.19	73.87±4.51	NS

a-d Means with different letters within the same column during the same period are significantly different at P≤0.05

**** = P < 0.01, * = P < 0.05 and NS = Not significant**

This result is in agreement with that of Sales and Janssens (2003) whom found that a dietary crude protein content between 12 and 18% and metabolizble energy content around 12MJ/kg, based on production of offspring, is recommended for feeding adult pigeons. Waldie *et al.*, (1991) showed that the 22% CP diet with or without corn and the 16% CP diet without corn gave similar responses for both the adult pigeons and squabs. Abed Al-Azeem, (1998) indicated that increasing level of protein (14, 17 and 20% CP) had no effect on LBW of adult pigeons. Heuser, (1946) reported that a good pigeon food usually contains about 13 to 15% crude protein. Wolter et l., (1970) found that the protein requirement for pigeons is about 12.5 to 13%. Also he indicated that higher protein level did not further improve body weight. Increasing dietary protein level did not result significant change in body weight of pigeons (Little and Angle, 1977).Also, Abed Al-Azeem, (2005) who found that The growth rates of squabs were very rapid during the first 28 days of age, then it was very poor until 6 months of age (sexual maturity) when parents fed of 14 % C.P and 3100 K cal ME /Kg mash diet.

Daily feed and protein intake of the squabs and young squabs (Exp. 1):

Data in (Table 3) show that the daily feed and protein intake at different ages studied the average amount (gm./pair/day). However the daily feed intake (gm./pair/day) which consumed by squab's pigeons during first and second months did not significantly affected. It is clear that daily feed intake was significantly affected during the 3rd, 4th, 5th and 6th month. Also results showed that the youngest pigeons fed diets content (18 and 20% CP) consumed a significantly higher feed intake compared to those fed others diets.

Table 3: Daily feed and protein intake of the squabs(Exp.1):

Measurements	Level of CP				Sig.
	14%	16%	18%	20%	
Daily feed intake of pairs (gm/day).					
1st month	20.54±0.79	20.55±0.74	20.67±0.69	22.45±0.60	NS
2nd month	24.81±0.84	24.43±0.78	25.37±0.72	25.89±0.61	NS
3rd month	27.66±0.91b	28.38±0.75b	29.26±0.63b	33.01±0.37a	*
4th month	34.41±0.37b	34.09±0.51ab	35.36±0.67ab	35.92±0.61a	*
5th month	46.10±0.43b	46.24±0.80b	47.87±0.71ab	49.49±0.94a	*
6th month.	55.98±0.62b	56.06±0.59b	57.68±0.88b	62.43±0.79a	*
Total feed intake of pairs (gm) during 6th month	6285.11±75.08c	6293.14±30.02c	6486.45±62.22b	6876.22±56.45a	
Daily protein intake of pairs (gm/day)					
1st month	2.87±0.11d	3.29±0.12c	3.72±0.13b	4.49±0.12a	**
2nd month	3.47±0.11d	3.91±0.12c	4.57±0.13b	5.17±0.12a	**
3rd month	3.87±0.13d	4.54±0.12c	5.27±0.11b	6.60±0.07a	**
4th month	4.82±0.05d	5.45±0.08c	6.36±0.12b	7.18±0.12a	**
5th month	6.45±0.06d	7.39±0.13c	8.62±0.13b	9.89±0.19a	**
6th month.	7.84±0.08d	8.97±0.09c	10.38±0.16b	12.49±0.16a	**
Total protein intake of pairs (gm) during 6th month	879.91±10.51d	1006.90±4.80c	1167.56±11.19b	1375.24±11.29a	**

a-d Means with different letters within the same column are significantly different at P≤0.05
**** = P < 0.01, * = P < 0.05 and NS = Not significant**

Results in Table (3) indicated that the dietary CP levels (14, 16, 18 and 20%) had highly significant effect on daily CP intake during the whole experiment period (28 days – age at onset of egg production). Concerning the dietary protein levels intake, the daily protein consumption values of squab's pigeons significantly increased due to increasing dietary protein levels.

