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DIVISION OF AGRICULTURE
Cooperative Extension Service

EDITOR'S COLUMN



Since the last issue of *Avian Advice*, several changes have occurred within the Center of Excellence

for Poultry Science. Dr. Frank Jones retired from the University on May 1. He was a faithful and steady influence on the Extension section of Poultry Science for many years and also was the editor of *Avian Advice*. When someone of Dr. Jones' caliber retires, many gaps are left to fill. Dr. Dustan Clark has assumed the position of Extension section leader on an interim basis. In the next issue, he will explain details of the re-assignment of Frank's responsibilities and those of Jerry Wooley, who retired from his position as Extension Poultry Specialist on June 1. So, two large holes have been left which we are attempting to fill in the short-run by reassigning duties to other specialists, primarily Drs. Keith Bramwell, John Marcy and Susan Watkins. I have taken on the role of Editor for *Avian Advice*. You may notice a few changes along the way in format or style, but I will strive to keep it the same high-quality, informative and practical publication it has been since its first issue in 1999.

Chlorination/Acidification Affects *Salmonella* Contamination

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Introduction

Salmonella contamination continues to be problematic for the poultry industry. Contamination can occur at any production or processing step and in live production *Salmonella* control is difficult because treatments can influence production characteristics, and, in turn, financial returns. Fortunately, many good management practices are also effective *Salmonella* control methods.

Water has long been known to be a vehicle for the transmission of bacterial, viral and protozoal diseases of poultry, including *Salmonella*. Indeed, researchers have verified that when birds consumed water containing fecal coliform levels of 10^6 , 10^5 , 10^4 , 10^3 , 10^2 and 10, *Salmonella* was isolated from 100%, 99%, 66%, 33%, 21% and 11% of the birds, respectively (Amaral, 2004). Even though the widespread adoption of closed, nipple drinker systems has reduced a good deal of contamination once passed from bird to bird, water chlorination alone may have little effect on cecal *Salmonella* levels for artificially inoculated birds consuming the water (Poppe et al., 1986). In addition, *Salmonella* may be isolated from 7 to 8% of water samples collected from nipple drinker systems and (Heyndrickx et al., 2002).

Many investigations of the potential effects of water chlorination on *Salmonella* have ignored the influence of oxidation-reduction potential (ORP). Yet, enhancing the ORP level by reducing the pH can significantly affect water disinfectants effectiveness (particularly chlorine) (Suslow, 2004). Consequently, a trial was undertaken to determine if free chlorine of ≥ 1 ppm free chlorine and acidified calcium sulfate (ACS) also injected at a rate necessary to maintain ≥ 650 mV oxidation reduction potential (ORP) affected *Salmonella* contamination in artificially inoculated broilers.

The sense of taste in chickens has been studied for decades and birds perceive taste entirely differently than humans. Flavors objectionable to most humans may or may not be accepted

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by chickens (Kare et al., 1957). The domestic chicken has definite likes and dislikes with respect to water taste. In fact, early studies suggest that birds are much more sensitive to flavors in water than those in feed (Kare and Pick, 1960). Virtually every production professional realizes that feed and water consumption are closely correlated...or...more directly – if they aren't drinking, they aren't eating. Early studies show that birds reject certain flavors: such differences may be easily detected because of the dramatic decrease in water consumption. However, birds tend to adapt to other flavors and can eventually accept them as “normal.”

The data in Figure 1 were collected by Kare et al., (1957) and illustrate one adaptation method employed by birds. These researchers placed two chick watering jars in each pen. One jar contained untreated water and the other contained flavored water. A comparison of the amount of water consumed from the two jars measured acceptance or rejection of flavors by the birds. The data in Figure 1 are similar to those observed in field situation when acidified calcium sulfate (ACS) is included in drinking water for poultry.

Materials and Methods

To measure the effectiveness of chlorination on *Salmonella* in broilers, two water regimes were designed, one, the treatment, with chlorination and the other, a control, without chlorination. For the chlorination treatment, an in-line gas chlorinator was installed and set to maintain ≥ 1 part per million (ppm) free chlorine along with a second injector that injected a food grade acid, acidified calcium sulfate, (ACS) to assure that an ORP reading of 650 mV or higher was maintained. The ORP, total and free chlorine levels were measured and recorded during four times daily.

Thirty (30) birds were placed in each of 16 pens and were raised under standard commercial conditions using nipple drinkers and tube feeders. Birds were housed in a solid-sidewall house with a minimum ventilation system and environmental controls and water regimes were given from 0 to 42 days of age. All birds were fed a dietary program based on the Cobb-Vantress nutritional recommendations. All birds were fed a pelleted diet; the starter diet was also crumbled. On day 7 of the trial, 3 pens of birds in each of the two water regimes were randomly selected and within each pen, 10 birds were marked with wing bands and challenged with Nalidixic acid resistant *Salmonella typhimurium* (NAL-SAL). On day 35, a second set of 3 pens for each water regime were selected and 10 birds were again marked with wing bands and challenged with NAL-SAL. The remaining 2 pens per water regime were not challenged and served as the controls.

On day 42, 10 of the NAL-SAL challenged birds per pen along with 5 of their non-challenged pen mates were sacrificed by asphyxiation with carbon dioxide gas and the ceca aseptically removed. In addition, 10 birds per pen from the non-challenged pens for each regime were also sacrificed to determine NAL-SAL incidence.

