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Road transportation effect on rectal temperature, respiration and heart rates of ostrich (*Struthio camelus*) chicks

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ABSTRACT

The responses of rectal temperature (RT), respiratory rate (RR) and heart rate (HR) of ostrich (*Struthio camelus*) chicks during road transportation were investigated using standard recording procedures. The RT and RR of the ostriches increased significantly ($P<0.05$) from 39.5 ± 0.1 ^{0}C and 12.2 ± 2.0 breaths per minute (bpm), respectively, before transportation, to 40.2 ± 0.3 ^{0}C and 50.7 ± 9.1 bpm, respectively, following transportation. The pre-transportation HR value of 61.4 ± 1.0 beats per minute did not differ significantly ($P>0.05$) from the value of 68.5 ± 2.2 beats per minute recorded during the journey. The RT, RR and HR values recorded six hours after the journey were not significantly ($P>0.05$) different from the corresponding pre-transportation values of the ostriches. The results showed that transportation of ostrich chicks for four hours induced a transient increase in RT and RR values. It is concluded that road transportation of ostrich chicks for four hours apparently has no adverse effects on health and performance of ostrich chicks.

Key words*:* heart rate, ostrich, rectal temperature, respiratory rate, transportation

Introduction

Transportation of ostriches (*Struthio camelus)* is very stressful and poses a great risk to both man and the bird itself (MITCHELL et al., 1996). This is because the ostrich is bipedal, with two-toed feet, a height of about 3 m and weighing more than 200 kg. The high centre of gravity of ostriches has contributed to its postural instability during road transportation, resulting in injuries and frequent death (FOGGIN, 1992; WOTTON and HEWITT, 1999). Although some countries have established welfare animal order (ANONYM., 1998), only a few recommendations relate solely to transportation of ostriches.

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There is paucity of information on the optimum conditions for road transportation of ostriches. In recent times the need to transport ostriches, especially chicks, has arisen due to increasing interest in rearing ostriches in new areas where they were never previously kept. Therefore, transportation of ostrich chicks has become necessary for those emerging ostrich farmers who have not acquired the techniques of ostrich hatching and brooding of chicks. In order to reduce the adverse effect of road transportation on ostriches there is a need to monitor their health status during transportation.

Rectal temperature (RT), respiratory rate (RR) and heart rate (HR) are important physiological parameters most relevant for on-the-spot evaluation of the health status and adaptability of animals, including poultry species (BIANCA, 1976; AYO et al., 1998). The parameters are easily measured and are of value in the determination of state of stress in birds, especially during the process of transportation in rural areas where laboratory facilities may be lacking. The aim of the present study was to investigate the changes in physiological parameters of RT, RR and HR of ostrich chicks during short duration road transportation.

Materials and methods

Management of birds and physiological measurements. Eight healthy 4-month-old farmed ostrich chicks of both sexes, belonging to the red neck breed, were obtained from a commercial farm located near Zaria town ($11^0$10`N, $07^0$38`E).The chicks were kept in their age group on the farm for two weeks and were accustomed to handling in a corral and recording of physiological parameters before transportation to Minna ($09^0$37`N, $06^0$36`E) in May, 2005.

Measurements of RT, RR and HR were done in a relatively calm condition at 06:00, 14:00 and 18:00 h daily for five days before transportation, at 06:00h on the day of transportation, and for five days post-transportation. During the transportation period the parameters were measured immediately after loading, and at 30 m., 1h. 30 m. and 4 h. of transportation. On arrival the parameters were measured immediately, and 30 m., 1, 2, 4 and 6 h. after transportation. The RT was measured by inserting a standard clinical digital thermometer (Cocet, China) about 5 cm deep into the rectum via the cloacae until the sound of the alarm was heard, indicating end of reading. The RR was recorded by measuring the number of respiratory flank movements over two 30-second periods. The HR was taken using a stethoscope by the left side of the thorax and by counting the number of heart beats per minute. Temperature and relative humidity were recorded, using dry and wet bulb thermometers.

Vehicle design and transportation procedures. The vehicle used for transportation was a modified 18-seater Toyota bus, 1.7 m high. The interior top ceiling was made of hard plastic material, while the outer roof was made from a solid iron material. The

floor (2.8 × 1.3 m) and the lower three-quarters of the sides of the vehicle were metallic, covered with a plastic material, while the remaining top sides comprised louver windows which permitted regulation of ventilation. The windows were provided with dark curtain materials. The floor of the vehicle, which lacked gaps and holes, was covered with non-slip rubber matting.

