Effect of strain, breeder age and probiotic on egg production, fertility, hatchability percentages and hatching weight in ostrich

El-Gendi, G.M.; El-Laithy S.M.**; Radwan, A.A.* and Ahmed, M.A

**Department of Animal Production Faculty of Agriculture
Benha University*
***Department of Animal Hygiene, Behaviour and Management
Faculty of Veterinary Medicine – Benha University*

Summary

This study was carried out to investigate the effect of strain, breeder age and the addition of commercially available probiotic Bio-power® on egg production, fertility, hatchability percentages and chick weight at hatching in ostrich (Struthio Camelus).

A total of 48 breeder ostriches were used for two successive breeding seasons (2005 and 2006). 24 of them were of blue neck (16 females and 8 males) and the other 24 were of black neck (16 females and 8 males). The birds in each strain were divided into 4 groups of trios (2 females x 1 male) x 2 replicates and were supplemented with zero (the control group), 0.25, 0.50 and 1.00 kg Bio-power®/ton feed for each group, respectively. **The results of the present study indicated that**: The egg production rate of black neck ostrich was significantly higher (16.39%) than those of blue neck females (13.90%). Older breeders during the second breeding season gave a significantly higher egg production rate (16.35%) than those obtained by younger ones (13.94%). The beginning of the laying season of ostrich under the Egyptian conditions was recorded in February and the end of laying was recorded in September for both breeding seasons. The peak of egg production rate was recorded during May and June for both seasons. The highest egg production rate was recorded in birds supplemented with 0.5 kg Bio-power®/ton feed. The blue neck females ostrich produced significantly heavier eggs (1612.75gm) than those produced by black neck females (1441.12 gm). The breeder age has no significantly effect on the mean egg weight allover the experimental period. Supplementation of different levels of Bio-power® has no significant effect on the average egg weight. Blue neck female ostrich gave a significantly higher fertility, hatchability of total and fertile eggs percentages than those recorded in black neck females. Also Blue neck females produced a significantly heavier chick weight at hatching than those produced by black neck females. There was no significant difference in the fertility % due to the breeder age while the hatchability of total and fertile egg percentages were significantly higher in older breeders than in younger ones. Also there was no significant difference in the chick weight of hatching due to the breeder age. Supplementation of birds with different levels of Bio-power® had no significant effect on fertility % or the chick weight at hatching while lead to significant increase in the hatchability of total and fertile egg percentages than the control group.

Introduction

Although ostriches have been in domestication for more than 100 years, the problems encountered in artificial incubation of eggs inhibit the world wide expansion of the ostrich industry *[1]*.

Three types of ostriches are found in Africa, namely the Red Neck, the Blue Neck and the Black Neck (domesticated) variety *[14]*. All subspecies found can be classified as one of these three. Different subspecies of ostrich have different phenotypic characteristics including size of the bird and growth rate *[14]*.Concerning the history of ostrich breeding in South Africa, only birds exhibiting the best marketable plumage were initially maintained as breeders *[15]*. Selection was based on feather quality, whereas other characteristics such as rate of body weight gain and egg production were not taken into account *[15]*. No published studies have adequately quantified differences between ostrich varities in their reproductive performance *[16]*. *[17]* reported that Zimbabwean blue neck ostriches were heavier than South African black neck, on the other hand, the egg production for South African black neck females was higher than those for Zimbabwean blue neck females.

Ostrich farming is currently being promoted as an alternative form of agriculture, with leather and meat as the principle products. As a result, the number of ostriches maintained in captivity has increased dramatically. Presently the market for ostrich products is limited by low production rates with demand for meat and leather much greater than the level of supply *[2]*. Ostriches are generally regarded as seasonal breeders *[3]*. According to some authorities the breeding season is synchronized photoperiodically *[4]* and *[5]* and coincides with increasing daylight.

The breeding season in the southern hemisphere starts in March/ April and extends into the spring (September), although in South Africa the season traditionally runs from June to February *[5]*. Annually, one female lays in two to three cycles and some times up to 6 cycles: the number of eggs in each cycle ranging from 18 to 20 *[6]*. He added that the number of eggs obtained each season in South Africa amounts to about 60 per female, while in Europe it usually ranges from 35 to over 50 suggesting that the climatic conditions are also important. Infertility in domestic poultry and duck eggs is an average between 5 and 10% of all eggs laid while infertility rates of 13.2 to 33.1%, assessed by candling, were reported for ostrich eggs from Namibia. *[1]* and *[7]*. The hatchability of artificially incubated ostrich eggs is, however, low and variable compared to other avian species ranging from less than 30% to approximately 60% *[1]*, *[8]* and *[9]*. Factors that affect ostrich egg hatchability include incubation variables (temperature, humidity and egg turning), length of egg storage, egg size, shell thickness and porosity *[10]* and *[10]*. Egg size and porosity may be affected by season, hen immaturity, nutrition and genetics *[12]*.

Contrary to the other poultry species, the most important factor reducing the hatchability of artificially incubated ostrich eggs is the high rate of mortality originating from oedema and malposition *[13]* and *[8]*. Artificial incubation of ostrich eggs is poorly understood compared with other poultry species *[1]*. They added that problems regularly encountered include achieving the correct weight loss from ostrich eggs during incubation.

The use of defined probiotic cultures in the poultry industry has recently become more common. However, few conclusive studies regarding their efficacy under commercial conditions have been reported in the scientific literature *[18]*. They added, selected probiotic cultures may potentially increase performance of avian species. Probiotic (meaning "for life") is a generic term, and products can contain yeast cells, bacterial cultures or both that stimulate microorganisms capable of modifying the gastrointestinal environment to favor health status and improve feed efficiency *[19]* and *[20]*. The addition of probiotics to diets benefit the host animal by stimulating appetite *[21]*, improve intestinal microbial balance *[20]*, stimulate the immune system *[22]*, decrease pH and release bacteriocins *[23]* that compete with other microbs for adhesive site, improve egg mass, egg weight, egg size in layers *[21] and [24]* and feed consumption in layers and also depress serum and egg yolk cholesterol concentrations in hens *[25]* and *[26]*.

The aim of this study was to establish the changes in egg production and incubation results as influenced by ostrich strain, breeder age and the addition of commercially available probiotic.

Material and Methods

This study was carried out at a private ostrich farm (Naoomy co.) at El-shourook city –Egypt.

Birds, their management and experimental design:

A total number of 48 breeder birds of blue and black neck ostrich (24 bird/strain) (16 females and 8 males) were used in this study for two successive breeding seasons (2005 and 2006) aged 3.5 years old at the beginning of the breeding season and with a body weight ranged from (115-121kg for females) and (129-133kg for males) of blue neck ostrich and (98-104 kg for females) and (119-124 kg for males) of black neck ostrich.

Birds of each strain were divided into four groups each of 3 birds (2 females and 1 male) x (2 replicates). The ostrich in the first group were fed basal diet only (table 1) and considered as control group, while those of the second, third and fourth groups were fed basal diet supplemented with 0.25, 0.5 and 1kg Bio-power®/ton ration, respectively.

In the presented study we used a commercially available probiotic Bio-power® produced by the Easterna for Agricultural & industrial development and contain the following formula. Sacchoromyces cerevisiae (270g), lactic acid producing bacteria (L. acidophilus, L. planterum and L.brvis) (16×10^9 c.f.u.), amylase 2200 unit, Beta-gluconase 1400 unit and Hemi celllulase enzyme 150 unit.

The birds were housed into trios (2 females X 1 male) in January (2005) with the aim of obtaining fertile eggs. Birds in trios were kept in enclosures with areas of (30 x 20m) and with a fence of 1.5m height.

The birds were fed 1.5kg/bird/day formulated ostrich breeder ration (20% protein) according to *[27]* and shown in table (1) during the breeding season, while the birds were feed 1.5kg of dried alfalfa/bird/day during the off season according to *[28]*. Drinking water was available at all times in the enclosures. All birds in all groups were marked by a numbered leather leg band. Free mating in all trios was used in the present study.

Egg Management

Eggs were collected twice/day at early morning and at late evening. Each egg was identified by using a pencile marker and weighed using electronic balance that was accurate to 0.01gm. Eggs were stored after collection in a special air conditioned room for 7 days at 16-18C° and 70-75 % R.H as recommended by *[28]*.

