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Do Vaccines Really Work at Reducing *Salmonella* in Poultry?

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Poultry accounts for nearly 17% of foodborne outbreaks associated with *Salmonella* in the United States. The United States Department of Agriculture (USDA) implemented the Hazard Analysis of Critical Control Points (HACCP) program in an attempt to reduce foodborne illnesses in the United States and set

Article continues on page 2

Contents

Do Vaccines Really Work at Reducing <i>Salmonella</i> in Poultry?	1-3
Excerpts. "Broiler Hatchery" "Chicken and Eggs" and Turkey Hatchery...	4
Broiler performance data (Company) Previous month	5
Meetings, Seminars and Conventions	6

Broiler Live Production Cost	Average Company
Feed Cost/ton w/o color (\$)	271.33
Feed cost /lb meat (c)	24.68
Days to 4.6 lbs	39
Chick cost / lb (c)	4.53
Vac-Med cost/lb (c)	0.04
WB & ½ parts condemn. Cost/lb	0.19
% mortality	3.62
Sq.Ft. @ placement	0.84
Lbs/sq. ft.	7.40
Downtime (days)	16

Data for week ending November 29th 2010

performance standards for the poultry industry with regards to chicken carcass contamination with *Salmonella*. Despite recent successes in lowering poultry carcass contamination with *Salmonella* to 7.5%, human illnesses associated with *Salmonella* have not changed in the 14 years since the inception of HACCP. With a recent multi-state, foodborne outbreak associated with *Salmonella enterica* Enteritidis and table eggs, there will be added pressure by the USDA and the Food and Drug Administration to bear on the poultry industry to reduce *Salmonella* levels in poultry products.

The HACCP *Salmonella* performance standard for allowable carcass contamination has recently been lowered to 7.5%. While many poultry companies have met the old standard for USDA compliance, some smaller companies may struggle with meeting the new HACCP compliance standard. Only so much can be done in the processing plant to reduce carcass contamination with *Salmonella* (inside-outside bird washers, chemical treatments, etc.). In order for a poultry company to be in compliance with the new USDA HACCP *Salmonella* performance standard may require reducing the level of *Salmonella* contamination coming into the plant.

Any on-farm intervention strategy for reducing *Salmonella* prevalence and load in birds entering the plant requires an understanding of pathogen transmission dynamics within the food production system and identifying an intervention that works. Several interventions have been proposed (vaccines, probiotics, etc.), but few have been validated “in the field”. In addition, there have been some reservations in the poultry industry to vaccinating pullets out of concerns over adverse vaccine reactions, reduced egg production, and doubts whether *Salmonella* vaccines actually work. We have recently evaluated the effectiveness of a *Salmonella* vaccination program at reducing broiler chicken carcass contamination with *Salmonella* by comparing two commercial poultry companies. One of the companies participating in the study had failed a HACCP 52-day sample set for carcass contamination with *Salmonella*. This company started a *Salmonella* vaccination program in response to non-compliance with USDA Food Safety Inspection Service (FSIS) over HACCP *Salmonella* performance standards. Their vaccination regimen involved the administration of a live, attenuated *S. Typhimurium* vaccine (Megan VAC1™) and a killed, bacterin vaccine consisting of *S. Berta* and *S. Kentucky* to chicken pullets. Placement of this intervention step at the breeder level was made under the assumption that most chicken carcass contamination was due to vertical transmission of *Salmonella* from breeders to broiler chicken progeny. The company vaccinating pullet chickens against *Salmonella* will be referred to in this communication as Company VAX. A second commercial poultry operation recruited for this study was passing their HACCP *Salmonella* performance standards. This company, referred to as Company NO VAX, did not vaccinate their birds against *Salmonella*. We observed for Company VAX a marked decrease in *Salmonella* prevalence in both breeder flocks (25% VS 57%; $p < 0.0001$) and their broiler progeny (23% VS 33%; $p = 0.005$) compared to Company NO VAX. Fewer *Salmonella* positive flocks were placed on broiler farms, originating from the breeder flocks vaccinated against *Salmonella* (18% vs. 33%; $p < 0.001$). We also observed lower *Salmonella* prevalence for broiler chicken farms contracted with Company VAX (14% vs. 30%; p

<0.001). The most pronounced reduction in *Salmonella* prevalence was observed for broiler chickens originating from vaccinated breeder flocks at the early to mid point in their egg laying production cycle. It also appears that vaccination identified proportion of carcass contamination attributed to vertical transmission of *Salmonella* from breeders to their broiler progeny. *Salmonella* isolates are currently being “fingerprinted” by pulsed-field gel electrophoresis to estimate how much of carcass contamination is due to vertical transmission. No other management practices were identified between the two poultry companies that accounted for reduction in carcass, other than vaccination.

