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Intestinal Integrity in Broilers

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The term "intestinal integrity" is difficult to define and yet absolutely critical in the conversion of feed to food. The efficiency of nutrient digestion and absorption is limited by the functional surface area of the intestinal tract which is itself dependant on the development and maintenance of a healthy intestinal lining. In this article Dr Fred Hoer, a well respected specialist discusses the nebulous topic of *Intestinal Integrity in Broilers*.

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Broiler Live Production Cost	Average Company
Feed Cost/ton w/o color (\$)	229.06
Feed cost /lb meat (c)	21.27
Days to 4.6 lbs	41
Chick cost / lb (c)	4.7
Vac-Med cost/lb (c)	0.05
WB & ½ parts condemn. Cost/lb	0.14
% mortality	4.01
Sq.Ft. @ placement	0.85
Lbs/sq. ft.	6.97
Downtime (days)	14

Data for week ending July 2nd 2010

Intestinal integrity for commercial poultry can be defined as the maintenance of intestinal health to enable the expression of the full genetic potential for growth and yield and to fully utilize the dietary nutrients. Evaluation of intestinal integrity in broiler production involves multiple approaches that involve assessment of production records, clinical examination of the flock, necropsy examination, and histopathology. Additional assessments are applied for research purposes. Evaluation of intestinal integrity should be an ongoing activity within a broiler production program. The evaluation is most valuable if performed consistently, using various measurements and scoring methods, and the results recorded in a spreadsheet for analysis. A selection procedure should define if random normal birds will be selected for examination, or affected birds that represent a problem, or a combination of healthy and affected.

Feed conversion and weight gain relative to the anticipated energy formulation of the diet are sensitive indicators of a problem that involve intestinal health. Total water consumption should be measured and recorded daily for each farm, or preferably, each house.

Clinical assessment of the flock includes assessment of fecal droppings. Poorly formed feces without a urate cap, and feces with excessive mucus, hemorrhage, red or yellow discoloration, and intact feed particles are indicators of poor intestinal health. Fecal staining of feathers around the vent is a sign of diarrhea. Diarrhea leads to excessive litter moisture which can result in ammonia intoxication.

At necropsy, lesions can be evaluated for severity and a semiquantitative scoring system applied. Lesion severity should be defined in a written protocol for continuity of data collection. One method used by the author is 1= normal, 2= minimal-mild, 3=moderate, and 4=marked-severe. Using a scoring system beginning with 1=normal allows for nonparametric statistical analysis.

Many parameters can be valuable if measured and recorded consistently over time. Oral lesions, crop lesions, gizzard erosion, proventriculitis, coccidiosis at all levels of the intestine, intestinal mucus, undigested feed in the distal digestive tract, focal or diffuse necrotizing lesions, weight and length of the intestine, and helminth parasites are some examples of parameters and lesions that can be scored, recorded, and analyzed. For research trials, the viscosity of intestinal contents, and the breaking (shearing) strength of the intestine are commonly measured.

For microscopic examination, the intestine should be evaluated in a consistent manner. The intestine should be uniformly collected and fixed in neutral-buffered formalin, with caution to not exceed the fixation capacity of the formalin. The author's preference is that the intestine is collected in 1-cm lengths, at the same location and kept intact (not opened). The intestine can be gently agitated when placed in the formalin to dislodge the content and allow penetration of the formalin to properly fix the tips of the villi. Collect the tissue within 5 minutes of euthanasia to prevent autolysis of the tips of the villi.

The author recommends 1-cm lengths of intestine be collected from 1) the descending duodenum (with pancreas attached), 2) middle - slightly proximal to the yolk stalk diverticulum, and 3) cecum - a section through the distal small intestine and the middle of the cecal pouches. Proventriculus and liver are also recommended for examination.

Routine histologic assessment includes grading for coccidiosis, crypt hyperplasia, villous atrophy, and inflammatory cells in the lamina propria. Other lesions can be included such as nematode parasites, adherent bacteria, long segmented filamentous organisms, and cystic crypts. For research trials, intraepithelial leukocytes, goblet cells, and mucus production can also be measured in the intestine. For proventriculus, inflammation of the mucosa and the glands are scored. For liver, inflammation is scored for parenchyma and bile ductules.

No single measurement provides a complete assessment of intestinal integrity. Multiple measurements collected over time with relatively uncomplicated analysis, can provide valuable information about the cause and pathogenesis of intestinal disease.

