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Growth performance and survivability of ostrich chicks in Bangladesh

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ABSTRACT

Aim: The study was aimed to investigate the growth performance and survivability of the ostrich chicks.

Method and Materials: The study was conducted in Advanced Avian Research Farm, Hajee Mohammad Danesh Science and Technology University, Dinajpur, Bangladesh. Total 15 unsexed 7 day old chicks were imported from South Africa by the pet animals importer. Commercial concentrated feed (Broiler starter) was provided to the experimental chicks up to 12th week of age.

Results: Average live weight of ostrich chicks were recorded as 998, 1651, 2926, 4292, 7115, 10026, 13005, 16540, 20837, 24964, 28728 and 33142 g at 1st to 12th week of age, respectively. Average live weight gain of ostrich chicks were recorded as 93.3, 182.2, 195.1, 403.2, 415.9, 425.6, 504.9, 613.8, 589.5, 537.8 and 487.7 g/day from 2nd to 12th week of age, respectively. The higher ($P<0.05$) live weight gains of ostrich chicks were found 613.8 and 589.5 g/day at 9th and 10th week of age. Average feed intake (concentrate feed) of ostrich chicks were recorded as 114.3, 222.0, 276.1, 328.6, 442.9, 458.1, 554.7, 685.71, 828.6, 866.7 and 969.3 g/day at 1st to 12th week of age, respectively. Feed consumption of ostrich chicks was increasing in accordance with increasing their age during the study period. The feed conversion efficiency of ostrich chicks were recorded as 1.22, 1.22, 1.22, 1.01, 1.15, 1.16, 1.18, 1.12, 1.41, 1.61 and 1.98 from 2nd to 12th week of age, respectively and the best feed conversion efficiency was observed at 5th week of age.

Conclusion: Ostrich chicks showed the better performance in relation to growth and survivability under the appropriate management and environmental conditions of Bangladesh.

Keywords: Growth performance, ostrich chicks, survivability.

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Introduction

Food product consumption of animal origin has been increasing rapidly. It is predicted that per capita demand for these products will increase even more in developing countries (Bradford, 1999). In order to maximize food production and meet protein requirements in developing countries, variable options need to be explored and evaluated (Owen *et al*., 2008). Therefore, introducing ostrich farming along with other poultry species like chicken, duck, turkey and quail could be a profitable income generating activities. Ostrich (*Struthio camelus*) are ratite (large flightless) birds having existed as a species for over 40 million years. Ostrich meat as a healthy red meat alternative on the shelves of the supermarket (Adams and Revell, 2003). The ostrich is a credible competitor in the red meat market in that it produces a very lean red meat. Ostrich meat is characterized by an extremely low intramuscular fat content, low cholesterol and favorable fatty acid profile (Djarova, 1996 and Mellett, 1985).

Ostrich farming is a new addition among livestock farming in different countries all over the world including China, Nepal, Japan, Iran, Iraq, Israel, UK, Canada, Mexico, Brazil, etc. Markets for ostrich eggs, meat, leather, feathers and related products are developing rapidly throughout the global. However at the present, ostrich producers are merely meeting 10 percent of the consumer demands globally.

Ostrich farming is now facing many problems in need of solutions, regarding chicks survivability, adaptability of the ostrich, the quality of its primary products and the potential

for local value-adding industries mean it deserves serious consideration as a livestock diversification option in integrated rural development. Successful ostrich farming is largely dependent on the ability of the farmers to rear sufficient numbers of viable and healthy chicks, However, high mortality of ostrich chicks, particularly during the first few months of life is critical for ostrich rearing around the world (O'Brien, 2008). Despite fairly intensive care, high levels of mortality are often reported for young ostriches under commercial conditions. The live weight gain of ostrich chicks depends mainly on feeding and management. Daily *ad libitum* feed intake of ostrich chicks depends mainly on their live weight gain and feed energy concentration (Kreibich and Sommer, 1995). General aspects of chicks management and husbandry hypothetically, have a considerable impact on chicks survival, but the ideal rearing system conducive to enhanced survival and optimal welfare and production is yet to be established (Jensen *et al*., 1992). More systematic studies of chicks survival would assist the industry in the development of adapted breeding and husbandry systems that reduce stress imposed on chicks while enhancing the ability of ostrich chicks to cope with and resist the effects of stress. Chicks survival and the consequent cost-efficient commercial production of high quality slaughter ostriches could thus be optimized (Verwoerd *et al*., 1999). However, this is the best time for Bangladesh to exploit the resource for ostrich farming to make our big share in the local and global market.

