Presented at 2001 Joint Meeting of ADSA
AMSA, ASAS and PSA, Indianapolis, IN

The effect of a biological litter treatment on *Salmonella sp.* prevalence in turkey breeder flock litter

T. Wiard[1], M. Gockley[1], T. Parrott[1], G. Troyer[2], and T. Rehberger[1]
[1]Agtech Products, Inc., Waukesha, WI, [2]Willmar Poultry Co., Willmar MN

A study was conducted to determine the effects of MicroTreat "P", a biological litter treatment on the prevalence of Salmonella of litter in turkey breeder flocks. A flock of breeder hens were moved from a brooder barn at five weeks of age and divided into two grower barns. One barn was used as a control barn with no biological litter treatment applied, while the second barn was treated with a biological litter treatment. At twenty-eight weeks of age hens from the control grower barn were moved into two layer control barns, and hens from the treated grower were moved into two treated layer barns. In both facilities, the litter treatment was reapplied to the treated barns every ten weeks. Monthly drag swabs were collected and used to determine the presence of *Salmonella* in each barn. In the grower barn, the initial *Salmonella* drag swab samples for both the treated and control barns were negative. In the control barns, the number of positive *Salmonella* samples rose to 60% by the second sampling, and to 80% by the third sampling, where they remained until the birds were moved out of the grower barns. During the same time period, *Salmonella* remained at an undetectable level in the treated barn. In the initial drag swab samples from the layer barns, only one sample was positive for *Salmonella* in the treated barns compared with three positive samples from the control barns. By the eleventh week in the layer barns, 40% of the samples tested positive for *Salmonella* in the control barns, while *Salmonella* was at an undetectable level in the treated barns. MicroTreat "P" was shown to be effective in controlling the proliferation of *Salmonella* populations present in litter from turkey breeder flocks.

Most poultry producers are faced with multiple challenges associated with the condition of grow house litter. Poor bird performance can often be the result of poor litter conditions (1). The detrimental effects of ammonia on bird health and performance have been well defined; however the overall affects of microbial populations in the litter are just beginning to be understood. Many researchers have reported a correlation between poor litter quality as measured by elevated water activity (Aw) levels in litter and the increased risk of *Salmonella* infection (2,3,4,5). Additionally, the level of specific microbial populations in litter has been shown to significantly influence the decomposition of uric acid thereby affecting the concentration of ammonia. Changing the microbial composition of litter can have significant influences on bird performance.

Many litter amendment products, both chemical and biological, claim to positively affect litter conditions. Chemical products have been shown to have an immediate impact on litter pH and ammonia levels. However these effects are typically short-lived. In contrast, biological litter treatment products offer the ability to control the decomposition of fecal matter in the litter over a long period of time.

MicroTreat "P" is a biological litter treatment product that contains bacteria that establish active populations in litter. MicroTreat "P" lowers litter surface water activity by digesting proteins and other undigested feed stuffs. This allows moisture to percolate down through the litter resulting in a lower water activity of the litter. The purpose of this study was to determine the effect of MicroTreat "P" on populations of *Salmonella* present in the litter of turkey breeder flocks.

MATERIALS AND METHODS

Field Trial Sites. The trial was conducted at commercial breeder facility in Minnesota. A single brooder house of poults was treated with MicroTreat "P" two weeks following placement. Following five weeks in the brood house birds were equally split between two separate starter/grow houses. One house was treated with MicroTreat "P" at the time the birds were moved. The remaining starter/grow house received no litter treatment and was used an experimental control. At 28 weeks of age birds from each grow house were equally split between two laying facilities. Those laying facilities that received birds from the treated starter/grow houses were treated with MicroTreat "P" at the time of move. The laying facilities that received birds from the control starter/grow houses did not receive any litter treatment at the time of move.

