Egypt Poult. Sci. Vol (26) (III): (1153-1168)

THE PIGEONS (COLUMBA LIVIA DOMESTICA): A REVIEW

By

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Received: **7/5/2006** Accepted: **14/8/2006**

INTRODUCTION

Despite that pigeons (Columba livia domestica) have been known since 2500 BC by man for meat production, ornamentals, sports and experimental animal (Sales and Janssens 2003), limited information is available about it. The young pigeons have been recognized as a delicious and nourishing food for many centuries ***(Levi, 1954).*** *Young pigeon from one day old to about thirty day of age is called squab, which is distinguish with no feather under the wing* ***(Levi, 1974).*** *In nature female of pigeons lay only two eggs per clutch 44 hours interval. Both parents incubate the eggs for 17 to 18 day and rearing squabs when the eggs hatch. Normally an efficient of pigeons may raise 24 squabs per year if allowed to incubate their eggs. Removal of eggs from nests may induce the hen to lay up to 50 eggs per year* ***(Romanoff and Romanoff, 1949).*** *Squabs are fed crop milk that is derived from sloughed off epithelial lining of the crop for the three days of their live by both parents* ***(Vandeputte-Poma, 1980).***

It is less well known that some birds fed their young on milk like secretion. In the pigeons this secretion is formed in the crop; it is known as crop milk and is regurgitated to feed the nestling. Curiously, the formation of crop milk is stimulated by the prolactin hormone, that is in mammals stimulates the mammary gland to produce milk ***(Nielsen and Duke, 1994).***

Advantages of raising pigeons and squabs

There are numerous advantages in the commercial raising pigeons and squabs.

1- Pigeons unlike other poultry species since are not so susceptible to plague –like diseases. Ended squabs are kept confined and thus are not as apt to be exposed to the germs of diseases as are poultry on range.

2- Production life of pigeons has an average of five years and half. and, usually may be kept that long before replacement.

3- The cost of raising pairs of pigeons is lower than other poultry species, because the parents of pigeons incubate their own eggs, feed, protect and raise their own young.

4- Pigeons can be successfully reared in hot and cold climate regions.

5- The squabs distinguish with a speed growth and reaches to marketing age in four weeks with no competition for any birds or animal. There is a quick and constant income selling of pigeons.

6- Squab prices (per pound) are usually good. It is about double the price of chickens.

7- The pigeons and squabs producers have little competition. Where themarket is uncrowded

8- Lower costs of houses and equipments are necessary for pigeons and squabs as compared with chickens or other poultry species.

9- The space required for mature pairs of pigeons is far less than for other kinds of poultry species (32 pair /10 m2).

10- The requirement of pigeons for vaccines or drugs is very low as compared with other poultry species.

11- Finally, the requirement of nutrients such as protein and other nutrients is lower than other poultry species, this conversely on profitability of pigeons business.

Disadvantages of squabs rising

Despite the former advantages, there are some problems may counterpart pigeons and squabs producers:

1- One of the most problems in the squabs business is getting a good market along the year.

2- Also, inferior of special farms of pigeons one of the most important cause of failure in many pigeons producing enterprises.

3- Pigeons should have attention at least once a day. Eggs and squabs in nests should be examined and records written.

4- Difficulties in artificial incubation of pigeon eggs perform to decrease intensive course production.

5- Difficulties in calculation of feed consumption and conversion ratio during feeding squabs, consequently difficulties of calculation of feed cost.

Classification

Columbidae family can be divided according to the size to large size as pigeons and small size as doves. The family columbidae is classified into four subfamilies containing 43 genera made up of about 300 species with 716 geographical races and forms **(Goodwin, 1983).** Furthermore**,** there is one clear taxonomic distinction between doves and pigeons, both forms belong to the family columbidae and are distributed almost every where, except in Polar regions. Some species of pigeons being no bigger than a sparrow and others as large as a turkey. **(The Great Book Of Birds, 1997**).