Results

No statistical differences were found when the weights,

feed conversions and mortality percentages of bird given chlorinated water were compared with those receiving water with no chlorine (data not shown). The data in Figure 2 summarize the findings of this study. No significant differences among treatments for non-challenged birds. In birds challenged with *Salmonella* at 7 days, more birds that drank chlorinated water were found contaminated as compared to birds given water with no chlorine. However, when challenged with *Salmonella* at 35 days, less contamination was found in birds drinking chlorinated water than in birds drinking water with no chlorine.

Discussion

Results of this study indicate that chlorinated water does not provide protection against early exposure (challenged at 7 days) to *Salmonella spp.* while chlorinated water maintained at an ORP of 65 mV or higher does reduce the incidence of *Salmonella spp.* when birds are challenged close to market age (challenged at 35 days). Lack of protection and actual increase in *Salmonella* incidence in chlorinated birds challenged at the early age is perplexing but might be related to acidifier used in these trials.

To illustrate the possible connection, consider the following observations on bird performance at the University of Arkansas' Division of Agriculture Applied Broiler Research Farm (ABRF). ABRF has utilized gas chlorine and acidifiers for its last 13 flocks. Average bird weights for these flocks have remained near the top of the settlement with the exception of three flocks which received the acidified calcium sulfate instead of the usual acidifier, sodium bisulfate. The average weight for these two flocks was below average. For the next 2 flocks, the acidified calcium sulfate was replaced with the sodium bisulfate and weights again were near the top of the settlement. These flocks were grown near the time this project was conducted so the potential that the acidifier could impact water consumption was not discovered in time to choose another acid product for the project. The acidified calcium sulfate may have depressed water consumption early on which is reflected in the lighter weights of the chlorinated birds though not significant at day 21 in either trial. The depressed weights for the birds on the chlorination regime in this experiment could be a reflection of depressed water consumption in the young birds and this would also mean a depressed feed consumption which may have allowed the *Salmonella* challenge at 7 days of age to be more infective. It has been proven that birds off feed do have an increase in gut pH and this would result in more favorable conditions for *Salmonella* colonization for chicks exposed to the microbe (Hinton et al.).

The fact that the chlorination/acidification treatments did significantly reduce the incidence of *Salmonella* in birds challenged at 35 days of age does make chlorination and water acidification which maintains a ≥ 650 ORP level along with >1 ppm free chlorine worth exploring further as an on-farm control option for *Salmonella*. It is interesting to note that birds in the other project which were drinking the ACS water were drinking 2-4 gallons more per thousand birds around

day 35 versus the birds consuming the SBS water. Since this is data from three flocks, it is safe to assume that water consumption at day 35 during this trial was not below normal consumption for the birds drinking the ACS/chlorinated water and therefore even though these birds were exposed to *Salmonella*, the more potent chlorine sanitizing residual helped reduce *Salmonella* colonization. One of the primary lessons learned in this project was how critical it is to monitor chlorine and ORP values when chlorine is used for water sanitation, as it affects water and feed consumption, efficacy of *Salmonella* treatments in water and in the final analysis, total bird performance and grower revenues. A second thought is the need to choose products including acids which will not impair water consumption any time during the bird's life cycle. This may require producers and company personnel to evaluate more than one product such as acids in order to find the best fit.

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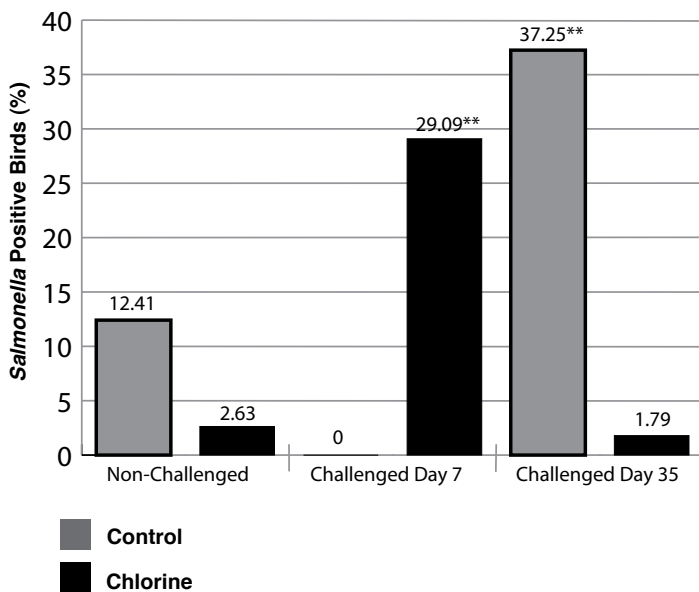
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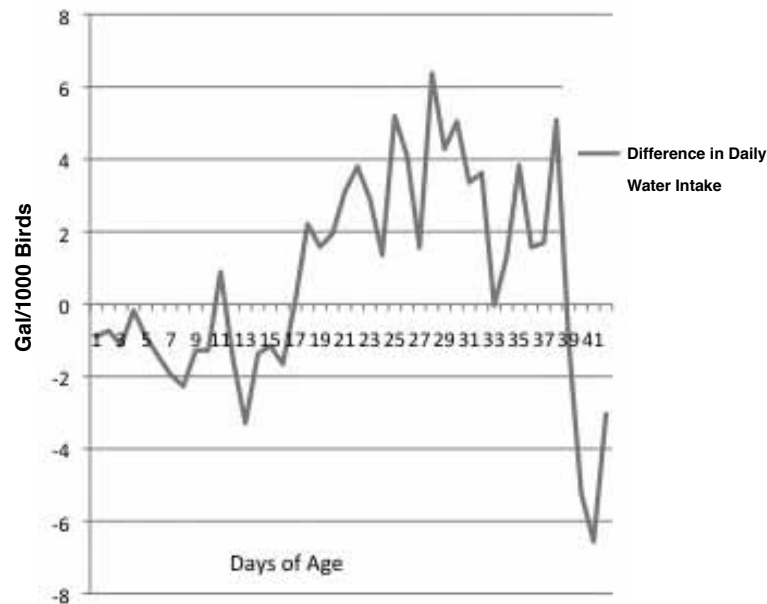
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Figure 1. Effect of Chlorinated Water on Broilers Inoculated with *Salmonella*



