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308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorijps@gmail.com

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# Effect of Nipple Lines vs. Water Trough on Pekin Duck Breeder Performance and Well-Being

Zachary S. Lowman[1], Carmen R. Parkhurst[1] and Jocelyn Romano[2]
[1]Prestage Department of Poultry Science, North Carolina State University, Raleigh, NC, 27695, USA
[2]Phytobiotics North America LLC, Wentzville, MO, 63385, USA

**Abstract:** Ducks have a unique fondness to water compared to other commercial poultry. There have been a few studies that shown positive improvement in welfare measurements such as foot pad condition in meat type slaughter ducks. However, after a review of the literature, there appears to be no trials that examine the effects of open source waterers on breeder ducks. In slaughter ducks high bacterial loads and increased litter moisture, both typically negative aspects of foot quality are typically found. But slaughter ducks are only grown an average of 38-42 day, which minimizes long term effects of these problems. However breeder ducks are kept for significantly longer periods of time. So it is logical to explore the long term effects of such practices on the welfare of breeder ducks. For this trial a commercial Pekin breeder flock of 6,262 ducks 17 weeks of age was equally split into 2 groups (3131 duck/trt) all birds were housed in the same house, equal stocking density and equal amounts of shavings added daily. One group was provided access to 4 conventional nipple lines; the other side was supplemented with a trough waterer, as well as 2 nipple lines to maintain equal water access between the groups. Numerous measurements were recorded including mortality, egg production, litter moisture, daily water consumption, water bacteria levels and foot pad scores. Data was analyzed using the ANOVA and Chi squared features of JMP 10. The trough group had significantly higher % litter moisture, elevated coliform and general aerobic CFU counts and increased incidents of foot pad lesion compared to the control group. The control group produced significantly more eggs and used less water than ducks from the trough group. Based on this trial, open source waterers appear to cause significantly more foot lesion in breeder ducks, which could cause significant welfare concerns.

**Key words:** Pekin ducks, breeder, welfare, trough, open source waterer

## INTRODUCTION

There has been much debate within the duck industry as to the proper method of providing water for commercially raised ducks. Ducks being waterfowl have a certain fondness for water, however when raised commercially, using large amounts of water comes with certain problems including cost, availability and increased litter moisture. From a welfare view many believe that access to an open water source is necessary in order for birds to perform natural behaviors such as head dipping and cleaning of eyes and nostrils (O'Driscoll and Broom, 2011). However, when birds are allowed increased access to water there is a simultaneous decrease in litter condition. The dry matter percentages (DM) are significantly higher from ducks that used open source waterers compared to conventional nipple lines (O'Driscoll and Broom, 2011). Wet litter causes numerous problems including increased bacterial contamination and ammonia levels. These conditions can be detrimental to duck health.

Many trials claim that open source waterers improve duck health and welfare by measures of water associated health parameters, including improvements in feather cleanliness, cleaner eyes, less dirty and blocked nostrils (Jones *et al*., 2008; Bergmann *et al*., 2011). However, these parameters alone cannot be the only measures of improved "health". Welfare is not simply keeping the ducks "happy," a key aspect of welfare is health, so an increase in disease or injury is decreasing welfare (Broom, 2006; O'Driscoll and Broom, 2011).

When reviewing the literature, there are conflicting reports on the effects open source waterers have on foot pad dermatitis (FPD). Some have found increased rates of foot pad dermatitis (FPD) associated with bell drinkers in ducks (Bergmann *et al*., 2011). There are others that have found decreased rates of FPD with increased access to open source waterers compared to nipple lines (Jones and Dawkins, 2010). These mixed results can most likely be explained due to the simple fact that many of the trials published thus far have been carried out in research settings with small numbers of birds and excessive addition/changing of bedding (O'Driscoll and Broom, 2011). These are two factors that are not plausible in a commercial setting. In fact, there is research that states that ducks raised on water

**Corresponding Author:** Zachary S. Lowman, Prestage Department of Poultry Science, North Carolina State University, Raleigh, NC, USA

troughs have significantly worse nostril, eye scores and feather cleanliness scores (Alenciks *et al*., 2015). Frazier *et al.* (2015) reports ducks raised on water troughs also had significantly higher mortality rates and cull rates at 3,4,5 weeks of age than ducks raised on nipple waterers (Frazier *et al*., 2015).

