Archiv Tierzucht 53 (2010) 1, 108-115, ISSN 0003-9438

Physical chick parameters and effects on growth performance in broiler

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Abstract

This study was made to compare physical chick quality indicators such as chick length and feather colour and their effects on the uniformity and subsequent growth performance in broiler. For this reason; 600 day old male chicks were used. Chicks were classified into two groups on the basis of their feather colour: deep and light yellow. Then, chicks in each group were further divided into three groups as small, middle and large according to their body length. The length of the middle group animals was varied between 18.0-18.3 cm, while that of the largest group was greater than 18.3 cm and the small group was lesser than 18.0 cm. A positive correlation between chick length and chick weight was observed in all groups at the 0 day of age. Body length uniformity in day old chick was more important than body weight uniformity. Longer chicks exhibited better growth potential throughout the experiment. The feeding efficiency and survival rate of longer chicks were numerically greater compared to smaller chicks. There were no significant differences for subsequent growth parameters in feather colour groups. Consequently; length of day old chick can be used as important criteria for selection of higher quality chicks having better growth performance.

Keywords: broiler chick, feather colour, chick length, body weight, uniformity

Zusammenfassung

Zusammenhang zwischen ausgewählten physikalischen Merkmalen und Ausgeglichenheit sowie Wachstum von Broilerkücken

Untersucht wurde der Einfluss von unterschiedlichen Körperlängen sowie Federfarben auf die Uniformität und das Wachstum von Broilerkücken. 600 Eintagskücken wurden nach ihren Federfarben hell- bzw. dunkelgelb in zwei Gruppen und nach ihrer Körperlänge in weitere drei Untergruppen (klein, mittel, groß) eingeteilt. Die Maße der drei Untergruppen betrugen für klein weniger als 18,0 cm, mittel 18,0 bis 18,3 und groß mehr als 18,3. Eine signifikant positive Beziehung bestand zwischen der Körperlänge und dem Körpergewicht. Bei den Eintagskücken war die Uniformität der Körperlänge stärker als bei den Gewichten ausgeprägt. Während der gesamten Versuchsdauer erreichten größere Kücken ein besseres Wachstum. Das traf auch für die bessere Futterverwertung und Überlebensrate zu. Bezüglich des Wachstums konnten keine signifikanten Unterschiede bei den zwei Farbgruppen nachgewiesen werden. Es wird geschlussfolgert,

dass die Körperlänge als bedeutendes Qualitätskriterium für das Wachstum von Broilerkücken gelten kann.

Schlüsselwörter: Broilerkücken, Federfarbe, Körperlänge, Uniformität, Körpergewicht

Introduction

Day-old chicks are the end product of the hatchery and important starting material for the poultry farms. A good-quality day-old chick is hence a crucial hinge between the hatchery and farm. Pre-incubation factors such as pre-storage incubation, length of egg storage and age of breeders, as well as incubation conditions, affect day-old chick quality and subsequent bird performance (MACHAL and SIMEONOVOVA 2002, PETEK and DIKMEN 2006). Moreover, it has been reported that good hatchability does not necessarily positively correlate with a high percentage of good-quality chicks and that maximal hatchability is not always linked to the highest post hatch quality and growth of the chick (DECUYPERE and BRUGGEMAN 2007).

