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Effect of Season on Egg Production, Fertility, Hatchability, and Chick Survival of Captive Red-necked Ostrich (*Struthio camelus camelus*)

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Abstract: An experiment was carried out to determine the effect of season on ostrich (*Struthio camelus camelus*) egg production, fertility, hatchability and chick survivability under captive conditions. The experiment was conducted during the period November 2007-June 2008 and further divided into two seasons, winter November 2007-February 2008 and summer March 2008- June 2008. Nineteen female and thirteen male ostriches were distributed in 6 pens: A (2 males + 4 females), B (1male +2 females), C (2 males + 4 females), D (2 males + 2 females), E (2 males + 4 females), F (4 males + 3 females). The experiment was conducted in a private farm about 75 kilometers south of Khartoum town. Ostrich eggs were manually collected and stored for seven days, at room temperature, before transference to the incubator. The eggs were candled before and at the end of the incubation period. Results showed that fertility was significantly (P ≤0. 01) higher for winter compared to that in summer. Total eggs production was significantly higher in winter than that of summer being 390 V 186 eggs respectively. Incubation rate for winter (55.83 ±8.33%) was significantly (P≤ 0.01) higher than that of summer (17.97±3.22%). Hatchability of incubated eggs for winter was (49.96+9.15%) which was significantly, higher (P ≤ 0.01) than that of summer (29.07±24.06%). The hatchability of fertile eggs for winter (89.79±11.70 %) being significantly higher (P≤ 0.01) when compared to that of summer (60.58±26.68%). Chick survivability was significantly (P≤0.05) higher for winter than that of summer, (26.6±14.42) and (16.46± 11.08%), respectively.

Keywords: Red neck ostrich, captivity, fertility, hatchability, chick survival**.**

Introduction:

In recent years, red neck ostrich (*Struthio. c. camelus*) farming increased for meat and skin production. That was due to consumer demand for an alternative animal protein source of good nutritional value and lower fat and cholesterol content. Other important ostrich products include oils, fat as well as fine leather commodities.

Hatchability of ostrich eggs drops as breeding season progresses and it has been found that hatchability is proportional to the number of eggs, particularly at the beginning and at end of season. This might be due to low rate of fertility or due to the unfavourable conditions in partially empty incubator (Deeming, 1996). He reported that black neck ostrich (Struthio camelus australis) hatchability was 72.8% under captive conditions in Saudi Arabia.

The present study looked into effect of season on egg production, fertility, hatchability and chick survivability of red-neck ostrich (*S. c.*

camelus) under captive conditions. The objective of the present study was to determine the effect of season on ostrich egg production, fertility and hatchability; external physical characters of ostrich egg and chick survivability.

Materials and Methods

The present study was conducted in Elrajia wildlife farm in Elgitaina District, on the eastern side of Khartoum Kosti road about 75 km south of Khartoum in the period (November 2007 - June 2008). 19 female and 13 male ostriches were distributed into 6 pens A (2 males and 4 female), B (1male + 2 females), C (2males + 4 females), D (2males +2 females), E (2males+4 females), F (4 males + 3 females). The dimensions of the pens were 45×52×3 meters. The pen floor was made of sandy ground. Drinking water and feed were provided in half barrel basins. Shade was by trees and shelters.

The incubator room was constructed of cemented brick walls and concrete roof, with dimensions (14×5×3 meters). Ventilation of incubator room was by roof fans and windows and an air conditioner for adjustment of temperature and relative humidity to 36.1°C and 18-25 %, respectively.

The eggs were manually collected at night and early in the morning and stored on table (2×1×1m) in stainless steel boxes for seven days at room temperature. Windows of the incubator room were opened, fan and air conditioners were worked to increase the relative humidity and reduce the temperature.

The eggs were weighed when transferred to the incubator and were set vertically with the air space at the top. The incubation period was 39 days and the eggs were turned, within rotation angle of 90, every 3 hours. The eggs were candled in dark room for determination of the air space, detection of embryonic development and after 39 days of incubation for determination of fertile and infertile eggs. Fertile eggs were transferred to the hatchery and infertile eggs were excluded.