Eggs were incubated in a commercially available locally manufactured ostrich incubator produced by (the scientific office for poultry, Alexandria) at temperature of

36.5C° and 30% relative humidity for 39 days as recommended by *[28]*. The eggs were turned through an angle of 45° every hour. Egg candling was performed once/week and the first candling was performed at the 14th day of incubation. Infertile eggs were determined by candling on 14th day of incubation and were removed from the incubator. Viable eggs were transferred to the hatcher on 39th day of incubation and maintained at 36C° and 40% RH until hatching as recommended by *[28]*.

- Eggs were remained under observation until each hatched or reached by 44th day of incubation without hatching unhatched eggs were opened to help the chick during hatching or to determine the embryo deaths.
- The hatched chicks were weighed at hatching by using electronic pan balance that was accurate to 0.01gm.

Parameters measured:

Egg production rate (%) per hen/day was calculated as follows:

$$\frac{\text{Number of egg produced}}{\text{Number of days paired x 0.5}} \text{ X 100}$$

According to *[29]*

Egg fertility % = (Number of fertile egg/ total number of eggs incubated) x 100

$$\text{Hatchability \% of total eggs} = \frac{\text{Number of hatched chicks}}{\text{Total number of incubated eggs}} \text{ X 100}$$

$$\text{Hatchability \% of fertile eggs} = \frac{\text{Number of chick hatched}}{\text{Number of fertile eggs}} \text{ X 100}$$

Statistical analysis

Analysis of variance was calculated by using SAS procedure *[30]*. Means were compared by the "Duncan" multiple comparison *[30]*.

Table (1): The composition and nutritive value of the basal breeder diet

Ingredients	Percentages (%)
Yellow corn	24
Soy beau meal (44%)	20
Dried alfalfa	33
Wheat bran	15
Dicalcium phosphate	3
Calcium carbonate	3
Salt	0.5
Vit and mineral mix	0.6
Methionin	0.2
Lysine	0.2
Choline	0.1
Zin C bacitracin	0.2
Antioxidant	0.2
Total	100
Calculated analysis	
Crude profein	20 %
ME (Kcal/kg)	2500 (k cal/kg)
Fiber	14 %
Fat	3 %
Methionine	0.38
Lysine	1.00
Calcium	2.4
Phosphorus	0.7

Formulation according to *[27]* and calculated according to *[31]*.

Results and Discussion

The egg production rate:

Data presented in table (2) showed that there was highly significant difference in the egg production rate between the blue and black neck ostrich strains from the beginning toward the end of the breeding season and allover the experimental period. The egg production rate allover the experimental period was 16.39 and 13.90% per hen per day for the black and blue neck strain respectively. The obtained results indicated that black neck ostrich females were superior in egg production rate than that of blue neck strain. Although no published studies have adequately quantified differences between ostrich varities in their reproductive performance *[16]*, the obtained results agreed with those reported by *[17]* who found that the egg production for South African black neck females was higher than those for Zimbabwean blue neck females. The egg production was 49.5 and 33.6 eggs for South African black and Zimbabwean blue neck female respectively. She added that egg production was affected by dam line, but not by sire line or the interaction between dam line and sire line.

Regarding the effect of breeder age on the egg production rate, the obtained results revealed that there was highly significant differences in the egg production rate during May and toward the end of the breeding season and allover the experimental period. The egg production rate allover the experimental period was 16.35 and 13.94% for the breeder age(4.5-5.5) and (3.5-4.5) years old respectively. These results indicated that older breeders during the second season (2006) gave a higher egg production rate than those produced by the younger breeders during the first breeding season during (2005). The obtained results agreed with those recorded by *[28]* who found that the number of eggs laid per female ostrich per season was 25 in the first breeding season but reaches 57 by the fifth. Also young female ostrich in their first season of laying produced 10 to 20 eggs, an increase in the number of eggs in subsequent seasons was also reported by *[32]*. Regarding the beginning and end of the breeding season, the obtained results revealed that during (2005) and (2006) the beginning of egg laying for both seasons was recorded during February and the end of laying was recorded during September. These results agreed with those reported by *[6]* who found that the breeding season lasts as a rule from February to September in Europe. Also *[5]* reported that the breeding season in the southern hemisphere starts in March/April and extends into the Spring (September). The obtained results in the present study revealed that the egg production rate was low at the beginning and at the end of the breeding season for both seasons, while the peak egg production rate was recorded during May and June for both seasons. The peak egg production rate was (22.18 and 27.08) and (20.62 and 33.02) percentages for (2005 and 2006) during May and June respectively. These results agreed with those recorded by *[28]*, *[9]*, *[33]* and *[6]* who found that for all ages of birds, the percentage of eggs laid was low at the beginning and at the end of the season. Also *[34]* explained that plasma LH concentrations in female birds increase one month before the onset of the breeding season and then decline steadily. In contrast, oestradiol concentrations, which influence egg formation, are elevated from the first month of the laying season until a month before its end; they peak during the third month of the season, which corresponds to the peak in egg production.

Regarding the effect of different levels of Bio-power® supplementation in ostrich feed on egg production rate, results in table (2) showed that there was highly significant difference in egg production rate from the beginning of the laying season, during different months of the season and allover the experimental period between birds supplemented with different levels of Bio-power® in their feed. The highest egg production rate during different months of the laying season and allover the experimental period was recorded in birds supplemented with 0.5kg Bio-power®/ton feed, followed by those supplemented by 1kg Bio-power®/ton and the lowest egg production rate was recorded in birds supplement with 0.25kg Bio-power®/ton feed and the control group. The egg production rate allover the experimental period was 19.16, 16.71, 12.52 and 12.18% for birds supplemented diet with 0.5, 1, 0.25 kg Bio-power® /ton feed and the control group respectively.

The obtained results in the present study agreed with those reported by *[25]*, *[35]* and *[36]*. who found that feeding laying hens with lactobacillus based probiotics resulted in significant increased in egg production rates. On the other hand the obtained results in the present study disagreed with those obtained by *[37]*, *[38]* and *[39]* who found that dietary supplementation of lactobacillus or yeast based probiotic showed no statistically significant differences in egg production in layer hens. They explained that these controversial results might be related to the dosages of probiotic and concentration of bacteria used in the diet. In the present study birds supplemented with 0.5 kg Bio-power®/ton feed showed significantly higher egg production rate than those supplemented with 1kg Bio-power/ton feed. These results agreed with a study conducted by *[40]* who reported that inclusion of probiotic in laying hen's diet caused non significant decrease in egg production. They explained that using of higher levels of lactobacillus 1000 and 2000 gm/ton feed caused serious damages to absorptive area of digestive system than in lower levels of zero and 400 gm of lactobacillus based probiotic/ ton feed. They added that another reason to variable effect of biological additives may be confounded by variations in gut flora and environmental conditions. Also *[41]* showed that feeding live lactobacillus acidophilus resulted in significant increase in egg production at one location, a numerical improvement at the second and no difference at the third location.

Due to no published scientific studies regarding the effect of probiotic on ostrich reproductive performance, in the present study, our discussion was supported with literatures about probiotic effect on reproductive performance in laying hens.

Egg weight

Regarding the effect of ostrich strain on the egg weight, data presented in table (3) showed that there was highly significant difference in egg weight between blue and black neck ostriches during different months of the breeding season and allover the experimental period. The mean egg weight allover the experimental period was 1612.75 and 1441.12 gm for blue and black neck females respectively. The obtained results regarding the egg weight in the present study agreed with those reported by *[4]* who reported that ostrich egg size varies with hen size, maturity and stage of season. Also *[42]* mentioned that, although the ostrich egg is the largest of the living birds, it is the smallest (1.5%) in proportion to adult female body weight. *[17]* reported that blue neck female ostriches were heavier than black neck females. So that in relation to the body weight of females in the present study, blue neck females with a body weights ranged from (115-121kg) produced a significantly heavier egg than those produced by black neck females with a body weights ranged from (98-104kg).

Regarding the effect of breeder age on the egg weight, the results in table (3) showed that there was no significant difference in egg weight due to breeder age during February, April, Augst and September and allover the experimental period. The mean egg weight allover the experimental period was 1526.5 and 1527.37 gm for breeder age (3.5-4.5) and (4.5-5.5) years old respectively. The obtained results in the present study disagreed with those reported by *[32] and [28]* who found that the number and weight of ostrich eggs increased with ageing in the following seasons. *[32]*reported that the egg weight varied between 1100 and 1600 gm in the first breeding season, whears *[43]*, reported that egg weight in the second breeding season was about 1500gm. *[28]* found that egg weight was 1380 gm in the first breeding season and reached 1495 gm in the fifth. The difference in egg weight in the present study was not significant between the two different breeder ages may be due to that the females were in the first (2005) and second (2006) breeding seasons of their production and *[44]* reported that ostriches reach a good reproductive ability at 6 years old. Regarding the effect of month of lay on the average egg weight, in the present study there was a fluctuation in the egg weight due to month of laying and these results agreed with those reported by *[45]* who found that the average egg weight, though affected by production months, did not show a constant increase during the laying season, as normally observed in hens.