Kingdom: Animal
Phylum: Chordata or Vertebrates
Class: Aveis
Order: Columbifomes
Family: Columbidae
Genus: Columba
Species: Livia
Columba livia domestica

Pigeon's milk (crop milk secretion) and composition

A few avian species, such as pigeons, doves and some species of flamingoes and penguins, have the ability to secret milk for their young, or lactate, milking them unique among birds. In birds and mammals, the milk produced and transfers from parents to offspring in form that is readily used by immature young**.** The pigeons are distinguish apparently than all other birds in that their nestling when they hatched they have been fed upon a semi digested substance from their parents crop known as crop milk **(Levi,1974).** Furthermore**, Kirk Baer and Thomas (1996**) indicated that squabs hatch with unopened eyes and cannot digest adult birds diet. The Columbidae regurgitate milk from the crop by both parents, a highly nutritive substance being mainly of protein and lipids **(Vandeputte-Poma, 1968)** for the nourishment of the young.

Sim *et al.*, (1986) found that crop milk containing 64 to 82 % moisture, 11-18.8 % protein, 4.5- 12.7 % ether extract, 0.8 -1.8 % ash and carbohydrate 0- 6.4 %. The higher values for carbohydrate may be due to containing of crop milk with food. **Vandeputte-Poma**

and Van Grembergen (1959) indicated that about 17 % of the total nitrogen in crop milk is in the form of free amino acid and 90 % of the protein is of casein type with a phosphorus content, about one – half that of casein from Cow's milk **(Vandeputte –Poma 1968).** However, **Desmeth (1980)** found that crop milk lipids contain about 81.2 % triglyceride and 12.2 % phospholipids.

Abs (1983) indicated that around the eighth day of brooding the first signs is thickening of the crop epithelial by day 13th, the epithelium thickens considerably to a multiple of its original width, and blood vessels grow into the epithelium. By day 14 th, crop milk is produced. At day 18 th of brooding, reddish bulging folds are visible in the crop, which start to retreat after about a week. While microscopic fat nodules are still found on the 16 th day after hatching , crop milk production generally ceases around day ten or shortly thereafter, although some pigeons may continue to produce crop milk even into the 25 th day **(Vandeputte –Poma and Desmeth 1978**). **Cock *et al.,* (1991)** indicated that the first changes in the non keratinized squamous epithelium of the crop wall indicative of "crop milk" formation occurred at the 11th day of brooding and consists of folding and thickening of the epithelium of the lateral crop sacs .The milk was formed from desquamated cells containing lipid droplets, milk production lasted for 13 days of male compared with only 3 days in female. Moreover**, Ferrando *et al.,* (1971)** indicated that crop milk has been characterized as consisting of cells loaded with fat. It contains 75-77 % water, 11-13 % protein, 5-7 % fat and 1.2-1.8 % mineral matter. The same authors found that crop milk contain 0.14- 0.17 % P, 0.12- 0.31 % Ca ,0.11- 0.15 % Na and 0.13 – 0.15 % K. Crop milk differs from mammalian milk by being devoid of lactose and casein. It is low in vitamin A, thiamin and ascorbic acid, but compares well in riboflavin content with cow's milk. It was also show to has a stimulatory effect on the growth of chickens **(Hedge, 1973).**

Desmeth and Vaaneputte –Poma (1980*)* reported that over 80 % of the crop milk fat is in the form of triglyceride and about 12 % consists of phospholipids. Other components include cholesterol and its esters, mono and diglycerides, and free fatty acids. About half the fatty acids in the lipid are monoenoic, with oleic acid (18:1) with the predominant one. Other fatty acids found in appreciable quantity are palimitic (16:0), stearic (18:0) and linoleic (18:1), with smaller amount of palmitoleic (16:1) acid. Crop milk compares well with

most mammalian milk as a source of essential fatty acids **(Desmeth, 1980).**

Ricarda *et al.*, (1992) indicated that crop milk contains considerably amount of IgA (1.45 mg/ ml) and significantly less IgG (0.34 mg/ ml). Most of the IgA as well as IgG remain in the intestine to provide local immunity. **Goudswaard *et al.*, (1977)** observed that a transfer of IgA from adult pigeons to their squabs via feeding of crop milk. Also, they added that immunoglobulin IgA is relatively abundant in crop milk.

