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Could in ovo probiotic be beneficial to chicks?

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Having discovered that the gut of the developing chick embryo is not sterile, Dr Adriana Pedroso, and Dr Margie Lee have decided to investigate the ramifications of in ovo probiotic administration. .

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Broiler Live Production Cost	Average Company
Feed Cost/ton w/o color (\$)	239.46
Feed cost /lb meat (c)	21.66
Days to 4.6 lbs	40
Chick cost / lb (c)	4.83
Vac-Med cost/lb (c)	0.05
WB & ½ parts condemn. Cost/lb	0.15
% mortality	3.46
Sq.Ft. @ placement	0.84
Lbs/sq. ft.	7.07
Downtime (days)	20

Data for week ending 21st November 2009

Synopsis

Work at The Poultry Diagnostic and Research Center suggests that development of the intestinal microbiota starts in ovo. Therefore, a probiotic may be effective if administered early in the chicken's intestinal development essentially at the embryonic phase. Early establishment of the "foundation" microbiota could induce better gut development, and animal performance. Understanding the embryo's response to these potentially symbiotic organisms is the first step to positively manipulate the microbiota to improve performance and intestinal health, while reducing enteropathogen colonization of broiler chickens.

In an organic production system, every ingredient in the product must be produced and harvested in an organic environment (USDA, 2006), without traditional growth promoters. The poultry organic market has almost quadrupled since 2003. Estimates of annual growth in the market ranges from 23 to 38 percent by the end of the decade, with annual sales expected to reach almost \$600 million (NBJ, 2006). At this moment, our challenge is to cost-effectively produce wholesome and safe organic poultry meat. In addition, the poultry industry is also facing pressure to reduce carcass contamination with *Salmonella* and *Campylobacter*, as the US government strives to reduce human foodborne illnesses by 2010 (FoodNet, 2005). While some success has been observed in reducing human illnesses associated with *Campylobacter* and *Listeria monocytogenes* (Healthy People 2010, 2000), *Salmonella* prevalence is 14 cases/100,000 people, far from the target goal of 7 cases/100,000.

As an alternative to traditional growth promoters, probiotics, products based on live microorganisms or microbial products have been widely sought in the poultry industry. The term competitive exclusion, introduced by Nurmi and Rantala (1973) is used to describe the process by which beneficial bacteria exclude pathogens from the intestine. Although probiotics composed of complex microbial communities may lack proper characterization as to genera or species, some field studies suggest these formulations can be effective in improving animal performance and reducing colonization with *Salmonella* or *Campylobacter*. However, probiotics have not been embraced by the poultry industry, partly due to inconsistent results. The problem with effectiveness may result from the lack of knowledge regarding the period in which to administer the probiotic while rearing birds.

Probiotics administered at the poultry farm can potentially provide better intestinal health and weight gain during production. Probiotics could be administered to 1-day-old chicks at the hatchery or at placement, in order to establish a healthy intestinal microbiota as soon as possible. However one-day old chicks may already have an established microbial community in their intestines (Pedroso et al., 2005). This resident microbial community can affect the establishment of probiotic strains because the intestinal niche is already occupied. Some researchers have shown that chicks are placed on farms only 48 hours after hatch (Baião et al., 1998), during this period animals are intensively handled, creating opportunities for colonization with undesirable microbes (Edens et al., 1997).

In order to promote early and beneficial intestinal colonization it has been proposed that chicks receive a probiotic at the hatchery. Probiotics can be administered as a spray to embryonating eggs inside the incubator or to newly hatched chicks during the chick classification (Gillingham, 2007). An attractive way to deliver probiotics might be *in ovo*. Many vaccines using the *in ovo* technology are applied at 18th day of incubation (Ding et al., 2005, Williams et al., 2000). However while there is a consensus that undefined probiotics need to be administered as early as possible, strategies for probiotic supplementation *in ovo* are scarce.

Although several studies have suggested that alimentary tract of the newly hatched chicks is sterile (Amit-Romach et al., 2004, van der Wielen et al., 2002, Mead, 1989), recent findings indicate that bacteria can become established in the intestine as the embryo develops to stage where the gastrointestinal tract differentiates and closes, and the embryo starts ingestion of the amniotic fluid (Klasing, 1998). Microorganisms present in the yolk could also be internalized at the 18th day of incubation as the yolk sac becomes internalized (Deeming, 2005). Therefore, probiotics could theoretically be introduced into embryonated eggs and establish itself as the chick's intestinal microbiota.

