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Original research article

Effects of aqua agar as water replacement for posthatch chicks during transportation on residual yolk-sac and growth performance of young broiler chickens

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ABSTRACT

Water is one of the most essential nutrients for the maintenance of chicks' function, and delayed access to feed and water post hatch has been reported to dehydrate chicks. Aqua agar (AA) was formulated to contain more than 95% water and an experiment was conducted to evaluate the effects of AA as water replacement for posthatch chicks during transportation. During the simulated transport, chicks were held for 24 h with (AA group) or without (NO-AA group) aqua agar in chick boxes. During the holding period, chicks in the AA group lost less body weight, compared with the NO-AA group. However, the weight of residual yolk tended to be lower in the AA-treated birds. There were no significant differences in the weight of gizzard, proventriculus, and liver, nor in the weights and lengths of the duodenum, jejunum and ileum. A higher body weight was also observed in the AA group at 7 days of age. At 21 days of age, weight gain and feed intake were higher ($P < 0.05$) in the AA group, when compared to that of the NO-AA group. No significant differences were observed in the feed conversion rate (FCR) between the two groups. In conclusion, the data suggests that the use of AA as a water replacement could reduce the negative impact of water deficiency in posthatch period during transportation, resulting in greatly improved growth performance of young broilers at 21 days of age.

1. Introduction

After hatching, environmental and nutritional conditions have extreme effects on the physiological functions of chicks, such as body temperature control, gastrointestinal tract function, yolk utilization and, in consequence, immunity response (Maiorka et al., 2006). A recent report suggested that early feeding and watering (<24 h posthatch) could improve the utilization of yolk nutrients (Bhanja et al., 2009). In the immediate posthatch period before access to feed and water is a critical point for survival and achievement of target growth of chicks. In commercial practice, posthatch birds undergo preparatory hatchery practices such as sexing, vaccination, packaging and transportation to production facilities, which involves a holding period without access to feed and water up to 24 to 36 h (Noy and Sklan, 1999). This procedure is associated with stress induced to the chicks, due to energy deficiency and dehydration. This phenomenon causes lower viability and impaired growth (Madsen et al., 2004). Noy and Sklan (1999) observed that chicks' body weight decreased by 7.8% when provided with no feed and water for 48 h after hatching, compared with birds that were provided with feed and water immediately post hatch.

Of particular importance is the fact that water is one of the most essential nutrients for the maintenance of chicks' function, including digestion, metabolism, temperature regulation, nutrient transfer and waste expulsion, as well as body fluid balance (Leeson and Summers, 2005). Furthermore, chicks can survive under feed withdrawal conditions for several days, but water deprivation for even a short time can considerably affect their hydration level. Dehydration is caused by immoderate water loss, which can

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negatively affect the chicks' physiological and metabolic status. Although concentrated nutrients are supplied to chicks during hatchery practices or transportation, it is impossible to supply water. In the current trial, aqua agar (AA) was formulated and an experiment was conducted to evaluate the effects of AA as a water replacement for posthatch chicks during holding and transportation on residual yolk-sac weight and growth performance of young broilers.

2. Materials and methods

2.1. Experimental chicks and treatments

In this experiment, AA was formulated to contain more than 95% drinking water (by weight), and agar powder. One hundred one-day-old male broiler chicks (Ross 308) were obtained from Pasang Hatchery under Charoen Pokphand Foods PCL., located in Lamphun, Thailand. After hatch, chicks were removed from the hatcher, evaluated for general health, feather sexed, and vaccinated (approximately 1 ± 1 h). All birds were separated into two treatment groups with 50 birds per group. All birds were tibia tagged and individually weighed. During the simulated transportation, the chicks were held in chick boxes for 24 h with (AA group) or without (NO-AA group) aqua agar. Treated chicks were provided with 20 g per bird of AA by sprinkling the product in the chick boxes. Transportation conducted under commercial conditions, using a van with air conditioning set at 28 to 30°C and 36 to 38% relative humidity. During the holding period, each bird was individually weighed at 6, 12, 18 and 24 h posthatch. Five birds from each group were then selected randomly and killed by neck cutting, to measure the weights of residual yolk-sac and visceral organs, as well as the intestinal weight and length. Euthanasia was done by trained researcher under Naresuan university animal care and use committee. All procedures were performed by the same person to ensure consistency. The weights of organs and intestine were expressed as a percentage of the live body weight. The remaining birds in each group were placed with feed and water ad libitum in production facilities at Naresuan University, Phisanulok. Commercial starter ration with 3,100 kcal/kg ME and 20.0% CP was used. Body weight and feed intake were measured weekly through to 21 days of age.

2.2. Statistical analyses

All collected data were statistically analysed using one-way analysis of variance (ANOVA) in SPSS statistical software package. The Student *T*-test was applied to compare the means, and differences were considered significant at $P < 0.05$.