**Significantly different P<0.001

Figure 2. Difference in Daily Water Consumption for Birds Receiving Acidified Calcium Sulfate versus Sodium Bisulfate (ACS gallons minus BS gallons)





APPLIED BROILER RESEARCH UNIT (SAVOY) - These four full-sized broiler houses are equipped with computerized environmental control and data collections systems capable of commercial-type production research.

A 100-Flock Comparison of Broiler Feed Ticket Weights and On-Farm Feed Weights at the ABRF

Introduction

Contract broiler producers do not manufacture or deliver feed to their farms nor do they purchase it outright. Because they do not directly pay for their feed, questions may arise concerning how much feed was delivered and if that feed was accurately weighed, this despite contracts have provisions for growers to be present when feed and birds are weighed. Accurate feed weights are critical because under most broiler growing contracts, a major portion of producer pay is based on how much feed birds consume and how well birds convert that feed to meat. The Applied Broiler Research Farm (ABRF) recently harvested the 100th flock of broilers grown at the farm. The ABRF is capable of weighing the feed birds consume on a daily basis and thus was able to compare feed-ticket weights with on-farm feed weights for 100 flocks of birds.

Comparisons

The on-farm feed weighing system and procedures for daily feed weighing were described in detail previously by Tabler (2001). The system allows the ABRF the capability to weigh feed consumed at each of 4 broiler houses on a daily basis. After harvest, feed intake for the 4 houses are combined and compared with feed ticket weights received during the flock and feed weight charged to the farm on the settlement sheet. A 100-flock comparison of on-farm feed weights and feed-ticket weights for broilers grown at the ABRF from November, 1990 through October, 2008 is presented in Table 1 (flocks 1-50) and Table 2 (flocks 51-100). Data indicate that on-farm weights and feed-ticket delivery weights never exactly matched but were for the most part, similar. For 81 of 100 flocks, weight differences favored the producer.

For the first 50 flocks, the difference between on-farm feed weights and feed-ticket weights favored the producer in 47 flocks by an average 1.02%. The remaining 3 flocks favored the integrator by an average of 0.59%. The overall combined difference between the 2 systems on the first 50 flocks was 0.99% in favor of the producer.

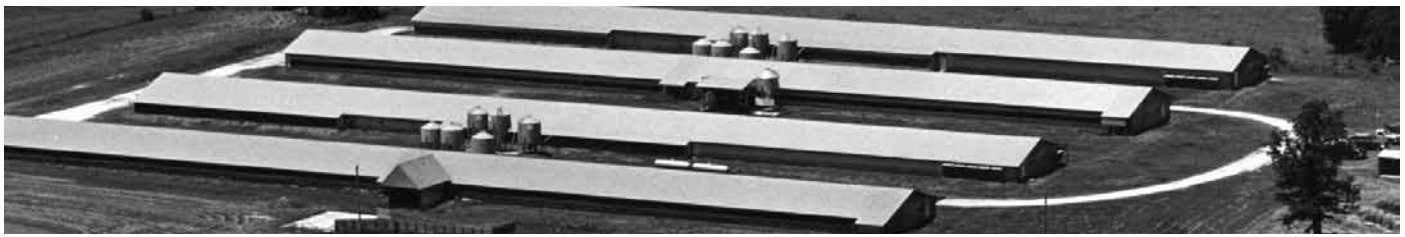
In the second 50 flocks, (51 through 100) the difference between on-farm feed weights and feed-ticket weights favored the producer in 34 flocks by an average of 0.81%. The remaining 16 flocks favored the integrator by an average of 0.48%. The overall combined difference between the 2 systems on the second 50 flocks was 0.70% in favor of the producer, slightly lower than the first 50 flocks. Ten of the 16 flocks that favored the integrator have occurred since 2006, after the ABRF was renovated. Several older load cells at bins that weigh feed on-farm had to be replaced during that time. Many of these were original load cells installed in 1990. This change in load cells may partially explain the increased number of flocks that recently favor the integrator. Overall, differences between on-farm feed weights and feed-delivery ticket weights averaged 0.85% for 100 flocks of broilers that consumed over 75 million pounds of feed.

Everyone's Best Interest

Every producer will eventually face the issue of feed being delivered a day too early and the bins not holding it all. By law, any feed that is returned by or picked up from a poultry producer must be weighed if feed weight is a factor in determining payment; the integrator must document and account for any returned or picked-up feed.

