



RESEARCH COMMUNICATION

Yolk sac utilization in ostrich (*Struthio camelus*) chicks

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ABSTRACT

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The mass of residual yolk sac expressed as a percentage of initial mass of the egg from which the chick hatched decreased sharply in the first 2 days post-hatching. A gradual reduction occurred between 3 and 10 days after which a sharp decline was noted between 11 and 13 days post-hatching. The highest number of chicks with unabsorbed yolk sac was noted on day 5 post-hatching followed by days 6 and 7. Chick mortality followed the same pattern. The dynamics, causes and clinical consequences of yolk sac utilization are discussed.

Keywords: Ostrich, *Struthio camelus*, yolk sac

INTRODUCTION

Utilization of yolk sac in the ostrich (*Struthio camelus*) is an important aspect of its post-hatching development (Bertram & Burger 1981). There is limited information as to when yolk sac resorption in ostrich chicks occurs (Keffen & Jarvis 1984; Deeming 1995). The latter author suggested a 10–14 day period for yolk utilization to be completed. This process has been more intensively studied in avian species other than the ratites (Paganelli, Oliszowka & Ar 1974; Moran & Reinhart 1980; Matshusita 1986; Murakami, Akiba & Horiguchi 1992; Reidy, Atkinson & Leeson 1998). In the ostrich, failure to establish when yolk sac is considered “retained” has often led to unnecessary surgical excision of the yolk sac (deutectomy). This surgical operation

would be justified in conditions such as omphalitis among others (Huchzermeyer 1994).

The main purpose of this study was to investigate the process of ostrich yolk sac resorption, the possible pertinent factors involved in this phenomenon and the clinical implications.

MATERIALS AND METHODS

Using sterile disposable gloves a total of 1 036 eggs were collected in the ostrich laying season from June 2002 to February 2003. These eggs were placed in sponge-padded, well-ventilated boxes twice a day, on the same day they were laid, to prevent brooding by the hens. The eggs were buffed with dry steel wool to remove dried mud on the surface and transported on their sides. Subsequently they were labelled to indicate source camp and date of collection. The eggs were weighed on an electronic balance (Adam Equipment Co., UK) and the mass of each egg recorded on the shell. The eggs were fumigated with a mixture of 200 g potassium permanganate 300 ml 40 % formaldehyde in a special

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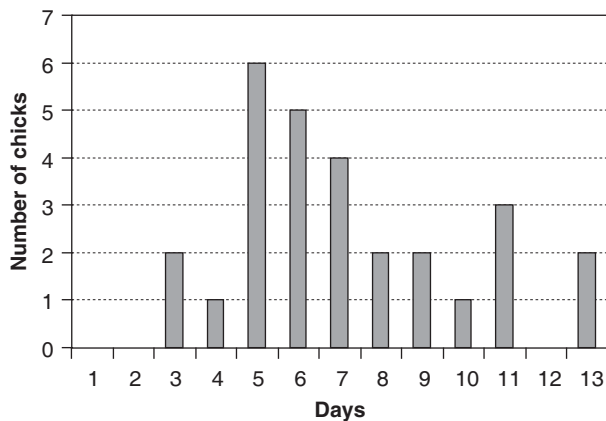


FIG. 1 Number of chicks with unabsorbed egg yolk

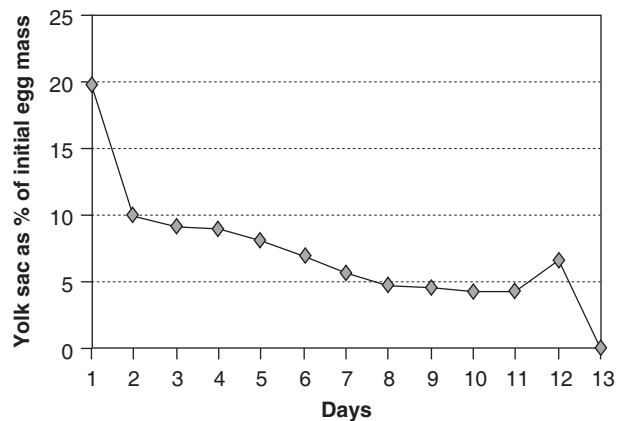


FIG. 2 Relationship between age of a chick ($n =$) and the mass of the residual yolk expressed as percentage of the initial egg mass from which the chick hatched

room and afterwards stored at 12–18 °C, relative humidity (RH) of 70–80 % in a cold room. Prior to transfer to the incubator, the eggs were warmed at 25 °C for 8–12 h and then set on day 10. Incubation was done at 36.2 °C and 42 % RH.