The quality of the day-old chick has an important effect on the growth performance of the broiler (CHRISTIENSEN 2001, MEIJERHOF 2005, MENDES *et al.* 2007, WOLANSKI *et al.* 2007). Visual score, Tona or Pascar score and day-old chick weight are commonly used for measuring chick quality (DECUYPERE *et al.* 2002, TONA *et al.* 2003; TONA *et al.* 2005; MEIJERHOF 2006). However, chick quality has proven to be a difficult and subjective matter to define (BRAH *et al.* 1999, WILLEMSEN *et al.* 2008). As the Pasgar score is mainly influenced by the conditions in the hatcher, as factors as navel closure, yolk uptake and vitality have a large influence on the score, until so far, a strong positive correlation between Tona or Pascar score and broiler performance has not been demonstrated. And also, it is reported that parameters included in the assessment of chick quality and scoring system may need to be revised (TONA *et al.* 2008). Chick weight is the most widely used indicator for day-old chick quality assessment (PETER *et al.* 1997, DECUYPERE *et al.* 2002). However, recent research (JOSEPH *et al.* 2006) has shown that differences for hatch weight among treatments are largely explained by variations in residual yolk mass. In addition, measuring yolk free body mass is rather laborious and has limited practical for field evaluation. In recent times, one of the practical ways employed to measure chick development was to determine the length of the chicken. There are limited findings about the relationship chick length and their effects on growth performance of broiler. If Pascar score and chick length was compared, it can be observed a rather low correlation between Pascar score and chick length and this correlation is sometimes even negative (MEIJERHOF 2005). Most common parameter for visual score is the feather colour of the chicks. The pigment of the chick feathers comes from the yolk, and as yolk is the fuel for the development of the embryo, a good yolk uptake will probably mean a more yellow and at the same time a more developed chick. A better yolk uptake and a smaller yolk residue is an indicator of high quality chicks. Hence, more darkness yellow of feather of chicks may be an indicator of better quality of chicks (SAINO *et al.* 2008). But, actually literatures on the value of chick feather colour are very limited.

Objective definition of chick quality needs probably a combination of several factors such as day old chick weight, chick physical aspects and others, etc. (TONA *et al.* 2005).

Until now, the effects of chick length or feather colour of chick on post-hatch performance and their interactions have not been investigated in detail. In the present study, chick length and feather colour parameters were compared in day old chicks in order to be able to select suitable broiler for the future.

Material and methods

The experimental procedures employed in this study were in accordance with the principles and guidelines set out by the Committee of Faculty of Veterinary Medicine on Animal Care. 600 day-old male broiler chicks (Ross PM3) were assessed for physical qualities based on chick length and feather colour.

Management

Chicks were classified into two groups according to feather colour as deep or light yellow (light until 2; deep greater than 2). Then, chicks in each group were further divided into three groups as middle, medium and large. Feather colour (FC) of chicks was determined by using the DSM colour fan (ANONYMOUS 2004). Chick length (CL) was taken by measuring the length of stretched chick from the tip of the beak to the middle toe using a ruler and recorded in cm. The middle group contained chicks with a length between 18.0-18.3 cm, the largest group greater than 18.3 cm and the small group less than 18.0 cm. Then, chicks were weighed individually. Chicks in each group were randomized into four replicates at hatch and they were reared under the standard growing conditions in a deep-litter house with tunnel ventilation. All chicks were brooded and reared at 30 °C from hatch to 7 d of age, 28 °C from 8 to 14 d of age, 26 °C from 15 to 21 d of age, and 21-24 °C from 22 to 35 days of age. Standard commercial broiler feed were used during the treatment (220 g/kg protein and 3 000 kcal/kg metabolize energy from 1 to 14 d of age, 200 g/kg protein and 3 050 kcal/kg metabolize energy from 15 to 28 d of age, 180 g/kg protein and 3 100 kcal/kg metabolize energy from 28 to 35 d of age). All birds had *ad libitum* access to feed and water. Continuous (24 h) lighting was used throughout the growth period.

Data

Individual body weights (BW) were measured at day-old age. Day-old uniformity and BW:CL ratio calculated in each group. BW and CL uniformity were calculated according to percentage of bird's falls within 10 % of the average flock weight and 3 % of the average chick length per flock (BOERJAN 2004). Subsequent end-of growth period body weights of chicks (35 days of age) were measured, and cumulative feed conversation (g of feed intake per g of body weight gain) was calculated. Mortality was recorded on a per group basis. Production index was calculated according to the methods described by AHMADI *et al.* (2007) as final body weight (kg) · % survival rate · 10 / period in days · feed conversion.

Statistical analysis

The data were analyzed by ANOVA with three levels of chick length as small, medium, large and two levels of chick colour as deep or light yellow (SNEDECOR and COCHRAN 1989). Mean separation was performed using the Duncan test. All tests were performed

in SPSS computer software 13.00 (SPSS INC 2004). The chick quality and feather colour were the main effects.