Current Observations in Broiler Intestinal Health

The runting stunting syndrome (RSS) remains a problem, based on the presence of histologic lesions and the recovery of enteric viruses, including astrovirus, rotavirus, reovirus, and parvovirus. In the author's experiences in Alabama, the current pattern is one of low-level or subclinical infection, that emerges as sporadic clinical disease when the correct combination of events occurs; however, the specific events are poorly defined. The typical disease five years ago involved broilers 7-12 day of age. Today, it is possible to see lesions and recover virus at 15-18 days, and in older birds, nonspecific enteritis as the sequela at 20-25 days of age. Cases with nonspecific enteritis and detectable RSS-associated viruses have been observed in broilers at 42 days of age, consistent with prolonged infectivity by the viruses.

An estimated 30 to 50% of the cases of RSS have one or more birds with mild to moderate lymphocyte depletion from either bursa or thymus. Cases have been observed in which lesions of RSS, or the sequela, and atrophied lymphoid organs are present in flocks undergoing infectious bursal disease challenge and acute necrotizing bursitis. These flocks are experiencing serial expression of potentially immunosuppressive diseases. Cases of RSS associated with necrotic enteritis (*Clostridium*) have been seen in broilers as young as 14 days.

Eimeria maxima is the predominant species of coccidia in broilers in cases presented to the Alabama diagnostic laboratories. Histologic assessment of intestines reveals that *E. maxima* coccidiosis often occurs in conjunction with infectious bursal challenge and onset of acute necrotizing bursitis. Flocks in which these two diseases occur simultaneously have vague clinical signs of increased mortality, huddling behavior suggestive of fever or chilling, and poorly formed feces. In the author's experience, most cases of necrotic enteritis are associated with moderate to severe *Eimeria maxima* coccidiosis.

The most common lesions in the proventriculus include nonspecific inflammation of the mucosa, and lymphocytic adenitis of the glands, indicative of transmissible viral proventriculitis. Although the general prevalence of transmissible proventriculitis has declined in the last two years, it remains a subclinical problem that can be observed in clinically normal, and in sick birds. Nonspecific enteritis can accompany transmissible viral proventriculitis. Inflammation of the proventriculus mucosa is relatively nonspecific. It is increased in transmissible proventriculitis, but in many cases the cause is not known. Irritating substances in the feed, possibly mycotoxins or other biotoxins, or litter consumption may be involved but are largely not defined by routine diagnostics.

Fissures and roughening of the gizzard lining (gizzard erosion) occurs with litter consumption, and in conjunction with lesions in the proventriculus. Microscopic examination of affected gizzards reveals that the mucosa is inflamed, typically with lymphocytes and plasma cells, and also heterophils. Hemorrhage can often be seen at the most distal region of the mucosal folds. The overlying koilin is poorly fused with layers of exfoliated epithelial cells, free erythrocytes, and spent inflammatory cells in the defects and associated with laminar and vertical defects in formation. It is possible to induce lesion of this type by experimental inoculation of broilers with adenovirus, with the development intranuclear inclusion bodies in the mucosa. This is a relatively rare lesion in broilers today. Adenovirus has the potential to induce gizzard lesions, but evidence of a significant role is lacking, based on diagnostic investigation.

