International Journal of Poultry Science 13 (2): 97-101, 2014
ISSN 1682-8356

Effect of Bac-D™ on Hatchability, Conductance, Growth Rate and Feed Conversion on Turkey Poults

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Abstract: The major factor facing the commercial poultry industry today is the cost of feed. Breeding companies have put great emphasis on selecting their lines for rapid growth and low feed to gain to increase the efficiency of production. Even though genetics have made drastic differences in growth parameters, evident from the last 45 years of genetic selection, producers still employ other methods to help birds perform more efficiently including; feed additives, temperature control, incubation, ventilation, hatchery sanitation and egg disinfection. Bac-D™ is a novel disinfectant, which is currently being used as a wound wash for humans and animals. The product utilizes benzalkonium chloride, a well-studied quaternary ammonium compound, which has been generally regarded as safe (GRAS). Bac-D™ has been effectively used as a human first aid antiseptic for many years. The objectives of this trial were to determine the effects of Bac-D™ on egg conductance, hatchability, body weight and feed conversion (FC) in turkey eggs and poults. Turkey eggs were washed with Bac-D™ then incubated under standard conditions while recording egg conductance and hatchability. Body weights were measured at hatch, 21d and 42d. The results showed that egg conductance, hatchability, or body weights of chicks hatched from Bac-D™ washed eggs did not differ significantly from water washed controls. However, mean feed conversion was significantly lower ($p<0.0062$) in Bac-D™ poults (FCR = 1.10) compared with the control birds (FCR = 1.17) at 21d. The improvement in FCR may be due to reduced levels of slightly pathogenic bacteria in the gut resulting from the Bac-D™ egg sanitization. The potential reduction in FCR will be of significant economic impact to poultry producers.

Key words: Bac-D™, poults, feed conversion, hatchability, benzalkonium chloride

INTRODUCTION

The main goal of the commercial poultry industry is to produce the largest bird on the smallest amount of feed. To do this companies have put great emphasis on selecting their lines for rapid growth rate while also selecting for feed conversion. This genetic progress has been demonstrated by Havenstein *et al.* (1994, 2003). Where the current commercial broiler was compared to a random breeding meat line that is representative of the broiler lines of 1957. From these studies the dramatic effects of over 45 years of genetic selection is very evident, 1957-2003. Even though genetics have made such a drastic difference in growth parameters, there are still other methods that producers employ to help the birds perform even more efficiently. Feed additives, temperature control, incubation, ventilation, hatchery sanitation, egg disinfection.

There are many methods that have been employed by producers to reduce bacteria on eggs including: ethylene oxide (Lorenz *et al.*, 1950), hydrogen peroxide (Sheldon *et al.*, 1990), quaternary ammonium sanitizers (Brake and Sheldon, 1989), antibiotics (Miller, 1956), UV light exposure (Coufal *et al.*, 2003) and heat treatment (Funk *et al.*, 1954). Many of these disinfectant methods are very effective at reducing bacterial counts; however, they also can have detrimental effects on the developing embryo due to the fact that some sanitizers may remove the cuticle of the egg, a protective thin layer that seals the egg, which allows for increase in loss of moisture from the egg, which directly affects the embryo by interfering with respiration (Peebles and Brake, 1985).

Formaldehyde fumigation has been the most commonly used method for egg sanitation in the industry (Coufal *et al.*, 2003). The main issues then industry face with formaldehyde is inhalation of the vapors by workers (Walker, 1944) as well as its carcinogenic properties and decrease in hatchability (Fasenko *et al.*, 2009). Since there are many drawbacks associated with formaldehyde use, there has been much effort aimed at finding alternative approaches to the use of formaldehyde (Brake and Sheldon, 1989).

The effect the product has on hatchability is a major consideration that hatchery managers must consider when searching for alternative hatching egg sanitizers. Coufal *et al.* (2003) explored the use of UV light as a disinfectant method. Ultra violet light was shown to yield the same hatchability results when compared to untreated eggs (Coufal *et al.*, 2003). Broiler eggs

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exposed to ozonated water for 30 min resulted in reduced hatchability rates, while eggs exposed to triple strength formaldehyde remained unaffected (Whistler and Sheldon, 1988). Eggs washed with electrolyzed water showed very little difference between the treatment and control groups (Fasenko *et al.*, 2009).

Bac-D™ is a novel disinfectant, which is currently being used as a wound wash for humans and animals. Bac-D™ utilizes a well-studied quaternary ammonium compound benzalkonium chloride. Benzalkonium chloride which has commonly been recognized as safe and has been effectively used as a first aid antiseptic developed for humans for many years (Dyer *et al.*, 1998; Gerald *et al.*, 2011). Recently, researchers have begun to study the effects of different benzalkonium chloride compounds on hatching eggs (Aygun and Sert, 2012a, b). There is still a great amount of investigation needed in order to determine the specific biocidal effects of Bac-D™ on different bacteria and viruses in order that the killing potential may be maximized. The mode of action of benzalkonium chloride consists on the modification of cell membrane permeability which results in the leakage of the contents of the cell (Fazlara and Ekhtelat, 2012; Gradel *et al.*, 2005). Bac-D™ is a novel disinfectant, which is currently being used as a wound wash for humans and animals and the active ingredient is benzalkonium chloride. Bac-D™ is a safe, potential substitute to harsh chemicals.