Regarding the effect of different levels of Bio-power® supplementation on egg weight, the results in table (3) showed that there was no significant difference in the egg weight due to different levels of Bio-power® during different months of the breeding season from February till August and allover the experimental period. The mean egg weights allover the experimental period were 1515.12, 1524.62, 1540 and 1528 gm for the control, 0.25, 0.5 and 1 kg Bio-power®/ton feed respectively. The obtained results agreed with those reported by *[25], [35] , [46], and [40]* who reported that probiotic inclusion in layer diets did not influence the egg weight significantly. The obtained results disagreed with those reported by *[21]* and *[47]* who showed that using vital biomass of probiotic supplements affects the egg weight significantly. A complementary reports by *[48]* and *[35]* suggested that addition of biological additives did not influence the egg weight significantly. These controversial results might be related to the dosages of probiotics, strain of bacteria, concentration and form of bacteria used (viability, dryness or their products).

The fertility percentage:

Data presented in table (4) showed that there was significant difference in the egg fertility % between blue and black neck female ostriches from April toward the end of the breeding season (September), while there was highly significant difference in the fertility % allover the experimental period. The fertility % allover the experimental period was 82.81 and 78.43 percentages for blue and black neck females respectively. The obtained result in the present study agreed with those reported by *[44]* for blue neck female ostrich and with those reported by *[28]*for black neck ostrich who found that the fertility percentage for blue neck female ostrich was 74.38% (at 6 years old) compared with 71% for black neck female at the same age. The difference in the fertility % between the two strains in the present study may be due to black neck hens may fail to reproduce due to intersexes which are a common problem in ostrich *[49]*.

Regarding the effect of breeder age on fertility %, the obtained results in table (4) revealed that there was no significant difference in the fertility % February and March, May, June and July and allover the experimental period between younger (3.5- 4.5) and older (4.5 – 5.5) years old breeders.

The fertility % allover the experimental period was 80.12 and 81.12 percentage for younger (3.5-4.5) and older (4.5 – 5.5) years old breeders respectively.

The obtained results disagreed with those reported by *[28]* who reported that the fertility % increased with age during five successive breeding seasons from (1998 to 2002) with ostrich females aged from 3 to 7 years old. The fertility % in their study were 58.3, 62.2, 68.5, 71. and 70.7 for 1998, 1999, 2000, 2001 and 2002, respectively. While *[50]* indicated that fertility is age related and that ostrich female fertility decline over time. Also *[44]* reported that there was notable increase in fertility % in female ostrich from 2000 to 2001 when the age was 5-6 years old while a decrease in the fertility % from 2001 -2002 when the age was 6-7 years old.

In *[44]* study the fertility was 66.09, 74.38 and 64.92% for 5, 6 and 7 years old breeders respectively. The non significant difference in the fertility % in the present study may be due to that the females were in their first and second breeding seasons of their life and there may be differences in the fertility % with advancing in age.

Regarding the effect of supplementation of diet with different levels of Bio-power® on fertility percentages, results presented in table (4) showed that there was no significant difference in the fertility % in the treated birds with different levels of Bio-power® allover the experimental period. The mean fertility was 79.47, 80.77, 82.71 and 82.54 percentage for the control, 0.25, 0.5 and 1 kg Bio-power®/ton feed respectively. The obtained results may be due to that fertilization of the ostrich eggs depends mainly upon successful mating between a sexually mature breeding pair in a good, healthy condition under suitable environmental conditions ***[51]***. Also no literature in this respect is available for ostrich egg fertility as affected by probiotic supplementation in feed.

The Hatchability percentage of total eggs:

Regarding of the effect of strain on the hatchability of total eggs', data presented in table (5) showed that there was highly significant difference in the hatchability % of total eggs between blue and black neck ostriches during different months of the breeding season (except February and April) and allover the experimental period. The hatchability of total eggs allover the experimental period was 62.47 and 55.69 % for the blue and black neck female ostriches, respectively.

The obtained results agreed with those reported by Ipek & Sahan, 2004 (for black neck ostriches) and with ***[44]*** (for blue neck ostriches) who found that the hatchability percentages of total eggs was 72.41% in blue neck females (at 6 years old) while 50.9 % in black neck females of the same age.

Regarding the effect of breeder age on the hatchability % of total eggs, results in table (5) showed that the hatchability percentages during different months of the breeding seasons was higher in older breeder age (4.5-5.5 years old) than those in younger breeders (from 3.5 -4.5 years old) but non significant ($P < 0.05$) (but significant during March and September). while there was significant difference in the hatchability % of total eggs between older and younger breeders allover experimental period ($p < 0.05$). The hatchability of total eggs allover the experimental period was 60.88 and 57.28% for older and younger breeders, respectively.

The obtained results in the present study agreed with those reported by ***[28]*** who found that the hatchability of total eggs was 37.5% in the first season and reached 51.7% in the fifth season in black neck ostriches which indicated that the hatchability % increased linearly with advancing in the breeder age. Also ***[44]*** found that the hatchability of total eggs increased from 62.06 to 72.41 % during two successive breeding season. ***[51]*** reported that the causes of the change in hatchability with female age have not been identified with any certainty.

Regarding the effect of different levels of Bio-power® supplementation in diet on hatchability of total eggs the results in table (5) showed that there was significant increase in the hatchability of total eggs in supplemented birds than in the control group during different months of the breeding season and allover the experimental period. The hatchability of total eggs allover the experimental period was 52.10, 57.45, 62.93 and 63.86% for the control, 0.25, 0.5 and 1kg Bio-power® per ton feed, respectively. Although convincing reports on the effects of defined probiotics under true commercial conditions in ostriches are lacking, the obtained results in this respect may be due to the improvement in egg size, egg quality and albumen quality as reported for laying hens by ***[35] and [47].***

Hatchability percentage of fertile egg:

Regarding the effect of ostrich strain on the hatchability of fertile eggs the results presented in table (6) showed that hatchability % of fertile eggs of blue neck ostrich increased than those of black neck ostrich during different months of the breeding season (except February and April) while there was significant increase in the hatchability of fertile eggs allover the experimental period between blue and black neck ostrich. The hatchability of fertile eggs allover the experimental period was 75.35 and 70.83% for blue and black neck ostriches, respectively. The obtained results in the present study agreed with those reported by *[44]* for (blue neck ostrich) and with those reported by *[28]* for (black neck ostrich). Who recorded that the hatchability of fertile eggs was 97.35% in blue neck ostriches (at 6 years old) while 71.8% in black neck ostriches of the same age. Which indicated that blue neck strains had better hatchability % than those attained by black neck females.

Regarding the effect of breeder age on the hatchability % of fertile eggs the results in table (6) revealed that the hatchability % of fertile eggs during different months of the breeding season was higher in older breeders (4.5 – 5.5 years old) than those recorded in younger breeders (3.5 – 4.5 years old) while there was significant difference ($p < 0.05$) in the hatchability of fertile eggs allover the experimental period due to breeder age.

The hatchability of fertile eggs was 71.28 and 74.90 % for younger and older breeders, respectively. The obtained results agreed with those reported by *[28]* who recorded that the hatchability of fertile eggs was 46.3% in the first season and increased to 73.1% by the fifth breeding season in black neck ostriches. Also *[44]* found that the hatchability of fertile eggs was 93.91% in the first breeding season of their study on blue neck ostrich aging 5 years old while increased in the successive season to 97.35% (at 6 years old).

Regarding the effect of different levels of Bio-power® supplementation in diet on hatchability of fertile eggs the results in table (6) showed that there was significant increase in the hatchability of fertile eggs in supplemented birds than in the control group during different months of the breeding season and allover the experimental period. The hatchability of fertile eggs allover the experimental period was 67.95, 71.06, 76.05 and 77.30 % for the control, 0.25, 0.5 and 1kg Bio-power® per ton feed, respectively. Although no available scientific literatures about the effect of probiotics on the reproductive performance of ostrich, the obtained results may be due to the improvement in eggs sizes, egg quality and albumen quality due to supplementation of diet with probiotic as reported by *[35]* and *[47]*.