Determination of litter Salmonella. *Salmonella* populations in the litter were monitored using a modification of Mallinson et al. (4) drag swab technique. Samples were routinely collected from both the grower and layer phases. The grower houses were separated into five equally spaced segments. Ten drag swabs (two from each segment) were collected from each house using a sterile surgical bootie premoistened with 0.1% of sterile peptone water. Due to the location of laying boxes the layer houses were separated into ten equally spaced segments. Ten drag swabs (one from each segment) were collected from each layer house using a similar technique. In each case, segments were crossed over 10 times to ensure complete coverage of the area.

The bootie was placed in 350 ml of 0.1% peptone water and transported to the laboratory to complete the analysis. Booties were incubated overnight at 41.5°C. A 10 ml sample of the incubated liquid was then transferred to 100 ml of Hajna's tetrathionate broth (Difco Laboratories) and incubated for 24 h at 41.5°C. Each enrichment flask was struck on xylose-lysine-tergitol 4 agar (XLT4) (Miller, et al, 1991) and brilliant green agar (Difco Laboratories) supplemented with 20 μg/ml novobiocin (Sigma Chemical). The plates were incubated for 24 h at 37°C. Typical *Salmonella* form black colonies on the XLT4 agar. Presumptive colonies were restruck on XLT4 agar for further isolation. Enrichment broth cultures that were negative at the time of initial analysis were incubated at room temperature for seven days. A 10 ml sample of original broth was then transferred to fresh Hajna's teterathionate broth. The same *Salmonella* isolation protocol was again followed.

Suspected isolates were confirmed as *Salmonella* using TSI slants biochemical confirmation tests for *Salmonella* according to FDA-BAM methods.

Water activity analysis. The water activity (a_w), which is a value that represents the biologically available water, of each litter sample collected from each layer house was determined using a Rotronic Quick Analyzer #A2101 (Rotronic Instrument Corp, Huntington, NY). Litter samples (454 g) were collected from a total of six equally spaced locations within each of the laying houses tested with samples from wet areas (feed and water line) and from dry areas to represent the overall conditions of the litter surface in the entire house.

RESULTS

Salmonella populations in litter. Using a modified drag swab technique, the level of Salmonella contamination in the litter was estimated. The effect of treatment on Salmonella populations in the grow period is presented in figure 1. Both the control and treated house were negative (0 of 10) for *Salmonella* at grow house placement through the 9 weeks of age. No *Salmonella* drag swabs were detected in the treated house throughout the grow 23 week period. By 14 weeks of age 60% (6 of 10) of the litter sections in the non treated house was positive for *Salmonella*. The highest percentage of Salmonella positive samples (80%) was observed in the non treated house at 23 and 28 weeks of age.

Figure 1. *Salmonella* positive litter samples collected from each turkey breeder grow house.