Therefore, the objectives of this trial were to determine the effect of washing eggs in Bac-D™ on the conductance, hatchability, livability, growth rates and feed conversion in turkey poults.

MATERIALS AND METHODS

General procedures: The experimental procedure used in this investigation was approved by the North Carolina State University Animal Care and Use Committee. Six hundred eggs from a commercial turkey company (Butterball, Garner, NC) were randomly divided into 2 groups, application at hatch and application prior to hatch. These two groups were further divided in to Bac-D™ or PBS at hatch or Bac-D™ and water prior to hatch. In the first group 150 eggs were sprayed before incubation with Bac-D™, 150 were sprayed with water, prior to spraying 50 eggs from each treatment were labeled with a number and were then weighed. The eggs were sprayed with ~20 mL per flat of eggs, with a manual hand pump sprayer (Fisher Scientific, Waltham, MA) for both the Bac-D™ and water sprayed eggs. The 300 eggs for the post-hatch application were incubated in the same incubator as the pre-incubation treated eggs. The eggs were incubated under standard conditions 99.5°F 55% RH; on day 7 the eggs that were numbered were weighed again to calculate relative moisture loss and conductance. On day 25 all of the eggs were moved to the same hatcher. Upon pip the 300 post hatch poult eggs were then split into their 2 treatment groups and half were misted with PBS and the other half misted with Bac-D™ just prior to removal from hatcher. Upon hatching the chicks were individually tagged and weighed.

Conductance and hatchability: The egg weights from day 0 and day 7 of incubation were used to calculate the relative moisture loss, as well as egg shell conductance. The average conditions for the 7 days were temperature of 99.5°F, barometric pressure of 30.11 and relative humidity of 50%. The conductance was calculated using the equation of Paganelli *et al.* (1974). Hatchability was calculated at hatch, the un-hatched eggs were broken out to determine if the eggs were infertile or time at which they had died.

Brooding: The poults were placed in groups of 10 poults in each pen. Birds were reared at North Carolina State University on the Turkey Education Unit (Lake Wheeler Road, Raleigh, NC). The house contained 48 pens, each pen had approximately 5 inches of pine wood shavings as bedding. Each pen contained one feeder and one plasson™ waterer and for the first week a second small hand waterer, as well as a cardboard scratch feed pan. After the first week the small waterer and cardboard scratch pan were removed. The house was kept at a constant 30°C for the first week, reduced to 28°C for the second week, reduced to 26°C for the third week and reduced to 24°C for the remainder of the trial. The poults were kept on 24 h of incandescent light for the first 3 weeks and then were placed on 23 h of light for the last 3 weeks of grow out. The feed and water were checked twice daily, feed was dispensed from hanging tube feeders. The waterers were washed once daily to keep them clean. The birds were fed 2 diets, a starter diet for the first 21 days and grower diet for the last 21 days of the trial. The starter diet was composed of 29.5% CP and 1481 kcal/lb. The grower diet consisted of 25.09% CP and 1481 kcal/lb. All feeds were produced by the North Carolina Agriculture Research Service Feed Mil.

Sampling, body weights and feed conversion: Individual body weights were recorded at hatch, 7, 21, 42 days. Feed conversion was recorded for the entire duration of the trial.

Statistical analysis: The experimental data were analyzed as a 2x2 design. Data were analyzed using ANOVA (JMP 10, SAS, Cary, NC) using Tukey-Kramer comparison of means. Eggs and Poults were used as the experimental units and an alpha of 0.05 was used to establish significances.

RESULTS AND DISCUSSION

Bac-D™ showed no significant effect on the hatchability of turkey eggs. The hatchability of the control group and treatment group varied only slightly from each other and were comparable with industry standards that week (Table 1). Bac-D™ also had no significant difference on the conductance of the turkey eggs. Eggs from Bac-D™ treated group had a mean conductance of 0.0176 and the control eggs had a mean conductance of 0.0169 (Table 2). Lowman and Parkhurst (2013) reported Bac-D™ to cause a small yet significant change in conductance of broiler breeder eggs (Lowman and Parkhurst, 2013).

Body weights: Significant differences were seen at the initial hatch weighing, with the Bac-D™ misted eggs having a significantly higher ($p<0.0001$) mean weight of 60.35 g when compared to the water washed control eggs which had a mean of 57.67g. The Bac-D™ and the PBS misted poults means did not differ significantly from each other (Table 3). There were no significant differences between any of the 4 treatment groups neither for the D21 weights nor for the D42 weights (Table 3).