Engberg *et al.*, (1992) reported that crop milk of pigeons contains considerable amount of IgG (0.34 mg / ml). In 1-day birds intestinal absorption of IgA occurred to only a very low extent. Most of the IgA, as well as IgG remained in the intestine to provide local immunity. **Vandeputte –Poma (1980)** indicated that squab are fed crop milk that is derived from sloughed off epithelial lining of the crop for about 3 days of their life by both the pigeon parents. Then they are gradually shifted to exogenous food at about 1 to 2 weeks of age, when the production of crop milk decreased and eventually ceases.

Table (1): Show chemical composition of crop milk.

Nutrient	Concentration %	Nutrient	Concentration %
Concentrate analysis (%as is)*		Fatty acids (weight % dry matter)***	
Moisture	64-84	14:0	
Crude protein	11-18.8	16:0	0.49
Ether extract	4.5-12.7	16:1(n-9)	16.67
Ash	0.8-1.8	18:0	7.90
Carbohydrate	0-6.4	18:1(n-9)	12.13
Amino acids (% of dry matter)**		18:1(n-6)	41.26
Arginine	5.48	18:3(n-3)	13.81
Glycine	4.99	20:0	0.78
Serine	5.2	20:1(n-9)	2.99
Histidine	1.52	20:2(n-6)	2.06
Isoleucine	4.50	20:3(n-6)	trace
Leucine	8.96	20:4(n-6)	0.45
Lysine	5.87	20:5(n-3)	trace
Methionine	2.84	22:0	0.59
Methionine+ Cystine	3.18	22:1(n-9)	trace
Phenylalanine	5.50	22:4(n-6)	0.11
Tyrosine	5.36	22:5(n-6)	trace
Threonine	5.49	22:5(n-3)	trace
Tryptophan	2.80	22:6(n-3)	0.23
Valine	5.61	24:0	0.34
		Minerals (% of dry matter)****	
		Calcium	0.81
		Potassium	0.62
		Magnesium	0.08
		Sodium	0.54
		Iron (ppm)	429

*From Carr and James (1931), Dabrowska (1932), Reed et al., (1932), Davies (1939), Ferrando et al (1971), Leash et al., (1971), Hedge (1972), Desmeth and Vandeputte –Poma (1980), Sim and Hickman (1986), Kirk Baer and Thomas (1996).
** From Hedge (1972).
*** From Desmeth (1980).
**** From Kirk Baer and Thomas (1996).

Table (2): Show comparison among crop milk produced by pigeon, emperor penguins and rabbit milk as % of total dry matter (cited by (Nielsen and Duke1994).

Constituents	Pigeon	Penguin	Rabbit
Protein	57.04	59.30	50.60
Lipid	34.20	28.30	34.30
Carbohydrate	0	7.80	6.40
Ash	6.5	4.60	8.40
Total	98.1	100.00	99.70

Growth rate of squabs and nutritive value of flesh

At about 30 days of age a squab is called a squeaker, and at about 6-7 weeks it is termed a youngster. At that time both parents feed the nestlings until they are mature enough to eat on their own **(David, 1991). The USDA Farmars Bulltine (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. It then weights from 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. **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 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 seeds feeding.

Frank (1951) reported that the flesh of squabs contains a larger proportion of soluble protein, and it is a good source of liquid protoplasm and vitamin C which is rich in phosphorus. The meat of squab has a fine texture and a distinct delicious flavor, and has a good tender and easily digested and is widely recommended by physicians for individual and convalescent. **Bhuyan *et al.*, (1999)** reported that moisture and fat percentages were higher but protein, calcium and phosphorus concentrations were lower in squabs meat than in pigeons meat.

Table (3): Show the rate of maturing (growth constant) derived from the Gompertz equation for different avian species.

Species	Rate of maturing	Source
Broiler	0.0450	*Gous et al., (1999)*
Quail	0.077-0.097	*Du Preez and Sales (1997)*
Guinea fowl	0.025-0.031	*Sales and DuPreez (1997)*
Ostrich	0.0085-0.0091	*Cilliers et al., (1995)*
Pigeon	0.1466-0.1945	*Vandeputte-Poma and VanGrembergen (1967)*

Gompertz equation :$C= C_m$ x exp(- exp (-B x (t-t*))) where C_m is the final mature weight (g) , B is the growth constant (g/d) ,and t* is the age (days) of maximum gain. Source (Sales and Janssens 2003).