There have been numerous papers examining the effects of water type on duck health and welfare in commercial meat ducks. However, there are no papers to date examining the effects that an open water source has on breeder performance. Unfortunately, the results of these previous studies in broiler ducks are mixed. One variable that is fairly consistent among all papers is the increase in bacterial load and contamination that comes along with increased access to water. Bergmann *et al*. (2011) found that Enterobacteriaceae levels were consistently higher in bell drinkers than from nipples. Liste *et al*. (2013) examined 3 different sizes of water troughs each with varying amounts of access to the water. Wider troughs that allowed more access to the water had higher levels of total dissolved solids, salinity, dissolved oxygen and conductivity. This experiment also demonstrated that wide troughs had the highest levels of *E. coli* contamination. Other trials have shown that waste production can increase up to 100% when comparing bell drinkers to nipple lines due to contamination of clean water (Liste *et al*., 2013). Houses with open water sources substantially increase the work load and amount of litter needed, since these houses typically have to bed twice daily in order to keep the environment dry (Liste *et al*., 2013). Water troughs have consistently been shown to have bacterial levels significantly higher than what is recommended for ducks. In fact, the reported bacterial levels in ducks are the highest reported levels in any poultry water in the literature thus far (Liste *et al*., 2013). Porter *et al.* (2015) found the water troughs to be contaminated with Riemerella *antipestifer* (RA), a very serious bacteria for duck producers, compared to no RA cultured from the nipple lines. Providing ducks with water that contains high levels of bacterial contamination is not only potentially detrimental to the duck, it can also result in serious problems for the human consumers. High bacterial counts in the ducks can result in higher counts on the carcass and lead to an increase risk of contamination during processing (Liste *et al*., 2013).

## MATERIALS AND METHODS

**General procedure:** A commercial breeder flock of 5,366 female and 896 male Pekin ducks were equally separated into a standard commercial breeder barn when they were 17 weeks of age. The house was divided into two identical sections. The control side was equipped with 4 standard nipple water lines, the trough side had a water trough that measured 7" x 7" x 130' and 2 standard nipple lines. The house was cared for by the same workers to ensure consistency. The water trough was cleaned once weekly. Both sides of the house had a separate feed weighing system that was supplied from the same feed bin. All ducks were fed a standard commercial duck breeder diet. Both sides of the house were bedded every other day with equal amounts of pine shavings. Egg production and mortality were recorded daily and egg weights were recorded biweekly in both sides of the house. Litter and water samples were collected at 3 different time points throughout lay. Water consumption was recorded daily from 5 am to 5 pm, the time in which water consumption is highest.

**Water samples:** Water samples were collected at 3 time points throughout the trial. Water samples were collected in a sterile 15 ml conical tube at 4 different locations from each group. A pure sample of 100 uL was plated on McConkey Agar (MAC) to determine the presence of Coliform's, then each sample was serially diluted 6 times and 1 mL of final dilution plated on tryptic soy agar with 5% Sheep Blood (TSA) to determine general aerobic bacterial load. All plates were incubated at 37°C for 24 h. After 24 h of incubation all plates were removed and bacterial colonies visually counted.

**Litter samples:** Litter samples were collected once a month at 4 similar locations on each side of the house. The samples were thoroughly mixed and approximately 200 g of litter was weighed out in a foil tray. The samples were placed in to a drying oven at 120°C for 24 h. Samples were removed from the oven and immediately weighed to determine moisture loss. All litter samples were run in duplicate and calculations made of average moisture loss.

**Foot pad scores:** Foot pad scores were taken at 21 weeks of lay. Birds were randomly penned at 6 different locations in each treatment. The feet were scored on a scale of 0-3 (Table 1). The scoring system used consisted of: (0) No dermal lesions observed on center or toe pads, (1) A. Lesions on $\leq$2 pads and no center pad lesions, or B. Lesion on center pad, with no toe lesions. (2) Lesion on center pad and $\leq$2 toe pad lesions. (3) A. Lesions on all 3 toe pads, or B. any pad with evidence of current or prior bleeding.