The ostrich meat is increasingly important as an alternative protein source in Bangladesh too. Now it is the time to put attention in ostrich farming in Bangladesh and it is necessary to understand the nature of the industry and the market for ostrich products. Some farmers are rearing ostrich with a limited extent in Bangladesh though they have no prior experience regarding ostrich chicks management, breeding and reproduction. As a result, they are facing the problems of chicks survivability, lower fertility and hatchability of eggs. There are many research works have been carried out in developed countries to elucidate the chicks survivability in ostrich industries, however there is no research work has yet been conducted to elucidate the ostrich chicks management in Bangladesh. Therefore, the study has been designed to investigate the growth performance and survivability of ostrich chicks in Bangladesh.

Materials and Methods

The study was conducted within the facility of the project entitled "Ostrich is a promising poultry species as an alternative protein source in Bangladesh: Study on its adaptability and feasibility of commercial production based on improved nutrition" at Advanced Avian Research Farm of Hajee Mohammad Danesh Science and Technology University, Dinajpur. Duration of the experiment was 12 weeks (from 1−12 weeks of age).

Experimental birds and brooding

A total of 15 unsexed ostrich chicks were imported from South Africa through registered pet bird's importer of Bangladesh (Fig 1). Just after arrival at the farm, the ostrich chicks were received, checked their health conditions, disinfected by Virkon-S spray (Antech International Ltd, UK) and then weighed before releasing in the brooding house and the weights were recorded as initial weights of the ostrich chicks. They were offered drinking water with lemon juice to minimize the stress during journey. Considering the critics and sensitivity of ostrich chicks, the well-ventilated brooding house was prepared at 48 hours before receiving the chicks maintaining required temperature (32.5^{0}C), relative humidity (60-65%) for the 1st day of brooding. Then the temperature and humidity maintained in the brooding house for ostrich chicks were recorded (Table 1).

Table 1. Temperature and humidity maintained during brooding of ostrich chicks

Age of ostrich chicks (week)	Temperature (^{0}C)	Relative Humidity (%)
2nd	32	60−65
3rd	29	60−65
4th	27	60−65
5th	24	60−65

Special management for ostrich chicks

Ostrich chicks rearing were very sensitive and critical in nature. The chicks were allowed to run in plane area because during running in early stage of rearing chicks became lame by displacing the tendon from upper and lower joint of the shank due to running to uneven place. The platform was covered by a thick rubber mesh that prevented the chicks from injuring themselves, as it conforms to the shape of the floor. The chicks in early stage like to eat some hard things like iron, nut and bolts, wastage parts of poly bags and pins etc. and

affected by some undesirable problems that's why chicks were restricted to run on walk in a particular places. Ostrich chicks were kept free every day for 2−3 hours in the morning for physical exercise and also get some sun light in the same time.

Feeding management of ostrich chicks

Concentrate feed supply

A standard broiler starter diet (Table 2) was provided to ostrich chicks all over the period of experiment, as there was no standard diet for ostrich in Bangladesh. The Commercial concentrate feed was purchased from Aftab Bahumukhi Farms Limited, Bangladesh and supplemented with 3% Dicalcium phosphate (DCP, Arifs Bangladesh Ltd.) additionally to meet up the optimal amount of Ca and P. The supplemented concentrate feed was provided to the ostrich chicks twice a day in the plastic feeders for *ad libitum* feeding (Fig 2). The feeders were spread out to prevent overcrowding and to ensure that each chicks could chance to eat a sufficient quantity of concentrate feed.

Table 2. Nutritional composition of commercial concentrate feed

Nutrients	Amount (%)
Moisture	12.00
Crude protein (CP)	19.30
Crude fat (CF)	5.00
Calcium	0.90
Av. Phosphorus	0.42
Metabolizable Energy (ME, Kcal/kg)	3000

Source: Aftab Bahumukhi Farms Limited, Bangladesh

Fodder and forage supply

Normally ostrich are herbivorous type birds. At an early stage of the birds, the young leaves of Ipilipil, Moringa and Azadirachta were used as fibrous feed sources to habituate them with the fibrous feed as well as to develop the microbial digestion capacity. At later stage, different types of grasses like Napier, roadside grass and the tree leaves generally used as small livestock forages were supplied regularly (Fig 3).

