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SOME ASPECTS OF REPRODUCTIVE POTENTIALS OF A CAPTIVELY MAINTAINED STOCK OF *ALECTORIS CHUKAR*: FECUNDITY, HATCHABILITY AND SURVIVAL RATE

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ABSTRACT

The current study was conducted to examine hatchability and fertility traits of *Alectoris chukar*. During the period of three months (March to May), total 348 eggs were obtained from 48-60 weeks old *Alectoris chukar* for this study. The external egg characters measured were egg color (EC), egg length (EL), egg breadth (EB), egg shape index (ESI), shell thickness (ST), membrane thickness (MT) and their relation to hatchability and fertility. Eggs were also categorized as infertile, hatched and unhatched eggs. Egg shell coloration and pigmentation also affects the fertility and hatchability of eggs. Light Creamy with Small Spots (LCSS) showed higher fertility and hatchability rate. EL, EB and ESI shows no significant effect on the fertility and hatchability. ST has shown a significant difference between the hatched, unhatched and infertile eggs while MT showed no significant difference between the infertile and hatched eggs. But MT varied significantly between hatched and unhatched eggs. Fertility and hatchability of *Alectoris chukar* are also affected by ST and MT. Temperature is an important physical factor that determines survival rates in *Alectoris chukar*. The egg production rate was higher in mid-March and two peaks in fatality were recorded in the month of April, June and July. Thus, the result of this study also indicates that when conditions are properly maintained, chukar partridges can be easily raised in captive conditions.

Keywords: *Alectorischukar,* Hatchability, fertility, egg shells, membrane thickness, pigmentation.

INTRODUCTION

The Chukar Partridge (*Alectoris chukar*) is a game bird and it belongs to the family Phasianidae. It is present in the mountainous area of Pakistan which includes Northwest region, Sindh, Baluchistan and Salt range. Three races are known in Pakistan (Lateef *et al*., 2006). Eggs of chukar partridge vary in color. They are usually from yellowish-white to creamy with various brown speckles of different sizes and shapes that appear all over the shell. Interior characteristics include yolk index, albumin index, proportions of egg components and chemical composition. Eggs are usually oblong in shape. The weight of an egg is from 16 to 25 g (average 21 g) and have average 42 mm length and 31 mm width (Stadelman, 1977).Weight of an egg, length and breadth of egg, and also the shell thickness are the physical characteristics of an egg that play an important and critical role in the hatching success. Intermediate eggs showed higher hatchability whereas small or large eggs showed lower hatchability (Wilson, 1991).

Different researchers have examined the effects of external egg characters using statistical methods in the poultry species, but number of studies conducted on partridges is very much lower than other poultry species. The studied external traits that were observed included egg length, egg breadth, egg weight and egg volume and these were significantly associated with hatchability (Karabag*et al*., 2010).

Therefore, this study was designed for estimating the breeding performance of captivity raised *Alectoris chukar*. Partridges are one of the examples of animals that are bred and released from conservation point of view. Some egg parameters are related to fertility, hatchability and egg pigmentation.

MATERIALS AND METHODS

The study was conducted in chukar breeding unit at Bioresource Research Centre, Islamabad, Pakistan. *Alectoris chukar*s were raised under a concentrated structure of administration. In the cages free mating was made possible to the groups of birds and males to females ratio was 1:4. *Alectoris chukar* at 50-60 weeks of age was used in this study. Thirty females and ten male chukars were housed in the cages.

Total 348 eggs were randomly selected and weighed. Before the setting of eggs proper cleaning, disinfection and fumigation were accomplished. All the birds had access to commercial poultry diet and fresh water throughout the day during the experimental period. Parent birds were housed in individual cages and these breeding cages were exposed to natural environment. Therefore, these parent birds were having natural cycles

of light and darkness. Every day the chukar eggs were collected and then they were set in the storage area at a position in which small-end pointed downward. All eggs were stocked up in a room that has the temperature at 20^0C and 60-75% humidity during seven days. Eggs were categorized into three groups as infertile, unhatched and hatched**.**

The main important external traits of eggs are shell thickness, egg breath, egg length and egg shape index (Narushin*et al.*, 2002). The egg characteristics were evaluated prior to incubation. Egg length and width were calculated with a vernier caliper and weight of the egg was determined using an electronic scale. Also the color of the egg was observed and categories into five shades that are white, light creamy with small spots, dark creamy with small spots, light creamy with large spots and dark creamy with large spots. Shape index of the egg was measured as a quotient of the egg width to the egg length as follows:

Egg shape index= (Egg width/Egg length) × 100

The hatchery was well ventilated and temperature was maintained at 21^0C to 28^0C. The room temperature and ventilation was maintained through room coolers and exhaust fans. An incubator was used that is huge enough to sustain the precise control of temperature and humidity for chukar eggs. Other essential feature includes mechanical turning of eggs and compulsory air movement. The total time period of incubation for chukar mostly is 24 days (23-25 days) depending on the stock and age (Woodard, 1982). Incubator temperature and humidity were maintained at 37^0C and 70 %. At 20^{th} day of incubation the eggs transferred to the hatcher trays.

Weight of the brooding chick is 13 to 14 grams at hatch. But still requires supplemental heat till its own temperature regulatory system is fully developed. After 24 hours chicks were transferred to the brooders where they can grow. Through dry bulb the brooder temperature was regulated. The temperature within the brooders was 32^0C for a one day old chick and decrease 5^0C for every week. At first 36 hrs, feed was not given to the chicks so that to dissolve the yolk. After that supplemental food was given that contained cerelac, cucumber along with free supply of water. When the chick started to regulate its own temperature they were shifted to small brooders. These brooders have an area of 6 ft^2 and can accommodate 10-15 individuals. After 7-10 days when the chicks started showing full growth, they were transferred to large brooders. These brooders were 32 ft^2 in area and can accommodate more than 50 chicks. The bottom of brooders was covered with sand to maintain the temperature.

At the last level of hatching procedure the eggs were categorized as infertile, hatched and unhatched. Hatched individuals were counted and weighed through an electronic scale. The shell and membrane thickness of infertile, unhatched and hatched eggs were measured by screw gauge (mm). It was studied that hatchability and fertility associated with egg characters or else not. Overall fertility, hatchability and mortality of eggs were calculated. Reproductive performances of chukar partridges include the hatchability of total eggs, hatchability of fertile eggs and total fertility was calculated by means of a formula:

Total egg hatchability = (Poults hatched /Total eggs set) × 100
Fertile egg hatchability = (Poults hatched /Fertile eggs set) × 100
Fertility = [(Total eggs set–Infertile eggs) / (Total eggs set)] × 100

Data obtained from every tentative group was investigated statistically byone way ANOVA using Tukey HSD and LSD test for comparing the means. Shell and membrane thickness, egg shape, length, breadth were compared using one way ANOVA using SPSS 12.0 software.

RESULTS

During the egg laying period which continued for about 90 days (March to May),total 348 eggs were obtained. As the present study hypothesized that egg shell coloration and pigmentation are associated with fertility rate and thus egg shell coloration and pigmentation is an important factor to be considered. Eggs were categorized into 5 types according to their colour: white (W), light creamy with small spots (LCSS), dark creamy with small spots (DCSS), light creamy with large spots (LCLS) and dark creamy with large spots (DCLS) as shown in Figure1. Comparison of fertility rate of these 5 types of eggs is given in Figure 2 and it was found that the LWSS eggs showed highest fertility rate while,"W" showed no fertility.

A B C D E

Figure 1: Egg pigmentation and coloration shade card:A. White, B. Light creamy with small spots, C. Dark creamy with small spots, D. Large creamy with large spots, E. Dark creamy with large spots