Temperature and relative humidity of the hatchery were 36.1°C and 30-60% respectively. Then the eggs were cracked (1-2 cm) on the air space to facilitate lung respiration and evaporation of excess water content of the eggs and assist chick hatching by breaking the shell. Number of total eggs produced for each season was recorded. The same applied to number of incubated eggs; number of fertile eggs were calculated and expressed as mean percentage. The weights were also recorded and changed to means. Axial length and width were recorded. Circumference width and length were taken and also water loss by subtracting the final weight from that before incubation .

Data obtained from the egg production performance during winter and summer was subjected to the mean comparisons according to the T-student (T-test) (Steel and Torrie, 1989).

Results

Total number of eggs produced in the winter, season was 390 eggs with a mean of 97.5±6.03 eggs/month and during the summer season was 186 eggs with monthly means of 46.5±5.03 eggs (Table 1) which were significantly different ($p \leq 0.05$). The initial egg weight was significantly lower in winter than summer ($p<0.05$) (Table1). Storage time (days) and water loss (%) were not significantly different between winter and summer. Egg setting weight was significantly lower ($p \leq 0.05$) for winter compared with that of summer (table 1). Figure (1) shows total egg production and the rate of production per month (%) for both winter and summer. The circumference (length) in cm, was 45.49±0.30 in winter and 46.23±1.03 in summer which were significantly different ($p \leq 0.01$) as shown in Table (2). The circumference width (cm) was not significantly different for the two seasons while the axial length (cm) was significantly different (Table 2). Table 3 shows the rate of fertile egg as % being 57.5±36.95 V 37.24±24.75 % for winter and

summer respectively which were significantly different ($p \leq 0.05$). The hatched eggs were significantly higher for winter ($p \leq 0.01$) with values 49.75±31.40 and 37.07±23.50, respectively (Table 3). The incubation time (days) was ($P \leq 0.01$) longer (42. 61 ±0.60) for winter as compared to that of summer (30.77±0.96). There was significant difference ($P \leq 0.05$) in water loss between winter and summer (Table 3)

The egg incubation rate was significantly higher ($p \leq 0.01$) for winter (55.83±8.33%) as compared to that of summer season (32.27 ±17.97 %). The hatchability of incubated eggs was significantly ($p \leq 0.01$) higher for winter season (49.96 ±9.15 % as shown in table (3) whereas hatchability of fertile eggs, chick survival rate, chick weight as % , water loss of hatching eggs% of the setting egg were all significantly higher ($p \leq 0.01$) for winter season as compared to those values of summer season (Table3).

Table 4 shows the mean values of ostrich chick mortality rate during laying season. The mortality was significantly ($p \leq 0.01$) higher for winter season as compared with that of summer season. However, chick mortality as % of fertile eggs was non-significant between the two seasons, but it was numerically higher for winter season. Water loss of dead chicks was significantly higher ($p \leq 0.01$) for winter season as compared to summer season.

Discussion

In the present study, the egg laying period for captive red-neck Ostrich (*S. c. camelus*) started from late November 2007 up to first week of June 2008. Brinsea (2003) reported that the egg laying season, in the Southern hemisphere extended from March to August then extending to September. It was reported by Jarvis *et al*., (1985) that, in Zimbabwe, the laying season is between June and October while in Namibia it was reported to be between August and October (Sauer and Sauer, 1966). These variations of laying season could be attributed to geographical distribution and climate of the area.

External measurements of the breeding ostrich egg were 45.49±0.30 and 41.81±0.01 cm for circumference length and width in winter, and 14.71±0.29 and 12.24±0.05 cm for axial length and width respectively, which disagreed with Shanawany and Dingle (1999) who reported that the egg size differs in the length and width and content, with average about 18 cm and 15 cm for axial length and width respectively. The circumference length and width were about 44.60 and 40.40 cm, which were cited by (Deeming, 1996., Kriebick and Sommer, 1995., Shanawany and Dingle, 1999).