Water supply

For keeping the chicks healthy, *ad libitum* clean drinking water was supplied to the ostrich chicks. Some water-soluble vitamins, multivitamins and electrolytes were supplied with drinking water. Normally water was provided 2−3 time daily in a special type of drinker.

Vaccination and medication

For the better immunization the following vaccination program was carried out for the experimental chicks (Table 3). Actually ostrich chicks were not affected by the common diseases available in Bangladesh except by the leg problem. To minimize the problem Manganese supplement (Aristovit X, Aristo Pharma Ltd., Sher Shah Suri Road, Block-D, and Mohammadpur Dhaka-1207) were used. Some pain killer type of medicine was used to treat against pain prescribed by specialist veterinarians. For the treatment of wound healing antiseptic cream (Povisep, Jayson Pharmaceuticals Ltd., 231 Tejgaon I/A, Dhaka-1208) and anti-bacterial (BaclovetN, Glaxo Smith Kline Group of Company, Chattogram) ointment were used.

Table 3. The vaccination program followed for the ostrich chicks

Name of vaccine	Dose	Route of application
*Covexin[10]	1ml	Subcutaneous
BCRDV	2 drops	Eye drop

**Covexin[10] was provided by the ostrich chicks's supplier*

Biosecurity measures

Biosecurity measures were taken strictly from the very beginning of the research. The steps of biosecurity measures taken to keep the chicks healthy and given below step by step.

a) When the chicks were received in the research farm they were disinfected by spraying Virkon-S (Antech International Ltd., UK) with water
b) Personnel related to the research work were followed the biosecurity measures by cleaning their hands and foots and wearing clean dress during conducting the research work
c) Ostrich chicks were sprayed by the Virkin-S solutions time to time. There was a footbath at the entry point of the farm and also in the entry point of brooding shed. The solution of footbath was changed regular interval of certain period of time
d) No strangers were allowed in the inside of the farm.

Record keeping

A standard record book was maintained throughout the experimental period. Following parameters were recorded in the record book.

Daily feed supply:

The amount of daily supplied and residual (waste feed) commercial concentrate feed was recorded in

the record book to measure the amount of feed consumed by the ostrich chicks.

Live weight:

Initially live weight of ostrich chicks were taken daily upto 3 week-old and then weekly to estimate the live weight in a particular age and also for calculate the live weight gain per day, week or per month.

Live weight gain= Final live weight −Initial or previous live weight

Feed conversion ratio (FCR):

Feed conversion efficiency was evaluated by calculating feed conversion ratio using the following formula-

$$\text{FCR} = \frac{\text{Amount of feed consumed (g)}}{\text{Live weight gain (g)}}$$

Mortality:

Mortality of birds were recorded and calculated in percent (Table 4).

Table 4. Mortality and survivability percent of ostrich chicks

Item	Ostrich chicks	Mortality (%)	Survivability (%)	Abnormality (%)
No. of ostrich chicks during initial stage	15	-	-	-
No. of ostrich chicks at end of the experiment	15	0	100	-
No. of ostrich chicks became abnormal due to lameness	2	-	-	13.33

Behavior study

Ostriches have many unique behavioral characteristics that suit their morphology. Their behavioral characteristics were studied by observing how could they take water, feed, fodder

Fig 1. Experimental ostrich chicks at different age

Fig 2. Feeding concentrate feed to ostrich chicks

Fig 3. Feeding fodder and forage by ostrich chicks

and forages, sandbath, etc. And how would they maintain their body temperature, protect themselves from the predators, walking, running, behavioral attitude to other birds or animals.

Statistical analysis

The parameters like live weight, live weight gain, feed intake, feed efficiency and mortality were analyzed using the one-way ANOVA following the GLM procedure of SPSS version 22.00. Significance of differences among the birds was compared by using Duncan's Multiple Range test of the same package. All data were expressed as Mean ± Standard Error of Mean (SEM). Differences were considered significant at 1% or 5% level of significance.

Results and Discussion

The study was to investigate the growth performance and survivability of ostrich chicks. The performance of ostrich chicks was studied in terms of live weight, live weight gain, feed intake and feed conversion efficiency up to 12th weeks of age.