Very little research has been initiated to evaluate the parameters of culture establishment in the gut of pre-hatched chicks. But the *in ovo* technique to apply probiotics can be promising; defined probiotics were successfully inoculated in embryonated eggs without damage to embryos (Oliveira et al., 2003, Leandro et al., 2004). For example Loddi et al. (2005, 2006) inoculated 10^6 CFU of a commercial formulation of *Lactobacillus acidophilus* and *Bifidobacterium bifidum* into embryos and obtained improved intestinal integrity and reduction of *Salmonella*.

Administration of a 10^3 and 10^6 dilution of an experimental cecal culture to embryos into the amniotic fluid at 18th d of incubation was not met with success (Cox et al., 1992). The dose of commercial probiotic to administer to chicks after hatch has been established; but little exists in the literature related to doses to be used in pre-hatching chicks. For example, the manufacturer's instructions for Aviguard is to dilute 40-fold (1.25 mg of bacteria) for administration to neonates (Bayer, 2000), 1 mg of Broilact can be delivered to chicks (Schneitz et al., 1998) and Preempt is used at a dose of 0.25 mL of reconstituted product per chick (BioScience, 1998).

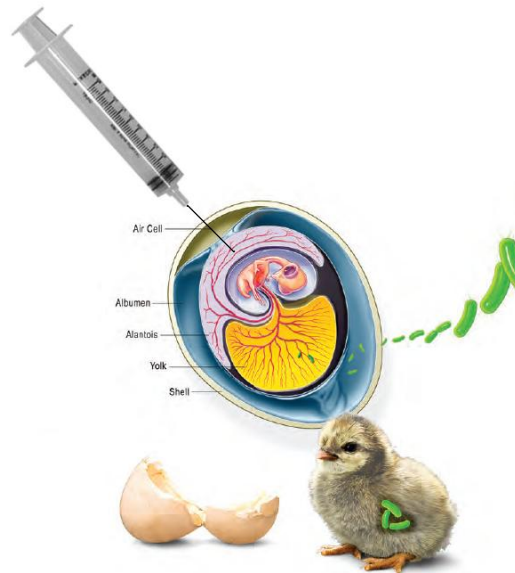


Figure 1. Methodology for inoculation of the probiotic in ovo

Published research has demonstrated that probiotics administered to embryonated eggs could provide protection to the chick gastrointestinal tract against colonization by pathogens as *Salmonella*. Chickens, hatched from eggs inoculated with probiotic, followed by *Salmonella* challenge after hatch, had similar performance after 21 days compared to the unchallenged control. Chicks which did not receive probiotic *in ovo*, and were challenged after hatching had decrease growth performance (Oliveira et al., 2004, Leandro et al., 2003). *In ovo* inoculation is currently an area of interest for our research team (Pedroso et al., 2006c). Probiotics may be effective as growth promoters in chicks, but we need a better understanding of the role of the microbiota in maturation of the developing chicken embryo.

Molecular tools have contributed greatly to our understanding of the microbial colonization dynamics of the developing chicken intestine. New approaches in the techniques of identification of the microbiota of the gastrointestinal tract of the chickens applied to probiotics may result in more comprehensive understanding of the intestinal microbial ecology.

Our research team has taken this approach to animal production in our attempt to better understand the microbial colonization dynamics of the intestinal tract of chicken embryos. The neonatal chick microbiota is an interest for our research team. Understanding the embryo's response to a probiotic is the first step to positively manipulate the microbiota for improved performance and intestinal health. The information gained from this research will assist in the production of drug-free chickens and a safer, wholesome product for consumption.

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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 23, 2009, by the National Agricultural Statistics Service

October Egg Production Up 1 Percent

U.S. egg production totaled 7.69 billion during October 2009, up 1 percent from last year. Production included 6.63 billion table eggs, and 1.06 billion hatching eggs, of which 990 million were broiler-type and 70 million were egg-type. The total number of layers during October 2009 averaged 336 million, up slightly from last year. October egg production per 100 layers was 2,292 eggs, up 1 percent from October 2008.