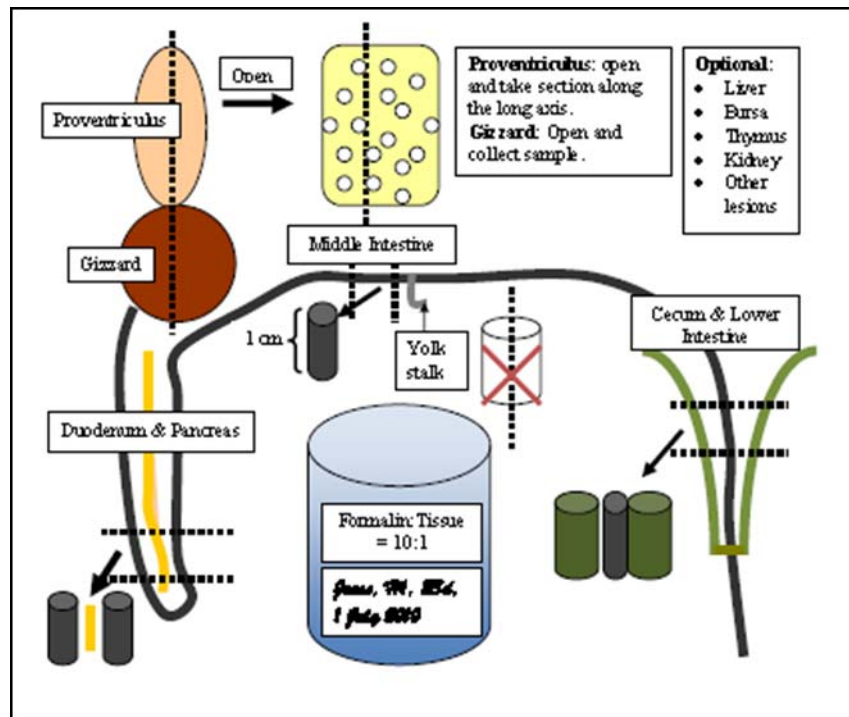


Figure 1. A guide to collection of digestive tissues for histopathology. Select tissues from 3 to 5 birds per flock that are representative of the problem. If mortality is a problem, select tissue from recent mortality and sick live birds. Use neutral-buffered formalin: formalin:tissue = 10:1 (avoid diluted hatchery formaldehyde). Collect proventriculus (gizzard optional), duodenum with pancreas, middle small intestine (in front of the yolk stalk), lower small intestine and cecum (at middle of cecum). Liver, bursa, thymus, kidney and other digestive tract tissues can be collected as indicated. Intestinal segments should be 1-cm in length; do not open – leave intact tubular shape. Close the formalin container and gently agitate to loosen the intestinal content and allow formalin perfusion and fixation. Label the formalin container (*not the lid*): Farm, flock, age, date of collection.

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 June 22, 2010, by NASS, Agricultural Statistics Board, USDA

May Egg Production Up 1 Percent

U.S. egg production totaled 7.69 billion during May 2010, up 1 percent from last year. Production included 6.58 billion table eggs, and 1.11 billion hatching eggs, of which 1.04 billion were broiler-type and 73 million were egg-type. The total number of layers during May 2010 averaged 338 million, up slightly from last year. May egg production per 100 layers was 2,276 eggs, up 1 percent from May 2009.

All layers in the U.S. on June 1, 2010 totaled 337 million, up 1 percent from last year. The 337 million layers consisted of 279 million layers producing table or market type eggs, 55.3 million layers producing broiler-type hatching eggs, and 2.94 million layers producing egg-type hatching eggs. Rate of lay per day on June 1, 2010, averaged 73.6 eggs per 100 layers, up 1 percent from June 1, 2009.

Egg-Type Chicks Hatched Up 6 Percent

Egg-type chicks hatched during May 2010 totaled 43.1 million, up 6 percent from May 2009. Eggs in incubators totaled 39.3 million on June 1, 2010, down slightly from a year ago. Domestic placements of egg-type pullet chicks for future hatchery supply flocks by leading breeders totaled 230 thousand during May 2010, down 16 percent from May 2009.

Broiler-Type Chicks Hatched Up 1 Percent

Broiler-type chicks hatched during May 2010 totaled 798 million, up 1 percent from May 2009. Eggs in incubators totaled 655 million on June 1, 2010, up 2 percent from a year earlier. Leading breeders placed 8.01 million broiler-type pullet chicks for future domestic hatchery supply flocks during May 2010, up 5 percent from May 2009.

Broiler Hatchery

Released July 14, 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 207 million eggs in incubators during the week ending July 10, 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 2 Percent

Broiler growers in the 19-State weekly program placed 173 million chicks for meat production during the week ending July 10, 2010. Placements were up 2 percent from the comparable week a year earlier. Cumulative placements from January 3, 2010 through July 10, 2010 were 4.59 billion, up 1 percent from the same period a year earlier.

Turkey Hatchery

Released July 15, 2010, by the NASS, Agricultural Statistics Board, USDA

Eggs in Incubators on July 1 Down 1 Percent from Last Year

Turkey eggs in incubators on July 1, 2010, in the United States totaled 29.7 million, down 1 percent from July 1, 2009. Eggs in incubators were up 4 percent from the June 1, 2010 total of 28.7 million eggs. Regional changes from the previous year were: East North Central up 7 percent, West North Central down slightly, North and South Atlantic up 3 percent, and South Central and West down 17 percent.

Poults Hatched During June Down 1 Percent from Last Year

Turkey poults hatched during June 2010, in the United States totaled 24.4 million, down 1 percent from June 2009. Poults hatched were up 1 percent from the May 2010 total of 24.2 million poults. Regional changes from the previous year were: East North Central up 11 percent, West North Central up 2 percent, North and South Atlantic down 1 percent, and South Central and West down 25 percent.