Live weight and live weight gain

Average live weight and live weight gain of ostrich chicks were presented (Fig. 4a & b). The live weight (g) of ostrich chicks was recorded 998, 1651, 2926, 4292, 7115, 10026, 13005, 16540, 20837, 24964, 28728 and 33142 up to 12th weeks of age, respectively (Fig. 4a). These findings revealed that progressive increase of live weight of ostrich chicks was observed throughout the experimental period. At first week of experiment the average live weight of ostrich chicks was about 1 kg (initial) and the live weight was above 33 kg after the end of the experiment (at 12th weeks of age). The growth curve showed smooth increasing trend for the ostrich chicks and growth was faster from the 5th weeks of age.

Average live weight gain of ostrich chicks were recorded as 93.3, 182.2, 195.1, 403.2, 415.9, 425.6, 504.9, 613.8, 589.5, 537.8 and 487.7 g/day from 2nd to 12th week of age, respectively (Fig. 4b). The results showed that there was fluctuation of live weight gain throughout the experimental period. Faster live weight gain was observed from 5th to 9th weeks of age. Higher ($P<0.05$) live weight gains of ostrich chicks were found at 9th and 10th weeks as 613.8 and 589.5 g/day, respectively. On the other hand, the first 3 weeks of the experiment, the live weight gain of the ostrich chicks was less than 200 g/day.

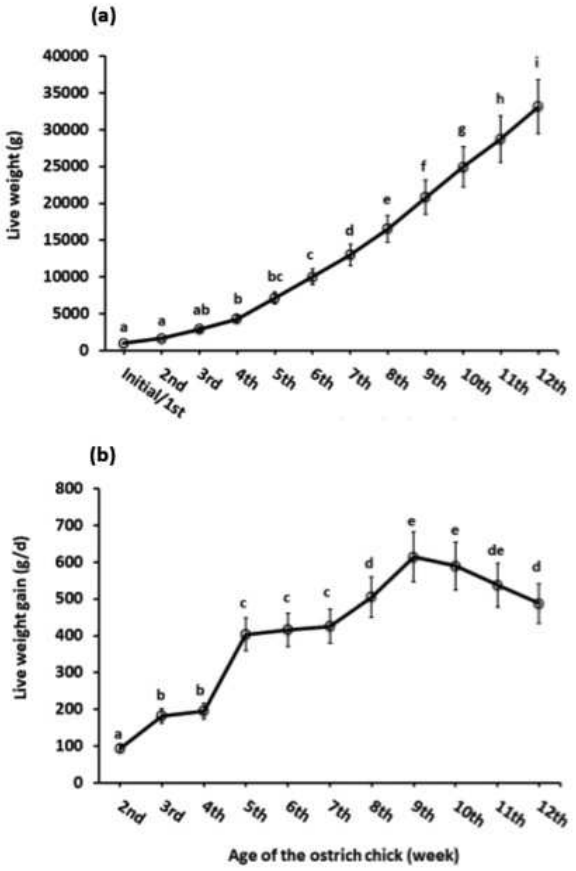

Fig 4. Live weight (a) and live weight gain (b) of ostrich chicks from 1st (initial) to 12th weeks of age. Each line with error bar represents mean ± SEM value. The different letters on the error bar indicates significant differences (P<0.05 or P<0.01) among the values in different time points.

Ostrich chicks exhibited high growth rate over 12th week of age and all performance entities were significant. The body weight was increased highly from about 1 kg to more than 33 kg/week during 12th week of age. The present results were in agreement with the findings of Angel (1996) who found 29.6 kg at 13 week of age. Rearing ostrich with concentrated feedstuffs resulted in too rapid growth during the age 1st - 16th weeks of age. Musa *et al*. (2005) reported that 3, 6, 10, 15 and 20 kg live weight at 1st, 3rd, 6th, 9th and 12th week of age, respectively. Live weight of ostrich chicks were observed in the present study was 4.29, 16.54 and 33.14 kg at 1st, 2nd and 3rd month of age, respectively. Selvan *et al*. (2012) reported that the live weight of ostrich chicks 3.78, 13.88 and 26.14 kg at 1, 2 and 3 month of age, respectively that in agreement with the results obtained from the present study, Though the live weight was lower than the present study. This difference might be occurred due to environmental and management differences.