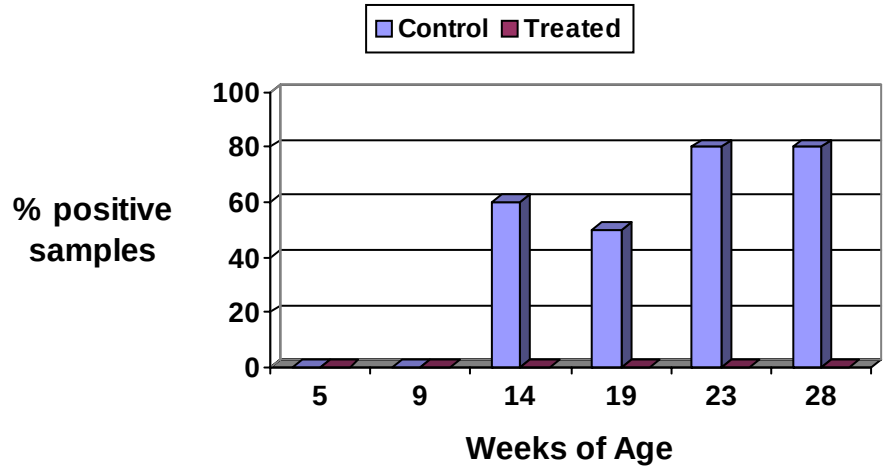
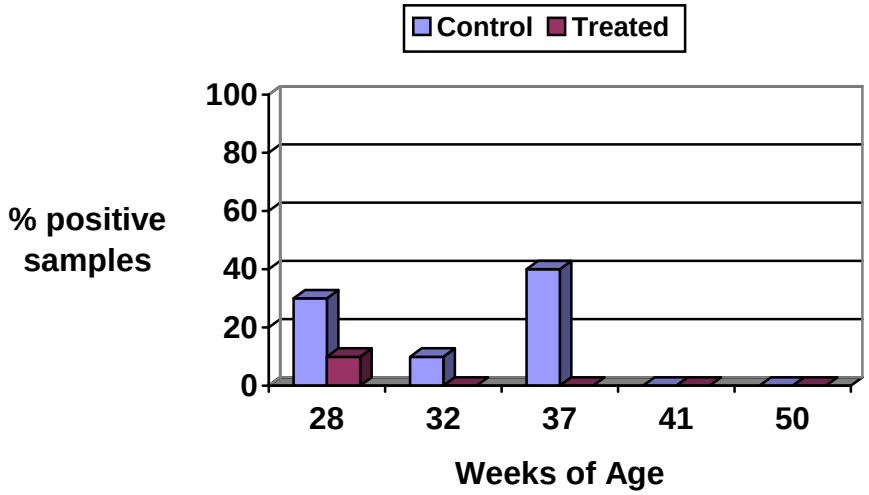


Figure 2. Mean *Salmonella* positive litter samples collected from each of two turkey breeder laying houses.



Overall, the prevalence of *Salmonella* tended to be lower in the layer house compared to the grow house (figure 2). The highest average *Salmonella* observed in the laying houses (40%) was detected at 37 weeks of age.

At the placement of hens in the laying house, *Salmonella* positive samples were 30% and 10% for control and treated houses respectively. This is the only period that Salmonella positive samples were observed in treated houses throughout the entire 50 week test period. The observed positive sample at this period may be due to stresses associated with bird movement, movement onto new litter or a combination of both.

Water activity analysis. The water activity results of samples collected from layer houses is shown in figure 3. Regardless of treatment, the highest observed litter water activity was determined to be at 28 weeks of age when hens were moved to the laying houses. Control houses had an average litter water activity of 0.962 with treated houses less than 1% lower at 0.956. The following sample period (32 weeks of age) had the lowest observed mean litter water activity for all treatments (control-0.903, treated-0.895).

DISCUSSION

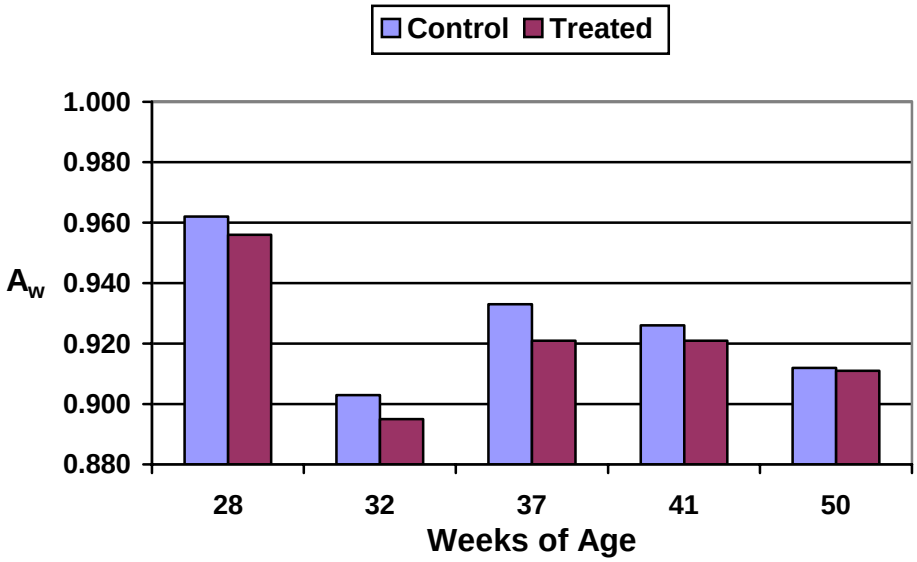
This study examined the ability of a biological litter treatment to influence the proliferation of *Salmonella* present in the litter of turkey hens from the grow-out phase through the first lay period. Previous studies had shown that a commercially available product (MicroTreat "P") can reduced the biologically available water of turkey litter material, as measured by water activity (A_w). Previous research has defined the relationship between high water activity and the proliferation of *Salmonella* in the litter (2,3,4,5). Additionally, this research has shown the effect of litter populations on the amounts of *Salmonella* detected on the bird and carcass (4).