The chick weight at hatching:

Regarding the effect of ostrich strain on the chick weight at hatching the results in table (7) showed that there was highly significant difference in the chick weight at hatching between blue and black neck strains during different months of the breeding season and allover the experimental period. Chicks hatched from blue neck female's eggs were significantly heavier in body weight at hatching than those hatched from black neck female's egg during different months and allover the experimental period. The mean chick weight at hatching allover the experimental period was 1020.83 and 879.50 gm for chicks hatched from blue and black female's eggs respectively. The obtained results in this respect agreed with those reported by *[52]* who reported that in domestic fowl, there is a strong positive correlation between the weight of an egg and the weight of chick hatched from it. Also *[53]* and *[44]* demonstrated that this relationship also exists in ostriches (i.e, heavier chicks were associated with larger eggs and vice-versa). Chick weight as a percent of egg weight is known to be fairly constant across species *[52]*. In the present study blue neck females produced eggs significantly heavier than those produced by black neck females as shown in table (3), so that it is reasonable to obtaining heavier chicks from heavier eggs.

Regarding the effect of the breeder age on the chick weight at hatching, the results in table (7) revealed that there was no significant difference in the chick weight at hatching between younger (3.5 -4.5) and older breeders (4.5 – 5.5) years old during different months of the breeding season and allover the experimental period. The mean of the chick weight at hatching allover the experimental period was 948.66 and 951.50 gm for younger and older breeders, respectively. The obtained results her disagreed with those reported by *[44]* who reported that seasons (2001 and 2002) when the age of breeders was 6 and 7 years old was significantly heavier than those hatched during (2000) when the breeder age was 5 years old, which indicated that older breeders, gave heavier chick weight at hatching than younger breeders. The same author added that no significant difference in the chick weight at hatching between the 6 and 7 years old breeders during 2001 and 2002 breeding seasons. The chick weight at hatching was 833.47 and 847.83 gm for the 6 and 7 years old breeders, respectively and these finding agreed with the results in the present study. The difference between the present study and the study of *[44]* may be due to that they compared the reproductive traits of breeder ostrich for 3 successive seasons beginning with 5 years old and end by 7 years old and they concluded that ostriches reach good reproductive ability at 6 years old, while in the present study we used relatively younger breeders 3.5 – 5.5 years old for only 2 successive breeding seasons.

Regarding the effect of supplementation of diets with Bio-power® on the chick weight at hatching the results in table (7) revealed that there was no significant difference in the chick weight at hatching due to supplementation of diets with Bio-power during different months of the breeding season and allover the experimental period. The mean chick weight at hatching allover the experimental period was 950.66, 950.66, 948.33 and 950.66 gm for the control, 0.25, 0.50 and 1kg Bio-power, respectively. The obtained results in this respect may be due to that the chick weight at hatching strongly related to the egg weight and there is a direct relationship between the chick weight and the egg weight as reported by *[53]* and *[44]* and by returning to the results in table (3) in the present study which show the effect of different levels of Bio-power® on the egg weight, the results showed no significant differences in the egg weight between the control and the supplemented birds (about 25 gm) which was not enough to show a significant differences in the chick weight at hatching. The obtained results agreed with those reported by *[25]*, *[35]*, *[46]* and *[40]*who reported that probiotic inclusion in layer diets did not influence the egg weight significantly and so in the present study supplementation of Bio-power® showed no significant influence on the chick weight at hatching.

Table (2) least – square means and standard errors for monthly egg production rate of different experimental groups as affected by studied factors

Independent variables	Egg production rate (%) hen/day at								
	February	*March*	*April*	*May*	*June*	*July*	*August*	*September*	*Allover the experimental period*
Strains									
blue Neck	5.00 ±0.24^{A}	13.95±.22^{B}	11.25±0.26^{B}	22.91±0.34^{B}	24.58±0.22^{B}	18.33±036^{B}	10.72±0.14^{B}	4.47+0.07^{B}	13.90+0.12^{B}
black Neck	5.41±0.24^{A}	16.35 ±0.22^{A}	12.91±0.26^{A}	26.35±0.34^{A}	29.06±022^{A}	21.87±0.36^{A}	12.70 ±0.14^{A}	6.45±0.07^{A}	16.39±0.12^{A}
Age (year)									
3.5-4.5	6.25±0.24^{A}	17.29±0.22^{A}	12.50±0.26^{A}	22.18±0.34^{B}	20.62±0.22^{B}	17.81±0.36^{B}	10.20±0.14^{B}	4.68±0.07^{B}	13.94±0.12^{B}
4.5-5.5	4.16±0.24^{B}	13.02±0.22^{B}	11.66±0.26^{A}	27.08±0.34^{A}	33.02±0.22^{A}	22.39±0.36^{A}	13.22±0.14^{A}	6.25±0.07^{A}	16.35±0.12^{A}
Bio-power® levels (kg/ton)									
Control	3.95±0.34^{C}	11.87±0.31^{C}	9.37± 0.38^{C}	19.58±0.49^{C}	22.29±0.31^{C}	16.45±0.51^{C}	9.37±0.19^{C}	4.58±0.10^{C}	12.18±0.17^{C}
0.25	4.37±0.34^{BC}	12.70±0.31^{C}	10.00±0.38^{C}	20.62±0.49^{C}	21.66+0.31^{C}	16.66±0.51^{C}	9.58±0.19^{C}	4.58±0.10^{C}	12.52±0.17^{C}
0.50	6.87±0.34^{A}	18.95±0.31^{C}	15.41±0.38^{A}	31.45±049^{A}	33.95±0.31^{A}	25.00±.51^{A}	14.79±0.19^{A}	6.87±.10^{A}	19.16±0.17^{A}
1.00	5.62±0.34^{AB}	17.08±0.13^{B}	13.54±0.38^{B}	26.87±0.49^{B}	29.37±0.31^{B}	22.29±.51^{B}	13.12±.19^{B}	5.83±0.10^{B}	16.71±0.17^{AB}
Overall mean	5.21	15.16	12.08	24.64	26.82	20.10	11.72	5.47	15.15

Means having similar letter in each column are not significantly different

F. Values for data presented in table (2)

S.O.V	d.f	F. Values at								
		February	March	April	May	June	July	August	September	Allover the experimental period
S	1	0.69	22.96***	11.11**	47.26***	80.25***	50.17***	15.66***	15.66***	24.74***
A	1	17.36***	72.96***	2.77	95.87***	614.62***	84.02***	36.50***	9.76***	23.21***
L	3	6.94*	46.57***	33.21***	124.23***	139.39***	71.81***	28.63***	4.90***	45.67***
SxA	1	0.69	3.51*	2.77	0.39	2.12	0.69	0.04	0.04	0.15
SxL	3	0.46	0.15	0.11	0.39	0.27	0.52	0.27	0.62*	0.14
AxL	3	0.46	2.24	0.34	7.10	13.35**	3.35	1.89*	0.27	1.71*
Error	3	0.46	0.39	0.58	0.39	0.97	1.04	0.16	0.04	0.13

Where: *=P<0.05, **P<0.01, ***P<0.001

S: Strains, A: Age, L: Levels

Table (3) least – square means and standard errors for monthly egg weight of different experimental groups as affected by studied factors