To date, Company VAX is into their 4th year of vaccination. The composition of the killed, *Salmonella* bacterin has changed from year to year in accordance with USDA regulations and *Salmonella* serotypes circulating in breeder and broiler chicken flocks. This company does their own “in-house” monitoring for carcass contamination with *Salmonella*. They did not observe any significant change in *Salmonella* prevalence until after 6 months of vaccination. This delay may reflect the time it takes to replace older breeder flocks with new, vaccinated birds. Presently, Company VAX is reporting 0 *Salmonella*-positive carcasses for their 52-day sample set.

Vaccination does appear to be the one intervention that is quite effective at reducing *Salmonella* contamination of broiler chicken carcasses (this study). Toyota-Hanatani et al. (2009) have also demonstrated the effectiveness of vaccination in reducing *S. Enteritidis* in commercial table egg operation (Applied and Environmental Microbiology volume 75: 1005-1010). Research is needed to correlate *Salmonella* antibody titers with protection in vaccinated flocks vs. un-vaccinated birds. Immunological tools are also needed to assess and measure a poultry flock’s immune response, immune status, and antibody titers to *Salmonella* and determine whether a vaccination regimen is working. While *Salmonella* vaccination is promising for reducing *Salmonella* contamination of meat birds and table eggs, it should be used as one part of a comprehensive prevention program that include other control measures and not as the sole intervention step for controlling *Salmonella* in poultry. The work described in this communication has recently been accepted for publication in Applied and Environmental Microbiology (title: The effect of *Salmonella* vaccination of chicken breeders on reducing carcass contamination of broiler chickens in commercial poultry operations).

Excerpts from the latest USDA National Agricultural Statistics Service (NASS) “Broiler Hatchery,” “Chicken and Eggs” and “Turkey Hatchery” Report and Economic Research Service (ERS) “Livestock, Dairy and Poultry Situation Outlook”

Chickens and Eggs

Released November 22, 2010, by NASS, Agricultural Statistics Board, USDA

October Egg Production Down Slightly

U.S. egg production totaled 7.68 billion during October 2010, down slightly from last year. Production included 6.60 billion table eggs, and 1.08 billion hatching eggs, of which 1.01 billion were broiler-type and 71 million were egg-type. The total number of layers during October 2010 averaged 336 million, up slightly from last year. October egg production per 100 layers was 2,285 eggs, down slightly from October 2009.

All layers in the U.S. on November 1, 2010, totaled 336 million, down slightly from last year. The 336 million layers consisted of 279 million layers producing table or market type eggs, 54.2 million layers producing broiler-type hatching eggs, and 2.96 million layers producing egg-type hatching eggs. Rate of lay per day on November 1, 2010, averaged 73.8 eggs per 100 layers, down 1 percent from November 1, 2009.

Egg-Type Chicks Hatched Up 10 Percent

Egg-type chicks hatched during October 2010 totaled 41.3 million, up 10 percent from October 2009. Eggs in incubators totaled 38.6 million on November 1, 2010, up 12 percent from a year ago. Domestic placements of egg-type pullet chicks for future hatchery supply flocks by leading breeders totaled 170 thousand during October 2010, down 39 percent from October 2009.

Broiler-Type Chicks Hatched Up 5 Percent

Broiler-type chicks hatched during October 2010 totaled 767 million, up 5 percent from October 2009. Eggs in incubators totaled 618 million on November 1, 2010, up 7 percent from a year earlier. Leading breeders placed 6.88 million broiler-type pullet chicks for future domestic hatchery supply flocks during October 2010, up 8 percent from October 2009.