The fertility of experimental ostrich eggs in winter was 57.50 ±35.95 and in summer 37.27±24.75 which disagreed with Cloete *et al*., (1989) who reported that fertility may reach 100%, while Deeming and Angle, (1996) reported that the fertility reaches 74.80%. These variations might be explained by differences in environmental conditions, nutrition and health status.

Candling is an important method for detection of the egg fertility, survival and mortality of the embryo. Candling after the first 14 days of incubation showed the small embryo as black spot, with advanced incubation, at the third week, the fertile egg as a big black shadow in the centre of the egg yolk surrounded by the light yellow coloured albumin. The infertile eggs usually show clear yellow light colour covering all the egg up to 21 days of incubation. These observations were similar to those reported by Deeming (1996); Van Schabwyk *et al.*, (1994); Sharp (1989) and Elobeid (2007).

The result of the water loss during incubation of eggs in the present study ranged between 10.27%±1.22 and 9.47±2.82 was different from that reported by Deeming and Ar (1999) who observed that water loss during incubation between 8% and 18%. When water

loss exceeds 20% the chick would become very weak. In the present study it was observed that water loss lower than 5% resulted in oedematous chicks. These results agreed with Elobeid (2007) and Wilson (1996) who reported that insufficient water loss results in large sluggish, oedematous chicks, while in the egg, causing problems in pipping the shell and in hatching. The hatchability of fertile eggs, in the present study was 89.79±11.70 and 60.58±26.68% in winter and summer respectively. Results of the present study differ from those of Philbey *et al.*, (1991) who reported that the hatchability of artificially incubated ostrich egg is poor at an average of 60%. This variation in hatchability could be attributed to difference between farm conditions and laying season.

In the present results, embryonic mortality rates were 8±0.85 and 1.25±0.58% in winter and summer respectively. This could be due to large egg weight that produced large chick, crippled, deformed and low percentage of water loss from the ostrich egg during incubation.

The results of present study were similar to those of Ley *et al.*, (1986) who reported that insufficient water loss resulted in a small air cell which may bring difficulties in the hatching process leading to embryonic mortality due to suffocation.

Season is an important factor for successful hatchability. Results of the present study revealed that winter was the most successful season, because the conditions were suitable for ostrich egg laying which reached a peak. The winter egg production was 390 eggs, as compared with summer egg production which was 186 eggs. In the winter the level of incubation temperature and humidity were best constant and not affected by season. Then hatchability of eggs was successful and mortality was lower compared with summer. Egg incubation rate in winter was 55.83±8.33% which was significantly higher than that of summer (37.24±24.75), hatchability of fertile egg for winter was 89.74±11.70% which was significantly ($P \leq 0.01$) higher than that of summer (60.58±26.68%). This difference might be explained by difference in environmental conditions.

Conclusion

The present study highlighted the effect of season on egg production, fertility, hatchability and chicks survivability of red neck ostrich (*Struthio camelus camelus*) under captive conditions.

It was clear that winter season attained significant results for ostrich egg production, fertility, hatchability and chick survivability.
It is recommended that summer season conditions be adjusted to create optimum conditions for better egg productivity, fertility and hatchability and to reduce young chick mortality. There should be work towards attaining male: female ratio to enhance egg production.