Eggs were frequently weighed to assess water loss by the embryo. They were turned 45° to each side of the vertical, six times a day. As hatching was expected to occur at day 42, the eggs were incubated for between 35–39 days, after which they were placed in a hatcher where the temperature was 0.5–1 °C lower. Eggs were now candled every 3 h to assess whether the chicks had pipped internally. Hatching chicks were not assisted, in order to prevent the establishing of a weak population of chicks. Once hatched, the umbilical cord was treated with a tetracycline-containing wound spray. The chicks were left to dry off completely and to settle down in a clean rest room. Prior to their removal from the drying room, the chicks were given either a commercial probiotic (Enteroform) or yoghurt depending on their availability.

Post-mortem examinations were conducted on all dead ostrich chicks from day 2 to day 13 post-hatching. The carcasses were refrigerated at 4 °C and autopsies were performed at most 2 days after death. The mass of the chick and of any residual yolk sac in the abdomen were recorded. Swabs of the yolk sac and viscera were taken for bacterial and fungal culture.

RESULTS

There was variation in the initial mass of the eggs, the average mass being 1.5 ± 0.5 kg. The post-

mortem examinations revealed that the chicks died from a variety of causes including omphalitis, starvation, dehydration, septicaemia and enteritis. High chick mortality was noted in the chicks aged between 3 and 11, peaking on days 6 and 7. It gradually declined after day 13.

The highest number of dead chicks with unabsorbed yolk sac was in the 3–11 day age group as depicted in the histogram in Fig. 1. The yolk sac mass was expressed as a percentage of the initial mass of the egg from which the chick hatched. At the time of hatching, it was noted that the yolk sac contributed to about 19.5 % of the initial egg mass. A sharp reduction in the mass of the yolk sac expressed as a percentage of the initial egg mass was realized in the first 48 h post-hatch. Thereafter a gradual decline occurred from day 3 to day 10. Subsequently, within 2 days, a sharp temporary increase was noted which fell precipitously to insignificant levels within a day.

The bacteriological culture of yolk sacs yielded various bacterial species, amongst others *Staphylococcus* spp., *Escherichia coli*, *Bacillus licheniformis*, *Achromobacter* spp. and *Acinebacter calcoaceticus*.

DISCUSSION

The mass of the 1 036 ostrich eggs that were incubated ranged from 1.4–1.6 kg. These values were comparable to those obtained by Keffen & Jarvis (1984) and Foggin (1992). The results obtained in this study suggest that the presence of a yolk sac in a chick beyond day 13 should be considered as retained. Studies conducted by Murakami *et al.* (1992) indicated that the residual yolk sac plays a

crucial role in complementing the nutrients absorbed to assure rapid growth of the chick once it has hatched. The yolk sac is therefore necessary for early initiation of growth, since dietary fat is only effective at 10 days after hatching (Chamblee, Brake, Schultz & Thaxton 1992). It has been found that in the avian uptake of fructose increases after hatching, which allows the inherent yolk glucose resources or reserves to become a major source of energy, as the yolk sac lipids are rapidly depleted (Sklan 2003). The presence of the enzyme sucrase in the yolk sac of the chick emphasizes the role played by the yolk sac in growth initiation during pre-hatch and post-hatch period (Matsushita 1986).

There was a precipitous fall in the mass of yolk sac within the first 48 h period post-hatch. In newly-hatched broiler chicks, absorption of the yolk sac was found to precede initiation of growth within 24 h (Chamblee *et al.* 1992). Loss of mass of the egg yolk in the chickens between the ages of 3 and 11 days post-hatch was variable. The gradual decline in mass may partly be attributed to the varied rate at which yolk constituents, mainly lipids and carbohydrates, are utilized by the growing chick (Moran & Reinhart, 1980; Reidy *et al.* 1998). The rate of yolk sac utilization is known to be influenced by exogenous feeding (Noy & Sklan 2001). It is also possible that various fractions of lipids are metabolized at different rates in the chicks as described by Reidy *et al.* (1998). Yolk sac utilization has been shown to be more rapid in fed rather than fasted birds, suggesting that the transport of yolk through the intestine could be increased by the greater intestinal motility found in chicks receiving feed (Noy & Sklan 2001). This finding lends support to the recommendation that ostrich chicks should be fed on the day they hatch, which is contrary to the common belief that dietary intake of carbohydrates and lipids delays yolk sac absorption.

The results of this study suggest that unless the yolk sac is infected, its early removal, before ostrich

chicks are 10 days old, may be detrimental. Deu-tectomy has been shown to delay growth by 2 days (Murakami *et al.* 1992). Systemic infections or lack of exercise may also reduce chick metabolism and slow down yolk sac utilization.

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