Feed conversion: There were significant differences ($p<0.0062$) in feed conversion at the 21 day weighing. The poults from the eggs washed with Bac-D™ prior to incubation had a mean FCR of 1.1 where the poults from the eggs washed in water had a mean FCR of 1.17(Table 4). This resulted in 6 points in improved feed conversion. There were no significant differences in feed conversion at the 42 day weigh back between the two groups (Table 4). There were no significant differences observed at Day 21 or 42 between the poults that were misted with Bac-D™ or PBS at pip (Table 5).

From the data collected from this trial Bac-D™ appears to have no negative effects on the hatchability or growth rates of poults that were hatched out of eggs that had been misted with Bac-D™. This lack of significant difference in hatchability and production parameters were all in agreement with (Ayugun *et al.*, 2012a), which demonstrated that Benzalkonium Chloride had no effect on the growth or hatchability in Japanese quail. The initial difference at hatch may be attributed to several potential causes. This could be due to the decreased bacterial load on the eggs during incubation, which resulted in increased growth. Even though bacterial counts were not measured in this trial, Lowman and Parkhurst (2013) have demonstrated that Bac-D significantly lowers exterior bacterial counts on the egg which could serve as a possible explanation to the changes observed from this trial (Lowman and Parkhurst, 2013). One other very plausible explanation could be change in conductance, even though not significantly different could have had a beneficial effect on the development of the embryo

Table 1: Hatchability of eggs and current industry average

		Breakout			
	Hatchability % hatch	Infertile	Early	Mid	Late
Bac-D	83.89	9	3	1	14
Water	86.3	8	3	1	7
Industry	83.18 *				

Hatchability of Turkey eggs from Bac-D treatment and Water treatment, Breakout for eggs that did not hatch, infertile, early dead (1D-9D) Mid-dead (10D-19D) late dead (20D-28D). *denotes number from personal communication with Butterball staff

Table 2: Conductance of turkey eggs by treatment

	Mean	N	SE
Bac-D	0.0175	49	0.00032
Water	0.0169	50	0.00032

Conductance values of Turkey eggs washed in either Water or Bac-D prior to incubation. Lack of super scripts denotes no significant different

Table 3: Poult body weights at D0, D21, D42

	D0		D21		D42	
	Mean	SE	Mean	SE	Mean	SE
Bac-D Washed	60.35^{A}	0.431	574.30^{A}	8.16	1840.43^{A}	25.85
Water Washed	57.68^{C}	0.431	598.18^{A}	8.16	1905.26^{A}	25.962
Bac-D Misted at pip	59.28^{AB}	0.422	581.34^{A}	7.99	1847.48^{A}	25.41
PBS Misted at pip	58.44^{BC}	0.429	581.57^{A}	8.13	1884.91^{A}	25.73

Body weight of poults at hatch (D0), D21 and D42 in grams. ^{ABC}denotes significance at the ($p<0.005$)

Table 4: Feed Conversion at 21D and 42D washed eggs

	D 21		D42		
	Mean FCR	SE	Mean FCR	SE	n
Bac-D Washed	1.1^{A}	0.014	1.77^{A}	0.042	12
Water Washed	1.17^{B}	0.015	1.74^{A}	0.042	12

Feed conversion ratios for eggs washed with Bac-D or Water prior to incubation, ^{AB}denote significance at ($p<0.005$) with in each column

Table 5: Feed Conversion at 21D and 42D of poults misted at pip

	D 21		D42		
	Mean FCR	SE	Mean FCR	SE	n
Bac-D at Pip	1.14^{A}	0.035	1.74^{A}	0.067	12
PBS at Pip	1.14^{A}	0.033	1.86^{A}	0.067	12

Feed conversion ratios for poults misted with Bac-D or PBS at pip, ^{AB}denote significance at ($p<0.005$) with in each column during incubation resulting in a larger chick at hatch as compared to the control group. Bac-D™ has been reported to significantly change the conductance of broiler breeder eggs (Lowman and Parkhurst, 2013). Duryan *et al*. (2012) demonstrated that changes in oxygen levels at various time points thorough out incubation cause a significant impact on the development of the embryo Duryan *et al*. (2012). The improvement in feed conversion could be due to the decrease in bacterial loads embryonically resulting in a change in the gut microflora as a result of the Bac-D™ egg sanitation. This change in FCR could be of great economic benefit to poultry producers. In North Carolina alone, even a one point in FCR could yield over one million dollars of monthly revenue (Mahmoud and Edens, 2003).

Conclusion and applications:

1: Washing eggs in Bac-D™ has no significant effect on hatchability or overall growth rate of turkey poults
2: Spraying eggs with Bac-D™ has some significant effect on feed conversion of poults
3: This improvement in feed conversion could be of great economic benefit to the poultry industry
4: Spraying eggs with Bac-D™ does not significantly change conductance or gas exchange of turkey eggs

ACKNOWLEDGEMENTS

The authors would like to thank RDM Products for providing the Bac-D™ used for the trial. We are also greatly indebted to the Charles Lee Guy foundation for financial support, as well as Butterball for supplying the turkey eggs.

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