But sometimes mistakes occur. Growers are urged to keep track of feed tickets and know when something is out of the ordinary (for example, feed is delivered too frequently or not frequently enough). It is in the best interest of both producer and integrator to resolve any issues as they arise. Waiting until the flock sells to try to resolve a questionable feed ticket from weeks ago may result in conflict. Service techs should be contacted at the first sign of a potential problem. If feed was received but no ticket can be found, ask the service techs to provide a copy.

Feed costs are nearly two-thirds of all broiler production costs. These costs are important to growers because feed conversion largely determines how well each grower settles at the



end of the flock. Integrators have millions of dollars invested in feed mills and feed processing equipment, feed trucks, labor costs, and feed ingredients. This is, in part, why service techs are always asking growers to manage feeder height correctly and to avoid feed waste when chicks are small and begin scratching feed out of the feed trays.

Safeguards

The USDA Packers and Stockyards Act (P&S Act) of 1921 is designed to promote fair competition and ensure fair trade practices in the livestock and poultry industries. This Act also protects contract poultry producers. P&S Act requires all scales used by integrators to weigh feed for purposes of payment and settlement be installed, maintained, and operated to insure accurate weights. The Packers and Stockyards Program (P&SP) enforces the Packers and Stockyards Act (P&S Act). P&SP promotes accurate weighing in the live poultry industry in the following ways (USDA, 2008):

1. All scales used for weighing feed for purchase, sale, acquisition, payment, or settlement must be installed and maintained in accordance to National Institute of Standards and Technology (NIST) Handbook 44 as incorporated by reference into the regulations.
2. All scales used to weigh feed for purchase, sale, acquisition, payment, or settlement under the Packers and Stockyards Act (P&S Act) must be tested for accuracy by a competent agency at least each 6 months, and the reports of these tests forwarded to P&SP.
3. Any scale found to be inaccurate according to accepted tolerances, must not be used until it is repaired, retested and found accurate again.
4. Whenever the weight of feed is a factor in determining payment or settlement to a poultry grower when live poultry is produced under a growing arrangement, live poultry dealers must base payment or settlement on the actual weight of feed shown on the scale ticket. If the actual weight used is not obtained on the date and at the place of transfer of possession this information must be disclosed with the date and location of the weighing on the accountings, bills, or statements issued. If there are any adjustments to the actual weight, this information and the reason must be disclosed on the accountings, bills, or statements issued
5. Integrators must employ qualified scale operators. Integrators must require scale operators to comply with federal regulations for weighing feed for payment purposes.
6. Every live poultry dealer must keep all accounts, records, and memorandum necessary to fully and correctly disclose all transactions involved in the business transaction,

including the true ownership. The scale ticket is a legal document. Every record that is issued where weight is a factor of settlement depends.

Scales used to weigh feed must be attached to a printer which should print weight values on a feed ticket. Producers should never receive scale tickets written by hand. In addition to safeguards at the feed mill, the P&S Act also requires that each scale ticket for feed, where weight of feed is a factor in determining settlement to a producer, must show (USDA, 2008):

1. Name of the company performing the weighing service;
2. Name and address of the producer receiving the feed;
3. Name, initials, or number of the feed weigher, or if required by State law, signature of the feed weigher;
4. Location of the scale;
5. Gross, tare, and net weight of each lot assigned to an individual producer;
6. Date and time gross and tare weights were determined, if applicable;
7. Whether the driver was on or off the truck at the time of weighing and
8. License number of the truck or other identification numbers on the truck and trailer, if weighed together, or trailer if only the trailer is weighed.

Even though integrators are required by law to maintain accurate records, it is important for growers to retain feed tickets and maintain accurate records. Alert the integrator at the first indication there may be a potential concern. The longer growers wait to report a problem, the harder it will be to resolve that problem. In most cases, problems can be quickly resolved when both producer and integrator have accurate records and act in a timely manner. In the unlikely event that a producer cannot satisfactorily resolve a feed issue, the P&S Act authorizes the Grain Inspection, Packers and Stockyards Administration (GIPSA) to investigate complaints of possible violations. Producers may report possible violations of the P&S Act to GIPSA toll free at 1-800-998-3447.

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Comparison – continued on pg. 6