Live weight gain of ostrich chicks were 93.31, 182.21, 195.11, 403.21, 415.91, 425.60, 504.96, 613.85, 589.56, 537.78 and 487.70 g/day, for 2nd to 12th weeks of age, respectively. Adewumi *et al*. (2017) reported that live weight gain of ostrich were 48.92, 67.38, 77.00, 88.52 and 141.42 g/day in 2nd to 6th week of age, respectively. At the 6th weeks live weight gain was lower to the reported value. In the 1st month the average live weight gain was 109.77 g/day, in second month the average live weight gain was 408.33 g/day and in the third month the average live weight gain was 553.33 g/day. Selvan *et al*. (2012) got slower live weight gain 097.00, 336.00 and 408.00 g/day in 1st, 2nd and 3rd months of age. The observed live weight gain was higher than the result got by Selvan *et al*. (2012) that might be due to better environmental situation and management.

Feed Intake and feed conversion efficiency

Average feed intake and feed conversion efficiency (as feed conversion ratio) of ostrich chicks during the experimental period was recorded (Fig. 5a&b). It was illustrated the amount of feed (concentrate feed) consumed by ostrich from 2nd to 12th weeks of age which were recorded as 114.3, 222.0, 276.1, 328.6, 442.9, 458.1, 554.7, 685.71, 828.6, 866.7 and 969.3 g/day, respectively (Fig 5a). From this study it was observed that feed consumption of ostrich chicks was increasing in accordance with the increase of age during the entire experiment. In the first week, the feed intake was significantly lower (P<0.05) than the rest of the periods. But the following period of the experiment there was significantly increased of feed intake. The maximum feed intake of ostrich chicks were found last week of the experiment (969.29 g/day).

The average feed conversion efficiency of ostrich chicks from 2nd to 12th week of age were recorded as feed conversion ratio 1.22, 1.22, 1.22, 1.01, 1.15, 1.16, 1.18, 1.12, 1.41, 1.61 and 1.98, respectively (Fig 5b). The results of feed conversion efficiency in ostrich chicks were better in earlier stage which extended up to end of the experiment. In this period less amount of feeds (about 1.2 or less kg) were required for1 kg of live weight gain (2nd – 9th week of age) and finally the more feed was required (10th – 12th week of age) with the increasing age and live weight. The best efficiency of feed conversion was found in the 5th week of age.

In the experiment the ostrich chicks consumed

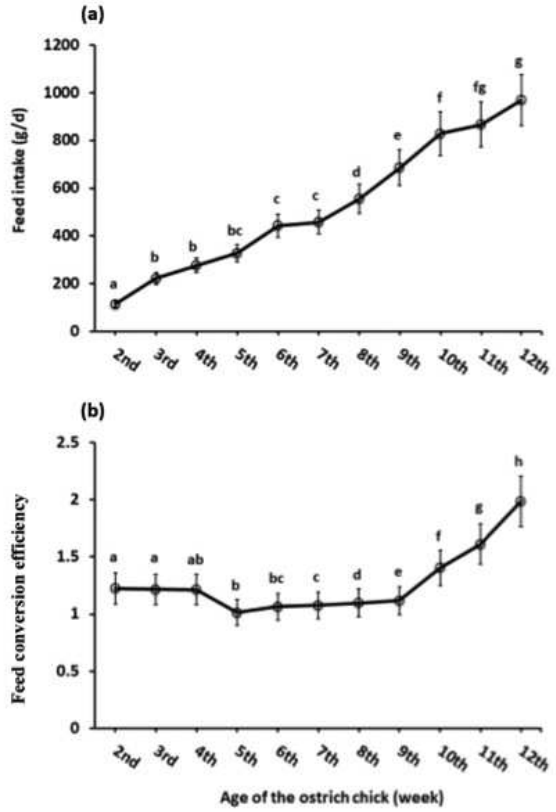

Fig 5. Feed intake (a) and feed conversion ration as feed efficiency (b) of ostrich chicks from 2nd to 12th weeks of age. Each line with error bar represents mean ± SEM value. The different letters on the error bar indicates significant differences (P<0.05 or P<0.01) among the values in different time points

average 2nd to 12th weeks of age which were recorded as 114.29, 221.86, 276.14, 328.57, 442.86, 458.14, 554.71, 685.71, 828.57, 866.71 and 969.29 g/day, respectively. Selvan *et al*. (2012) observed ostrich chicks consumed 211.23, 548.00 and 638.00 g concentrate feed per day in 1st, 2nd and 3rd month, respectively. This result agreed with the present findings. Waugh *et al*. (2006) reported 1.00−1.42, 1.90−1.91 and 1.95−1.97 kg concentrate feed consumed by the ostrich chicks in 1st, 2nd and 3rd month, respectively and this report disagreed by the result obtained in this experiment.