All layers in the U.S. on November 1, 2009 totaled 337 million, up slightly from last year. The 337 million layers consisted of 281 million layers producing table or market type eggs, 52.3 million layers producing broiler-type hatching eggs, and 2.90 million layers producing egg-type hatching eggs. Rate of lay per day on November 1, 2009, averaged 74.3 eggs per 100 layers, up 1 percent from November 1, 2008.

Egg-Type Chicks Hatched Down 7 Percent

Egg-type chicks hatched during October 2009 totaled 37.4 million, down 7 percent from October 2008. Eggs in incubators totaled 34.8 million on November 1, 2009, up 3 percent from a year ago. Domestic placements of egg-type pullet chicks for future hatchery supply flocks by leading breeders totaled 241 thousand during October 2009, down 12 percent from October 2008.

Broiler-Type Chicks Hatched Down 2 Percent

Broiler-type chicks hatched during October 2009 totaled 729 million, down 2 percent from October 2008. Eggs in incubators totaled 577 million on November 1, 2009, down 1 percent from a year earlier. Leading breeders placed 7.02 million broiler-type pullet chicks for future domestic hatchery supply flocks during October 2009, down slightly from October 2008.

Broiler Hatchery

Released November 25, 2009, by the National Agricultural Statistics Service (NASS).

Broiler-Type Eggs Set In 19 Selected States Down 1 Percent

Commercial hatcheries in the 19-State weekly program set 202 million eggs in incubators during the week ending November 21, 2009. This was down 1 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 Down 1 Percent

Broiler growers in the 19-State weekly program placed 151 million chicks for meat production during the week ending November 21, 2009. Placements were down 1 percent from the comparable week a year earlier. Cumulative placements from December 28, 2008 through November 21, 2009 were 7.79 billion, down 4 percent from the same period a year earlier.

Turkey Hatchery

Released November 16, 2009, by the National Agricultural Statistics Service (NASS).

Eggs in Incubators on November 1 Down 6 Percent from Last Year

Turkey eggs in incubators on November 1, 2009, in the United States totaled 25.8 million, down 6 percent from November 1, 2008. Eggs in incubators were down 2 percent from the October 1, 2009 total of 26.4 million eggs. Regional changes from the previous year were: East North Central down 9 percent, West North Central up 3 percent, North and South Atlantic down 18 percent, and South Central and West up 9 percent.

Poults Hatched During October Down 5 Percent from Last Year

Turkey poults hatched during October 2009, in the United States totaled 22.0 million, down 5 percent from October 2008. Poults hatched were down slightly from September 2009 total of 22.0 million poults. Regional changes from the previous year were: East North Central down 9 percent, West North Central up 3 percent, North and South Atlantic down 12 percent, and South Central and West down 11 percent.

Net Poults Placed During October Down 5 Percent from Last Year

The 21.1 million net poults placed during October 2009 in the United States were down 5 percent from the number placed during the same month a year earlier. Net placements were up 1 percent from the September 2009 total of 20.8 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 (\$)	239.22	219.34	246.16	238.43	238.89	239.46
Feed cost /lb meat (c)	21.65	19.90	21.90	22.48	21.90	21.66
Days to 4.6 lbs	41	39	40	39	39	40
Chick cost / lb (c)	4.66	4.64	4.89	4.29	4.71	4.83
Vac-Med cost/lb (c)	0.03	0.04	0.08	0.03	0.03	0.05
WB & ½ parts condemn. Cost/lb	0.14	0.18	0.12	0.15	0.14	0.15
% mortality	3.30	3.87	3.53	3.99	3.07	3.46
Sq.Ft. @ placement	0.80	0.81	0.84	0.98	0.82	0.84
Lbs/sq. ft.	7.27	7.22	6.82	7.10	7.61	7.07
Downtime (days)	18	16	21	22	20	20
Broiler Whole Bird Condemnation	Region					Average Company
	SW	Midwest	Southeast	Mid-Atlantic	S-Central	
% Septox	0.131	0.233	0.092	0.120	0.076	0.119
% Airsac	0.022	0.080	0.033	0.027	0.030	0.031
% I.P.	0.007	0.034	0.004	0.009	0.021	0.013
% Leukosis	0.000	0.001	0.000	0.002	0.001	0.001
% Bruises	0.002	0.001	0.005	0.001	0.002	0.002
% Other	0.006	0.005	0.009	0.006	0.006	0.006
% Total	0.168	0.354	0.142	0.165	0.136	0.172
% ½ parts condemns	0.232	0.253	0.205	0.281	0.296	0.263