TABLE 1. On-Farm Bin Scale Weights Versus Feed Ticket Weights (Flocks 1-50)¹

Flock No.	Flock dates	On-farm Feed Wts (lbs)	Scale Ticket Wts (lbs)	Difference (lbs)	Difference (%)
1	11/19/90-1/14/91	853330	846900	6430	0.754
2	2/1/91-3/29/91	819520	814480	5040	0.615
3	4/15/91-6/9/91	814290	806240	8050	0.989
4	6/20/91-8/18/91	840360	886960	lightening damage	
5	8/29/91-10/23/91	865658	859360	6298	0.728
6	11/12/91-1/7/92	911938	903720	8218	0.9
7	1/23/92-3/16/92	802864	793960	8904	1.109
8	4/2/92-5/21/92	688720	683580	5140	0.746
9	6/8/92-7/30/92	757580	751230	6350	0.838
10	8/7/92-10/1/92	885928	881620	4308	0.486
11	10/15/92-12/10/92	967180	962810	4370	0.452
12	12/21/92-2/17/93	970436	962900	7536	0.777
13	3/2/93-4/29/93	973240	965190	8050	0.827
14	5/11/93-7/6/93	875352	868970	6382	0.729
15	7/9/93-9/2/93	857972	853220	4752	0.554
16	9/17/93-11/11/93	984974	978570	6404	0.65
17	11/29/93-1/25/94	1072612	1062440	10172	0.948
18	2/10/94-4/6/94	948546	935060	13486	1.422
19	4/19/94-5/31/94	660784	655240	5544	0.839
20	6/9/94-8/3/94	748054	748560	506	0.068
21	8/5/94-9/14/94	588722	586160	2562	0.345
22	9/20/94-11/3/94	666354	664020	2334	0.35
23	11/15/94-12/28/94	671776	665860	5916	0.88
24	1/10/95-2/23/95	692770	686280	6490	0.937
25	3/7/95-4/19/95	578528	582980	4452	0.764
26	5/5/95-6/15/95	649266	644900	4366	0.672
27	6/29/95-8/9/95	618756	610200	8556	1.383
28	8/18/95-9/28/95	647574	641960	5614	0.867
29	10/13/95-11/22/95	613104	605720	7384	1.204
30	12/7/95-1/22/96	665134	671360	6226	0.927
31	1/26/96-3/7/96	557626	552940	4686	0.841
32	3/15/96-4/26/96	601490	595900	5590	0.829
33	5/9/96-6/20/96	598276	593240	5036	0.842
34	7/4/96-8/16/96	618418	606780	11638	1.882
35	10/31/96-12/10/96	685446	689340	3896	0.565
36	12/30/96-2/6/97	591834	581120	10714	1.81
37	2/24/97-4/7/97	663096	654200	8896	1.342
38	4/24/97-6/6/97	661088	652410	8678	1.313
39	6/26/97-8/18/97	858594	850380	8214	0.957
40	9/1/97-10/22-97	776572	770300	6272	0.808
41	11/7/97-12/30/97	839070	830120	8950	1.067
42	1/27/98-3/20/98	848298	843280	5018	0.592
43	4/6/98-5/27/98	777952	767860	10092	1.297
44	6/12/98-8/6/98	816662	813440	3222	0.395
45	8/18/98-10/12/98	866424	863020	3404	0.393
46	10/30/98-12/15/98	746540	695350	51190	6.86
47	1/8/99-3/1/99	818744	810900	7844	0.96
48	3/22/99-5/14/99	831298	820820	10478	1.26
49	5/31/99-7/27/99	933730	928680	5050	0.54
50	8/5/99-9/29/99	911550	901080	10470	1.15
	TOTALS	38694030	38401610	---	---
	AVERAGE	773881	768032	7534	0.99

¹**Bold numbers indicate flocks when scale ticket weights were greater than on-farm feed weights.**

TABLE 2. On-Farm Bin Scale Weights Versus Feed Ticket Weights (Flocks 51-100)¹

Flock No.	Flock dates	On-farm Feed Wts (lbs)	Scale Ticket Wts (lbs)	Difference (lbs)	Difference (%)
51	10/12/99-12/3/99	851880	856600	4720	0.55
52	12/20/99-2/8/00	784042	778900	5142	0.66
53	3/13/00-5/4/00	854550	845030	9522	1.11
54	5/15/00-7/11/00	930726	930940	214	0.02
55	7/21/00-9/12/00	853534	842980	10554	1.24
56	9/22/00-11/13/00	844766	841120	3646	0.43
57	11/28/00-1/19/01	784058	781980	2078	0.27
58	1/30/01-3/23/01	927512	916700	10812	1.18
59	3/29/01-5/10/01	660764	653700	7064	1.08
60	5/18/01-6/30/01	671108	659980	11128	1.69
61	7/5/01-8/17/01	727610	728360	750	0.10
62	8/30/01-10/10/01	681540	651560	29980	4.60
63	10/30/01-12/7/01	611030	608200	2830	0.47
64	12/21/01-2/6/02	903546	898850	4696	0.52
65	2/15/02-4/1/02	868838	866780	2058	0.24
66	4/11/02-5/28/02	930624	935990	5366	0.57
67	6/4/02-7/19/02	843580	831660	11920	1.43
68	8/5/02-9/18/02	770174	767240	2934	0.38
69	11/4/02-12/17/02	697376	697780	404	0.06
70	1/3/03-2/14/03	650214	649670	544	0.08
71	2/27/03-4/10/03	610242	608270	1972	0.32
72	4/29/03-6/10/03	612478	606510	5968	0.98
73	6/19/03-7/31/03	603640	603070	570	0.09
74	8/18/03-9/29/03	591556	589250	2306	0.39
75	10/7/03-11/18/03	685668	677240	8428	1.24
76	12/30/03-2/10/04	749558	752090	2532	0.34
77	2/23/04-4/2/04	610150	606040	4110	0.68
78	4/15/04-5/26/04	563054	561720	1334	0.24
79	6/3/04-7/17/04	645268	637870	7398	1.16
80	8/22/04-10/11/04	740508	733550	6958	0.95
81	10/17/04-11/29/04	713678	699580	14098	2.02
82	1/3/05-2/14/05	809018	809790	772	0.10
83	2/28/05-4/11/05	772700	766430	6270	0.82
84	4/25/05-6/3/05	647250	642160	5090	0.79
85	6/13/05-7/22/05	617892	614490	3402	0.55
86	8/8/05-9/16/05	588314	587940	374	0.06
87	4/11/06-5/19/06	619420	619640	220	0.04
88	6/5/06-7/13/06	703208	704860	1652	0.23
89	8/1/06-9/21/06	1001448	1005120	3672	0.37
90	10/6/06-11/24/06	1002777	992780	9997	1.01
91	12/21/06-2/7/07	902726	912880	10154	1.11
92	2/26/07-4/20/07	947448	947020	428	0.05
93	5/15/07-7/10/07	1035918	1037400	1482	0.14
94	7/27/07-9/24/07	1085270	1088770	3500	0.32
95	10/8/07-12/3/07	1114396	1123690	9294	0.83
96	12/14/07-2/6/08	1003356	998160	5196	0.52
97	2/21/08-4/11/08	947624	945970	1654	0.17
98	4/25/08-6/13/08	906596	915510	8914	0.97
99	6/26/08-8/14/08	929254	942698	13444	1.43
100	8/22/08-10/10/08	950312	955475	5163	0.54
	TOTALS	39558199	39429993	---	---
	AVERAGE	791164	788600	5454	0.70



