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The effect of egg weight on the hatchability and growth performance of New Hampshire and Rhode Island Red chicks

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Abstract

A trial was conducted to determine the effect of egg-weight on the hatchability and growth performance of chickens. Large and medium eggs of New Hampshire (NH) and Rhode Island Red (RIR) hens were grouped in four categories, according to their weight and breed. Twenty-seven eggs from each group namely, New Hampshire-Large (NH-L), New Hampshire-Medium (NM-M), Rhode Island Red-Large (RIR-L) and Rhode Island Red-Medium (RIR-M), were incubated. After hatching, twenty randomly selected chicks per group were raised for six weeks. Egg-weight, hatching weight and growth rate were determined individually. Comparisons were made between the large and medium eggs within each breed. The hatching percentage of large eggs in both breeds tended to be better than that of the medium eggs. A strong positive correlation was found in all four groups between egg weight and hatching weight of the chick (r = 0.99). No statistical difference between the average daily gain (ADG) and the mean final weight of NH-L and NH-M were found during the rearing period. In contrast, the mean ADG recorded in the RIR-M chicks during the six-week rearing period was about 2 g higher than that of the RIR-L chicks. The RIR-M chicks consequently reached the same weight as the RIR-L chicks within the first two weeks of rearing. At six weeks of age they were about 38 g heavier than the RIR-L chicks. It was concluded that in both breeds hatchlings from medium eggs were lighter at hatching, but subsequently showed compensatory growth during the rearing period. The results indicate the occurrence of a more favourable compensatory growth amongst RIR-M chicks reared separated from RIR-L chicks.

Keywords: Chickens**,** compensatory growth, final weight, hatchling weight, hatchability
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Introduction

Poultry breeds have been artificially selected over many generations for two main economic traits, egg production and growth rate. According to French & Tullet (1991), these two traits are negatively correlated. Selection for increased body weight has been shown to increase egg weight, whereas selection for increased egg production decreases egg weight (French & Tullet, 1991). Early studies on chickens (Upp, 1928; Wiley, 1950) found little association of egg weight or hatchling weight with body weight at two weeks of age. There is, however, a strong positive correlation between egg weight and hatchling weight, which is constant across species (Wilson, 1991). The phenotypic correlation between chicken egg weight and hatchling weight is generally high, ranging from 0.50 to 0.95 (Tullet & Burton, 1982; Yannakopoulos & Tserveni-Gousi, 1987). The correlation between egg weight and body weight between 5 and 8 weeks of age is also significant in many broiler lines, but of a lower magnitude than the correlation between egg weight and hatchling weight (McNaughton *et al*., 1978). Hearn (1986) suggested that if eggs were segregated by size in the hatchery and the chicks raised separately, the variability at slaughtering age would be reduced and the growth of each group optimized. The aim of this trial was to compare the growth performance of chicks from two poultry breeds, and hatching from different egg sizes, during the first six weeks of intensive rearing.

Materials and Methods

Eggs (108) from two different dual-purpose chicken breeds, namely New Hampshire (NH) and Rhode Island Red (RIR), were obtained from purebred hens three days after AI at the Agriculture Research Council (ARC) poultry unit at Glen in the Free State Province. In order to compare the growth performance of chicks hatched from large and medium eggs, 54 eggs from each breed were weighed and further divided into two groups. Eggs weighing between 51 and 60g were classified as large (L), while those weighing between 43 and 50g were classified as medium (M). Twenty-seven eggs from each class in a breed (NH-L, NH-M, RIR-L and RIR-M, respectively) were individually weighed, marked, and placed individually into a net-bag, before being placed into the same incubator for 19-days. On day 19 of incubation, all eggs were transferred at once into the same hatcher. Within 30-minutes of hatching, each chick was removed from the net-bag and weighed, to determine the correlation between egg weight and hatchling weight. At the same time, the chick was marked with a leg-band with the same number as the egg it had hatched from, to correlate individual growth performance with egg weight, and hatchling weight.

Twenty chicks per group were randomly selected for usage in a subsequent growth trial. The four groups were reared in the same building in four square cages (1.2 x 1.2 m) placed next to each other in order to form a larger square (2.4 × 2.4 m). A layer of about 6 cm of peanut-shells was used for bedding and a 24-hour lighting program was used during the 6-week trial period. One infrared light, two feeding-trays and one water-drinker were provided per cage. A commercial pullet grower's mash was fed *ad libitum* to all the groups. It was assumed that the microenvironment within cages were similar, justifying the use of individual chicks as experimental units.

The composition of the feed was as follows: crude protein 160 g/kg (min), crude fibre 80 g/kg (max), moisture 120 g/kg (max), calcium 8-12 g/kg (max), and phosphorous 6 g/kg (min).