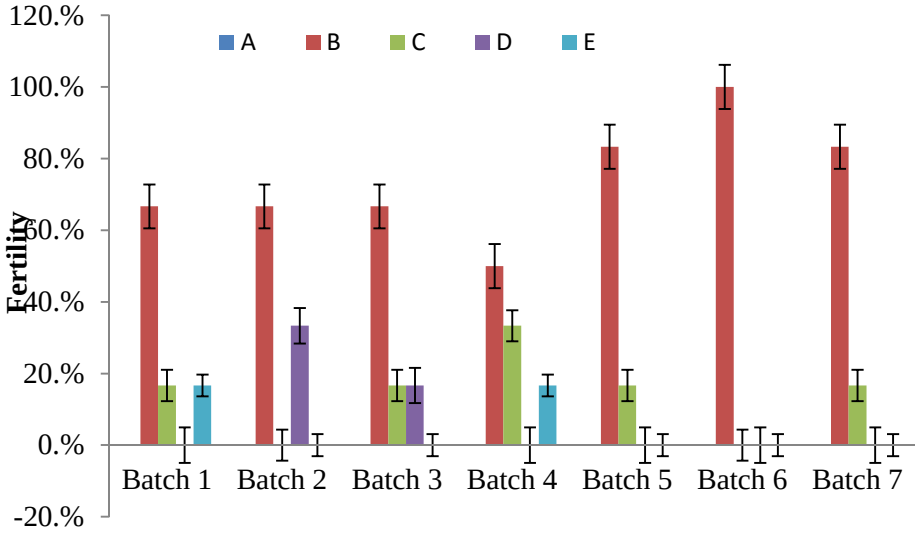

Figure 2: Relationship of egg color with fertility. Light creamy with small spots (B) showed highest fertility while all others (A, C, D and E) exhibited low fertility (≤ 30 %). Each value is average of three repetition and error bars on chart showed standard error.

The shell thickness of infertile hatched and unhatched eggs of chukar were compared as shown in Figure 3. The data showed that there is a significant difference between shell thickness of infertile, hatched and unhatched eggs with p value of less than the 0.05 level. The shell was significantly thickest in unhatched eggs as compared to hatched and infertile eggs. Membrane thickness of infertile, hatched and unhatched was also compared shown in Figure 4. The data illustrate that there was no significant difference in the membrane thickness of infertile and hatched eggs. But there was a significant difference between the hatched and unhatched eggs where the p value is less than 0.05 significant levels.

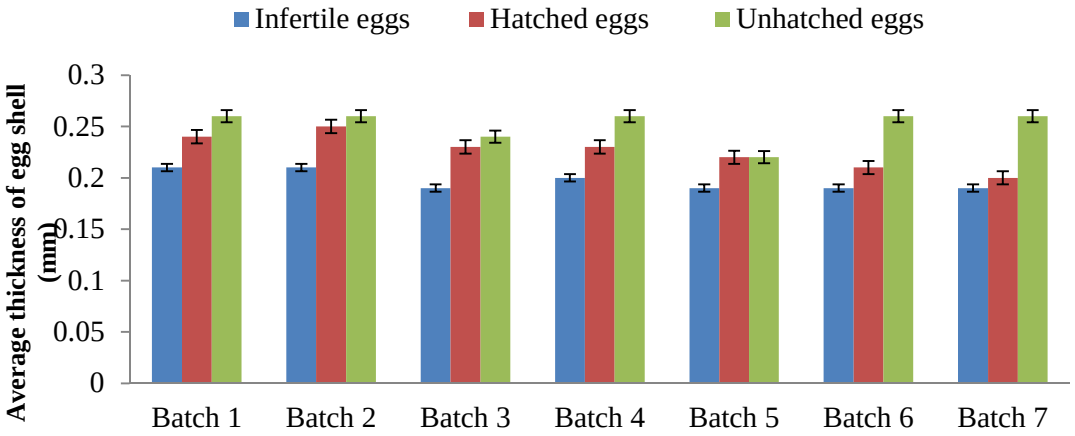

Figure 3: Comparison of shell thickness of infertile, hatched and unhatched egg. The bar diagram showing that all three groups (infertile, hatched and unhatched eggs) are significantly $p < 0.05$ different from each other. Each value is average of three repetition and error bars on chart showed Standard error.