3. Results and discussion

The effects of AA as a water replacement on body weight, residual yolk weight, and visceral organ weights, as well as on the intestinal weight and length of posthatch chicks are presented in Table 1. During the 24-h simulated transportation period, body weight tended to decrease in both experimental groups, but chicks in the AA group showed a higher body weight when compared with the NO-AA group. This indicates that immediate provision of water in the form of AA during simulated transportation could reduce the weight loss of posthatch chicks. Body weight loss appears to be the consequence of dehydration and yolk utilization (Noy and Sklan, 1999; Vieira and Moran, 1999; Careghi et al., 2005). However, residual yolk weight tended to be lower in the AA-treated birds. Physiologically, the yolk sac is the main source of crucial nutrients (Yadgary et al., 2010), available energy (Speake et al., 1998) and maternal immunity (Ulmer-Franco et al., 2012) for young birds during the hatching interval and the early posthatch days. Noy and Sklan (2001) found that yolk content transition through the embryonic intestine could be promoted by higher intestinal movements. According to the findings of Noy and Sklan (1998), intestinal peristalsis is related to yolk content transportation, resulting in an increased amount of yolk in the proximal intestine after the hatching stage. The decreased yolk sac weight from current study might be associated with a change in peristaltic function, in order to absorb the water from AA. There were no significant differences in the relative weights of gizzard, proventriculus, and liver, nor in the weights and lengths of the duodenum, jejunum and ileum (Table 1).

Table 1
Effects of the use of aqua agar (AA) as water replacement on body weight, residual yolk weight, and visceral organ weight, as well as the intestinal weight and length of posthatch chicks (mean ± SD).

Item	NO-AA group	AA group	*P*-value
Body weight, g			
Post 0 h	44.22 ± 0.62	44.17 ± 0.58	0.983
Post 6 h	42.60 ± 3.14	44.10 ± 3.08	0.295
Post 12 h	41.57 ± 2.94	42.97 ± 3.07	0.942
Post 18 h	41.44 ± 2.92	42.37 ± 3.03	0.761
Post 24 h	41.03 ± 2.87	41.52 ± 3.24	0.962
Residual yolk-sac weight, %	4.62 ± 0.73	3.71 ± 0.26	0.712
Visceral organ weight, %			
Gizzard	6.82 ± 0.41	6.35 ± 0.98	0.082
Proventiculus	1.06 ± 0.11	1.07 ± 0.19	0.172
Liver	2.74 ± 0.50	2.89 ± 0.48	0.881
Intestinal weight, %			
Duodenum	1.05 ± 0.09	1.23 ± 0.25	0.155
Jejunum	1.43 ± 0.24	1.69 ± 0.44	0.386
Ileum	1.13 ± 0.15	1.49 ± 0.55	0.06
Intestinal length, %			
Duodenum	19.08 ± 2.13	20.51 ± 3.27	0.616
Jejunum	41.14 ± 6.08	38.07 ± 10.55	0.103
Ileum	33.73 ± 4.20	32.58 ± 3.11	0.103

The body weight up to 7 days of age increased in both groups, but a numerically higher body weight was observed in the AA group at 7 days of age (Fig. 1). The data agrees with the study of Fairchild et al. (2006), who reported that the chicks provided with water showed a greater body weight compared with the birds without water provision. The effects of AA as a water replacement on the growth performance of young broilers at 21 days of age are shown in Table 2. Compared with the NO-AA group, weight gain and feed intake were higher ($P < 0.05$) in the AA group. However, no

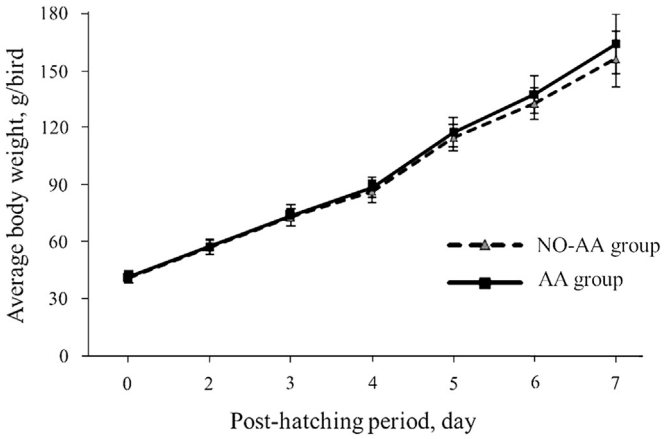

Fig. 1. Effects of the use of aqua agar (AA) as water replacement on relative body weight during 1 to 7 days of age (mean ± SD).

Table 2
Effect of use of aqua agar (AA) as water replacement on growth performance of young broilers at 21 days old (mean ± SD).

Parameters	NO-AA group	AA group	*P*-value
Body weight, g	670.16 ± 45.51[b]	710.00 ± 20.17[a]	0.014
Feed intake, g	753.15 ± 33.61[b]	814.24 ± 10.51[a]	0.002
Feed conversion ratio	1.20 ± 0.10	1.20 ± 0.04	0.233

[a,b] Means within each treatment with different letter designations differ ($P < 0.05$).

significant differences were observed in the feed conversion rate (FCR) between the groups. During the experimental period, mortality was not observed in both groups (data not shown). The results from current study show that AA-treated chicks maintained this advantage through to 21 days of age with a higher growth performance.

4. Conclusions

The data from this study suggests that use of AA as a water replacement could reduce the negative impact of water deficiency in posthatch chicks during transportation, resulting in greatly improved growth performance in young broilers at 21 days of age.

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