Handling and loading of ostriches into the vehicle were carried out according to standard procedures, as described by SALES and SMITH (1995) and WOTTON and HEWITT (1999). The vehicle travelled a distance of 224 km on an asphalt road at an average speed of 50 km/h. Food and water were withdrawn completely 6 h. before the journey, as well as during the period of the journey. On arrival the ostriches were immediately hooded out of the vehicle individually, through a provided horizontal unloading bay and into a pen about 4 acres in area and which had runs measuring 1.5-2.4 m wide. The ostrich chicks were fed the same feed and ration as they received prior to their transportation.

Analysis of results. All data obtained were subjected to Student's *t*-test and correlation analysis. Data were expressed as mean ± standard error of the mean (mean ± SEM). Values of $P<0.05$ were considered significant.

Results

Meteorological data. Dry-bulb temperature at the site before departure was 29 ^{0}C. During transportation the temperature inside the vehicle was between 30 and 34 ^{0}C. On arrival, dry-bulb temperature ranged between 28 and 33 ^{0}C, and relative humidity during the experiment period ranged between 65 and 72%.

Responses of rectal temperature, and respiratory and heart rates. Results of physiological parameters are presented in Tables 1 to 3. Prior to transportation the RT, RR and HR values were 39.5 ± 0.1^{0}C, 12.2 ± 2.0 bpm, and 61.4 ± 1.0 beats per minute, respectively (Table 1). The RT and HR values did not increase significantly immediately after loading, but the RR value rose significantly ($P<0.001$) to 30.4 ± 1.3 bpm. After 30 m. of transportation the RT, RR and HR values rose significantly ($P<0.05$) to 40.2 ± 0.1 ^{0}C, 67.8 ± 1.3 bpm and 69.9 ± 2.3 beats per minute, respectively. After 1 h. 30 m. of the journey, the RT further increased significantly ($P<0.05$) to 40.7 ± 0.2 ^{0}C. The RR and HR values were not significantly different from those obtained after 30 m. of transportation, but significantly ($P<0.05$) higher than the corresponding values recorded immediately after the ostriches were loaded. After 4 h. of transportation the RR and HR did not differ significantly ($P>0.05$) from the corresponding values recorded immediately after loading (Table 2). At this time, the obtained RT value of 40.3 ± 0.1 ^{0}C was significantly higher than the 39.5 ± 0.1 ^{0}C, recorded immediately after loading.

Table 1. Rectal temperature, respiratory rate and heart rate of ostrich chicks for five days pre- and post-transportation (Mean ± SEM, n = 8)

Rectal temperature			Respiratory rate		Heart rate	
Period	(^{0}C)	Range	Breaths/min	Range	Beats/min	Range
Pre-transportation	39.5 ± 0.1	39.4-39.5	12.2 ± 2.0	9.1-15.9	61.4 ± 1.0	60.5-63.4
Post-transportation	39.4 ± 0.1	39.3-39.5	12.1 ± 1.4	10.6-14.9	66.3 ± 6.2	66.1-78.8

For each parameter, values are not significantly different (P>0.05).

There was a negative and insignificant (P>0.05) correlation between the duration of the journey and RR, and HR (r =-0.169 and-0.023, respectively) values, but that between the duration of the journey and RT was positive (r = 0.457).

Table 2. Rectal temperature, respiratory rate and heart rate of ostriches during transportation (Mean ± SEM, n = 8)

	Rectal temperature (^{0}C)	Respiratory rate breaths/min	Heart rate beats/min
After loading	39.5 ± 0.1^a	30.4 ± 1.3^a	63.9 ± 1.4^a
30 min	40.2 ± 0.1^b	67.8 ± 1.3^b	69.9 ± 2.3^b
1 h 30 min	40.7 ± 0.2^c	64.4 ± 1.6^b	73.9 ± 2.3^b
4 h	40.3 ± 0.1^b	40.3 ± 4.4^c	66.4 ± 3.1
Overall mean	40.2 ± 0.3	0.7 ± 9.1	68.5 ± 2.2

For each parameter, values with different superscript alphabets are significantly (P<0.05) different

After unloading, the RT decreased slightly (P<0.05) from 40.2 ± 0.04 ^{0}C to 39.9 ± 0.04 ^{0}C at 30 m. after unloading, and further to 39.5 ± 0.1 ^{0}C at 1 h. after unloading. At 4 and 6 h. after unloading the RT was 39.4 ± 0.1 ^{0}C, this value not being significantly (P>0.05) different from the 39.5 ± 0.03 ^{0}C, recorded before commencement of the journey (Tables 1 and 3).