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Poultry Litter Production and Associated Challenges

Introduction

Agricultural production and processing is big business in Arkansas. A recently released study by the University of Arkansas' Division of Agriculture indicates that in 2007, agriculture accounted for one in six jobs in the state and \$9.16 B in labor income, more than 15% of the state total. Poultry and egg production and processing is the leading industry, with direct impacts of 1 in every 4 agricultural jobs and \$1 in every \$4 in agricultural wages and income. Production of poultry is more heavily concentrated now than in years past in terms of intensity of production, that is, more birds being grown and processed in the same geographic areas as in the past. The result of this increased production activity is larger quantities of poultry litter production. Because of benefits it provides (crop nutrients, increased organic matter), the majority of this poultry litter is, in some form, land applied. Although innovative utilization methods continue to appear, land application remains the current standard.

In 2003, the Arkansas General Assembly passed three companion acts addressing nutrient planner and applicant certification (Act 1059), registration of poultry operations (Act 1060) and application of nutrient and utilization of poultry litter in nutrient surplus areas (Act 1061). Detailed explanations of these acts are contained in the University of Arkansas' Cooperative Extension Service Fact Sheet FSA29 "New Arkansas Laws Regulate the Use and Management of Poultry Litter and Other Nutrients" published in September, 2003.

A significant portion of Act 1061 addresses development and implementation of nutrient management and poultry litter management plans for poultry feeding operations (grow-out farms). Poultry litter management planners shall have obtained certification from Arkansas Soil and Water Conservation Commission (now Arkansas Natural Resources Commission, ANRC) in planning. The poultry litter management plan shall contain: a periodic poultry litter nutrient content analysis component; poultry litter utilization component providing for the proper utilization of the litter produced, including provisions ensuring that land application within a nutrient surplus area is in accordance with a nutrient management plan or at a rate not to exceed the protective rate; land application outside a nutrient surplus area is in a method and at a rate acceptable to ANRC; and litter not land applied is converted to a non-nutrient use or other use acceptable to ANRC; and a records

component that requires the poultry feeding operation owner to maintain sufficient records at the feeding operation to determine poultry litter utilization and compliance with the other portions of the poultry litter management plan.

So, it is necessary that producer operations abide by rules and follow best management practices. Extension personnel can assist agricultural producers in adopting practices and behaviors to help meet their needs, one of which is to determine the amount of poultry litter their operation will likely generate in any given year.

ABRF Litter Production

The Applied Broiler Research Farm (ABRF) at Savoy has been utilized as a source of developing and evaluating management practices and innovative approaches that may improve industry results. The ABRF had grown 98 flocks of birds through June, 2008. To assist producers by sharing experiences with litter produced on the ABRF, detailed records that have been kept on litter removal during total cleanouts and caked litter (de-cake) removal between flocks since the farm began operating were assessed. Table 1 lists yearly caked litter removal at the ABRF. Removal ranged from a low of 31 loads in 1992 to a high of 173 loads in 2002. During the period, a total of 1,459 loads of de-cake were removed by a standard poultry house de-caker pulled behind a tractor with each load containing approximately 2 tons of de-cake. The 1,459 loads at 2 tons per load amounted to 2,918 tons of de-cake or 30% of the total litter removed.

Litter removal during total cleanouts is listed in Table 2. There were 3 periods when the farm was not on an annual cleanout schedule. During the first period, House 1 was not cleaned out from September, 1996 through February, 2000 and houses 2, 3, and 4 were not cleaned from October, 1997 through February, 2000 due to ongoing research. During the second period, the houses were not cleaned from October, 2001 through April, 2003 to cycle back to a spring cleanout schedule. Finally, the houses were not cleaned out in 2007 due to a bedding material shortage. There were 2 cleanouts in 2005; one in April and another in September when the farm underwent renovations. Cleanout totals ranged from a low of 264 tons in September, 2005 to a high of 875 tons in June, 2008. During the period, a total of 6,864 tons of litter were removed at cleanout or 70% of the total. A combined total

of 9,782 tons of litter and de-cake had been removed from the ABRF through June, 2008. This resulted in the following yearly and per-flock litter production information:

9,782 tons/18 yrs = 543 tons per yr/4 houses = **135.87 tons/house/yr**

or

9,782 tons/98 flocks = 99.82 tons/flock for the farm = **24.96 tons/house/flock**

The 4 houses at the ABRF are 40 x 400' (16,000 sq. ft. floor space). Pounds of litter generated per square foot of floor space can be calculated as follows:

135.87 tons of litter per house per year x 2000 lbs per ton = 271,740 lbs litter per house per yr/16,000 sq ft = **16.98 lbs litter per sq ft of floor space per yr**

Pounds of litter produced on a per bird basis can also be estimated. If the total lbs of litter produced (Tables 1 and 2) are divided by either head placed or head sold (Table 3), the pounds of litter per bird can be calculated. The 9,782 total tons of litter removed from the farm converts to 19,564,000

lbs. During the 18 yr period, there were a total of 8,165,941 birds placed on the farm and 7,759,295 birds harvested.