Acknowledgment

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Table 1: Effect of season on egg production performance (Mean±SD) of ostriches during the laying months of winter and summer

Item	Winter Months	Summer Months	D.F	±s.e.m	Level of Significance
Total incubated eggs	97.5±6.03	46.5±5.03	2	16.04	*
Initial egg wt. (g)	1633.63±23.63	1709.41±96.35	2	20.25	*
Storage time (day).	3.38±1.6	3.45±0.3	2	0.33	NS
%Water loss during storage time	12.53±2.40	12.45±2.05	2	0.64	NS
Setting egg wt. (g)	1640.52±10.36	1700.49±30.43	2	19.78	*

N.S = Non significant.
* = Significant (P≤0.05)

Table 2: Effect of season on the diameters (Mean±SD) of eggs of experimental breeding ostriches during laying months of winter and summer

Item	Winter Months	Summer Months	D.F	±s.e.m	Level of Significance
Total incubated eggs	97.5±6.03	46.5±5.03	2	16.04	*
Initial egg wt. (g)	1633.63±23.63	1709.41±96.35	2	20.25	**
Circumference length (cm)	45.49±0.30	46.23±1.03	2	0.05	**
Circumference width (cm)	41.81±0.11	41.93±1.20	2	0.24	NS
Axial length (cm)	14.71±0.29	14.95±0.31	2	7.5	*
Axial width (cm)	12.24±0.05	12.39±0.28	2	0.35	NS
Shape index %	83.23±1.43	83.05±0.88	2	0.34	NS

N.S = Non significant.
* = Significant (P≤0.05).
** = significant (P≤0.01)

Table 3: Effect of season on the values of incubated egg performance of experimentally breeding ostriches during the laying months of winter and summer.

Item	Winter Months	Summer Months	D.F	±s.e.m	Level of Significance
Total incubated eggs	97.5±6.38	46.50±50.3	2	16.04	**
Fertile egg	57.5±36.95	37.24±24.75	2	10.57	*
Hatching egg	49.07±24.06	37.07±23.50	2	9.92	*
Incubation time (day)	42.61±0.60	30.77±0.96	2	0.23	**
%water loss of incubation egg	10.27±1.22	9.47±1.22	2	0.63	NS
Incubated eggs%	55.83±8.33	32.27±17.97	2	4.04	NS
Hatchability of incubated egg	49.96±9.15	29.07±24.06	2	5.25	**
Hatchability of fertile egg	89.79±11.70	60.58±26.68	2	5.95	**
Chick survival%	26.60±14.42	16.40±11.08	2	6.43	**
Chick weight (g)	1004.5±31.81	716.51±37.76	2	7.98	**
% water loss of hatching egg	11.39±0.12	7.32±0.92	2	0.19	**
Chick weight as % of setting egg	61.23±1.66	42.98±4.88	2	1.04	**

N.S = Non significant.
* = Significant (P≤0.05).
** = significant (P≤0.01).

Table 4: Effect of season on the mortality (Mean± S.D) of chicks of experimentally breeding ostriches during the laying months of winter and summer

Item	Winter Months	Summer Months	D.F	±s.e.m	Level of Significance
Total incubated eggs	97.5±60.38	46.50±50.30	2	16.04	**
Mortality rate chick	8±8052	1.25±0.52	2	1.74	**
Mortality % of fertile egg	16.46±11.08	14.42±26.68	2	5.9	N.S
%Water loss of dead chick	10.2±1.01	6.83±3.09	2	6.60	**

N.S = Non significant.
* = Significant (P≤0.05).
** = significant (P≤0.01).