The RR after unloading the ostriches gradually decreased (P<0.001) from 19.5 ± 1.2 bpm. to 8.8 ± 0.3 bpm. at 4 h. after unloading (Table 3). The values of 8.8 ± 0.3 and 9.5 ± 0.4 bpm recorded after 4 and 6 h. of unloading, respectively did not differ significantly (P>0.05) from the value of 12.2 ± 2.0 bpm recorded before the commencement of transportation (Tables 1 and 3).

Table 3. Rectal temperature, respiratory rate and heart rate of ostriches within six hours after transportation (Mean ± SEM, n = 8)

Time after transportation	Rectal temperature (^{0}C)	Respiratory rate breaths/min	Heart rate beats/min
After unloading	40.2 ± 0.04^a	19.5 ± 1.2 ^{a}	63.3 ± 1.2^a
30 min	39.9 ± 0.04^b	12.1 ± 1.3^b	57.8 ± 1.0^a
1 h	39.5 ± 0.1^c	9.6 ± 0.4^b	54.3 ± 1.3^{a,b}
2 h	39.1 ± 0.04^c	9.9 ± 0.6^b	57.8 ± 1.2^{a,b}
4 h	39.4 ± 0.1^c	8.8 ± 0.3^{b,c}	52.8 ± 1.7^a
6 h	39.4 ± 0.1^c	9.5 ± 0.4^{b,c}	60.0 ± 2.0^a
Overall Mean ± SEM	39.6 ± 0.2	11.6 ± 1.7	57.7 ± 1.6

For each parameter, values with different superscript alphabets are significantly (P<0.05) different

The HR of ostriches before transportation was 61.4 ± 1.0 beats per minute. Immediately after loading the value obtained was 63.9 ± 1.4 beats per minute (P>0.05). After 30 m. of transportation the HR rose slightly to 69.9 ± 2.3 beats per minute, while after 1 h. 30 m. of transportation, the HR increased (P<0.001) to 73.9 ± 2.3 beats per minute. At the end of transportation the HR value of 66.4 ± 3.1 beats per minute obtained was not different (P>0.05) from that recorded after 1 h. 30 m. of transportation (Table 2). On arrival, HR progressively decreased from 63.3 ± 1.2 beats per minute immediately after unloading to 57.8 ± 1.0 beats per minute 30 m. after transportation. Thereafter, HR fluctuated between 54.3 ± 1.3 and 52.8 ± 1.7 beats per minute at 1 h. and 4 h. post-transportation, respectively. Six h. post-transportation, HR value was 60.0 ± 2.0 beats per minute (Table 3), this value being not significantly different from the pre-transportation HR value of 61.4 ± 1.0 beats per minute. There was a negative correlation between the duration of transportation and HR, and time post-transportation of the ostriches (r = -0.708, P<0.01).

After transportation, the RT, RR and HR values recorded for five days on the new farm were 39.4 ± 0.1 ^{0}C, 12.1± 1.4 bpm and 66.3 ± 6.2 beats per minute, respectively (Table 1). The values were not significantly different from the corresponding pre-transportation values. Values fluctuated according to the hour of the day. The RT, RR and HR values obtained at 14:00 h. were higher than those recorded at 06:00 and 18:00 h., both pre-and post-transportation period.

Discussion

The RT, RR and HR values recorded pre-transportation in this study fell within the established normal values for ostriches (GIDEON, 1972). This indicated that the birds were healthy and therefore fit for transportation.

The results obtained during transportation in the present study showed that transportation significantly increased RT, RR and HR values in ostriches. The increase in RR was significant immediately after loading, followed by that of RT and HR after 30 m. of transportation. Thus, it appeared that the respiratory system was the first of the three investigated body systems to manifest responses to changes, occurring due to transportation in ostriches. The responses of the respiratory system were immediately followed by those of thermoregulatory and cardiovascular systems. The results indicated the stressful nature of transportation, demonstrated by the birds constantly opening their throughout the period of transportation.

