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The effect of egg turning and fertility upon the potassium concentration of the albumen and yolk of the Japanese quail.

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Static incubation is known to decrease the amount of sub-embryonic fluid accumulating within the yolk sac (Babiker and Baggott, 1992). Deeming *et al.* (1987) attributed this to a depletion of sodium from albumen adjacent to the yolk sac, suggesting this would reduce sodium transport across the blastoderm so decreasing fluid transfer. Latter and Baggott (1996) measured directly differences in sodium within the albumen and found a depletion of sodium from albumen adjacent to the yolk sac in unturned eggs. However, as it was present in both fertilised and unfertilised eggs and at the vegetal pole of the yolk sac, they concluded that this depletion of sodium was not dependent upon active sodium transport across the blastoderm. Because of the large difference in sodium concentrations between albumen and yolk, they suggested that sodium depletion from albumen was caused by passive movement of sodium into the yolk sac. Stirring of albumen by turning eggs would dissipate the sodium-depleted layer and ensure maximal transfer of sodium and water into the sub-embryonic fluid. If this explanation were correct, we would expect to observe similar changes within the albumen for a non-transported ion which can enter the yolk sac. The aim of this study was to investigate the effects of static incubation and egg fertility upon potassium concentrations within the albumen and yolk. Eggs were collected from mated females verified to lay only fertilised eggs; unfertilised eggs were obtained from unmated females. Eggs were incubated at 36.7°C for 24h or 72h and turned 90° around the long axis every hour by a moving platform. Unturned eggs were incubated contemporaneously raised above the platform. Albumen was sampled just beneath the shell membranes and adjacent to the yolk sac. Yolk was sampled adjacent to the inner albumen sampling site. Sampling locations were at both the yolk equator and vegetal pole. The albumen and yolk samples were excised from eggs frozen in liquid nitrogen for 65s and potassium concentrations, [K], assessed by flame photometry (Latter and Baggott, 1996). The effects of the treatments, turned vs. unturned and fertilised vs. unfertilised eggs, were assessed by two-way Anova. The difference in [K] between albumen underlying the shell membranes and albumen adjacent to the yolk sac, [Δ K], was unaffected by static

incubation or egg fertility (all means $n=6$, $P>0.05$). For example, at the yolk equator, after 24h of incubation, $[\Delta K]$ was 0.20 ± 0.07 mM/Kg (mean \pm SEM) for turned, fertilised eggs and 0.28 ± 0.09 mM/Kg for unturned, fertilised eggs. Similarly for unfertilised eggs, $[\Delta K]$ was 0.18 ± 0.06 mM/Kg for turned eggs and 0.17 ± 0.06 mM/Kg for unturned eggs. Likewise, at 72h of incubation no effect of turning or fertility was detected for $[\Delta K]$, and at the vegetal pole, for both periods of incubation, an identical lack of effect of turning and fertility upon $[\Delta K]$ was observed. At the yolk equator, albumen $[K]$ increased between 24 and 72h of incubation in fertilised eggs only (Table). Yolk $[K]$ was unaffected by turning treatment or egg fertility. Consequently, the difference in $[K]$ between albumen and yolk at 24h of incubation was small but in fertilised eggs had increased 3-4 times by 72 h of incubation (Table). These observations were identical for the vegetal pole (not presented). In contrast to sodium, static incubation does not deplete potassium from albumen adjacent to the yolk sac. This suggests that a passive loss of potassium from albumen to yolk, as proposed for sodium, may not occur. However, from the early stages of incubation the difference in $[Na]$ between albumen and yolk is substantial, about 50 mM/kg, as albumen $[Na]$ is in the order of 80-90 mM/kg, whereas yolk $[Na]$ is similar in magnitude to $[K]$, around 40 mM/kg (Latter and Baggott, 1996). Even in fertilised eggs at 72h of incubation the difference between albumen and yolk $[K]$ approached only half of that observed for sodium. Our results suggest, therefore, that for this period of incubation the gradient for a passive potassium flux into the yolk is inadequate to produce a detectable depletion of this ion from albumen of unturned eggs.

BABIKER, E.M. & BAGGOTT, G.K. (1992) Effect of turning upon the sub-embryonic fluid and albumen of the egg of the Japanese quail. *British Poultry Science*, **33**: 973-991.

DEEMING, D.C., ROWLETT, K. & SIMKISS, K. (1987) Physical influences on embryo development. *Journal of Experimental Zoology, Supplement 1*, pp. 341-345.

LATTER, G.V. & BAGGOTT, G.K. (1996) Effect of egg turning and fertility upon the sodium concentration of albumen of the Japanese quail. *British Poultry Science*, **37**: 301-308.

Table. The effect of egg turning upon the albumen and yolk potassium concentrations ([K], mM/Kg) at the yolk equator, and upon the difference between the potassium concentration of albumen adjacent to the yolk sac and the yolk, for both fertilised eggs (F) and unfertilised eggs (U) during the first 72 hours of incubation.

Period of incubation		[K] of albumen next to yolk		Yolk [K]		Albumen [K] - Yolk [K]	
		Turned	Unturned	Turned	Unturned	Turned	Unturned
24h	F	44.57±0.03 ^a	44.40±0.05 ^a	37.05±0.02 ^c	37.05±0.02 ^c	7.52±0.05 ^d	7.35±0.06 ^d
	U	44.02±0.02 ^b	44.02±0.02 ^b	37.05±0.03 ^c	37.02±0.02 ^c	6.96±0.04 ^e	6.75±0.07 ^e
72h	F	64.55±0.09*	63.17±0.02*	37.58±0.04 ^g	37.45±0.09 ^g	26.97±0.08	25.72±0.10
	U	44.15±0.03 ^f	44.07±0.02 ^f	37.58±0.02 ^g	37.57±0.02 ^g	6.57±0.04 ^h	6.50±0.03 ^h

Means ± SEM for 6 observations. At each period of incubation, and within each group of four means (turning and fertility treatments), those means sharing a common superscript do not differ significantly ($P > 0.05$). [K] of albumen next to yolk : * - means for fertilised eggs at 72h differ significantly from those for fertilised eggs at 24h ($P < 0.001$).