Independent variables	Egg weight (gm) at								
	February	*March*	*April*	*May*	*June*	*July*	*August*	*September*	*Allover the experimental period*
Strains									
blue Neck	1595.99±23.36^{A}	1621.01±9.39^{A}	1613.93±10.94^{A}	1612.84±7.40^{A}	1621.60±7.36^{A}	1609.43±8.36^{A}	1622.61±11.03^{A}	1609.33±15.70^{A}	1612.75±2.83^{A}
black Neck	1418.33±15.58^{B}	1438.78±8.66^{B}	1439.38±10.14^{B}	1446.57±6.90^{B}	1463.40±6.70^{B}	1458.42±7.52^{B}	1449.15±9.98^{B}	1421.42±12.93^{B}	1441.12±5.25^{B}
Age (year)									
3.5-4.5	1518.64±21.57^{A}	1548.15±8.38^{A}	1527.59±10.36^{A}	1511.49±7.51^{B}	1562.28±7.80^{A}	1516.01±8.41^{A}	1530.27±11.12^{A}	1500.16±15.47^{A}	1526.50±6.68^{A}
4.5-5.5	1495.68±17.61^{A}	1511.64+9.65^{B}	1525.71±10.72^{A}	1547.92±6.79^{A}	1522.72±6.18^{B}	1551.84±7.46^{B}	1538.49±9.97^{A}	1530.59±13.17^{A}	1527.37±6.14^{A}
Bio-power® levels (kg/ton)									
Control	1471.95±37.10^{B}	1514.15±14.06^{B}	1512.84±16.16^{A}	1529.65±11.2^{A}	1547.51±10.80^{A}	1526.39±12.33^{AB}	1540.84±16.51^{AB}	1482.14±21.63^{B}	1515.12.±8.83^{A}
0.25	1512.37±28.8^{AB}	1542.72±13.89^{A}	1523.53±16.09^{A}	1531.83±10.8^{A}	1541.92±10.82^{A}	1537.85±12.14^{AB}	1546.13±16.10^{AB}	1465.59±22.44^{AB}	1524.62±8.78^{A}
0.50	1532.00±19.06^{A}	1543.47±11.1^{BA}	1535.91±12.89^{A}	1529.64±8.79^{A}	1528.95±8.71^{A}	1551.06±9.85^{A}	1549.42±12.97^{A}	1553.41±17.69^{B}	1540.00±8.78^{A}
1.00	1512.32±21.50^{A}	1519.23±11.7^{A}	1534.34±13.75^{A}	1527.69±9.49^{A}	1551.62±9.31^{A}	1520.39±10.45^{A}	1501.14±13.68^{B}	1560.37±19.27^{B}	1528.00±6.52^{A}
Overall mean	1501.01	1527.05	1522.25	1524.77	1531.54	1529.57	1526.38	1509.06	1526.81

Means having similar letter in each column are not significantly different

F. Values for data presented in table (3)

S.O.V	d.f	F. Values at								
		February	*March*	*April*	*May*	*June*	*July*	*August*	*September*	*Allover the experimental period*
S	1	464084.84***	2263069.03***	1676567.32***	3101310.12***	2923000.97***	2078695.12***	1638944.31***	843187.85***	752137.65***
A	1	8025.04	90659.21**	194.90	148457.78***	182720.13***	117004.29***	3552.96	22186.75	24371.41
L	3	8530.04	16257.75	6107.85	317.50	13738.81	19793.06	30703.55	55358.33***	23417.32
SxA	1	9536.72	65626.41**	553.16	62.70.78*	90409.68**	67378.30**	59402.61*	7382.07	6832.77
SxL	3	29916.80	18616.61	26668.02	5234.03	4150.47	19070.11	44419.34**	71097.52***	61232.51
AxL	3	271.67	13732.71	52664.19**	94105.61***	87172.77***	31724.17*	2872.89	7890.70	6871.20
Error	3	11637.52	11107.12	12258.03	12258.03	11577.71	11527.72	11641.74	9866.35	8732.24

Where: *=P<0.05, **P<0.01, ***P<0.001

S: Strains, A: Age, L: Levels

Table (4) least – square means and standard errors for monthly Fertility % of different experimental groups as affected by studied factors

Independent variables	Fertility % at								
	February	*March*	*April*	*May*	*June*	*July*	*August*	*September*	*Allover the experimental period*
Strains									
blue Neck	49.82±4.23^A	79.23±1.13^A	84.76±1.34^A	85.96±0.51^A	86.86±0.57^A	84.84±0.77^A	85.72±0.97^A	78.33±0.62^A	82.81±0.32^A
black Neck	64.89±4.23^A	76.54±1.13^A	78.65±1.34^B	79.52±0.51^B	80.66±0.57^B	80.59±0.77^B	77.96±0.97^B	73.25±0.62^B	78.43±0.32^B
Age (year)									
3.5-4.5	54.82±4.23^A	76.59±1.13^A	80.54±1.34^A	83.76±0.51^A	84.77±0.57^A	82.78±0.77^A	82.73±0.97^B	72.70±0.62^B	80.12±0.32^A
4.5-5.5	59.89±4.23^A	79.18+1.13^A	82.87±1.34^A	81.72±0.51^A	82.75±0.57^A	82.65±0.77^A	80.94±0.97^A	78.88±0.62^A	81.12±0.32^A
Bio-power ® levels (kg/ton)									
Control	47.50±5.99^A	75.97±1.60^A	76.05±1.90^A	78.96±0.72^B	79.90±0.81^B	77.30±1.09^B	78.54±1.73^A	72.43±0.89^B	79.47.±0.46^A
0.25	67.02±5.99^A	75.91±1.60^A	83.63±1.90^A	82.07±0.72^{AB}	83.44±0.81^{AB}	84.01±1.09^A	81.06±1.73^A	75.20±0.89^{AB}	80.77±0.46^A
0.50	59.23±5.99^A	79.20±1.60^A	83.86±1.90^A	85.17±0.72^B	86.27±0.81^B	85.00±1.09^A	83.22±1.73^A	76.51±0.89^{AB}	82.71±0.46^A
1.00	55.69±5.99^A	80.45±1.60^A	83.29±1.90^A	84.77±0.72^B	85.44±0.81^B	84.55±1.09^A	84.53±1.73^A	79.02±0.89^A	82.54±0.46^A
Overall mean	57.36188	77.88875	81.71063	82.74563	83.76250	82.71750	81.84125000	75.79500	80.62563

Means having similar Letter in each column are not significantly different

F. Values for data presented in table (4)

S.O.V	d.f	F.Values at								
		February	*March*	*April*	*May*	*June*	*July*	*August*	*September*	*Allover the experimental period*
S	1	908.87	28.89	149.02*	166.08***	153.88***	72.42*	241.02**	102.92**	76.51***
A	1	102.66	26.93	21.78	16.58	16.24	0.07	12.81	152.64***	3.97
L	3	262.44	21.17	57.02	32.95*	32.16*	52.82*	27.55	30.09*	33.72
SxA	1	883.72	18.57	8.80	3.33	2.64	0.23	62.72	16.16	1.27
SxL	3	82.43	25.84	4.15	1.44	1.92	5.29	19.84	49.39	4.20
AxL	3	63.81	10.42	7.41	1.72	5.06	5.69	3.59	91.46**	1.27
Error	3	143.73	10.32	14.44	2.10	2.65	4.79	7.59	3.17	0.86

Where: *=P<0.05, **P<0.01, ***P<0.001

S: Strains, A: Age, L: Levels

Benha Vet. Med., J. Vol. 18, No.2, Dec. 2007

Table (5) least – square means and standard errors for monthly hatchability percentage (for total eggs) of different experimental groups as affected by studied factors

Independent variables	Hatchability % (for total eggs) at								
	February	*March*	*April*	*May*	*June*	*July*	*August*	*September*	*Allover the experimental period*
Strains									
blue Neck	33.92 ± 4.67^{A}	55.92 ± 0.68^{A}	59.89 ± 1.85^{A}	67.97 ± 0.78^{A}	68.70 ± 1.23^{A}	65.37 ± 1.04^{A}	64.01 ± 0.05^{A}	56.66 ± 1.73^{A}	62.47 ± 0.64^{A}
black Neck	37.92 ± 4.67^{A}	51.42 ± 0.68^{B}	54.06 ± 1.85^{A}	60.00 ± 0.78^{B}	59.56 ± 1.23^{B}	56.87 ± 1.04^{B}	55.13 ± 0.50^{B}	46.09 ± 1.73^{B}	55.69 ± 0.64^{B}
Age (year)									
3.5-4.5	31.63 ± 4.67^{A}	51.74 ± 0.68^{B}	55.44 ± 1.85^{A}	63.69 ± 0.78^{A}	63.66 ± 1.23^{A}	59.74 ± 1.04^{A}	58.92 ± 0.50^{A}	45.41 ± 1.73^{B}	57.28 ± 0.64^{B}
4.5-5.5	30.20 ± 4.67^{A}	$55.60+0.68^{A}$	58.52 ± 1.85^{A}	64.28 ± 0.78^{A}	64.61 ± 1.23^{A}	62.50 ± 1.04^{A}	60.22 ± 0.50^{A}	57.34 ± 1.73^{A}	60.88 ± 0.64^{A}
Bio-power® levels (kg/ton)									
Control	21.66 ± 6.60^{A}	48.08 ± 0.97^{C}	49.61 ± 2.62^{C}	55.55 ± 1.10^{C}	58.25 ± 1.47^{C}	54.60 ± 1.47^{C}	51.87 ± 0.71^{C}	44.87 ± 2.45^{B}	52.10 ± 0.90^{C}
0.25	42.37 ± 6.60^{A}	51.49 ± 0.97^{BC}	54.23 ± 2.62^{AB}	61.98 ± 1.10^{B}	60.98 ± 1.47^{BC}	59.01 ± 1.47^{BC}	59.35 ± 0.71^{B}	47.29 ± 2.45^{AB}	57.45 ± 0.90^{B}
0.50	32.67 ± 6.60^{A}	55.14 ± 0.97^{B}	62.37 ± 2.62^{A}	69.11 ± 1.10^{A}	69.33 ± 1.47^{A}	64.98 ± 1.47^{AB}	61.85 ± 0.71^{B}	55.30 ± 2.45^{AB}	62.93 ± 0.90^{A}
1.00	27.01 ± 6.60^{A}	59.96 ± 0.97^{A}	61.70 ± 2.62^{A}	69.29 ± 1.10^{A}	67.96 ± 1.47^{AB}	65.90 ± 1.47^{A}	65.22 ± 0.71^{A}	58.05 ± 2.45^{A}	63.86 ± 0.90^{A}
Overall mean	30.92313	53.67250	56.98250	63.98813	64.13563	61.12688	59.57750	51.38000	59.08563