Age at onset of egg production:

Data in (Table 5) showed that the dietary protein levels (14, 16, 18 and 20% CP) had highly significant (P≤0.05) effect on age at onset of egg production.

The lowest level of dietary protein (14 % CP) has delayed sexual maturity compared with other groups (16, 18 and 20% CP). While, the young pigeon given 20% CP entered lay at earlier age followed by these fed contain diet 18%CP. It can be concluded that the protein level seemed to be affect remarkably on age at onset of egg production, the pigeons fed on a high level of protein enter in laying at earlier age than pigeons fed low protein level. This result is in agreement with that of **Abed Al-Azeem, (1998)** who indicated that increasing level of protein in the diet had a significant effect on age at onset of egg production.

Body weight and change in body weight of the adult pigeons (Exp. 2):

The effect of protein levels on the production performance of the laying period from (age at onset of egg production to 12 months of age) are presented in (Table 4). Results showed that the initial body weight of the male parent pigeons were higher than those of the female pigeons. There were no significant differences in initial body weight between the different treatments. All parent pigeons lost weight during the laying period except males fed diets (18 and 20% CP) body weight was increased than other groups. Results in (Table 4) indicated that the body weight of pigeon's males is significantly affected by the increasing of protein level in the diets. While, the body weight of pigeon's females is not affected by the increasing of protein level in the diets.

Table 4: Body weight and changes in body weight of the adult pigeons (Exp.2):

Measurements	Level of CP				Sig.
	14%	16%	18%	20%	
Initial body weight (gm/bird).					
Males	305.75±1.49c	306.00±2.03c	313.25±1.47b	317.00±1.69a	**
Females	258.25±0.55e	265.25±0.56d	265.75±0.67d	267.50±0.42d	**
Mean	282.00±6.17	285.62±5.35	289.50±6.18	292.25±6.44	NS
Final body weight (gm/bird).					
Males	303.50±1.02c	304.00±1.25c	318.75±0.55b	323.75±0.56a	**
Females	257.00±0.27f	263.75±0.31e	265.25±0.56de	266.50±0.42d	**
Mean	280.25±6.02	283.87±5.23	292.00±6.92	295.12±7.39	NS
Change in body weight(gm)					
Males	-2.25±1.47b	-2.00±0.92b	5.50±1.12a	6.75±1.73a	*
Females	-1.25±0.49	-1.50±0.62	-0.50±0.19	-1.00±0.46	NS
Mean	-1.75±0.76b	-1.75±0.54b	2.50±0.94a	2.87±1.32a	*

a-d Means with different letters within the same column are significantly different at P≤0.05

**** = P < 0.01, * = P < 0.05 and NS = Not significant**

The body weight of pigeons males is heavier than females these perhaps due to the main function of the female of egg laying. This result is in agreement with that of Abed Al-Azeem, (1998) who indicated that increasing level of protein (14, 17 and 20% CP) had no effect on LBW of adult pigeons. Bottcher, *et al.* (1985) whom reported that the live body weight of pigeons was not affected by increase of protein content in the diet. Also Wolter, *et al.* (1970) reported that the protein requirement for pigeons is about 12.5 to 13%, they stated that the higher protein level did not further improved body weight.

Egg cycle:

Pigeon fed low protein (14%CP)recorded the long length of egg cycle(Table 5).

The length of the egg cycle values of adult pigeons significantly increased due to decreasing dietary protein levels. This result is in partial agreement with that of Meleg *et al.* (1999) whom found that the length of the egg cycle was not affected by the dietary protein levels (12, 14, 16, 18 and 20% CP) either in the first or in the second production cycle.

Egg number (EN), Egg weight (EW):

The data of egg production presented in (Table 5) showed that total egg number of treatments and total egg number produced per pair during the whole experimental period (180 days) were not significantly affected by the increasing of CP levels in the diet. It's interesting to note genetically that hens of pigeons laid only two eggs per reproductive cycle (45 days), so egg produced were not affected by the increasing of CP levels or any other nutrients in the diet. Results indicated that the slight increase in egg number with increase in dietary CP content supports the results of Bottcher *et al*,. (1985), whom stated a similar tendency with utility type pigeon populations. Also, Abed Al-Azeem, (1998) indicated that total egg number laid per pairs of pigeons in a year were not affected by the increase level of protein in diet. Meleg *et al.*(1999) whom found that increasing protein level (12,14, 18 and 20% CP) had no effect on egg number of adult pigeons but, slightly increase in egg number with increase in dietary CP content.