**Data analysis:** All data were analyzed using JMP 10 (SAS institute, Cary, NC) using the ANOVA and Chi squared. Group means were analyzed using Tukey Kramer and Students T-Test.

## RESULTS

**Environmental sampling:** Significant differences ($p \leq 0.05$) were observed in litter moisture in all 3 of the sampling time points. The control side consistently had between 11 to 20% lower litter moisture than the trough

Table 1: Scoring legend for duck foot pads

| Score | Scoring criteria |
|---|---|
| 0 | No dermal lesions observed on center or toe pads |
| 1 | Lesions on ≤2 pads and no center pad lesions |
| 1 | Lesion on center pad, with no toe lesions |
| 2 | Lesion on center pad and ≤2 toe pad lesions |
| 3 | Lesions on all 3 toe pads |
| 3 | Any pad with evidence of current or prior bleeding |

group (Table 2). The trough side used considerably more water than the control side during the course of the trial. The ducks with the trough used almost 180 more gallons of water a day than the ducks on the nipple lines (Fig. 1).

Water samples collected from the trough contained significantly ($p \leq 0.05$) higher levels of total aerobic bacteria at sampling 1 and 2 and though not significantly different ($p = 0.09$) at sampling 3, the trough group had 2 fold higher CFU counts than the control group (Table 3). Similar data was gathered using coliform selective media (MAC) (Table 4). The water samples from the trough side had significantly ($p \leq 0.05$) higher coliform levels at all 3 sampling than did the water samples collected from the control side.

**Foot pad scores:** There were significant differences ($p \leq 0.0316$) in overall mean foot scores between treatments with control group mean score of 1.45, compared to 1.73 mean score in trough group (Table 5). There were significant differences ($p \leq 0.003$) in the distribution of scores between groups. Control score: (0) 9.4%, (1) 44.8%, (2)35.4%, (3)10.4% compared to trough scores: (0) 7.89%, (1) 43.6%, (2) 24.6%, (3) 23.4%.

**Production and mortality:** There were significant differences observed between the treatments in regards to egg production. Egg production from 1-8 weeks of lay was similar, with no significant differences in production. However, from weeks 9-21 the production levels of the control group were significantly ($p \leq 0.05$) higher each week (Fig. 2). There were no significant differences in mortality by week between the groups. However, though not significantly different at each time point, the trough group consistently had higher weekly mortality (Fig. 3).

## DISCUSSION

The significantly higher litter moisture from the group with access to open source waterers comes as no surprise; there are numerous accounts of a rapid decline of litter quality from ducks with open source waterers (Bergmann *et al*., 2011; O'Driscoll and Broom, 2011; Fraley, 2015). Increased litter moisture causes numerous negative consequences on bird health. High litter moisture causes increased levels of ammonia (Fraley, 2015), which is very detrimental to duck health. Jong *et al*. (2014) demonstrated the numerous negative effects wet litter has on broilers. The authors report that

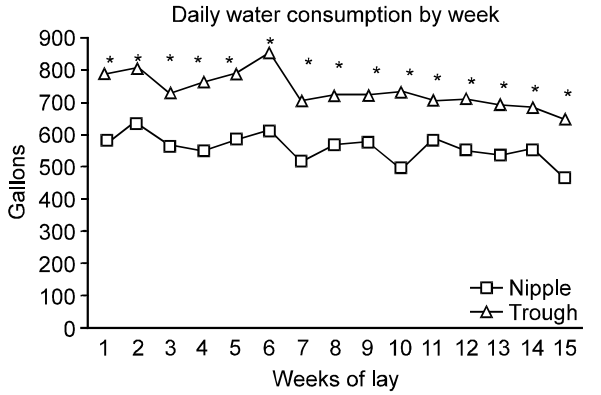


Fig. 1: *Denotes significant differences ($p \leq 0.05$) between treatments by week of lay, lack of *denotes no significant difference