Egg laying and squabs production

Levi (1954) reported that normally female of pigeons only lay two eggs, if one egg or three eggs are laid, it is not normal and the hens laying organs are not functioning properly .He added that the first egg is laid about six in the afternoon. While the second egg is laid after 44h at about two P.M of the following day. **Abs (1983)** found that two eggs are the normal clutch.There is rare instances of one egg clutches in domestic pigeons. The first egg is laid in the evening, while the second in the early afternoon of the next day by interval of about 43 to 44 hours between two eggs. Good stock of pigeons usually will produce well for 3 to 4 years. If more than two eggs are laid, it is advisable to remove the extra ones, as a pair of pigeons can raise only two good squabs at one time **(USDA 1960). Goodwin (1983) and Bokhari (1994)** illustrated that the normal clutch size of pigeons were 2 eggs with a rear instances of one egg clutch's in domestic pigeons. Also, they reported that 2 eggs were the normal clutch size in pigeons. **Morely (1974)** showed that well bred pigeons usually give good results in squab production for about 5 years. **Allen (1959)** reported that good utility of pigeons sometimes produce as many as 11 pairs of squabs per a year.

Fred *et al.*, (1953) indicated that squabs number were highest during the late spring months and lowest during the fall and winter months when the adult birds were going through the molt. On the other hand, squab weight was highest when squabs number were lowest, indicating a negative correlation between number and weight.

Courtship and mating of pigeons

The courtship of pigeons is quit a colorful and fascinating ceremony. First the male of pigeon go directly toward the hen of his choice. He struts and coos continually as he dances about the hen with crop inflated, body feathers ruffled, wing and tail feathers spread. He often attempt to press against the hen. If the hen is ready to mate, she shows her interest by bobbing her head and swallowing air so that her neck swells and pulsates

visibly. Mate will be done after mutual billing. The female interest her beak into that of the male, who feeds her small amounts of feed regurgitate from his crop. When billing occurs it is sure sign that mating is soon to follow. Mating usually takes place shortly after billing (**Allen, 1959). Morley (1974)** illustrated that pigeons mate in pairs and each pair remains faithful to each other during the succeeding reproductive cycles of the season. **Haynes (1987)** reported that pigeons mated for life. They mate in pair and remained together for live unless they were forced to be separated by removal or death, without a special season for breeding. However, **Bokhari (1994*)*** indicated that pigeons were monogamous and retained the same mate for life. **Essam (1997)** found that pigeons are mainly a monogamous bird; deviation from monogamous system of breeding can be noted during pair formation but rear and may occur due to breeding of unequal number of both sexes.

In free –living pigeons the female is usually first attracted to the male by his display flight and or by his giving the bowing display at her. She then responded to the latter by nodding. Billing, copulation and post copulatory display flight soon follow **(Abs 1983).**

Brooding, hatching and rearing of squabs.

The period of incubation of pigeons egg is approximately 17 days, but the first squab does not hatch until about 18 days after the first egg is laid **(USDA, 1960). Bokhari (1994)** illustrated that incubation period lasted from 17 to 18 days and shared by both parents. Furthermore, **Oud-Ka *et al.*, (1991)** indicated that the incubation period of pigeons ranged from 17-20 days. Squabs are reared and fed by both of the parents on a thick creamy mixture called pigeons milk. Pigeons usually feed their squabs shortly after they themselves are fed and should not be disturbed at that time. **Levi (1954)** indicated that the first egg is not closely brooded until the second egg is laid. The hen broods the eggs during the night and until about ten in the morning. The cock then relieves her and broods the eggs until about two o'clock in the afternoon. Then the hen returns back until relieved by her cock in the morning. The incubation period is about two weeks and half.

Abs (1983) found that the pair sits (in turn) in the nest from the time the first egg is laid but incubation usually begins with the second egg. The hen incubates from early evening or late afternoon until mid morning of the following day, the cock for the remainder of the daylight hours. While the young are small they are kept warm by brooding young and fed them in a few hours of hatching. The parents takes the squabs soft bill into its mouth and regurgitates pigeons milk, which the squab gulbs down.