Significant ($P<0.05$) increase in egg weight with increasing CP level in the diet was observed the recorded weight of egg ranged from 14.67 to 15.51g. The results of Abed Al-Azeem, (1998) indicated that egg weight produced from pigeons was ranged from 18.51 to 19.60g. on average.

It could be concluded that decreasing dietary CP level decrease egg number (EN) and egg weight (EW). Egg weights (EW) were significantly higher with 20, 18 and 16% CP than with 14% CP. Significant improvement was recorded in EW with the increasing dietary protein level.

Fertility and hatchability:

Results showed that the fertility of laid eggs, hatchability of laid eggs and hatchability of fertile eggs were higher when pigeons were fed high protein diets, but these differences were not significantly (Table 5). This result is in agreement with Meleg *et al.*(1999) whom found that increasing level of protein (12, 14, 18 and 20% CP) had no effect on hatchability of laid eggs and hatchability of fertile eggs. On the other hand, results of Abed Al-Azeem, (1998) who showed that fertility rates decreased by increasing level of protein in the diets. While, hatchability percentage of pigeon eggs were not affected

by increasing level of protein in the diets. Also, Bottcher *et al.* (1985), whom showed that fertility of pigeon eggs decreased when the protein level increasing from 12 to 18%.

Squab production (Exp. 2):

Significant differences were observed among treatments in the number of squabs hatched, 1st week, 2nd week, 3rd week and weaned squabs (Table 5). Results indicated that no significant effect when pigeon fed 20, 18 and 16% CP. Also, no significant effect when pigeon fed 18. 16 and 14% CP at number of squabs hatched. But significantly differences when pigeon fed 20%CP compared with those fed 14%CP in the number of squabs hatched. Number of squabs at end of 1st week and 2nd weeks were not effected when pigeon fed 20 and 18% CP. Also, no significant effect when pigeon fed 18. 16 and 14% CP. But significantly differences when pigeon fed 20%CP compared with those fed 14%CP at the end 1 and 2 weeks. Similar results in other periods (number at the end of 3rd week and number of weaned squabs) significantly high protein level (20% CP) recorded the highest number of weaned squabs than the low protein level (14% CP) which recorded the lowest number of weaned squabs. These result is in agreement with Meleg *et al.*(1999) whom found that increasing level of protein (12,14, 16,18 and 20% CP) had a significant differences between the treatments in the number of squabs hatched and weaned squabs when pigeon fed 20% CP diet. While, U.S.D.A (1960) reported that the level of protein required for squab production was about 13.5 to 15%CP. On the other hand, Abed Al-Azeem, (1998) showed that increasing level of protein in the diet 14, 17and 20% decreased the number of squabs per treatment and number per pairs in a year.

Squab growth during 28 days of age (Exp. 2):

Table (5) shows results of squab's growth from hatching until 28 days (males and females during the experimental period). Significant differences were observed in the body weight of squabs hatched, 7 days, 14 days, 21 days and weaned squabs which fed different levels of protein. Significant heavier weight when pigeon fed the 20% CP in all periods.

Results indicated that increasing dietary CP content in the experimental periods significantly increased body weight of squabs. Although this difference did not excee 7.5% between the diets of the lowest and the highest protein content in the market age. Diet containing less than 16% CP fed to pigeons kept ilk cages resulted in smaller from hatching until 28 days. These result is in agreement with Meleg *et al.*(1999) whom found that increasing level of protein (12,14, 16,18 and 20% CP) had significantly increased squabs body weight at weaned and marketable squabs.