Broiler Hatchery

Released December 1, 2010, by NASS, Agricultural Statistics Board, USDA

Broiler-Type Eggs Set In 19 Selected States Up 2 Percent

Commercial hatcheries in the 19-State weekly program set 206 million eggs in incubators during the week ending November 27, 2010. This was up 2 percent from the eggs set the corresponding week a year earlier. Average hatchability

for chicks hatched during the week was 84 percent. Average hatchability is calculated by dividing chicks hatched during the week by eggs set three weeks earlier.

Broiler Chicks Placed Up 4 Percent

Broiler growers in the 19-State weekly program placed 165 million chicks for meat production during the week ending November 27, 2010. Placements were up 4 percent from the comparable week a year earlier. Cumulative placements from January 3, 2010 through November 27, 2010 were 7.95 billion, up 2 percent from the same period a year earlier.

Turkey Hatchery

Released November 17, 2010, by the NASS, Agricultural Statistics Board, USDA

Eggs in Incubators on November 1 Up 9 Percent from Last Year

Turkey eggs in incubators on November 1, 2010, in the United States totaled 28.3 million, up 9 percent from November 1, 2009. Eggs in incubators were up 8 percent from the October 1, 2010 total of 26.2 million eggs. Regional changes from the previous year were: East North Central up 19 percent, West North Central up 8 percent, North and South Atlantic up 12 percent, and South Central and West down 8 percent.

Poults Hatched During October Up Slightly from Last Year

Turkey poults hatched during October 2010, in the United States totaled 22.1 million, up slightly from October 2009. Poults hatched were down slightly from the September 2010 total of 22.1 million poults. Regional changes from the previous year were: East North Central up 7 percent, West North Central down 2 percent, North and South Atlantic down 2 percent, and South Central and West up 3 percent.

Net Poults Placed During October Down Slightly from Last Year

The 21.2 million net poults placed during October 2010 in the United States were down slightly from the number placed during the same month a year earlier. Net placements were down 2 percent from the September 2010 total of 21.7 million.

Current Month Charts

Broiler Performance Data Live Production Cost	Region					Average Company
	SW	Midwest	Southeast	Mid-Atlantic	S-Central	
Feed Cost/ton w/o color (\$)	264.09	252.88	278.22	275.72	240.06	271.33
Feed cost /lb meat (c)	23.01	22.83	24.79	26.02	24.71	24.68
Days to 4.6 lbs	40	39	39	39	39	39
Chick cost / lb (c)	4.26	4.45	4.77	4.15	4.37	4.53
Vac-Med cost/lb (c)	0.08	0.02	0.04	0.05	0.01	0.04
WB & ½ parts condemn. Cost/lb	0.17	0.21	0.14	0.22	0.16	0.19
% mortality	3.58	3.52	3.65	4.40	3.33	3.62
Sq.Ft. @ placement	0.80	0.80	0.84	0.92	0.83	0.84
Lbs/sq. ft.	7.82	7.45	6.88	7.47	7.82	7.40
Downtime (days)	15	13	16	18	16	16

Broiler Whole Bird Condemnation	Region					Average Company
	SW	Midwest	Southeast	Mid-Atlantic	S-Central	
% Septox	0.164	0.258	0.107	0.163	0.090	0.157
% Airsac	0.029	0.062	0.031	0.071	0.026	0.043
% I.P.	0.009	0.018	0.006	0.042	0.014	0.021
% Leukosis	0.001	0.001	0.001	0.001	0.000	0.001
% Bruises	0.003	0.001	0.007	0.003	0.002	0.003
% Other	0.007	0.009	0.017	0.044	0.005	0.016
% Total	0.211	0.349	0.168	0.324	0.138	0.240
% ½ parts condemns	0.236	0.290	0.207	0.253	0.326	0.279

