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Period of Incubation and Posthatching Holding Time Influence on Broiler Performance

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ABSTRACT

The present study had the objective of investigating the performance of broilers housed immediately after hatching or after a 12 or 24 hour of post-hatching holding time. One thousand and six hundred male Ross 308 broiler chicks with an initial body weight of 46 grams were used. These chicks were distributed in a completely randomized experimental design with 5 treatments and 8 replications of 35 birds in each treatment. The treatments in this study consisted of the removal of chicks from the hatchery in three different times: after 480, 492 and 504 hours of incubation. In each one of these times, 280 chicks were removed from the hatchery and immediately housed. Another group of an identical number of chicks of each time remained in the hatchery to be housed at 504 hours after hatching. The chick group corresponding to those hatched at 480 and 492 hours performed better until 7 days. However, no differences in body weight or body weight gain were observed at the end of the study. Feed efficiency, however was worse for the birds hatched and placed at 480 hours. There were no differences among treatments for mortality.

INTRODUCTION

Broiler chicks hatch during a time interval of 480 to 510 hours (Vieira & Pophal, 2000). Therefore, a group of "day-old chicks" usually include birds with different ages. Factors, such as breeder age, time and temperature of fertile egg storage, incubation temperature, egg weight, season, and type of bird, influence total incubation time (Wilson, 1991).

Commercial hatcheries used incubation times of approximately 504 hours, which are considered optimal for the complete hatching of the incubated eggs. In this context, birds that hatch early remain for several hours without food or water before they are removed from the hatcher. However, this practice takes into consideration mainly the convenience of procedures inside commercial hatcheries. Halevy *et al.* (2000) showed that post-hatching fasting impairs weight gain and breast muscle deposition capacity. Also, the longer chicks remain in the hatcher after hatching, the worse is their performance (Fanguy *et al.*, 1980). In this sense, Wyatt *et al.* (1985) observed that chicks that remained in hatching trays between 14 to 32 hours weighed 5 to 32% less as compared up to 7 hours, in average, after hatching. Nir & Levanon (1993) and Sklan *et al.* (2000) found lower losses, between 5 and 15%, and body weight reduction continued up to slaughter.

Hager & Beane (1983) and Baião & Cançado (1998) carried out experiments to evaluate the effects of maintaining chicks in the hatching chambers. Birds were removed from the hatcher after incubation periods between 486 and 522 hours. The first authors observed negative effects on the performance only in birds removed from the hatcher at 522

hours, and the latter did not find statistical differences on the live performance of broilers. On the other hand, Castell *et al.* (1994) found that the permanence of chicks in the hatcher for 24 hours after hatching improved weight gain at 21 days of age, but did not affect performance at 43 days. Contradictory results were found by Noy & Sklan (1999), who compared the performance of birds fed immediately after hatching with the performance of birds fed 34 hours later. These authors verified better performance for birds fed immediately after hatching; however, this better performance was only observed until birds were 21 days old. According to Newey *et al.* (1970), fasting after hatching lowers the capacity of the intestine to absorb amino acids and other nutrients when feed is supplied.

The period immediately after hatching is critical for the development of the immune and and gastrointestinal systems. During the first days of the bird's life, the small intestine grows five times faster than the body, and microvilli of the small intestine grow significantly faster in birds supplied with water and feed immediately after hatching (Dibner *et al.*, 1998).

Bird performance during the first week of life has high correlation with its performance at market age (Nitsan, 1995). Therefore, all factors causing lower initial weight also tend to affect weight at market age.

This study aimed at evaluating the live performance of broiler chicks housed immediately after hatching at 480, 492, and 504 hours of incubation or after 504 hours in the hatcher.

MATERIAL AND METHODS

The present experiment was carried out at the Experimental Station of the Federal University of Rio Grande do Sul, located in Eldorado do Sul, RS, Brazil. A total number of 1,600 male Ross 308 broiler chicks, derived from 45-week-old breeders, were used. Chicks were weighed and distributed in pens in an experimental poultry house, using wood shavings as litter. The eggs, from which the broilers used in this experiment derived, were obtained in the same farm, and were laid on the same day. Eggs were incubated in a commercial hatchery in multiple-stage incubator.

Times for the removal of chicks from the hatcher were established to house the chicks at 480, 492, and 504 h. Therefore, chicks that completely hatched at 480 h were removed, than those that hatched between 480 and 492 h, and between 492 and 504 h. AT each removal time, chicks were immediately housed in the experimental facilities, and a second group consisting of birds hatched at the same time remained in the hatcher to be removed together with those housed at 504 h. the treatments consisted, therefore, of bords hatched and housed as follows: **T1**: (480-480) – removed from the hatcher and housed at 480 h; **T2**: (492-492) – removed from the hatcher and housed at 492 h; **T3**: (504-504) - removed from the hatcher and housed at 504 h; **T4**: (480-504) – hatched at 480 h and removed for housing at 504 h; **T5**: (492-504) – hatched at 492 h and removed for housing at 504 h.