The USDA (1960) indicated that a squab is a young pigeon usually marketed at 25 to 30 days of age just before it is ready to leave the nest. As the weight ranged between 12-24 ounces. Levi (1954*)* reported that each day for six or seven days body of squabs seems to double in size. After 26 to 28 days of hatching the squab has reached the peak of its growth for fat, size, and weight. Bokhari (1994) indicated that squabs grow very rapidly until about 21 days, and then the growth continued at slower rate afterwards. Aggrey and Cheng (1993) indicated that the maximal weight gain of squabs

was observed during 8-14 days of age, while weight gain by the squab between days 21 and 28 days was minimal. In fact, some squabs actually lost weight during this period. Essam (1997) showed that the highest growth rate of squabs was obtained during feeding on the crop milk and the lowest was during seeds feeding. On contrast to the present results Abed Al-Azeem, (1998) showed that increasing level of protein in the diet decreased squabs growth. Also squab's growth has affected by sex, since the males is higher females.

Table 5: Squabs and pigeon performance production(Exp.2):.

Measurements	Level of CP				Sig.
	14%	16%	18%	20%	
Age at onset of egg production (day)	201.75±0.45d	199.25±0.45c	193.25±0.53b	189.37±0.56a	**
Egg cycle (day)	51.75±0.41a	51.62±0.37a	50.75±0..36ab	50.12±0.29b	*
Egg number	6.87±0.51	7.12±0.48	7.25±0.41	7.62±0.32	NS
Egg weight(gm)	14.68±0.11b	15.17±0.15a	15.38±0.13a	15.51±0.06a	*
Total fertility	97.22±1.81	93.35±2.58	97.22±1.82	97.22±1.81	NS
Total hatchability	92.36±3.78	91.57±2.55	94.44±3.64	97.22±1.82	NS
Hatchability in fertile eggs	94.79±2.58	98.21±1.78	96.87±2.04	100.00±0.00	NS
Squab production (squabs number)					
Hatch number	6.25±0.31b	6.50±0.42ab	6.75±0.16ab	7.37±0.18a	*
Number in7 days	5.37±0.26b	5.75±0.31b	6.00±0.27ab	6.62±0.26a	*
Number in 14 days	4.37±023b	5.25±0.16a	5.25±0.16a	5.37±0.29a	*
Number in 21 days	4.12±0.23b	4.37±0.18b	4.50±027b	5.75±0.31a	*
Weaning number	3..50±0.26b	4.00±0.32b	4.50±0.27b	5.75±0.31a	*
Squabs growth at 28 days of age (gm)					
Hatch weight(gm)	12.18±0.13c	12.41±0.04c	12.93±0.05b	13.35±0.07a	**
Weight in 7 days(gm)	63.74±0.68b	64.22±0.52b	68.16±0.47a	69.29±0.62a	*
Weight in 14 days(gm)	142.74±1.56b	144.09±0.45b	146.49±1.68b	150.96±0.95a	*
Weight in 21 days(gm)	196.09±2.16b	195.93±1.04b	200.85±2.53b	211.73±1.06a	*
Weaning weight(gm)	227.80±1.53a	232.82±0.75a	239.50±1.13a	244.69±3.19a	**
Relative growth rate in squab(RGR)+					
Relative growth in 7 day %	135.83±0.01b	135.71±0.61b	138.34±0.63a	138.41±0.93a	*
Relative growth in 14 day %	76.52±0.02a	76.69±0.51a	72.93±1.33b	74.17±0.48b	*
Relative growth in 21 day %	31.48±0.01ab	30.48±0.36b	31.27±1.69ab	33.51±0.23a	*
Relative growth in 28 day %	14.98±1.01bc	17.21±0.38ab	17.59±0.97a	14.39±0.84c	*
Overall relative growth rate	179.69±0.19	179.94±0.13	180.27±0.25	180.38±0.36	NS
Body Weight Gain in squabs (BWG)					
Gain 1-7 day (gm)	51.56±0.55b	51.80±0.53b	55.22±0.46a	55.94±0.56a	*
Gain 8-14 day (gm)	79.01±0.88	79.87±0.33	78.33±1.1	81.67±0.59	NS
Gain 15-21 day (gm)	53.35±0.58b	51.84±0.78b	54.36±3.10b	60.77±0.37a	*
Gain21-28 day (gm)	31.71±2.06b	36.89±0.75ab	38.65±1.89a	32.96±2.22b	*
Total gain 1-28 day (gm)	215.62±1.48b	220.41±0.79b	226.56±1.09a	231.35±3.13a	*
Mortality rate%++	5.69±0.32	5.88±0.42	6.10±0.17	6.61±0.19	NS
Livability%+++	51.23±3.07b	56.21±2.88b	61.31±4.27b	74.43±4.77a	*

a-d Means with different letters within the same column are significantly different at P≤0.05