Means having similar letter in each column are not significantly different

F. Values for data presented in table (5)

S.O.V	d.f	F. Values at								
		February	March	April	May	June	July	August	September	Allover the experimental period
S	1	784.14	80.82**	136.07	254.16***	334.24**	288.74**	315.24***	446.68*	184.07***
A	1	8.19	59.75*	37.94	1.38	3.61	30.49	6.76	569.29**	51.94*
L	3	313.53	103.49**	150.90*	172.80**	115.00*	113.06*	128.63***	158.53	118.75**
SxA	1	110.30	16.40	60.29	13.05	1.67	4.48	84.73**	51.67	0.27
SxL	3	111.79	39.89*	17.51	13.30	0.68	6.19	47.75**	142.29	4.16
AxL	3	118.25	5.62	11.40	3.23	9.16	4.28	3.60	224.82*	1.30
Error	3	174.63	3.79	27.47	4.90	12.17	8.74	2.05	24.01	3.27

Where: *=$P<0.05$, **$P<0.01$, ***$P<0.001$

S: Strains, A: Age, L: Levels

Table (6) least – square means and standard errors for monthly Hatchability % (for fertile eggs) of different experimental groups as affected by studied factors

Independent variables	Hatchability % (for fertile eggs) at								
	February	*March*	*April*	*May*	*June*	*July*	*August*	*September*	*Allover the experimental period*
Strains									
blue Neck	48.74±3.97^{A}	70.56±1.84^{A}	70.69±2.07^{A}	78.89±1.19^{A}	78.99±0.94^{A}	76.97±0.67^{A}	74.69±0.51^{A}	71.66±2.08^{A}	75.35±0.61^{A}
black Neck	56.53±3.97^{A}	66.95±1.84^{B}	68.45±2.07^{A}	75.40±1.19^{B}	73.81±0.94^{B}	70.46±0.67^{B}	70.34±0.51^{B}	61.81±2.08^{B}	70.83±0.61^{B}
Age (year)									
3.5-4.5	55.48±3.97^{A}	67.45±1.84^{B}	68.53±2.07^{A}	75.84±1.19^{A}	74.94±0.94^{A}	71.96±0.67^{A}	70.79±0.51^{B}	61.03±2.08^{B}	71.28±0.61^{B}
4.5-5.5	49.79±3.97^{A}	70.07+1.84^{A}	70.61±2.07^{A}	78.45±1.19^{A}	77.86±0.94^{A}	75.48±0.67^{A}	74.24±0.51^{A}	72.43±2.08^{A}	74.90±0.61^{A}
Bio-power® levels (kg/ton)									
Control	45.83±5.62^{B}	62.99±2.61^{B}	64.92±2.92^{B}	70.41±1.68^{B}	72.83±1.34^{B}	70.470±0.95^{B}	65.54±0.73^{C}	59.99±2.94^{B}	67.95±0.86^{B}
0.25	62.91±5.62^{A}	67.97±2.61^{B}	64.99±2.92^{B}	75.45±1.68^{AB}	73.08±1.34^{B}	70.19±0.95^{B}	73.03±0.73^{B}	61.60±2.95^{AB}	71.06±0.86^{B}
0.50	54.79±5.62^{A}	69.62±2.61^{B}	74.33±2.92^{A}	81.12±1.68^{A}	80.26±1.34^{A}	76.39±0.95^{A}	74.29±0.73^{AB}	72.08±2.95^{AB}	76.05±0.86^{A}
1.00	47.02±5.62^{B}	74.47±2.61^{A}	74.03±2.92^{A}	81.61±1.68^{A}	79.43±1.34^{A}	77.83±0.95^{A}	77.21±0.73^{A}	73.27±2.95^{A}	77.30±0.86^{A}
Overall mean	52.63938	68.76250	69.57188	77.15000	76.40313	73.72250	72.52188	66.73813	73.09250

Means having similar letter in each column are not significantly different

F. Values for data presented in table (6)

S.O.V	d.f	F. Values at								
		February	March	April	May	June	July	August	September	Allover the experimental period
S	1	242.19	52.05	20.04	48.65	107.58*	169.52***	75.73***	388.38*	81.81**
A	1	129.90	27.35	17.24	27.40	34.01	49.49*	47.64**	519.72*	52.41*
L	3	250.83*	89.68*	113.43*	112.03*	63.81*	62.67*	98.69***	190.64	76.08**
SxA	1	105.42	1.13	52.96	7.95	0.003	7.48	20.54*	60.80	4.14
SxL	3	136.48	21.00	24.55	17.18	2.16	1.85	30.08*	134.55	1.97
AxL	3	232.81	4.07	24.49	7.69	13.98	0.72	1.16	149.74	0.46
Error	3	126.49	27.27	34.32	11.33	7.19	3.61	2.15	34.78	3.002

Where: *=P<0.05, **P<0.01, ***P<0.001

S: Strains, A: Age, L: Levels

Table (7) least – square means and standard errors of chick weight at hatching of different experimental groups as affected by studied factors

Independent variables	Chick weight at Hatching (gm) at							
	March	*April*	*May*	*June*	*July*	*August*	*September*	*Allover the experimental period*
Strains								
blue Neck	1019.19±6.55^{A}	1024.51±7.61^{A}	1022.06±4.86^{A}	1017.18±4.6^{A}	1023.72±5.59^{A}	1020.72±5.59^{A}	1007.41±8.21^{A}	1020.83±0.98^{A}
black Neck	891.31±6.37^{B}	880.46±7.45^{B}	872.84±4.81^{B}	883.29±4.49^{B}	876.36±5.35^{B}	875.36±5.35^{B}	850.32±7.54^{B}	879.50±0.93^{B}
Age (year)								
3.5-4.5	950.77±6.13^{A}	950.13±7.49^{A}	948.61±5.09^{A}	948.02±5.07^{A}	953.60±5.88^{A}	943.45±7.55^{A}	913.27±6.33^{A}	948.66±1.24^{A}
4.5-5.5	959.72±6.78^{A}	954.84±7.57^{A}	946.30±4.58^{A}	952.45±3.98^{A}	946.47±5.03^{A}	952.48±6.46^{A}	928.21±8.41^{A}	951.50±1.85^{A}
Bio-power® levels(kg/ton)								
Control	950.27±10.55^{A}	964.60±12.45^{A}	943.51±8.04^{A}	953.53±7.27^{A}	953.15±8.87^{A}	941.03±11.74^{A}	940.40±10.22^{A}	950.66±3.07^{A}
0.25	955.14±10.01^{A}	956.95±11.59^{A}	944.75±7.34^{A}	951.51±7.12^{A}	944.40±8.37^{A}	954.29±10.63^{A}	949.60±11.21^{A}	950.66±2.02^{A}
0.50	954.97±7.79^{A}	940.59±8.67^{A}	952.11±5.65^{A}	948.40±5.37^{A}	952.39±6.51^{A}	944.94±8.41^{A}	950.30±7.23^{A}	948.33±2.02^{A}
1.00	960.61±7.91^{A}	947.8±9.31^{A}	949.45±6.10^{A}	947.51±5.83^{A}	950.21±6.95^{A}	951.60±8.61^{A}	948.20±7.18^{A}	950.66±1.81^{A}
Overall mean	952.36	948.98	947.70	949.84	947.81	947.43	935.96	950.10