Birds included in each hatching period were those which accumulated hatching until that determined number of hours of incubation. For statistical analysis purposes, "say one" was considered as the day of treatments "housed at 504 h of incubation. During the period of 1 to 41 days of age, birds were submitted to the traditional broiler management, and were fed with the same diets based on corn and soybean meal commonly used in this sector. Light regime was continuous, that is, 24 hours of continuous light. Water was supplied *ad libitum* since the birds were housed in the experimental farm. Birds were weighed at housing, and at 7, 14, 21, 28, 35, and 41 days of age, when feed intake, average weight gain, feed conversion ratio, and mortality rate. A completely randomized experimental design was used, consisting of five treatments with 8 replicates of 35 birds each.

Results were submitted to analysis of variance, and differences among means were submitted to the test of Tukey ($p < 0.05$).

RESULTS AND DISCUSSION

Performance results are presented in Tables 1, 2, 3, 4, and 5. Table 1 showed that birds that remained for periods of 24 and 12 hours in the hatcher after hatching (480-504 and 492-504) lost 12.4 and 8.33 % of body weight as compared to those removed at the same moment or immediately housed (480-480 and 492-492). According to Pinchasov (1991), it is expected that birds loose weight during the first 24 hours after hatching, even if having free access to feed and water. This loss is associated to negative effects on subsequent performance (Hager & Beane, 1983, Halevy *et at.* 2000). The first week of the chick's life present a series of peculiarities that indicate that it is critical for its future performance.

Due to the continuous pressure of genetic selection on muscle mass gain, the expected slaughter age has increasingly been reduced, and consequently the first days of the chick's life represent a increasing proportion

of the total production time (Vieira & Moran, 1999). This evolution resulted in an increase in the proportion of the first week from 8 to 17% in the broiler's life (Gyles, 1989). During this stage, broilers present different digestive system anatomy and physiology, limiting nutritional requirements due to the difficulty to digest and to absorb nutrients, fast potential growth, and difficulty in ensuring survival in cold environments, as they require very hot environments to properly develop their potential (Penz & Vieira, 1998).

The results of the present study show better performance in terms of live weight and average and weight gain at 7 days of age for chicks removed from the hatcher at 480 and 492 h (Tables 1 and 2). These birds had higher weight gain, which negatively influenced feed conversion ratio (Tables 3 and 4). This negative performance continued for the complete experimental period only for birds housed at 480 hours.

The worse feed efficiency found in birds house early (480 hours) is not supported by literature. Published studies report higher intake for these birds, as well as higher weight gain, therefore, with no effect on feed conversion ratio, as well as no difference in these parameters.

Studies considering hatching day as "day one" usually report increasing feed intake as the interval between hatching and housing decrease. This is due to the fact that these birds, as they were housed earlier, had higher intake time as compared to birds housed after 24, 48, or more hours after hatching. This higher feed intake usually continues throughout the bird's life, not affecting feed conversion ratio as this increase is accompanied by higher weight gain (Wyatt *et al.*, 1985; Pinchasov & Noy, 1993; Corless & Sell, 1999; Almeida, 2002; Gonzales *et al.*, 2003; Pedroso *et al.*, 2005). Other authors, such as Nir & Levanon (1993), Baião *et al.* (1998), and Vieira & Moran (1999), did not find feed intake and feed conversion ratio differences during any stage of the broiler's life.

As to live weight and average weight gain, responses decreased after the first week of life until no differences were found for the total experimental period. These results are intriguing and difficult to explain, as they are opposite to a physiological profile of the birds that presented better performance during the first week. Noy & Sklan (1999) found better performance in birds fed immediately after hatching as compared to those fed 34 hours later. Wyatt *et al.* (1986) observed superior performance during the entire experimental period for birds with a 12-hour interval between hatching and housing. According to Dibner (1998), one of the causes of this is an increase in the gastrointestinal surface area stimulated by early feeding. However, literature presents conflicting results as to this matter. Castell *et al.* (1994) and Cançado (1999) verified that the permanence of chicks for 24 hours in the hatcher after hatching was beneficial to performance up to 21 days of age.