Feeding pigeons and squabs

Feeding Columbids is challenging because of the large variation among species, and the diversity in natural history and origin of these birds **(Jaims 2000).** The scarcity of experimental data available on the nutritional requirement of pigeons is likely attributed to the above factors. The greatest amount of available information related to protein requirement; however, they reported values show rather wide variation. At the same time, numerous data indicate exist on the bred related weight and weight gain **(Pelzer 1990 a,b)** as well as the feed conversion ratio **(Rizmayer, (1969)** of young meat type pigeons. **Waldie *et al.*, (1991)** indicated that experiments are necessary for determining the nutritional requirements of pigeons 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. **Sales and Janssens (2003)** showed that a dietary crude protein content of 12 to 18 % and metabolizable energy content around 12 MJ/ Kg, based on production of offspring is recommended for feeding adult pigeons, which could utilize lipid better than carbohydrate as energy sources. No nutritional requirements for pigeons were included in the summary for poultry published by the **National Research Council (1994)**. The **USDA (1960)** indicated that feeding of pigeons differ radically from the feeding of other poultry species. Pigeons can not fed mash or green diet .The protein required is ranged from 13.5 to 15 %, carbohydrate 60 to 70 %, fat 2 to 5 % and fiber not more than 5 %. **Griminger (1983)** reported that pigeons are graminivorous and pigeons producers have traditionally fed their flock with a mixture of locally available grains

Hullar *et al.*, (1999) showed that no appreciable difference between pigeons and chicken in the digestibility coefficient of the cruder protein content of feeds. Although carbohydrate (NFE) has lower digestibility, ether extract has higher digestibility in pigeons than in chickens. **Janssens *et al.*, (2000*)*** reported that the use of a compound pellets in pigeons feeding is still marginal. Pigeons feeds mainly consist of whole grains and seeds while minerals, vitamin and some other nutrients are provided as separate supplements. A crude extra protein is not recommended in pigeons feeds as common in poultry diets. **Waldie *et al.*, (1991)** reported that 16 % crude protein was sufficient for pigeons without adversely affecting eggs production or number of young pigeons produced. **Meleg *et al.*, (1998)** indicated 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 (502.6 to 532.3 g) of squabs at 28 days and annual production per pair (*4.1 to 5.4 Kg).* Furthermore, **Bottcher *et al.*, (1985)** showed that increasing protein 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. **Fred *et al.*, (1953)** indicated that ration used almost exclusively in the commercial squab industry consists of whole grains and peas plus a grit and mineral mixture. **Frank (1951)** found that a good food of pigeons usually contains from 13.5 to 15 % protein, 60-70 % carbohydrate, 2 – 5 % fat and not more than 5 % fiber. The minerals are fed in a separate mixture .He added that corn is the best foods for pigeons and is the basis of all diets used for this purpose. Feed consumption varies with the size of the breed and with the number of squabs produced.

Table (4): Show comparison of the digestibility coefficient (DC) of some feeds for pigeons and chicken.

Feeds	DIGESTIBLE COEFFICIENT					
	Crude protein		Ether extract		Nitrogen free extract	
	Pigeons1	Chicken2	Pigeons	Chicken	Pigeons	Chicken
Corn	85.15	84.37	82.32	92.0	72.27	90.0
Barley	86.3	68.0	75.58	61.0	62.37	83.0
Sorghum	86.02	72.0	93.32	83.0	77.57	91.0
Peas	85.7	86.0	82.59	80.0	63.45	77.0
Sunflower	85.97	85.0	98.10	96.0	57.56	12.0

Hullar et al., (1999) and Janseens (1989).

Fred *et al.*, (1953) indicating supplementation riboflavin in diets of pigeons increased squabs number significantly. Also, B_{12} appeared to had a beneficial effect on squab number.

Sexual maturity

The **USDA (1960)** indicated that squabs usually are mated from 5 to 8 months of age. However, **Willimas (1976)** showed that the age of puberty of pigeons occurred around the age of 4-5 months. Also **Morley (1974)** and **Haynes (1987)** found that the age of mating in pigeons was ranged from 5 to 8 months.

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