Means having similar letter in each column are not significantly different

F. Values for data presented in table (7)

S.O.V	d.f	F. Values at							
		March	April	May	June	July	August	September	Allover the experimental period
S	1	586819.50***	630858.12***	1558715.65***	1320954.23***	1175338.35***	639655.12***	763241.14***	645321.17***
A	1	2873.46	673.55	373.06	1438.49	2741.90	2480.19	2654.13	2260.14
L	3	658.51	3398.61	1177.81	551.70	758.92	1009.19	1146.12	1121.20
SxA	1	5436.99	67.01	11.67	90.53	779.62	4465.75	1012.16	3621.18
SxL	3	2692.87	3343.39	3320.98	3094.49	5343.26	3757.13	2763.14	2891.14
AxL	3	2662.59	1037.39	857.98	505.60	2004.10	1284.88	1413.61	12.62.11
Error	3	3000.56	3455.86	3277.83	3057.76	3236.24	3009.66	4128.43	3124.42

Where: *=P<0.05, **P<0.01, ***P<0.001

S: Strains, A: Age, L: Levels

References

[1] ***Deeming, D.C., Ayres, L & Ayres, F.J. (1993):*** Observations on the commercial production of ostrich (Sruthio Camelus) eggs in the united kingdom: incubation veterinary Record, 132: 602-607.

[2] ***Deeming, D.C. and Angle, C.R. (1996):*** Introduction to the ratites and farming operations around the world. In: D.C. Deeming (Editor), Improving our understanding of ratites in a farming environment, Ratite conference, Oxfordshire, pp 1-4.

[3] ***Deeming, D.C. & Ar, A. (1999):*** Facotrs affecting the success of commercial incubation. In: The ostrich: biology, production and health (edited by D.C. Deeming). Pp 159-190. oxon, Wallingford: CABI publishing.

[4] ***Hicks, K.D. (1992):*** Ratite reproduction proceeding of the Association of Avian Veterinarians, pp. 318-324.

[5] ***Mellett, F.D. (1993):*** Ostrich production and products, in: MAREE, C. & Casey, N.H. (Eds) livestock production systems, principles and practice, pp.187-194 (Pretoria Agridevelopment foundation).

[6] ***Horbanczuk, J (2002):*** Egg production, in: The ostrich, pp: 77-82 (Warsaw).

[7] ***Deeming, D.C. & Ayres, L. (1994):*** Factors affecting the rate of growth of Ostrich (struthio camelus) chicks in captivity. Veterinary Record, 135: 617-622.

[8] ***Deeming, D.C. (1995):*** Factors affecting hatchability during commercial incubation of ostrich (struthio camelus) eggs. British poultry science, 36: 51-65.

[9] ***Deeming, D.C. (1996)***: Production, fertility and hatchability of ostrich (struthio camelus) eggs on a farm in the united kingdom. Animal science, 6r3: 329-336.

[10] ***Wilson, H.R.; Eldred, A.R. & Wilcox, C.J. (1997):*** Storage time and ostrich egg hatchability. Journal of applied poultry research, 6: 216-220.

[11] ***Dzoma, B.M. & Dorrestein, G.M. (1998):*** Problems in ostrich forming. Equator, 10: 1-6.

[12] ***More, S.J. (1996a):*** The performance of formed ostrich eggs in eastern Australia, preventive veterinary medicine, 29: 121-134.

[13] ***Philbey, A.W.; Button, C.; Gestier, A.W.; Munro, B.E.; GlastonBury, J.R.W.; Hindmarh, M. & Love, S.G.J. (1991):*** Anasarca and myopathy in ostrich chick. Australian veterinary Journal, 68: 237-240.

[14] ***Madeiros, C.A. (1995):*** An introduction of the ostrich. In: 2 Toe, the practical guide to ostrich farming West Bar Veterinary Hospital, Banbury, Oxfordshire.

[15] ***Petite, J.N. & Davis, G (1999):*** Breeding and genetics. In: The ostrich: biology, production and health. (edited by D.C. Deeming). Pp 275-292. Oxon, Wallingford: CABI publishing.

[16] ***Bunter, K.L. (2002):*** The genetic analysis of reproduction and production traits recorded for formed ostriches (struthio camelus) phD thesis university of New England, Armidale, Australia.

[17] ***Brand, M.M. (2006):*** Reproduction criteria and meat quality of south African Black (struthio camelus Var. Domesticus), Zimbabwean blue (struthio camelus Australis) and south African black X Zimbabwean Blue ostriches. Master thesis. University of stellen bosch.

[18] ***Torres-Rodriguez, A.; Donoghue, A.M., Donoghue, D.J.; BArton, J.T.; Tellez, G. and Hargis, B.M. (2007):*** Performance and condemnation rate analysis of commercial

Turkey Flocks treated with a Lactobacillus spp. Based probiotic poultry science, 86: 444-446.

[19] Dierck, N.A. (1989): Biotechnology aids to improve feed and feed digestion: enzymes and fermentation Arch. Animal Nutr. Berl, 39: 241-261.

[20] Fuller, R. (1989): Probiotics in man and animals A review. J. Apple. Bacterial., 66: 365-378.

[21] Nahashon, S.N., Nakaue, H.S. & Mirosh, L.W. (1992): Effect of direct-fed microbials on nutrient retention and production parameters of laying pullets. Poult. Sci., 71: 111.

[22] Toms, C. and Powrie, F. (2001): Control of intestinal inflammation by regulatory T cells. Microbes infect., 3: 929-935.

[23] Rolf, R.D. (2000): The role of probiotic cultures in the control of gastrointestinal health. J. Nutr., 130: 396-402.

[24] Jin, L.Z., Ho, Y.W.; Abdullah, N. and Jalaludin, S. (1997): Probiotic in poultry: modes of action world's poultry Sci. J., 53: 351-368.

[25] Mohan, B.; Kadirvel, R.; Bhaskaran, M. and Natara Jan, A. (1995): Effect of probiotic supplementation on serum/Yolk Cholesterol and on egg shell thickness in layers. Br. Poult. Sci., 36: 799-803.

[26] Kurtoglu, V.; Kurtoglu, F.; Seker, E.; Coskun, B Balevi, T. and Polat, E.S. (2004): Effect of probiotic supplementation on laying hen diets on yield performance and serum and egg yolk cholesterol. Food Addit. Contam., 21: 817-823.

[27] Scheideler, S.E and Sell, J.L. (1997): Nutrition guidelines for ostriches and emus. IOWA state university, university extension.

[28] Ipek, A. & Sahan, U. (2004): Effect of breeder age and breeding season on egg production and incubation in farmed ostriches. British poultry science. 45, p: 643-647.

[29] Jarvis, M.J. Jarvis, C. and Keffen, R.H. (1985): Breeding season and laying patterns of the southern African ostrich, struthio camelus. Ibis, 127: 442-449.

[30] SAS (1996): SAS procedure guide "version 6.12 Ed" SAS Institute Inc., Cary, NC, USA.

[31] National research council (1994): Nutrient requirement of poultry. 9th rev. ed. National academy press. Washington, D.C.

[32] Foggin, C.M. (1992): Pathology of ostrich eggs and investigation of incubation problems, in: ostrich workshop for veterinarians, university of Zimbabwe veterinary faculty, Harare, 11th to 12th April, pp 62-73.

[33] More, S.J. (1996b): The performance of formed ostrich hens in estern Australia. Preventive Veterinary Medicine, 29: 107-120.

[34] Degen, A.A.; Well, S.; Rosenstraugh, A.; Kam, M. & Dawson, A. (1994): Seasonal plasma levels of lutenizing and steroid hormones in male and female domestic ostrich (struthio camelus). General and comparative Endocrinology, 93: 21-27.

[35] Haddadin, M.S.Y.; Abdulrahim, S.M.; Hashlamoun, E.A. and Robinson, R.K. (1996): The effect of lactobacillus acidophilus on the production and chemical composition of hen's eggs. Poult. Sci., 75: 491-494.

[36] Yoruk, M.A.; Gul, M.; Hayirli, A. and Macit, M. (2004): The effect of supplementation of Humate and probiotic on egg production and quality parameters during the late laying period in hens. Poult. Sci, 83: 84-88.