Apparently, the conflict among these results may be related to the methodologies used to evaluate the results. Some studies consider the day the chicks are housed in the farm as their first day of life, regardless the interval between hatching and housing. Other studies, effective hatching time is considered as the first day of life. Chicks that have early access to water and feed have a competitive advantage as compared to birds that hatched later or took longer to be housed. In the present study, birds in treatment 1 (480-480) hatched and were housed 24 hours before birds in treatment 3 (504-504) and 12 hours before birds in treatment 2 (492-492). This longer period of intake is indubitably a competitive advantage. Therefore, at the time of first weighing, chicks had effectively 8 and 7.5 days of age, whereas treatment 3 birds had 7 days of age. This advantage was subject of interest in the present study as this could be translated in better performance.

It was also possible to observe that performance decreased as birds remained longer in the hatcher after hatching. These results were observed already at housing, with birds that remained for 12 and 24 hours in the hatcher for later housing (492-504 and 480-504) presently statistically worse performance as compared to the other treatments. This continued up to 21 days; however, no significant differences were found at 41 days.

The supply of feed and water immediately after hatching is beneficial for the development of the gastrointestinal tract (Nir, 1998). The gastrointestinal tract is immature at hatching, and feed intake is needed before intestine relative size and pancreatic enzyme production limit growth rates (Nir, 1998). It is during this phase that the relative growth rate is highest (Bjornhag, 1979), with an approximate four-fold increase of the housing weight at the end of the first week. After hatching, the gastrointestinal tract presents preferential growth relative to body muscle, and this growth occurs regardless the presence of feed or not, as yolk sac reserves are used for this purpose. The composition of the yolk sac is more favorable to cell membrane synthesis and maintenance of passive immunity than to the energy requirements. Therefore,

Table 1 - Weight of broiler chicks housed immediately after hatching with different incubation periods or after 12 and 24 hours of permanence in the hatcher*, g.

	Day						
	1	**7**	**14**	**21**	**28**	**35**	**41**
Significance	0.0001	0.0001	0.0910	0.0098	0.0579	0.9813	0.5823
**T1: 480-480	46.36^{a}	189^{a}	463	893^{ab}	1432	2122	2712
T2: 492-492	46.71^{a}	187^{a}	476	916^{a}	1485	2123	2699
T3: 504-504	45.89^{a}	177^{b}	465	894^{ab}	1471	2115	2722
T4: 480-504	40.61^{c}	175^{b}	458	883^{b}	1434	2114	2718
T5: 492-504	42.82^{b}	180^{b}	471	887^{ab}	1458	2107	2689
CV, %	5.66	3.73	2.99	2.32	3.00	2.54	2.58

*Means followed by the same letter in the columns are not statistically different by the test of Tukey at 5% probability level: C.V: coefficient of variation. **Number of hours of incubation at hatching followed by the number of hours at housing.

Table 2 - Weight gain of broiler chicks housed immediately after hatching with different incubation periods or after 12 and 24 hours of permanence in the hatcher*, g.

	1-7	**7-14**	**14-21**	**1-21**	**21-28**	**28-35**	**35-41**	**1-41**
Significance	0.0016	0.0771	0.0671	0.0642	0.1988	0.1054	0.0538	0.4890
T1: 480-480	143^{a}	275	429	847	540	690	589	2666
T2: 492-492	140^{a}	289	440	869	569	638	576	2652
T3: 504-504	131^{b}	288	429	848	577	645	607	2677
T4: 480-504	134^{b}	283	425	843	551	680	604	2678
T5: 492-504	137^{b}	291	416	845	570	650	582	2647
CV, %	3.75	4.30	3.92	2.35	6.32	7.24	7.26	2.65

*Means followed by the same letter in the columns are not statistically different by the test of Tukey at 5% probability level: C.V: coefficient of variation.

Table 3 - Feed intake of broiler chicks housed immediately after hatching with different incubation periods or after 12 and 24 hours of permanence in the hatcher*, g.

	1-7	7-14	**14-21**	**1-21**	**21-28**	**28-35**	**35-41**	**1-41**
Significance	0.0001	0.0001	0.0032	0.0001	0.0032	0.0075	0.0737	0.0001
T1: 480-480	203^{a}	412^{a}	676^{a}	1291^{a}	1011^{a}	1301^{a}	1316	4919^{a}
T2: 492-492	188^{b}	400^{b}	634^{abc}	1222^{b}	961^{abc}	1180^{abc}	1261	4624^{b}
T3: 504-504	149^{c}	373^{d}	631^{abc}	1153^{c}	943^{b}	1151^{b}	1347	4595^{b}
T4: 480-504	150^{c}	374^{d}	613^{b}	1137^{c}	921^{b}	1217^{abc}	1337	4612^{b}
T5: 492-504	151^{c}	386^{c}	613^{b}	1150^{c}	930^{b}	1200^{abc}	1302	4582^{b}
CV, %	13.97	4.32	6.22	5.87	7.05	7.54	7.07	4.78

*Means followed by the same letter in the columns are not statistically different by the test of Tukey at 5% probability level: C.V: coefficient of variation.