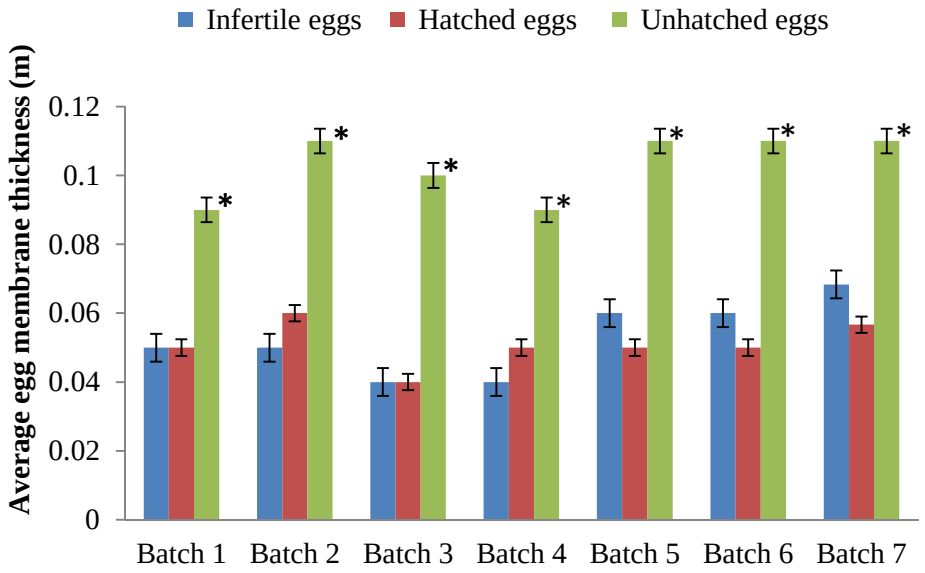

Figure 4: Comparison of membrane thickness of infertile, hatched and unhatched. Group of infertile eggs are significantly ($p < 0.05$) dissimilar from other groups (hatched and unhatched eggs) shown in the bar diagram. Each value is average of three repetition and error bars on chart showed standard error.

Association of external traits of egg (egg breadth, egg length and egg shape index) with fertility was also studied. It was found that that there was no significant difference in the length breadth and shape index of infertile and unhatched eggs. The length, breadth and shape index of infertile and unhatched eggs is shown in Table 1 and Table 2 respectively.

Table 1: Characteristics of infertile eggs. The values are Mean ± SD

Batch No	Infertile Eggs (#)	Length (cm)	Breadth (cm)	Shape Index (cm)	Minimum Weight (g)	Maximum Weight (g)
1	2	3.5±0.1	2.5±0.0	0.7±0.0	15	21
2	8	3.7±0.3	2.7±0.2	0.07±0.0	17	22
3	30	3.7±0.6	3.1±0.4	0.9±0.2	14	21
4	19	4.3±0.4	3.0±0.1	0.7±0.1	19	24
5	33	3.9±0.1	3.1±0.2	0.8±0.0	19	24
6	24	3.7±0.2	2.7±0.2	0.7±0.1	16	20
7	25	3.8±0.3	2.7±0.2	0.7±0.0	13	19

Table 2: Characteristics of unhatched eggs. The values are Mean ± SD

Batch No	Unhatched Eggs (#)	Length (cm)	Breadth (cm)	Shape Index (cm)	Minimum Weight (g)	Maximum Weight (g)
1	1	3.3±0.2	2.0±0.1	0.7±0.1	19	19
2	2	3.6±0.6	2.4±0.1	0.7±0.1	20	20
3	12	3.6±0.2	2.9±0.1	0.8±0.0	19	24
4	9	4.0±0.5	2.7±0.1	0.8±0.1	18	25
5	9	3.7±0.6	3.0±0.1	0.8±0.1	13	21
6	1	3.5±0.1	2.3±0.2	0.7±0.1	18	18
7	2	3.7±0.6	2.5±0.2	0.8±0.0	17	22

Table 3. Egg production in different weeks of months with average temperature

Weeks	Month	Total Egg(#)	Average Temperature (^{0}C)
1	March	15	12.1
2	March	129	15.0
3	March	79	16.2
4	March	54	27.2
5	April	86	21.6
6	April	49	26.1

Table 4. Average weight of fertile eggs of all batches with their hatchability and survival

Weeks	Month	Total Eggs (#)	Average Egg Weight (g)	% Hatchability	% Survival
1	March	12	22	88.8	50.0
2	March	120	23	89.4	100.0
3	March	45	23	75.5	97.3
4	March	21	22	74.2	84.6
5	April	30	22	83.0	88.6
6	April	44	21	95.8	65.2

In the Table 3 the egg production in different weeks of months was compared with average temperature. The egg number was highest in March, when the temperature was 12-16^{0}C and in April the egg number decreased with increase in temperature. The table 4 shows that during mid-March the hatchability and survival was 89% and 100% respectively;whereas in mid-April the hatchability was 95% with 65 % survival rate.