[37] ***Goodling, A.C. (1987):*** Production performance of white leghorn layers fed lactobacillus fermentation products. Poult. Sci., 66: 480-486.

[38] ***Balevi, T., An, U.S.; Coskun, B.; Kurtoglu, V. and Etingul, I.S. (2001):*** Effect of dietary probiotic on performance and humoral immune response in layer hens. Br. Pult. Sic., 42: 456-461.

[39] ***Asli, M.M.; Hosseini, S.A.; Lotfollahian, H. and Shariatmadari, F. (2007):*** Effect of probiotics, yeast, vitamin E and vitamin C supplements on performance and immune response of laying hen during high environmental temperature. International journal of poultry science, 6 (12): 895-900.

[40] ***Mahdavi, A.H.; Rahmani, H.R. and Pourreza, J. (2005):*** Effect of probiotic supplements on egg quality and laying hen's performance. International journal of poultry science 4 (7): 488-492.

[41] ***Miles, R.D.; Arofa, A.S.; Harms, R.H.; Carl Son, C.W. Reid, B.L. and Crawford, J.S. (1981):*** Effect of a living non freeze-dried lactobacillus acidophilus cultures on performance egg quality, and gut microflora in commercial layers. Poult. Sci., 60: 993-1004.

[42] ***Bertram, B.C.R. (1980):*** Breeding systems and strategies of ostriches. Proceeding of the 17th International ornithological congress. Pp 890-894.

[43] ***Corvine, T. (1996):*** Italians prefer African blacks. International Hatchery practice, 10 (3): 13-16.

[44] ***Zoccarato, I., Guo, K.; Gasco, L. and Picco, G. (2004):*** Effect of egg weight on ostrich (struthio camelus) chich weight and growth. Italian. J. Anim. Sci. vol. 3, (7-17).

[45] ***DIMeo, C.; Stanco, G.; CutriGnelli, M.I.; Castaldo, S. and NiZZA, A. (2003):*** Physical and chemical quality of ostrich eggs during the laying season. British poultry science 44, (3): 386-390.

[46] ***Chen, Y.C. and Chen, T.C. (2003):*** Effects of commercial probiotic or prebiotic supplementation on production,size and quality of hen eggs. Poult. Sci., 82 (suppl. 1): 330 (abstr).

[47] ***Tortuero, F. and Fernandez, E. (1995):*** Effect of inclusion of microbial culture in barley-based diet fed to laying hens. Animal. Feed. Sci. Tec., 53: 255-265.

[48] ***Nahashon, S.N.; Nakaue, H.S. and Mirosh, I.W. (1996):*** Performance of single comb white leghorn fed a diet supplementated with a live microbial during the growth and egg laying phases. Animal. Feed. Sci. Tec., 57: 25-38.

[49] ***Stewart, J.S. (1994):*** Ratites. In: Harrison, Harrison and Ritchie (eds) Avian Medicine. Application and principles. Wingers Publishing Inc., Florida.

[50] ***Button, C.; Moon, D. and Turner, D. (1994):*** Improving the hatchabiity of ostrich eggs. Australian ostrich association Journal, No. 27: 10-23.

[51] ***Badley, A.R. (1997):*** Fertility, hatchability and incubation of ostrich (struthio camelus) eggs. Poultry and Avian Biology Reviews, 8 (2): 53-76.

[52] ***Wilson, H.R. (1991):*** Inter relationships of egg size, chick size, posthatching growth and hatchability. World's poultry science. J. 47: 5-20.

[53] ***Gonzalez, A.; Satterlee, D.G.; Moharer, F. and Cadd, G.G. (1999):*** Factors affecting ostrich egg hatchability. Poultry science,78: 1257-1262.

تأثير نوع وعمر الأمهات وإضافة البروبيوتك على معدل إنتاج البيض ونسبة الخصوبة والفقس ووزن الكتاكيت عند الفقس فى النعام

جعفر محمود الجندى* سعيد محمد مرسى الليثى**
أحمد أبو السعود رضوان* محمود عاطف أحمد*

* قسم الإنتاج الحيوانى- كلية الزراعة- جامعة بنها.
** قسم الصحة وسلوكيات ورعاية الحيوان- كلية الطب البيطرى- جامعة بنها.

أجريت هذه الدراسة لبحث تأثير نوع النعام وعمر الأمهات وكذلك إضافة أحد أنواع البروبيوتك (بيو- باور®) المتوفرة فى الأسواق على معدل إنتاج البيض ونسبة الخصوبة والفقس ووزن الكتاكيت عند الفقس فى النعام.

استخدم فى هذه الدراسة عدد (٤٨) نعامة (٢٤ أزرق الرقبة و ٢٤ أسود الرقبة) على مدار موسمى تزاوج متتاليين (٢٠٠٥) و (٢٠٠٦).

تم تقسيم النعام الأسود والأزرق الرقبة إلى ٤ مجموعات (لكل نوع) (مكررين لكل مجموعة) على أساس مستوى إضافة البيو- باور® (مجموعة كنترول و ٠,٢٥ و ٠,٥٠ و ١كيلو جرام بيو- باور® لكل طن عليقة) واحتوت كل مجموعة على عدد (٢ أنثى + واحد ذكر).

ويمكن تلخيص نتائج هذه الدراسة فيما يلى:

- وجد أن معدل إنتاج البيض فى النعام أسود الرقبة أعلى معنوياً (١٦,٣٩%) عنه فى النعام أزرق الرقبة (١٣,٩٠%).
- سجلت أمهات النعام الأكبر سناً فى الموسم الثانى معدل إنتاج بيض أعلى معنوياً (١٦,٣٥%) من الموسم الأول (١٣,٩٤%).
- وجد أن بداية موسم وضع البيض فى النعام فى مصر خلال شهر فبراير ونهايته خلال شهر سبتمبر لكلاً من الموسمين.
- سجل أعلى معدل إنتاج للبيض خلال شهرى مايو ويونيه لكلاً من الموسمين.
- سجل أعلى معدل لإنتاج البيض فى الطيور التى تم إضافة البيو- باور® لها بمعدل ٠,٥ كيلو جرام للطن عنه فى المجموعات الأخرى.
- إناث النعام أزرق الرقبة تنتج بيضاً أثقل معنوياً (١٦١٢,٧٥جرام) عما ينتجه النعام أسود الرقبة (١٤٤١٠١٢جرام).
- عمر الأمهات فى النعام لم يكن له تأثير معنوى على متوسط وزن البيض على مدار موسم التزاوج.
- نسبة الخصوبة والفقس (للبيض الكلى والمخصب) فى النعام الأزرق الرقبة أعلى من النعام أسود الرقبة.
- إضافة البيو- باور ® بمستوياته المختلفة لم يكن له تأثيرا معنويا على وزن البيض المنتج.
- وجد أن عمر الطيور لم يكن له تأثيرا معنويا على نسبة الخصوبة ووزن الكتاكيت عند الفقس بينما وجد أن الطيور الأكبر تعطى نسبة أعلى معنويا للفقس للبيض الكلى والمخصب عنها فى الطيور الأصغر سنا.
- وجد أن إضافة البيو- باور ® لعلائق النعام لم يكن له تأثيرا معنويا على نسبة الخصوبة وأوزان الكتاكيت عند الفقس بينما أدت إضافة البيو- باور® إلى زيادة معنوية فى نسبة الفقس للبيض الكلى والمخصب عنها فى مجموعة الكنترول.

الخلاصـــة

١- يتميز النعام أسود الرقبة بارتفاع معدل إنتاج البيض عن النعام أزرق الرقبة لكن النعام أزرق الرقبة يتميز بنسبة خصوبة وفقس أعلى وأوزان بيض وكتاكيت أثقل من ا لنعام أسود الرقبة.

٢- يبدأ موسم وضع البيض فى النعام فى مصر خلال شهر فبراير وينتهى خلال شهر سبتمبر وأعلى معدلات لإنتاج البيض فى شهرى مايو ويونيه.

٣- إضافة البيو- باور® لعلائق النعام يؤدى إلى زيادة معدلات إنتاج البيض كذلك يؤدى إلى زيادة نسبة الفقس للبيض الكلى والمخصب.

٤- يلاحظ تحسن فى معدل إنتاج البيض فى النعام وكذلك فى نسب الفقس للبيض الكلى والمخصب مع تقدم عمر الطيور.