+RGR=((W2-W1)/0.5(W2+W1))*100 Where: W1= initial body weight W2 = LBW at end of periods (Brody 1954)

++ Mortality rate = (No. of squabs at hatch day- No. of squabs at 28 day)/ No. of squabs at hatch day x100

+++ Livability = (No. of squabs at 28 day / No. of egg hatching) x100

**** = P < 0.01, * = P < 0.05 and NS = Not significant**

Relative growth rate (RGR) and body weight gain (BWG) during 28 days of age (Exp. 2):

Results indicated that R.G.R. recorded the highest values at the first days (Table 5) however, after which, the RGR declined gradually to reach the minimum value at the last days of the experimental period.

The growth rate showed that there were three different phases of growth could be observed for squabs. The first represents the region of slow growth, which occurs form the hatching to 7 days of age. The second phase (8-14 days) the curve is characterized by a faster growth rate, since squabs fed with mixture of both crop milk and grains, thus leading to increase rate of metabolism Yanni (1969). The later period extended from 15 to 21 and from 22 to 28 days of age, growth rate decreased again compared with the previous mentioned periods, wherese during the period from 29 days of age until sexual maturity (6 months) the increase of weight were very poor (Table 5).

The results showed that the weight gain during 8 to 14 days of age was higher compared with other periods. While the weight gain from 21 to 28 days of age was very poor, where the pigeon squabs reach in maximum weight gain during first 28 days of age. Results indicated that increase in dietary CP content in the all experimental period (28 days) BWG of squabs significantly increased. (Table, 5). These results are in agreement with those obtained by Levi (1974) who found that growth rate of squabs is very rapid, especially at the first 7 days of age, and the growth peak was at 26 to 28 days of age. However, Essam (1997) indicated that the highest growth rate of squabs was obtained during feeding on the crop milk and the lowest was observed during seeds feeding. Abed Al-Azeem, (2005) found that growth rates of squabs were very rapid during the first 28 days of age and he showed that parents fed their squabs on crop milk at the first 7 days of age. While, in the later period 8-14 days of age the squabs received mixed diet containing crop milk and digested grains. During the period of 15 –28 day's squabs fed only on whole grains taken by parents.

Mortality rate:

The mortality rate of pigeon squabs was affected by the dietary protein levels (14, 16, 18 and 20% CP) high protein diets (20%CP) had a significant effect on mortality rate compared with low protein diets (14%CP). But diets (20, 18 and 16%CP) did not significant affect on mortality rate. Also diets (18, 16 and 14%CP) did not affect on mortality rate during experimental period (Table 5). Results indicated that the mortality rate of squabs increases during 7 days and 14 days of age, while the mortality rate of squab's decreased during 21 days and 28 days of age compared with the first age. Generally total mortality rates during the experimental period did no affected significantly by the treatments. However, slight increase in mortality rate of squabs observed with the increasing dietary crude protein content. This result is in agreement with than the Abed Al-Azeem, (1998) indicated that mortality rates were higher for squabs fed on increasing level of protein 20 and 17 %CP., there after the mortality rates decreased by the decreasing level of protein in the diet. On contrast to the present results Meleg *et al.*(1999) whom

found that squabs mortality was significantly affected by the protein content of the diet. Feeding 14 and 12%CP resulted in the highest mortality rates.

It can be observed that the increase of mortality rate of squabs may be due to the increase of plasma uric acid and non protein nitrogen since abnormal increase in uric acid in blood (uricemia) which may be fatal of squabs.