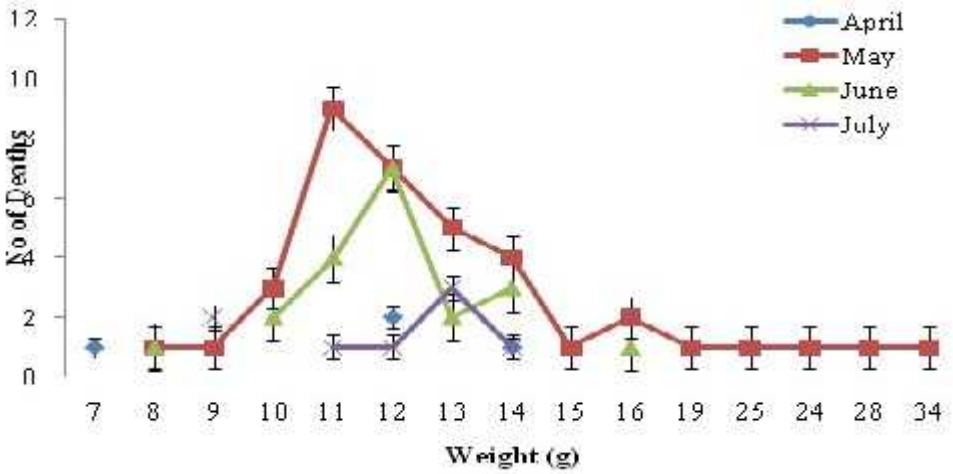

Figure 5. The death trend of chicks having different weight chicks in months of study (April – July). Chicks of all weight (7-34 g) categories died in May, whereas lowest most death occurred in April with weights 7-14 g. Errors bars on the line chart showed standard error.

Following hatching the chicks become more susceptible to external environment and need proper care and temperature for their growth. Mortality was particularly severe in the first 4 weeks after hatching. The figure 5 shows that two peaks were observed in the death rate, first during the month of April and second in the months of June and July.

DISCUSSION

Egg coloration and pigmentation affecting the fertility and hatchability is a dynamic aspect in this study.The results showed that eggs which had light creamy color with small spots had much higher hatchability and fertility rate. The uniformly distributed pigmentations are compatible to the egg fertility. The

light colored eggs with no pigmentation were utterly infertile, while dark creamy colored eggs showed low hatchability and fertility.The same aspect was reported by (Kumar *et al*., 2012) that there is higher fertility rate in dark colored eggs whereas light colored eggs have low fertility rate.

The shell and membrane thickness of an egg plays a vital role in the hatchability rate. The hatched eggs have the lowest shell thickness and membrane thickness while the unhatched but fertile eggs have significantly highest shell and membrane thickness. The results showed that shell thickness among the three types of eggs varied significantly with each other. This suggests that, the thickness affects the hatchability in the eggs. Thicker shells and membranes rendered difficulty for the chicks to exit from the shells. Our results did not support the study carried by Mehmet *et al.* (2005) who reported that shell thickness has no significant effect on the rate of hatchability in Japanese quail and no difference in the shell thickness of different egg shell regions.

In this study our first hypothesis was that the shape, size and structure of an egg determines the fertility rate of a chick and the length, breadth and shape of an egg have a significant effect on the fertility and infertility rate. But the results showed no significant difference in the length, breadth and shape index of infertile, hatched and unhatched eggs. Similar results were in accordance with our study, reported by Mehmet *et al.* (2005) that shape index has also no significant effect on the hatchability of Japanese quail. While Kul and Seeker (2004) accounted that average shape index had a significant effect on the hatchability rate of Japanese quail eggs.

Temperature is one of the physical factors that determine the success in survival rates of *Alectoris chukar*. This study showed that during mid-march when the temperature was about 13-16^{o}C, the egg production rate was higher in *Alectoris Chukar*. This explains that the temperature play an important role in triggering the egg producing hormone in *Alectoris chukar*. Hughes (1986) reported that temperature also enhance the egg production. Thomas and Wilson (1978) reported that change in intensities allow an increase in both the duration of lay and number of eggs.

The temperature also affects the mortality in growing Chukars. The result of this study showed that in the month of April a peak in fatality was observed. The rising temperature in the month of April was intolerable by the chicks. However in June and July, a second peak of fatality rate was also observed while the temperature was incessantly rising. After hatching, the chicks become more responsive and they need proper care and temperature for their growth.

Conclusion: Our study clearly indicated a link between the thickness of shell and membrane and also egg shell coloration and pigmentation on the fertility, hatchability and survival rate of the chukar egg. It is now obvious that *Alectoris chukar* can be raised under captive conditions when properly managed. For that reason natural and environmental stability can be made available for *Alectoris chukar* inhabitants in usual and natural habitat by means of nurturing and releasing of partridges.

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