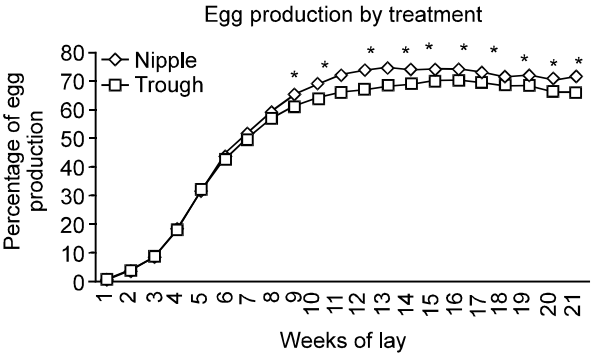


Fig. 2: *Denotes significant differences ($p \leq 0.05$) between treatments by week of lay, lack of *denotes no significant difference

wet litter not only induces foot pad dermatitis, but also reduces overall welfare of the bird. Similar results were observed in this trial, significant differences ($p \leq 0.0316$) were observed in overall mean foot scores between treatments with control group mean score of 1.45, compared to 1.73 mean score in trough group (Table 5). There were significant differences ($p \leq 0.003$) in the distribution of scores between groups. Control score: (0) 9.4%, (1) 44.8%, (2) 35.4%, (3)10.4% compared to trough scores: (0) 7.89%, (1) 43.6%, (2) 24.6%, (3) 23.4% (data not presented). These results should come as no surprise to researchers that open source waterers appear to cause significantly more foot lesion in breeder ducks, which could result in significant welfare concerns. One major difference being that breeder ducks have a much longer life span compared to broiler type ducks, thus resulting in longer exposure to poor litter quality. This is a prime example of why broiler data cannot always be implemented into breeder production without proper testing.

The trough group had significantly higher Coliform counts in the drinking water at all 3 sampling

Table 2: Litter moisture (%)

| Treatment | Sampling 1 | Sampling 2 | Sample 3 | n |
|---|---|---|---|---|
| Nipple waterer | 49.88$^{A}$ | 49.55$^{A}$ | 21.1$^{A}$ | 4 |
| Trough waterer | 61.23$^{B}$ | 64.63$^{B}$ | 41.9$^{B}$ | 4 |
| Pooled SEM | 2.15 | 4.18 | 2.92 | |

$^{AB}$Values with different superscripts denote significant differences ($p \leq 0.05$) with in the same column

Table 3: Total aerobic CFU's (TSA)

| Treatment | Sampling 1 | Sampling 2 | Sample 3 | n |
|---|---|---|---|---|
| Nipple waterer | 0$^{A}$ | 500$^{A}$ | 132.5 x 10^4 | 4 |
| Trough waterer | 687.5 x 10^5$^{B}$ | 142.7 x 10^6$^{B}$ | 482.5 x 10^7 | 4 |

$^{AB}$Values with different superscripts denote significant differences ($p \leq 0.05$) with in the same column

Table 4: Total Aerobic CFU's (MAC)

| Treatment | Sampling 1 | Sampling 2 | Sample 3 | n |
|---|---|---|---|---|
| Nipple Waterer | 1.75$^{A}$ | 0$^{A}$ | 1.5$^{A}$ | 4 |
| Trough Waterer | <250$^{B}$ | <250$^{B}$ | <250$^{B}$ | 4 |
| Pooled SEM | 1.02 | 1.19 | 0.84 | |

$^{AB}$Values with different superscripts denote significant differences ($p \leq 0.05$) with in the same column

Table 5: Mean paw score by treatment

| Treatment | Paw score | SE | n |
|---|---|---|---|
| Nipple | 1.47$^{B}$ | 0.1 | 96 |
| Trough | 1.73$^{A}$ | 0.1 | 152 |