Based on these figures:

19,564,000 lbs /8,165,941 birds placed = **2.396 lbs litter per bird placed**

or

19,564,000 lbs /7,759,295 birds harvested = **2.521 lbs litter per bird harvested**

Litter production figures can vary greatly from farm to farm based on house size, bird harvest weight, management practices, number of flocks per year, etc.

Reference

Goodwin, Jr., H.L., Frank T. Jones, Susan E. Watkins and Janie S. Hipp. "New Arkansas Laws Regulate the Use and Management of Poultry Litter and Other Nutrients." University of Arkansas, Cooperative Extension Service. Publication Number FSA29. September, 2003.

TABLE 1. Yearly caked litter removal between flocks at the ABRF

Year	Decaker loads	Litter (tons) ¹	Litter (lbs)
1992	31	62	124,000
1993	69	138	276,000
1994	120	240	480,000
1995	108	216	432,000
1996	127	254	508,000
1997	68	136	272,000
1998	85	170	340,000
1999	58	116	232,000
2000	85	170	340,000
2001	101	202	404,000
2002	173	346	692,000
2003	104	208	416,000
2004	123	246	492,000
2005	79	158	316,000
2006	50	100	200,000
2007	43	86	172,000
2008	35	70	140,000
TOT			
TOTALS	1,459	2,918	5,836,000

¹Tonnage based on 2 tons per decaker load as determined by portable scales.

Litter Production – continued on pg. 10

TABLE 2. Litter removal at the ABRF during total cleanouts

Year ¹	Cleanout Month	Spreader loads	Litter (tons) ²	Litter (lbs)
1992	March	157	864	1,727,000
1993	May	115	633	1,265,000
1994	April	80	440	880,000
1995	April	74	407	814,000
1996	Sept	74	407	814,000
1997	Oct	52	286	572,000
2000	Feb	130	715	1,430,000
2001	Oct	106	583	1,166,000
2003	April	100	550	1,100,000
2004	April	75	413	825,000
2005	April	78	429	858,000
2005	Sept	48	264	528,000
2008	June	159	875	1,749,000
TOTALS		1,248	6,864	13,728,000

¹Total cleanouts were not always performed on an annual basis.

²Tonnage based on 5.5 tons per spreader truck load as determined by portable scales.

TABLE 3. Yearly number of broilers placed and harvested at the ABRF

Year	Broilers placed ¹	Broilers harvested
1991	376,000	351,532
1992	451,200	419,194
1993	378,400	357,076
1994	602,900	567,416
1995	549,500	535,795
1996	537,875	519,811
1997	514,912	496,376
1998	375,234	366,159
1999	375,214	358,688
2000	378,838	355,158
2001	618,266	593,581
2002	575,919	529,514
2003	495,305	470,235
2004	525,752	495,590
2005	468,980	444,238
2006	343,080	328,058
2007	361,162	345,116
2008 ²	237,404	225,758
TOTALS	8,165,941	7,759,295

¹Placements varied based on harvest age and number of flocks per year.

²Placements include birds placed and harvested between Jan and June 2008.



Broiler Water Consumption

Measuring water consumption of broilers can be an important tool for monitoring flock performance. Birds consume approximately 1.6 to 2 times as much water as feed (on a pound per pound basis); both feed and water consumption steadily increase as a flock ages. Growers often ask “Exactly how much should my birds be drinking each day and should I be concerned if water consumption does not increase every day?” The daily water usage/consumption for the last twelve flocks at the Applied Broiler Research



10 gallons/1000 birds on a daily basis. Water usage dropped around the time the birds began eating the withdrawal feed for most flocks.