Livability:

Results indicated that the livability percentage of squab increased with increasing protein level in the diet (Table 5). These observations in disagree with results of Abed Al-Azeem, (1998) who showed that increasing level of protein in the diet decreased the livability percentage. Also Bottcher et al, (1985) whom showed that the increased of CP content from 12 to 18% decrease livability of squabs and pigeons.

Daily feed and CP intake of the adult pigeons without or with squabs (Exp. 2):

Data indicated that feed and CP intake were significantly ($P<0.05$) increased as the CP levels increased from 14 to 20% (Table 6). From these results it can be observed that the feed intake by pigeons increases at all period when the protein level increases from 14 to 20%. Also the protein intake increasing with the increases in feed intake. The amount of feed intake increases with the increasing the age of squabs. The hatching squabs are given only crop milk from the first day until 4th day, then the parents start to give the squabs rations mixed with the crop milk, while the amount of feed intake by pigeons increased at 14,21 and 28 days. This may be due to the increase of body weight of squabs, and the increase of crop size, also the crop milk produced by parent decreases with the increase age of squabs, so squabs required a large amount of feed when advanced of age. These results agree with Meleg *et al.*(1999) who found that increasing level of diet CP (12, 14, 18 and 20%) had increases significantly the feed and protein intake. Pigeons consumed higher quantities of the high protein diets than of the others. Also Morely (1974) showed that the mount of feed consumption by pigeon is determined by the mount of protein consumed. Bottcher et al, (1985), whom indicated that with a higher content of feed protein the pigeons showed a tendency to a smaller amount of feed consumption. On contrast to the present results Abed Al-Azeem, (1998)who found that increased level of protein diet of pigeons caused a decreased in the amount of feed consumed at different periods.

Results indicated that feed intake increased (81.37, 83.00, 85.75 and 89.62 gm/pair/day) with the increase of CP levels in the diet (14, 16, 18 and 20%) for pigeons without squabs, respectively. Also, the daily average CP intake of pair of pigeons varied between (11.39, 13.28, 15.43 and 17.92 gm) for group fed (14, 16, 18 and 20%) respectively for pigeons not producing squabs.

From the previous results it can be concluded that the CP content of pigeon diets plays an important role and effects the most important reproduction traits significantly. Feeding utility type breeding pairs with high protein diets increases both the number and the weight of weaned squabs.

Table 6: Daily feed and protein intake of the adult pigeons without or with squabs(Exp.2):

Measurements	Level of CP				Sig.
	14%	16%	18%	20%	
Daily feed intake of pairs (gm/day).					
Without squabs	81.37±0.88c	83.00±0.57c	85.75±1.14b	89.62±0.53a	**
With squabs at 7 days	86.00±0.65d	91.37±0.84c	96.37±0.94b	104.75±0.65a	**
With squabs at 14 days	100.500±0.78d	106.50±0.82c	110.12±1.04b	119.75±0.65a	**
With squabs at 21 days	109.00±1.08d	113.87±0.78c	117.00±1.08b	126.75±0.64a	**
With squabs at 28 days	117.75±0.99d	123.25±0.99c	125. 87±0.85b	133.75±0.66a	**
Total feed intake of pairs (gm) With squab during 28 days	2892..75±18.32d	3045.00±18.04c	3145.62±21.61b	3395.00±18.13a	**
Total feed intake of pairs (gm) Without squab during 28 days	2278.50±24.78c	2324.00±15.85c	2401.00±32.07b	2509.50±14.91a	
Daily protein intake of pairs (gm/day)					
Without squabs	11.39±0.12d	13.28±0.09c	15.43±0.21b	17.92±0.11a	**
With squabs at 7 days	12.04±0.09d	14.62±0.13c	17.04±0.13b	20.95±0.12a	**
With squabs at 14 days	14.07±0.11d	17.04±0.13c	19.82±0.18b	23.95±0.12a	**
With squabs at 21 days	15.26±0.15d	18.22±0.12c	21.06±0.19b	25.35±0.13a	**
With squabs at 28 days	16.48±0.14d	19.72±0.16c	22.66±0.15b	26.75±0.12	**
Total protein intake of pairs (gm) With squab during 28 days	318.99±3.47d	371.84±2.54c	432.18±5.77b	501.90±2.98a	**
Total protein intake of pairs (gm) Without squabs during 28 day	404.98±2.56d	487.20±2.87c	566.21±3.89b	679.00±3.62a	**

a-d Means with different letters within the same column are significantly different at P≤0.05