Data for week ending Nov. 29th 2010

Previous Month Charts

Broiler Performance Data Live Production Cost	Region					Average Company
	SW	Midwest	Southeast	Mid-Atlantic	S-Central	
Feed Cost/ton w/o color (\$)	248.83	236.40	263.36	259.00	252.05	254.56
Feed cost /lb meat (c)	22.60	21.19	23.19	24.12	23.01	22.94
Days to 4.6 lbs	40	39	39	39	39	40
Chick cost / lb (c)	4.21	4.29	4.70	4.16	4.20	4.44
Vac-Med cost/lb (c)	0.08	0.03	0.05	0.05	0.01	0.05
WB & ½ parts condemn. Cost/lb	0.14	0.17	0.12	0.17	0.14	0.16
% mortality	3.35	4.08	3.42	3.72	2.98	3.37
Sq.Ft. @ placement	0.80	0.81	0.84	0.91	0.83	0.84
Lbs/sq. ft.	7.77	7.57	6.97	7.44	7.89	7.43
Downtime (days)	14	12	14	18	15	14

Broiler Whole Bird Condemnation	Region					Average Company
	SW	Midwest	Southeast	Mid-Atlantic	S-Central	
% Septox	0.129	0.203	0.087	0.143	0.089	0.129
% Airsac	0.025	0.033	0.018	0.044	0.021	0.030
% I.P.	0.007	0.014	0.004	0.028	0.011	0.016
% Leukosis	0.000	0.000	0.000	0.001	0.001	0.001
% Bruises	0.002	0.001	0.004	0.004	0.002	0.003
% Other	0.007	0.004	0.014	0.014	0.004	0.009
% Total	0.170	0.256	0.128	0.234	0.128	0.186
% ½ parts condemns	0.224	0.289	0.201	0.247	0.318	0.266

Data for week ending Oct. 29th 2010

Meetings, Seminars and Conventions

2011 January

January 24-25, 2011. Southern Conference on Avian Diseases (SCAD) The meeting will be held together with Southern Poultry Science Society at the International Scientific Forum in Atlanta GA. Registration is on line at <http://www.internationalpoultryexposition.com/ipsf/>

January 26-28, 2011. International Poultry Expo To be held at the Georgia World Congress Center in Atlanta, GA. For more information go to <http://www.ipe11.org/>

2011 March

March 16-17, 2011. The Midwest Poultry Federation 40th Annual Convention. Saint Paul River Centre in Saint Paul, Minnesota. For details, please visit http://www.midwestpoultry.com/?option=com_frontpage&Itemid=1

March 21-23, 2011. 60th Western Poultry Disease Conference. Holiday Inn Capitol Plaza, Sacramento, CA, USA. For more info: <http://www.conferences.ucdavis.edu/wpdc>

March 25-27, 2011. 7th International Poultry Show & Seminar. Bangabandhu International Conference Center in Dhaka, Bangladesh. For more info, please contact Dr. M.A. Saleque, ma_saleque05@yahoo.com

2011 April

April 11-14, 2011. National Institute for Animal Agriculture (NIAA) Annual Conference. San Antonio, TX. For more info: <http://www.animalagriculture.org/Solutions/Annual%20Conference/2011/Home.html>

April 13-16, 2011. AMI International Meat, Poultry, & Seafood Industry Convention and Exposition. To be held at McCormick Place in Chicago, IL. <http://www.amiexpo.com/>

2011 May

May 15-18, 2011. 1st International Avian Respiratory Disease Conference Georgia Center for Continuing Education, University of Georgia, Athens, GA. For more information, please contact Dr. Mark Jackwood, mjackwoo@uga.edu.

2011 July

July 16-19, 2011. AVMA Annual Convention. The American Veterinary Medical Association is holding this event with the Poultry Science Association (PSA) and the American Association of Avian Pathologists. St. Louis, MO. For more info: <https://www.avmaconvention.org/avma10/public/Content.aspx?ID=2816&sortMenu=101001>

2011 August

August 14-18, 2011. XVII Congress & Exhibition of the World Veterinary Poultry Association Cancun, Mexico. More info: www.congressmexico.com

2011 September

September 18-22, 2011. IEC's Annual Marketing and Production Conference. The International Egg Commission will hold this event in Washington D.C. this year. Further details to be announced.

September 29-October 5, 2011. USAHA Annual Meeting. The U.S. Animal Health Association will be holding this event in Buffalo Adam's Mark Hotel in Buffalo, NY. More info: <http://www.usaha.org/meetings/>



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Reminder

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