For the first two weeks, each group's daily feed intakes were measured and all the chicks were weighed every third day. From weeks 3 - 6, the chicks were weighed once a week and their weekly feed intake was determined. Mineral and vitamin supplements were given four days of the week in the water and clean water was supplied *ad libitum* every day. No mortalities occurred during the 6-week growth trial. The chicks were not sexed or vaccinated against any disease. PROC ANOVA of SAS (1995) was used to analyse individual egg and chick weights. The proportions of eggs that hatched in the medium and large categories were compared within breed, using PROC FREQ of SAS (1995). All comparisons were made within breeds, and the breeds were not compared with each other.

Results and Discussion

The hatching percentage, hatchling weight, and average daily weight gain during a 6-week rearing period of chicks hatched from L and M eggs are summarized in Table 1.

Table 1 Hatching percentage, hatchling weight, and growth performance (mean ± s.e.) during a 6-week rearing period, of New Hampshire and Rhode Island Red chicks hatched from large and medium eggs

Breed	New Hampshire		Rhode Island Red	
Egg size	Large	Medium	Large	Medium
Hatching (%)	81.5	76.1	92.6	81.5
Egg weight (g)	$58.3^{a} \pm 0.4$	$48.7^{b} \pm 0.3$	$57.8^{a} \pm 0.3$	$47.9^{b} \pm 0.3$
Hatching weight (g)	$42.0^{a} \pm 0.4$	$34.6^{b} \pm 0.3$	$40.9^{a} \pm 0.3$	$33.8^{b} \pm 0.4$
Finishing weight at 6 weeks (g)	$703^{a} \pm 20$	$674^{a} \pm 23$	$579^{a} \pm 12$	$617^{b} \pm 14$
Average daily gain (g/day)	$15.8^{a} \pm 0.5$	$15.2^{a} \pm 0.5$	$12.9^{a} \pm 0.3$	$13.9^{b} \pm 0.3$
Feed conversion ratio (g DM/g)	2.45:1	2.31:1	2.48:1	2.34:1

$^{a,\,b}$ means with different superscripts within lines for the same breed, differ significantly ($P < 0.05$)

Although larger eggs from both breeds tended to record higher hatching percentages, these differences were not statistically significant. Larger sample sizes are needed to test if these tendencies are significant. Causes of variation in egg characteristics (i.e. size, shell thickness, etc.) are hen age, genetics, nutrition, and environment (French & Tullet, 1991). It is well accepted that younger hens lay lighter eggs (Nagai & Gowe, 1969), so age may be an important factor determining fertility of the egg, but this factor was not considered in this study.

Although egg weight was significantly heavier than hatchling weight ($P < 0.05$), an extremely high and positive correlation ($r = 0.99$, $P < 0.01$) between the two variables was recorded in both breeds. This result is in line with the values in the literature, being slightly higher than the values reported by Tullet & Burton, (1982) and Yannakopoulos & Tserveni-Gousi (1987). According to Wilson (1991), the hatchling weight is determined primarily by egg weight and secondarily by weight losses during incubation, shell and residue weight, strain, incubation time, breeder age, gender of chick and time after hatching. Chick weight normally represents 62-76 % of initial egg weight (Tullet & Burton, 1982). The correlation between egg weight and chick weight decreased with age of the chick, and at the end of trial period, no significant correlation was recorded in either breed.

In both breeds, hatchlings from large eggs were ($P < 0.05$) heavier than those hatched from medium eggs. The NH-M chicks tended to record lighter weights than the NH-L contemporaries during the six week rearing period. However, no statistical differences between the ADG, and the mean final weight of NH-L and NH-M were found during the trial. These results suggest that a lower hatching weight as a result of a lighter egg (medium) has no negative effect on the growth performance of NH-M chicks compared to NH-L chicks.

In contrast, the mean ADG recorded in RIR-M chicks during the six week rearing period was about 1 g higher ($P < 0.05$) that in RIR-L chicks. The RIR-M chicks were ($P < 0.05$) lighter at hatching, but reached the same weight as the RIR-L ones within the first two weeks of rearing. At 6 weeks of age they were about 38 g heavier ($P < 0.05$) than RIR-L chicks.

These results suggest the occurrence of a more favourable compensatory growth amongst RIR-M chicks reared separated from RIR-L chicks. It is tempting to suggest that segregated rearing of chicks (based on egg weight) may be advisable, although the separations of chicks according to size was not explicitly tested against a control treatment. Further research is warranted to fully understand the complex interactions between egg weight (and the factors determining egg weight) and post hatching growth performance in commercial poultry breeds.

Although the FCR of the chicks hatching from medium eggs in both breeds seemed more favourable than that of those hatching from large eggs, no statistical analyses could be conducted as the chicks were group fed. The experimental design used was thus not optimal. If several replicates (involving groups of chicks) were used per treatment, it would benefit the statistical analysis. Such a design would have allowed analysts to arrive at conclusions regarding feed intake and feed conversion. This procedure is recommended for further studies on the same topic.

Conclusion

Trends in hatchability, feed intake and feed conversion ratio could not be confirmed, owing to relatively low egg numbers and an inadequate experimental design. The obtained results suggest breed differences in individual growth of New Hampshire and Rhode Island Red chicks hatched from medium and large eggs respectively. Further research on this topic is indicated.

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