Feed conversion efficiency (FCE) obtained under the present study was recorded as 1.22, 1.22, 1.22, 1.01, 1.15, 1.16, 1.18, 1.12, 1.41, 1.61 and 1.98, respectively. Kreibich and Sommer (1995) recorded a FCE of 1.40 to 1.60 in African black ostrich chicks and agreed with the present findings. The FCE obtained 0.99, 0.97 and 1.36 at 1st, 2nd and 3rd month, respectively, whereas, Selvan *et al*. (2012) reported 1.67, 1.64 and 1.60 during 1st, 2nd and 3rd month, respectively. In 1st and 2nd month FCE obtained in this experiment vary more with the Selvan *et al*. (2012) but in the 3rd month result were almost similar.

Survivability of the ostrich chicks

The survivability related parameters of ostrich chicks during the experimental period were recorded (Table 1). There was no mortality (0%) during all over the experimental period that means excellent (100%) survivability was obtained. On the other hand, 13.33% abnormality was occurred due to leg problem, because of slipped at uneven place during running or morning exercise in the free area under sunlight in the earlier stage of the study.

Survivability of ostrich chicks in this experiment was excellent. Actually no mortality was occurred in the experimental period. Adewumi *et al*. (2017) reported 67% mortality within 6 weeks of age, whereas Musa *et al*. (2005) found 41% mortality. Health related culling by limb malfunction affected most of the birds. Agab *et al*. (2008) observed that the mean annual mortality rates for ostrich chicks during the rearing phase were 29%. In a study done by More (1996) chicks survival was found to differ between farms. Some farms exhibited superior survival during the first month of post hatch with high mortalities thereafter while other farms demonstrated low survival of chicks younger than a month with improved survival thereafter. Impaired chicks survival was largely the result of the removal of the birds from their natural wild habitat, and then introduced to intensive and semi-intensive farming conditions. General aspects of chicks management and husbandry greatly influence chicks survival, although the ideal conditions optimal for survival have yet to be established. The first 10 days to 3 months of age were most critical period of the chicks live and chicks diseases could be avoided by keeping them at the prescribed temperature, provide a well-balanced ration with good management so that they can eat greedily by 10 days of age and thus increase their chances of survival to three months of age and older (Vannickerk, 1996). Cogburn (2006) found the chicks livability was only 10% heritable therefore the environment played the largest role than genetics. Probably the biggest mortality of ostrich chicks was due to stress, and intensive care should be taken to avoid any unnecessary stress due to heat, wind and over handling.

Behavior

The ostrich chicks from the very beginning of its life showed to be fond of taking any brighter objects as foods. The ostrich chicks showed jollier in all over the experimental period when they freed on under sunlight or in the field in later stage. They start a special type of dance when they freed on. They like cool weather and cool place. When the water was sprayed on them they showed more amusement. They took concentrated feed like other birds and also eaten green grasses and forages. They were more active but after taking feed they lay down and got rest for some time. Pecking behavior was started soon after hatching and was carried on into adulthood. Objects (droppings, dung, pellets etc.) on the ground were most frequent targets of pecking. At a very early stage, they were very sensitive. They showed their weakness after eating any polythene or small parts of iron or any other undesirable substances and slip tendon tendency was observed after their slipping during running. That's why; intensive care was taken during early stage of their life. They were afraid in nature, when they run; they don't want to see what object was in their front. Degen *et al*. (1989) and Bubier *et al*. (1996) reported the similar behavior of ostrich chicks.

Conclusions

Fluctuation of live weight gain throughout the experimental period was observed. The highest live weight gain of ostrich was found at 9th week. The feed intake was increasing in accordance with the increasing of age during the entire experiment. The results also indicated that the FCE of ostrich from 2nd to 12th weeks of age and the best FCE was observed in 5th weeks. On the other side, no mortality was recorded i.e. excellent survivability. Therefore, it may be concluded that ostrich chicks showed the better performance in relation to growth and survivability under the appropriate management and environmental conditions of Bangladesh.

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