Therefore the goal of this research was to determine if previously observed reductions in litter water activity with the use of MicroTreat "P" were sufficient to influence the growth of *Salmonella* in litter.

Drag swab analysis of litter surfaces was successful in detecting the presence of *Salmonella* in both grow and laying houses. In control houses the percentage of positive drag swab samples tended to be higher in the grower barn compared to the layer. No *Salmonella* positive drag swabs from treated grow houses were observed even after including a secondary enrichment process. The initial *Salmonella* drag swab samples for both the treated and control barns were negative. In the control barns, the number of positive *Salmonella* samples rose to 60% by the second sampling, and to 80% by the third sampling, where they remained until the birds were moved out of the grower barns.

Unfortunately, water activity analysis of grow house litter was only performed at 28 weeks of age, the end of the grow period. At that time the water activity for control and treated houses was 0.931 and 0.924, respectively.

Figure 3. Mean water activity (A_w) of litter samples collected from each of two turkey breeder laying houses.



Initial drag swab samples from the layer barns, resulted in one *Salmonella* positive sample (10%) in the treated barns compared with three positive samples (30%) from the control barns. By the eleventh week in the layer barns, 40% of the samples tested positive for *Salmonella* in the control barns, while *Salmonella* was at an undetectable level in the treated barns.

The analysis of layer house litter tends to suggest that reducing the water activity to 0.920 and lower will reduce the incidence of *Salmonella* in the litter. Both treatments were positive when the mean water activity was above 0.950. As the water activity dropped to near 0.920 and lower the number of *Salmonella* positive drag swabs also decreased.

This study demonstrated the relationship of litter water activity and *Salmonella* prevalence in the litter material of laying hens. The use of MicroTreat “P”, a biological litter treatment, was shown to be effective in controlling water activity and thus the proliferation *Salmonella* present in litter from turkey breeder flocks.

REFERENCES

1. Bender, F.E. and E.T. Mallinson. 1991. Healthy birds are lower costs birds. Broiler Industry. 54:62-64.

2. Carr, L.E., E.T. Mallinson, C.R. Tate, R.G. Miller, E. Russek-Cohen, L.E. Stewart, O.O. Opara and S.W. Joseph. 1995. Prevalence of *Salmonella* in broiler flocks: Effect of water activity, house construction, and watering devices. Avian Diseases. 39:39-44.

3. Christian, J.H.B. and W.J. Scott. 1953. Water relations of *Salmonellae* at 30EC. Australian Journal of Biological Sciences, 6:565-73.

4. Mallinson, E.T., L.E. Carr, G.W. Malone, C.J. Wabeck, D.H. Palmer, E.B. Pusey, E. Russek-Cohen and S.W. Joseph. 1995. Lower water activity in broiler litter and the reduction of *Salmonella* on farms and processed carcasses. Bulletin No. 348, Maryland Cooperative Extension Service.

5. Opara, O.O., L.E. Carr, E. Russek-Cohen, C.R. Tate, E.T. Mallinson, R.G. Miller, L.E. Stewart, R.W. Johnson, and S.W. Joseph. 1992. Correlation of water activity and other environmental conditions with repeated detection of *Salmonella* contamination on poultry farms. Avian Diseases. 36:664-71.