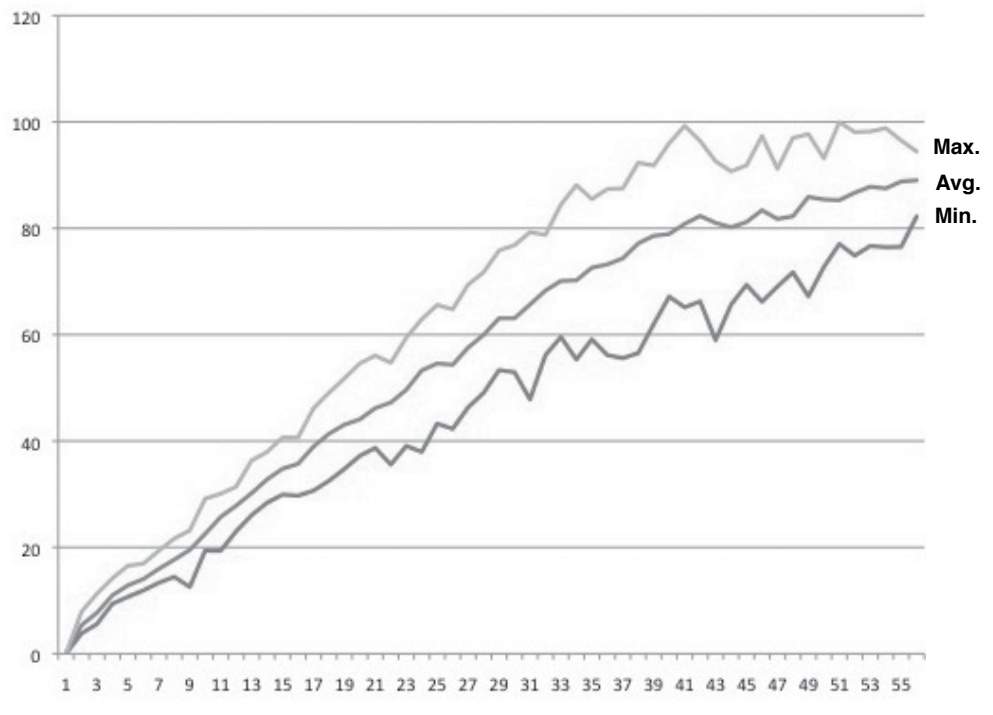
This observation has led us to evaluate some water treatment options which might help the birds adjust to the last feed. Since the ABRF settlements are good, the data presented here should encourage growers to not hit the panic button if flocks experience slight declines or a flat line in water usage for a day. However, there should be an increasing consumption trend. If water usage remains unchanged for more than a day or two, growers should try to identify the cause. A good check list to follow is:

1. Drinker line height, too high or too low
2. Air locks in the water system
3. Water line pressure not correct for age of bird
4. Clogged water filters or drinkers

Farm (ABRF) (4 commercial broiler houses) was analyzed. Daily mortality was removed from the next day’s bird count so that water consumption reflected the actual bird number and not the placement number. Although the ABRF flocks aren’t always at the top of their settlement, average weights and feed conversions /flock are typically good so the following water usage is realistic estimates.

As shown in Table 1, and Figure 1, overall daily water consumption steadily increases between one to almost four gallons per 1000 birds, but there were days when usage dropped or remained similar to the previous day’s usage. Consumption was also analyzed by season; it was observed that water consumption was similar for all seasons until about day 18, when the hotter weather seasons began to show much higher water usage patterns. By day 21, consumption in the warmer seasons outpaced cooler season usage by as much as 6 to

Chart. Daily Water Usage-Minimum, Maximum and Average Gallons per 1000 Birds



Broiler Water – continued on pg. 12

5. Dramatic change in light intensity
6. Frequent changes in day length
7. Feed changes or feed outages
8. Water treatments /additives
9. Birds are sick
10. Too many birds per drinker (due to migration or bird placement numbers in the house)

Water consumption continues to be one of the simplest and most effective tools a poultry grower can use to monitor flock progress. Growers who lack good flock water consumption guidelines can utilize the information from the ABRF as a guideline but are encouraged to develop their own usage patterns. Identifying inconsistencies in water usage patterns can be a useful tool in establishing root causes of performance issues.

Table. Daily Water Usage for 12 Flocks at the Applied Broiler Research Farm

Gallons/1000 Birds

Age (Days)	Minimum Usage	Maximum Usage	Average Usage	Age (Days)	Minimum Usage	Maximum Usage	Average Usage	Age (Days)	Minimum Usage	Maximum Usage	Average Usage
1	0	0	0	19	34.75	51.78	43.07	37	55.57	87.49	74.35
2	3.8	7.89	5.35	20	37.22	54.59	44.08	38	56.54	92.33	77.16
3	5.59	11.27	7.7	21	38.7	56.07	46.19	39	61.99	91.8	78.59
4	9.39	14.17	10.98	22	35.57	54.71	47.23	40	67.15	95.99	78.92
5	10.7	16.55	12.84	23	39.07	59.43	49.63	41	65.14	99.26	80.83
6	11.9	16.95	10.04	24	37.96	62.89	53.28	42	66.24	96.43	82.32
7	13.34	19.35	15.96	25	43.26	65.58	54.58	43	58.97	92.61	81.01
8	14.46	21.65	17.69	26	42.29	64.76	54.34	44	65.63	90.7	80.19
9	12.55	23.17	19.51	27	46.33	69.41	57.56	45	69.37	91.83	81.18
10	19.39	29.15	22.54	28	49.05	71.73	59.96	46	66.19	97.36	83.39
11	19.38	30.08	25.71	29	53.33	75.82	63.08	47	69.05	91.2	81.75
12	23.01	31.4	27.83	30	52.94	76.83	63.08	48	71.72	97	82.26
13	26.04	36.33	30.19	31	47.83	79.26	65.66	49	67.22	97.7	85.9
14	28.39	37.94	32.78	32	56.15	78.76	68.29	50	72.72	93.16	85.41
15	29.92	40.64	34.78	33	59.55	84.47	70.1	51	77.05	99.95	85.29
16	29.71	40.64	35.71	34	55.33	88.12	70.22	52	74.86	98.08	86.69
17	30.66	46.14	38.94	35	59.12	85.49	72.59	53	76.68	98.19	87.82
18	32.51	49.07	41.36	36	56.15	87.38	73.21	54	76.45	98.83	87.5

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