**** = P < 0.01, * = P < 0.05 and NS = Not significant**

Generally. the diet containing 14% CP levels or 11.39 gm crud protein intake/pair/day were suggested to be suitable requirement and satisfactory for growth, egg and squabs production at the growing period (28 days – age at onset of egg production) and the laying period (during the 6 month in production after 7 month of age) under Egyptian conditions.

REFERENCES

Abed Al-Azeem, F.A.M. (2005) Social life, reproductive behavior and squab growth of local Egyption baladi pigeon. Egypt poultry Sci.vol. 25 (1):13-28.

Abdel-Azeem, F.A. (1998). Effect of protein levels on some nutritional and physiological parameters in pigeon. MSc., Faculty of Agriculture, Al-Azhar University, Egypt.

Aggrey. S. E., and K. M. Cheng., (1993). Genetic and post hatch parental influences on growth in pigeon squab. J... Heredity., 84: 184-187.

Bokhari, S. A. (1994): Commercial squab production. Monogamous couples grow delicious product .World Poultry, 10, 30-33.

Bottcher, J., Wegener, R. M. Petersen, J. and M. Gerken, (1985): Untersuchungen zur reproductions, Mast – und Schlachtleistung von Masttauben II.Mitteilung: Einfflub des Rohproteingehaltes im Futter und Schlachtalters der Jungtauben.Archiv fur Geflugelkunde, 49:63-72.

Duncan, D. B. (1955). Multiple range and multiple F-test. Biometrics 11: 1 – 42.
Essam, A. M. (1997): Behaviour and management of pigeons. PhD. Faculty of Veterinary Medicine, Moshtohr, Zagazig University Benha
Frank, G. (1951): Raising Small Animals For Pleasure And Profit .United State Department of the enterior New York London.
Heuser, G. F., (1946). Feeding Poultry. U.S.A. New York. London. I.N.C.
Levi, W. M. (1954): The Pigeons: R.L.Company . Columba. S.C (C.F. Abed Al-Azeem, F,. *et al.* 2006)
Levi, W.M. (1969) The pigeon. Levi Publishing, Sumter SC (C.F. Canadian Council on Animal Care 1984)
Levi, W. M. (1974): The Pigeons: R.L.Company ,Columbia ,S.C.(C.F. Abed Al-Azeem, F,. et al . 2006)
Little, J.M., and E.A. Angle., (1977) Dietary protein level and experimental atherosclerosis. Atherosclerosis., 26:173-179.
Meleg, I., Dublecz, K.; L. Vincze, and Horn, P. (1999): Effect of dietary protein levels on reproductive traits of commercial pigeons in different production terms. Acta Agraria Kaposvariensis. Vol.3 no. 2 :247-253.
Morely, A. Jull, (1974): Raising Turkeys Ducks ,Geese And Game Birds.New York. USA .(C.F. Abed Al-Azeem, F,. et al . 2006)
National Research Council (1994): Nutritive Requirement of Poultry. 9th Rev.Ed.National Academy Press Washington, D.C., USA.
Pelzer, A. (1990a): Die Haltung Van Flcischtauben I.Geflugel .32:942-945.
Pelzer, A. (1990b): Die Haltung Van Flcischtauben II.Geflugel .33:970- 973.
Rizmayer, M. (1969): First two years experience of large scale meat pigeon breeding at the Racalmas farm of the Bov (in Hungarian) Baromfitenyesztes 1:7.
Sales, J; and G. P. J. Janssens, (2003): Nutrition of the domestic pigeons (Columba livia domestica) .Worlds Poultry Science Journal Vol. 59:221-232.
SPSS (1997). SPSS user's guide statistics Version 10. Copyright SPSS Inc., USA.
USDA (1960): Squab raising .Farmers Bulletin No.684, Washington .D.C.USA
Waldie, G. A., J. M. Olomu., K. M. Cheng and J. Sim, (1991): Effects of two feeding system,two protein levels ,and different dietary energy sources and levels on performance of squabbling pigeons. Poultry Sci., 70:1206-1212.
Wolter, R., Boidot, J. P. and M. Morice, (1970): Protein and metabolizable energy requirement of hand –fed squabs from hatching to 28 days of age. Poultry Science, 49:2017-2023.
Yanni, M., (1969). Biophysics of developing eggs and rate of growth of squab of domestic pigeons. Poultry Sci, 48:1536 – 1541.