$^{AB}$Values with different superscripts denote significant differences ($p \leq 0.05$) with in the same column

compared to the control group (Table 4). Similar results were observed with general aerobic bacteria. Though not significantly different at the third sampling, there was a noted increase in CFU's in the trough samples when compared to the nipple lines (Table 3). This data is in agreement with much of the past research in broiler type ducks, in that open source type waterers have elevated bacterial counts (Bergmann *et al*., 2011; Kuhnt *et al*., 2004; Liste *et al*., 2013; Porter *et al*., 2015). In the very small amount of data regarding broiler ducks, there are mixed reports as to the issues that arise from increased bacterial contamination of drinking water. Some researchers report that there was no decreased growth or performance as a result of high bacterial levels (O'Driscoll and Broom, 2001), yet there are others that report significant increases in mortality as well as decreases in production in meat type ducks (Frazier *et al*., 2015). There are many factors that can contribute to these differences in results ranging from: type of duck, type of bacterial contaminant, cleaning methods of the troughs. Regardless of these factors, open source waterers have a greater opportunity to contain higher levels of contamination, higher levels of suspended solids, adverse tastes and other factors that can change a duck's water intake (Rodenburg *et al*., 2005).

There were differences in egg production observed as well. There were no significant differences at the start of lay. However, as the trial continued, there was a definite separation between the two groups, with significant differences appearing at 9 weeks of lay. The birds on the nipple line consistently had higher egg production that did the birds on the trough (Fig. 2). In fact, the nipple

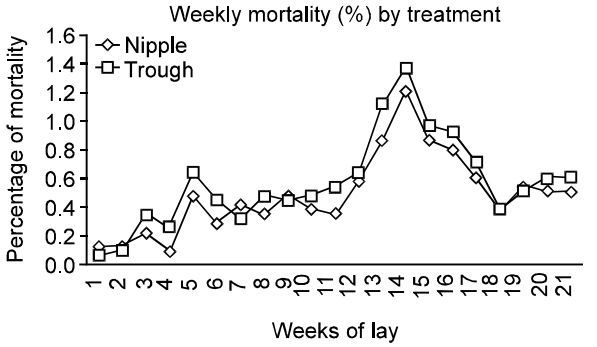


Fig. 3: *Denotes significant differences ($p \leq 0.05$) between treatments by week of lay, lack of *denotes no significant difference

group produced almost 12,500 more eggs in the 15 week time than did the trough group. After a review of the literature, there appears to be no prior research examining the effect of water quality on breeder duck performance. However, the results presented should come as no surprise. Grizzle *et al*. (1997) found significant decreases in egg production of broiler breeder hens consuming water with elevated levels of nitrate and bacterial contamination. Amaral (2005), describes a host of bacterial infections that can be transmitted by feces contaminated water, including Colibacillosis and Fowl Cholera, both common duck maladies. Porter *et al*. (2015) isolated Riemerella sub types from trough waterers, a bacterium that is specific to ducks and can cause significant losses to producers. Even though there were not significant differences in mortality between the groups, the overall mortality from this trial follows the trends of Frazier *et al*. (2015) who found higher mortality levels in ducks watered with troughs compared to nipple lines. The weekly mortality was higher at most time points (Fig. 3). The trough group had 1.76% higher mortality over the trial period than the group on the nipple lines.

From these data there are several take away points: water troughs significantly increase bacterial loads in the drinking water of ducks. Houses equipped with water troughs have significantly wetter floors than houses with nipple lines if treated under identical conditions. Breeder ducks with troughs have significantly worse foot pad scores than those raised on nipple lines. Breeder birds allowed access to open source waterers have higher mortality and lower egg production than control counterparts. All of these factors must be considered by the producer and should be thoroughly considered when developing welfare standards for the management of breeder ducks versus management of broiler type ducks. Many trials claim that open source waterers improve duck welfare by measures of water associated parameters such as improvements in feather cleanliness, cleaner eyes and less dirty and blocked nostrils. However, these parameters are somewhat superficial to true animal health and should not be the only measures of improved "welfare". The most key welfare aspect must be animal health and as such, factors which increase disease or injury, decrease welfare. An assessment, such as foot pad lesions scores, mortality and egg production can offer a quantitative measurement and in turn better reflect the true welfare of the animals.

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