Net Poults Placed During June Down Slightly from Last Year

The 24.1 million net poults placed during June 2010 in the United States were down slightly from the number placed during the same month a year earlier. Net placements were up slightly from the May 2010 total of 24.0 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 (\$)	227.6	216.78	234.69	230.69	227.27	229.06
Feed cost /lb meat (c)	21.32	19.92	21.15	22.09	21.47	21.27
Days to 4.6 lbs	43	41	41	40	42	41
Chick cost / lb (c)	4.56	4.67	5.12	4.19	4.65	4.7
Vac-Med cost/lb (c)	0.04	0.03	0.06	0.08	0.02	0.05
WB & ½ parts condemn. Cost/lb	0.15	0.18	0.1	0.15	0.12	0.14
% mortality	4.03	4.71	4.4	4.09	3.59	4.01
Sq.Ft. @ placement	0.8	0.81	0.83	0.98	0.83	0.85
Lbs/sq. ft.	7.24	7.13	6.49	7.07	7.26	6.97
Downtime (days)	13	11	15	15	12	14
Broiler Whole Bird Condemnation	Region					Average Company
	SW	Midwest	Southeast	Mid-Atlantic	S-Central	
% Septox	0.12	0.168	0.068	0.114	0.070	0.103
% Airsac	0.045	0.064	0.026	0.039	0.020	0.032
% I.P.	0.009	0.012	0.003	0.011	0.019	0.012
% Leukosis	0.001	0.001	0.00	0.003	0.001	0.001
% Bruises	0.002	0.001	0.004	0.001	0.002	0.002
% Other	0.023	0.002	0.010	0.025	0.005	0.016
% Total	0.2	0.248	0.111	0.194	0.116	0.166
% ½ parts condemnns	0.229	0.323	0.192	0.248	0.301	0.263

Data for week ending Jul 2nd 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 (\$)	228.31	217.49	234.27	231.04	227.09	229.51
Feed cost /lb meat (c)	21.22	19.73	20.97	21.86	21.48	21.16
Days to 4.6 lbs	41	40	41	40	41	41
Chick cost / lb (c)	4.57	4.58	5.05	4.26	4.53	4.7
Vac-Med cost/lb (c)	0.04	0.03	0.008	0.06	0.02	0.05
WB & ½ parts condemn. Cost/lb	0.14	0.15	0.11	0.16	0.13	0.14
% mortality	4.16	4.09	3.97	4.5	3.87	4.1
Sq.Ft. @ placement	0.80	0.80	0.83	0.94	0.83	0.84
Lbs/sq. ft.	7.48	7.30	6.62	7.22	7.5	7.13
Downtime (days)	13	11	17	15	13	14

Broiler Whole Bird Condemnation	Region					Average Company
	SW	Midwest	Southeast	Mid-Atlantic	S-Central	
% Septox	0.128	0.185	0.066	0.109	0.068	0.102
% Airsac	0.044	0.153	0.043	0.059	0.032	0.047
% I.P.	0.009	0.008	0.004	0.066	0.017	0.022
% Leukosis	0.00	0.001	0.00	0.002	0.001	0.001
% Bruises	0.003	0.001	0.003	0.002	0.002	0.002
% Other	0.013	0.003	0.009	0.008	0.007	0.010
% Total	0.198	0.251	0.124	0.244	0.126	0.183
% ½ parts condemnns	0.223	0.239	0.196	0.230	0.285	0.241

Data for week ending Jun 18th 2010

Meetings, Seminars and Conventions

2010 August

August 1-4, 2010 AVMA/AAAP 2010 Scientific Program at the Georgia World Congress Center in Atlanta, Georgia, USA. Registration is available at www.avmaconvention.org

August 23-27, 2010 - XIIIth European Poultry Conference in Tours, France. Full information relative to this conference is online at www.epc2010.org

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. For more information contact Conference Secretariat Integress Meetings and Events, 2 Ravinia Drive, Suite 605, Atlanta, GA 30345 Tel: 1 404 233 6446, Fax: 1 404 233 2827

September 22-23, 2010. The 82nd Northeastern Conference on Avian Diseases (NECAD) in conjunction with the Pennsylvania Poultry Sales and Service Conference (PSSC). State College, PA at the Penn Stater Conference Center / Hotel.

September 28th 2010 WestVet 21 Lake Louis, Alberta, Canada. For more information Phone 604-854-6600 or email admin@canadianpoultry.ca

September 29 - October 1. Poultry Service Industry workshop (PSIW) Banff Centre, Banff, Alberta, Canada. For details contact Kate Cheney, Workshop Manager or Lisa Doyle, Workshop Coordinator. Phone: 403.244.7821, Fax: 1.866.808-0366, info@poultryworkshop.com

2010 October

October 4-6, 2010. 45th National Meeting on Poultry Health and Processing. Clarion Resort Fontainebleau Hotel Ocean City, Maryland. For more information contact: Bill Satterfield, Phone: (302) 856-9037, Email: satterfield@dpickicken.com

October 17-20, 2010: The 5th International Workshop on the Molecular Pathogenesis of Marek's Disease Virus. 1st Symposium on Avian Herpesvirus. For more information and registration: <http://www.georgiacenter.uga.edu/conferences/2010/Oct/17/avian.phtml>

2011 January

January, 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/>

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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