The sustained increase in RT, RR and HR of transported birds during the 4 h. transportation period indicated that road transportation of chicks, even for a short period on a relatively good road, induced a transient stressful effect. The findings of the present study were in agreement with those of WOTTON and HEWITT (1999), who reported that ostriches are very hardy birds, resistant to environmental stress factors.

The diurnal fluctuations in the physiological parameters recorded in the present study agreed with the results of previous studies, in that RT, RR and HR varied with the hour of the day (ZAYTSEV et al., 1971; AYO et al., 1998). Such a variation, classical of most mammals, was driven by a biological clock (PICCIONE and CAOLA, 2002). The results also showed that not only transportation itself induced increases in RT, RR and HR, but that the parameters were also increased as a result of unloading the ostriches from the vehicle. Thus, the very process of unloading of ostriches in a new environment by new handlers also constituted an important component of multiple stressors acting on the bodies of ostriches post-transportation. A similar observation, that novelty of environment and of handlers increase ostrich aggression, was made by REINER et al. (1996) and WOTTON and HEWITT (1999).

After 1 h. of completion of transportation, RT, RR and HR decreased insignificantly compared to the corresponding pre-transportation values.

Road transportation for four hours apparently induced a transient alarm stage of stress in ostriches, characterized by a rise in physiological parameters and the return of the values to pre-transportation values 1 h. after transportation. Such a rapid return indicated that a 4 h. transportation of ostriches by road was a transient stressor during the early rainy season in the Guinea Savannah zone of Nigeria. Consequently, it may not have an adverse effect on the health status and performance of ostriches, especially if they had sufficient space to sit down comfortably during transportation, as provided in this study. Although there are no recommendations on stocking rates or density for ostrich chicks during transportation (WOTTON and HEWITT, 1999), the provision of sufficient, comfortable space has been known to prevent over-heating, overcrowding and poor ventilation, which are potential stress factors (SMITH, 1993).

The vehicle used for transportation of the ostriches was a converted closed bus provided with dark curtain materials, thus reducing the possible effect of the vehicle itself on transportation. This is in accordance with the observation of FREEMAN (1984), that closed vehicles and the provision of curtain materials by window sides tend to alleviate the adverse effect of transportation stress on birds. Efforts were also made in the present study to reduce adverse effects of meteorological conditions on ostriches during their transportation. Thus, they were transported in the early hours of the day in order to reduce the effect of concomitant actions of high ambient temperature and humidity, known to adversely affect birds during transportation (FREEMAN, 1984).

The results of the present study provide preliminary information on the physiological responses of ostrich chicks to road transportation in the Guinea Savannah zone of Nigeria, which until now has been lacking.

Conclusions

Road transportation of ostriches during the early hours of the day for four hours during the early rainy season in the Guinea Savannah of Nigeria induced transient increases in RT, RR and HR, but may not have adverse effects on the health and performance of ostrich chicks.

Further studies involving biochemical, hormonal and haematological analyses are required in order to elucidate fully the effect of road transportation stress on ostriches, and to make appropriate recommendations on guidelines and regulations governing the transportation of ostriches in Nigeria.

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SAŽETAK

Vrijednosti rektalne temperature, frekvencije disanja i bila praćene su standardnim metodama u nojevih pilića (*Struthio camelus*) za vrijeme cestovnog prijevoza. Vrijednosti rektalne temperature i frekvencija disanja znatno su porasle ($P<0,05$) s 39,5 ± 0,1 ^{0}C i 12,2 ± 2,0 udisaja u minuti prije početka prijevoza na 40,2 ± 0,3 ^{0}C i 50,7 ± 9,1 udisaja u minuti nakon prijevoza. Vrijednosti od 61,4 ± 0,1 otkucaja u minuti prije prijevoza nisu se značajno razlikovale ($P>0,05$) u odnosu na vrijednosti od 68,5 ± 2,2 otkucaja u minuti u tijeku prijevoza. Vrijednosti rektalne temperature, frekvencije disanja i bila zabilježene šest sati nakon prijevoza nisu se značajno razlikovale ($P>0,05$) od odgovarajućih vrijednosti prije započetog prijevoza. Rezultati su pokazali da prijevoz nojevih pilića u trajanju od četiri sata potiče prolazno povećanje rektalne temperature i frekvencije disanja. Autori su zaključili da cestovni prijevoz pilića u trajanju od četiri sata nema štetan učinak na zdravlje i proizvodnost nojevih pilića.

Ključne riječi: noj, bilo, rektalna temperatura, frekvencija disanja, prijevoz