دراسات غذائية و رعائية على الحمام:
تقدير الاحتياجات الغذائية من البروتين

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اجريت هذة التجربة لتقدير الاحتياجات الغذائية من البروتين ومدى تاثيرها على الصفات الانتاجية والتناسلية فى الحمام البلدى تحت الظروف المصرية . تم عمل تجربتين, التجربة الأولى (فترة النمو) استخدم فيها عدد ٦٠ زوج حمام زغاليل من عمر ٢٨ يوم الى العمر عند وضع أول بيضة قسمت الى أربع معاملات بكل معاملة ١٥ زوج زغاليل قسمت المعاملة الى ٣ مكررات بكل مكرر ٥ أزواج زغاليل. بينما التجربة الثانية (فترة الانتاج) استخدم فيها الحمام البالغ من التجربة الأولى حيث قسم عدد ٣٢ زوج حمام بالغ عمر٦ شهور الى ٤ معاملات بكل معاملة ٨ زوج حمام قسمت المعاملة الى ٤م كررات بكل مكرر زوجين (النسبة الجنسية ١:١) قسمت المعاملات وفقا لمستويات البروتين ١٤-١٦-١٨-٢٠% فى كلا التجربتين وتحتوى العلائق على ٢٧٠٠ كيلو كالورى/ كجم عليقة وتحتوى على الاملاح المعدنية والفيتامينات وتتعرض الطيور الى ١٤ ساعة ضوء خلال اليوم ويتم تقديم العلائق والماء بصورة حرة حتى الشبع.

وكانت اهم النتائج كما يلى :

1- التجربة الأولى (مرحلة النمو): لم يؤثر مستوى البروتين فى العليقة معنويا على كلا من وزن الجسم والغذاء المتناول خلال ا الشهر الأول والثانى بينما زاد متوسط وزن الجسم للذكور والاناث وكذلك كمية الغذاء المتناول معنويا بزيادة مستوى البروتين فى العليقة من ١٤ الى ٢٠% خلال الأشهر ٣و٤و٥و٦ من العمرز بينما تزيد كمية البروتين المأكول معنويا بزيادة مستوى البروتين فى العليقة خلالفترة التجربة.
2- التجربة الثانية (مرحلة الانتاج): لم يتاثر وزن الجسم النهائى وعدد البيض الكلى لكل زوج حمام والخصوبة ومعدل الفقس ونسبة الفقس من البيض المخصب ومعدل النفوق معنويا بزيادة مستوى البروتين فى العليقة. بينما تاثر معنويا دورة البيض حيث تقل المدة بزيادة بروتين العليقة بينما ذاد كلا من وزن البيض و الغذاء الماكول وكذلك البروتين المتناول معنويا بزيادة مستوى البروتين فى العليقة مع او بدون الزغاليل كما يزيد عدد الزغاليل ووزنها وحيويتها كذلك وزن الجسم المكتسب للزغاليل خلال ٢٨يوم من العمر معنويا بزيادة مستوى البروتين فى العليقة من ١٤ حتى ٢٠%.

نستخلص من هذة الدراسة ان مستوى ٢٠% بروتين فى علائق الجمام كان افضل من المستويات الأخرى ولكن مستوى ١٤% بروتين فى العليقة يغطى الاحتياجات الغذائية للحمام دون اى تاثير عكسى على الأداء الانتاجى والتناسلى للحمام البلدى المصرى تحت الظروف المصرية.