Data for week ending 21st November 2009

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 (\$)	244.75	222.63	248.33	240.74	241.29	243.37
Feed cost /lb meat (c)	21.94	20.02	21.89	22.46	22.03	21.88
Days to 4.6 lbs	41	40	40	39	40	40
Chick cost / lb (c)	4.91	4.59	5.00	4.31	4.55	4.85
Vac-Med cost/lb (c)	0.04	0.04	0.08	0.03	0.03	0.06
WB & ½ parts condemn. Cost/lb	0.15	0.16	0.12	0.15	0.14	0.15
% mortality	3.19	3.49	3.51	3.88	2.99	3.38
Sq.Ft. @ placement	0.80	0.81	0.83	0.98	0.82	0.84
Lbs/sq. ft.	7.23	7.19	6.76	7.06	7.68	7.06
Downtime (days)	18	14	20	20	20	19

Broiler Whole Bird	Region					Average Company
	SW	Midwest	Southeast	Mid-Atlantic	S-Central	
% Septox	0.144	0.198	0.087	0.132	0.082	0.126
% Airsac	0.024	0.032	0.033	0.031	0.033	0.030
% I.P.	0.008	0.014	0.004	0.010	0.021	0.012
% Leukosis	0.000	0.001	0.001	0.002	0.001	0.001
% Bruises	0.002	0.001	0.005	0.002	0.003	0.002
% Other	0.006	0.005	0.011	0.006	0.006	0.006
% Total	0.184	0.251	0.140	0.182	0.145	0.177
% ½ parts condemns	0.232	0.258	0.205	0.264	0.315	0.272

Data for week ending 31st October 2009

Meetings, Seminars and Conventions

2010

January

January 25-26, 2010 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/lipf/>

2010

February

February 10-13, 2010 National Turkey Federation Annual Convention at the Westin Riverwalk in San Antonio, Texas For more information contact: Jennifer Zukowski at email: jzu-kowski@turkeyfed.org

2010

March

March 14-16: 61st North Central Avian Disease Conference Call for Titles. St. Paul River Centre, St. Paul, Minnesota. Titles and a brief description should be submitted by December 1, 2009 to Dr. Daniel Shaw (573-884-0879) at shawd@missouri.edu (Veterinary Medical Diagnostic Laboratory, P.O. Box 6023, Columbia, MO 65205)

2010

April

April 18-21, 2010: The 59th Western Poultry Disease Conference (WPDC) and American College of Poultry Veterinarians Workshop will be held at The Fairmont Hotel Vancouver - Vancouver, BC, Canada. Information regarding title submission, registration and hotel can be found on the WPDC website: <http://conferences.ucdavis.edu/wpdc>.

April 20-23: VIV Europe 2010, Utrecht, The Netherlands. Contact: XNU Exhibitions Europe B.V, P.O. Box 8800, 3503 RV Utrecht, The Netherlands, Fax: +31 302-952-809; Website: www.viv.net

April 26-30: XII International Seminar on Avian Pathology and Production. Program in Spanish and English. AMEVEA-University of Georgia, Athens, Georgia. , 2010. Contact: Dr. Pedro Villegas, Univ. of Georgia. Seminar2010@uga.edu

2010

August

August 1-4, 2010 AVMA/AAAP 2010 Scientific Program at the Georgia World Congress Center in Atlanta, Georgia, USA. AAAP is calling for submissions of papers to the Poultry Section for Oral & Poster Presentations. Applications must be submitted on or before December 1, 2009. Submissions can be done online on our web site at: [2010 AVMA/AAAP Meeting - Call for Papers Online Submission Form](#) or by completing the application form (pdf) and submitting to: 2010AAAP@aaap.info

2010

September

September 2-7, 2010. Options for the Control of Influenza VII. Hong Kong, SAR, CHINA. Launched in 1985 this international conference is devoted exclusively to influenza for all disciplines involved in influenza prevention, control and treatment, including seasonal and pandemic planning.

2010

October

October 4-6, 2010. 45th National Meeting on Poultry Health and Processing. Clarion Resort Fontainebleau Hotel Ocean City, Maryland

2011

September

September 19-24, 2011. XVII Congress & Exhibition of the World Veterinary Poultry Association Cancun, Mexico. More info: www.congressmexico.com



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