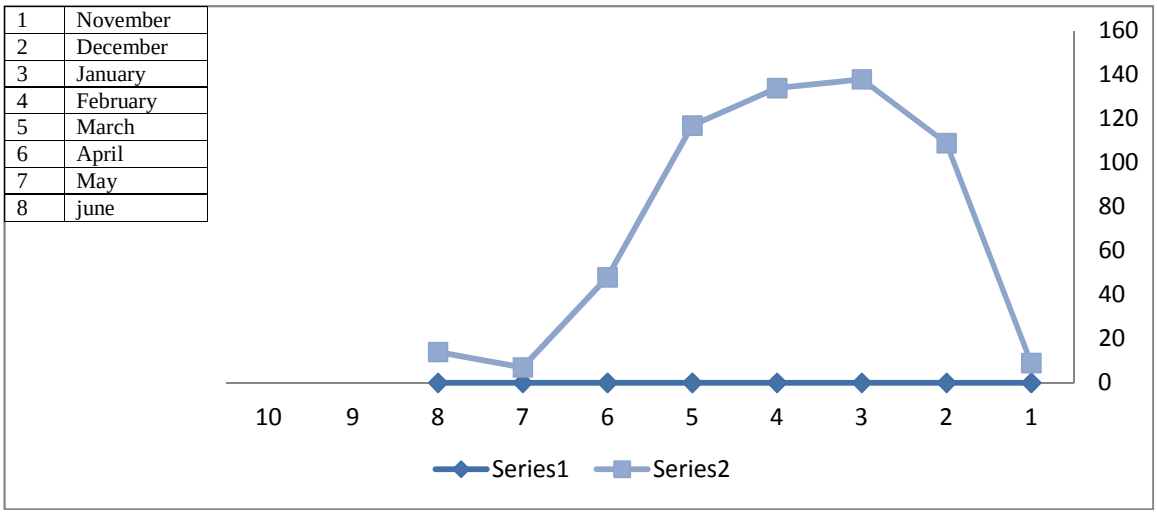

Figure 1: Monthly egg production percentage throughout laying season.

تأثير الموسم على إنتاج البيض، الخصوبة، نسبة الفقس و بقاء الكتاكيت حيةً للنعام أحمر الرقبة تحت ظروف الحبس

حسين عبدالرحيم العبيد وعلي سعد محمد

قسم الاسماك وعلوم الحياة البرية كلية الإنتاج الحيواني– جامعة السودان للعلوم والتكنولوجيا

المستخلص

أجريت هذه التجربة لتحديد تأثير الفصل المناخي على أداء النعام احمر الرقبة في انتاجية البيض، خصوبة ونسبة فقس البيض ونسبة بقاء الكتاكيت حية بعد الفقس تحت ظروف الأسر. فترة اجراء التجربة إمتدت من نوفمبر 2007– يونيو 2008. قسمت فترة التجربة الى موسمين : فصل الشتاء (نوفمبر 2007– فبراير 2008)، وفصل الصيف (مارس 2008– يونيو 2008). وقد تم تقسيم 19 من إناث النعام و 13 من ذكوره الى 6 معاملات (حظائر): أ. (2 ذكر + 4 إناث)، ب. (1 ذكر + 2 انثى) ، ج. (2 ذكر + 4 إناث) ، د. (2 ذكر + 2 أنثى) ، هـ. (2 ذكر + 4 إناث) و و. (4 ذكور+3 إناث). اجريت التجربة في مزرعة خاصة تبعد جنوب الخرطوم بحوالي 75 كيلومتر. وقد تم جمع بيض النعام باليد وخُزّن لمدة 7 أيام على درجة حرارةالغرفة قبل نقله الى الحاضنة، ثم الكشف على البيض ضوئيا في غرفة مظلمة قبلوبعد فترة الحضانة. اوضحت النتائج ان خصوبة البيض المنتج كانت معنويا ($P\leq0.01$) اعلى في فصل الشتاء مقارنة بفصل الصيف وكانت انتاجية البيض اعلى معنويا ($P\leq0.01$) في فصل الشتاء منها في فصل الصيف 186V390 على التوالي كما كانت نسبة خصوبة البيض المنتج (83%±55.83) و (17.91±32.27) للشتاء والصيف على التوالي. وبلغت نسبة الفقس للبيض المخصب (11.70%±89.97) و (26.68%±60.58) للشتاء والصيف على التوالي، وهذه النسبة اعلى معنويا في الشتاء ($P\leq0.01$) مقارنة بها في الصيف. نسبة بقاء الكتكوت حيا بعد الفقس كانت اعلى ($P\leq0.01$) معنويا في فصل الشتاء عنها في فصل الصيف. بالنسبة لنسبة الوفيات للبيض المخصب فهي اعلى رقميا في فصل الشتاء مقارنة بفصل الصيف: 14.48%±26.46 و 11.08%±16.46 على التوالي.