Table 4 - Feed conversion ratio of broiler chicks housed immediately after hatching with different incubation periods or after 12 and 24 hours of permanence in the hatcher*, g/g.

	1-7	**7-14**	**14-21**	**1-21**	**21-28**	**28-35**	**35-41**	**1-41**
Significance	0.0001	0.0001	0.0025	0.0001	0.0010	0.0325	0.1252	0.0001
T1: 480-480	1.42^{a}	1.51^{a}	1.58^{a}	1.50^{a}	1.87^{a}	1.88^{a}	2.23	1.87^{a}
T2: 492-492	1.35^{b}	1.39^{b}	1.45^{b}	1.40^{b}	1.70^{ab}	1.85^{ab}	2.20	1.78^{b}
T3: 504-504	1.13^{c}	1.29^{c}	1.47^{b}	1.36^{b}	1.64^{b}	1.79^{b}	2.22	1.75^{b}
T4: 480-504	1.11^{c}	1.32^{c}	1.44^{b}	1.35^{b}	1.67^{b}	1.79^{b}	2.22	1.76^{b}
T5: 492-504	1.10^{c}	1.33^{c}	1.47^{b}	1.36^{b}	1.63^{b}	1.85^{ab}	2.24	1.77^{b}
CV, %	12.41	6.99	5.52	6.78	6.58	6.33	6.15	5.64

*Means followed by the same letter in the columns are not statistically different by the test of Tukey at 5% probability level: C.V: coefficient of variation.

Table 5 - Mortality of broiler chicks housed immediately after hatching with different incubation periods or after 12 and 24 hours of permanence in the hatcher*, g*, %.

	1-7	**7-14**	**14-21**	**1-21**	**21-28**	**28-35**	**35-41**	**1-41**
Significance	0.7142	0.6139	0.3338	0.8995	0.5354	0.1896	0.1427	0.6553
T1: 480-480	0.36	0.36	0.71	1.43	1.07	1.43	1.43	5.35
T2: 492-492	0.71	1.07	-	1.78	1.78	0.36	0.36	4.28
T3: 504-504	0.36	0.36	1.07	1.79	0.36	-	1.07	3.22
T4: 480-504	-	1.43	-	1.43	0.36	1.43	0.36	3.58
T5: 492-504	0.36	0.39	-	0.75	1.07	0.71	2.14	4.67
CV, %	267.95	234.44	370.72	156.49	201.80	164.44	130.44	71.81

*Means followed by the same letter in the columns are not statistically different by the test of Tukey at 5% probability level: C.V: coefficient of variation. Statistical analysis after transformation of data in arcosine, but table presents raw means.

it should be preserved for that purpose (Dibner *et al*. 1998).

In the present study, the estimated worse performance for birds fasted for 12 and 24 hours in hatcher was not confirmed. According to Handy *et al*. (1991), birds that remained for more than 12 h inside the hatcher after hatching are already subjected to stressing processes, due to the higher heat production and the excessive temperature in the hatcher. The birds respond with higher physiological release of corticosterone, which is already high in birds due to the normal hatching process. The permanence of high levels of this hormone reduced yolk sac absorption rate, leading to yolk sac malabsorption conditions. Under these circumstances, there is also high secretion of the hormone ACTH, which reduces bursal and spleen weights and blood protein levels, and increasing glycemia. These lead to decreased immunity and lower lung expansion post-hatch due to a lower production of surfactants. The result of all this can be observed from the second and third day of age, causing culling (Gustin, 2003).

Mortality data can be observed in Table 5. There was no statistical difference among treatments. These results are not consistent with the data of Vieira & Moran (1999), who showed that 24-hour delays in housing increased total mortality. However, it must be noted that this fasting period was measured in chicks that were outside the hatcher. Our findings on mortality agree with Almeida (2002), who did not find mortality differences at 21 days in birds housed after 48 hours fasting after removal from the hatcher.

CONCLUSIONS

1. Birds removed from the hatcher at 480 and 492 hours of incubation and immediately housed were heavier at 1 and 7 days of age. However, this superior performance was not after these ages;
2. Birds removed from the hatcher at 480 hours of incubation presented higher feed intake, which was not accompanied by higher weight gain, resulting in worse feed conversion ratio for the complete experimental period;
3. No differences in mortality were observed among treatments.
4. The results of the present study suggest that there is no advantage, in terms of performance, in removing birds from the hatcher for subsequent housing.

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