Results

Physical traits of chicks are presented in Table 1. Average feather colour score in small, middle and large length chicks were as 2.38, 2.39 and 2.36, respectively. Moreover, this value was 1.68 and 3.08 in light and deep yellow groups, respectively.

Table 1
Physical traits of day-old chicks in the experiment
Physikalische Merkmale der Eintagsküken und Merkmalsbeziehungen

Groups	CL, mm	BW, g	BW : CL	Uniformity, %		r
				BW	CL	BW · CL
Chick length						
Small	172.8 ± 0.3[c]	47.31 ± 0.27[c]	2.74 ± 0.15	86.19	85.71[c]	0.304**
Middle	181.6 ± 0.4[b]	49.15 ± 0.40[b]	2.70 ± 0.18	91.90	100.00[a]	0.174*
Large	187.2 ± 0.4[a]	50.71 ± 0.44[a]	2.71 ± 0.17	92.38	96.66[b]	0.245**
Significance	0.001	0.001	0.293	ns	0.001	
Chick colour						
Light yellow	180.7 ± 0.2	49.04 ± 0.25	2.71 ± 0.13	89.16	94.12	0.346***
Deep yellow	180.4 ± 0.4	49.07 ± 0.35	2.72 ± 0.12	91.16	94.15	0.484***
Significance	0.475	0.915	0.956	ns	ns	

CL chick length, BW body weight, r correlation coefficient, [a,b,c] Values with different superscript differ significantly at *P<0.05, **P<0.01, ***P<0.001.

Table 2
Effects of chick length and colour on end-of growth period parameters of broiler
Effekte von Körperlänge und Federfarbe der Kücken auf Wachstumsmerkmale

Groups	Body weight, g	Feed conversation ratio	Survival rate, %	Production index
Chick length				
Small	2 227.46 ± 14.83[b]	1.67 ± 0.03	95.63 ± 1.69	36.5
Middle	2 347.10 ± 14.87[a]	1.64 ± 0.03	94.38 ± 1.68	38.6
Large	2 352.89 ± 14.54[a]	1.60 ± 0.02	96.88 ± 1.68	40.7
Significance	0.001	0.312	0.584	
Chick colour				
Light yellow	2 324.16 ± 12.10	1.61 ± 0.03	95.00 ± 1.38	39.2
Deep yellow	2 294.15 ± 11.93	1.66 ± 0.02	96.25 ± 1.37	38.0
Significance	0.079	0.264	0.527	
Chick length · chick colour				
Light yellow–Small	2 272.37 ± 21.32	1.62 ± 0.05	92.50 ± 2.38	37.1
Light yellow– Middle	2 362.44 ± 21.04	1.62 ± 0.03	95.00 ± 2.38	39.6
Light yellow- Large	2 337.22 ± 20.50	1.60 ± 0.04	97.50 ± 2.40	40.7
Deep yellow-Small	2 182.15 ± 20.63	1.73 ± 0.03	98.75 ± 2.38	35.6
Deep yellow-Middle	2 331.73 ± 21.04	1.66 ± 0.04	93.75 ± 2.40	37.6
Deep yellow-Large	2 368.55 ± 20.63	1.60 ± 0.05	96.25 ± 2.38	40.7
Significance	0.014	0.466	0.218	

[a,b,c] Values with different superscript differ significantly at *P<0.05, **P<0.01, ***P<0.001.

The BW of day-old chicks in small, middle and large length groups were significantly different ($P<0.001$). Feather colour had no significant effect on BW in day-old age. Among the groups there was also no significant difference for BW:CL ratio. Similarly, except the body weight uniformity in length groups, there was no difference for the uniformity among the groups. Chicks in each length and feather colour groups exhibited excellent uniformity and there was a positive correlation between body weight and length in all groups ($P<0.05$, $P<0.01$).

End-of growth period parameters in the groups are presented in Table 2.

Although, the final BW parameter exhibited significant difference for chick length groups ($P<0.001$), there was no difference between deep and light yellow feather colour groups. Among the groups there were also no significant differences for feed conversion ratio and survival rate. Production index in large and light yellow groups was found highest.

Discussion

In this experiment, significant difference was observed for the day-old body weight in CL groups. Hatch weight in small group was found to be significantly lower than the longer groups ($P<0.001$). Chick weights at hatch were, on average 3.4 g higher in the large group compared with the small chick length group. The body weight is the most widely used parameter for assessing day-old-chick quality. But the differences observed in hatch weight may have been mainly influenced by initial egg weight (SILVERSIDES and SCOTT 2001, BOERJAN 2002, DECUYPERE *et al.* 2002, TONA *et al.* 2004). Although reports are conflicting about the relationship between day-old chick weight and broiler performance (VIERA and MORAN 1999, TONA *et al.* 2003), it is agreed that chick weights may be related to slaughter performance. Body weight at 1 d and 7 d of age had the most important predictive value of BW at slaughter age among all the quality measurements performed, closely followed by the ratio between BW at 1 d of age and chick length (WILLEMSEN *et al.* 2008). BW:CL ratio in the length groups was not different and there were no significant effects of feather colour on day-old BW and CL. In this study, all groups have excellent on hatch day BW and CL uniformity (Table 1). In middle group, CL uniformity was 100%. Current industry standards dictate that to achieve good uniformity, 80-85% of birds must fall within 10% of the average flock weight and 3% of the average chick length per flock (BOERJAN 2004). The more the chicks are uniform when they hatch, the greater their chances of achieving their full genetic potential as greater body weight gain and the lowest possible mortality and feed conversion. At hatching period, the uniformity of CL was more important compared to BW. For that reason, and as reported by HILL (2001) and WOLANSKI *et al.* (2006) chick length might be much more important for acquiring the greatest uniformity and predicting growth performance. Moreover, correlation coefficiency between the day-old body weight and length in all groups are positively significant ($P<0.05$, $P<0.01$). This finding concurrent with the findings of DECUYPERE and BRUGGEMAN (2007) who reported that there was a weak but significant correlation ($r=0.20$) between chick length at hatch and BW at 6 week of age, indicating that chick length could be a tool for predicting chick growth potential.

In this study, the mean final body weight of chicks from large length group was significantly higher than the other groups. Similarly, middle chicks group birds showed higher mean body weight value than those of belonging to small length. These results were found similar to the finding of MOLENEAR *et al.* (2007) who reported that a positive correlation between chick length at day 0 and chick weight at day 7. And also, these results are concurrent with the findings of MSOFFE *et al.* (2001) who reported a positive correlation between day old body length and adult body weight and with those of HILL (2001) who showed embryo development can be expressed in terms of embryo length. In agreement to these researchers, TONA (2003) reported a positive correlation between day old chick quality and relative growth up to 7 days as well as slaughter performance. The negative effect of small chick length on broiler growth is in accordance with the observations with MEIJERHOF (2006). As shown in Table 2, the feed conversion values do not show significant differences between the groups. The birds in large length group show a lower feed intake per kg body weight gain, numerically. And also, no significant differences in survival rate were determined between the groups. Production index of larger groups were found greater than smaller groups. In this study, no significant differences for the body weight of the chicks having deep or light yellow feathers during the experiment were observed. As for body weight, differences for the feed conversion ratio and survival rate in deep and light feather colour groups were found insignificant. This might be linked to formaldehyde used in the hatchery. Because, formaldehyde is used for obtaining yellow coloured chicks, but it would not lead to a better-developed chick.

As a conclusion; the positive effect of day old chick length and its influence on chick quality and broiler growth was evaluated. There is highly positive relationship between body weight and chick length suggesting that the use of chick length measurement of day-old chick can be used to make prediction on the chick quality. And also, chick length uniformity in each group was found greater than body weight uniformity. Therefore, the longer chick would have better uniformity and might have better developed organs. It may be concluded that chicks having larger length and deep yellow colour are preferred because they provide optimal growth performance without any problems. Also, utilization of visual score parameters such as navel quality, firmness of legs, the size of beak, eyes, vital and alert chicks etc. together with chick length may be recommended as a suitable way for determining highest quality chicks.

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Received 14 November 2008, accepted 18 November 2009.

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