This study was undertaken to evaluate the antibacterial activity antibacterial activity of ethanol and methanol extracts of date pits against *Staphylococcus aureus* and *Escherichia coli* by disc diffusion technique using six concentrations ranged from 300 to 9,375 μg/mL methanol or ethanol extract/mL Nutrient broth. The results obtained exhibited that methanol extract inhibited the growth of *Staphylococcus aureus* at the concentration level of 75 μg/mL and *Escherichia coli* at the concentration level of 150 μg/mL with inhibition zone diameter of 10 mm and 17 mm, respectively. While the ethanol extract of date pits inhibited the growth of *Staphylococcus aureus* at the concentration level of 18.75 μg/mL with inhibition zone diameter of 10 mm. The growth of *Escherichia coli* was not inhibited by all the ethanol extract concentration levels used in this experiment. This revealed that methanol extracts have antimicrobial activity on *Staphylococcus aureus* and *Escherichia coli*, while the ethanol extracts showed antimicrobial activity on *Staphylococcus aureus* with no effect on *Escherichia coli*. Results obtained suggested that methanol and ethanol extracts of date pits probably might be used to control infections associated with these common poultry pathogenic organisms.

**Key Words:** Antibacterial activities, date pits, *Staphylococcus aureus*, *Escherichia coli*

**M2** Control of complicated respiratory distress in broilers using a synergistic effect with Ma5 and 4/91 IB vaccine strains at different ages. Francisco Rios-Cambre¹, Jesús Cabrillas-Jimenez, Alejandro García-Cantú¹, Francisco Zorrilla-Fierro, ²*MSD Animal Health Mexico, Santiago Tianguistenco, Mexico; ³MSD Salud Animal Mexico, Santiago Tianguistenco, Mexico*

Mortality due to respiratory disease in broilers in the Mexican poultry industry has been a common problem for several years. The most frequent lesion found is tracheal plugs, usually between 20 and 30 days of age. This pathology can cause an increase in mortality than may be up to 20% or more in broiler flocks that up until they reached such age, it had been within the normal parameters. This paper describes the sampling design, monitoring and results; followed by vaccination program adjustments, conducted according to a synergistic effect previously described, by using a combination of Ma5 and 4/91 IB vaccine strains; as well as subsequent sampling, lab monitoring and production results of such adjustments. According to the available literature, both vaccines can be applied either at one day of age, mixed together, or Ma5 strain applied at one day of age, whilst 4/91 strain is applied at farm level, in this case at 12 days of age. In this is a report a significant difference in body weight and uniformity was observed between both vaccination programs, being the flock vaccinated with both vaccine viruses simultaneously showing the most favorable results, with an average 100 g more in body weight and 1% less coefficient of variation.

**Key Words:** Respiratory, Infectious bronchitis, Ma5 strain, 4/91 strain, Synergistic effect

**M3** Coccidiostat withdrawal from broiler diets containing refined functional carbohydrates (RFC) from enzymatically hydrolyzed yeast
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Appropriate enzymatic hydrolysis of yeast can produce RFCs that have protective activities against a range of bacterial and protozoal species. Specifically, Aviator (Aviator SCP, Vi-COR, Mason City, IA) possesses a complex sugar that reduces the ability of Eimeria sporozoites to attach to intestinal epithelial cells, which should provide an opportunity to modify usage of coccidiostats in broiler feed. To test this theory, three scenarios were developed that covered a range of commercial environments and involved growing Ross 708 male broilers from a 26-wk-old breeder flock to 49 d on either new litter with clean water and coccidiostat (Salinomycin), used litter with dirty water and coccidiostat, or used litter with dirty water and no coccidiostat after 16 d of age. These scenarios were termed Best, Intermediate, and Worst, respectively. Aviator was included in the starter, grower, and finisher feeds at either 0 or 50 g/MT in each of the three scenarios. Feed consumption and BW were determined at 35 and 49 d of age. Average BW was 2332 and 4061 g at 35 and 49 d, respectively, which generally represented small and larger broilers at marketing. BW did not differ by scenario but feed intake was greatest (P<0.05) in the Worst scenario as compared to the Intermediate scenario, with the Best scenario intermediate at both 35 and 49 d. The FCR was poorest (P<0.05) in the Worst scenario at 35 and 49 d. Addition of Aviator to the Worst scenario improved FCR (P<0.05) to that observed in the Best scenario containing coccidiostat without affecting feed intake and BW. This demonstrated the capacity of this RFC to maintain feed efficiency in the absence of a coccidiostat in grower-finisher diets.

**Key Words:** coccidiostat, broilers, functional carbohydrates, yeast

**M4** Is white striping of the breast affected by the coccidiosis control program?
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White Striping (WS) is an alternation of breast muscle characterized by the presence of visible white stripes between muscle fibers that is becoming increasingly important in meat-type heavy chickens (Bauermeister *et al.*, 2009). The aim of the study was to evaluate the influence of coccidiosis control program and diet on WS. Four groups of 140 broiler chickens were randomly allotted to the four experimental treatments: Control (C), Coccidiostat (Cox), Vaccinated (V), and Vaccinated fed a Low Energy diet (VLE) were slaughtered at 51 days of age and all breasts have been scored for WS (0= no WS, 1= mild WS, 2= severe WS). Mean BW were 3.5±0.3, 3.7±0.3, 3.6±0.3 and 3.7±0.3 kg, and mean DWG were 67.6±5.8, 71.1±5.5, 69.6±6.9 and 71.2±6.3 g/day, for C, Cox, V and VLE, respectively, being significant (P<0.05) the difference C vs Cox and VLE. No BW differences were observed between Cox and V groups that received the same diet, nor between the two vaccinated groups fed different diets. Mean FCR were 1.97±0.07, 1.92±0.10, 1.90±0.08, 1.84±0.10, for C, Cox, V and VLE, respectively (ns).
M5 An evaluation of the anticoccidial efficacy of the feed additives AlgamuneTM AM or AlgamuneTM ZPC fed to commercial broiler chickens exposed to a mixed challenge of Eimeria acervulina, E. maxima, and E. tenella

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Coccidiosis can have significant adverse effects on performance in commercial broiler operations. The objective of the current study was to determine how dietary inclusion of a new feed additive made from microalgae containing beta-1,3-glucan impacts performance and gut health in birds challenged by Eimeria. This study was carried out in cages at Southern Poultry Research, with 4 cages per treatment group and 8 male birds (Cobb X Cobb) per cage (0.63 sq.ft/bird). The eight treatment groups included a non-infected, non-treated control and an infected, non-treated control, along with groups fed 50, 100, or 200 g/MT of AlgamuneTM AM or AlgamuneTM ZPC. Both products are similar in that they contain about 50 wt.% beta-1,3-glucan derived from the algae Euglena gracilis, but AlgamuneTM AM contains 2% zinc in the form of a zinc polysaccharide complex (ZPC). On day 14, all birds, except the non-infected control, were orally dosed with coccidia from a mixed inoculum containing Eimeria acervulina, E. maxima, and E. tenella. Fecal samples were collected 120-144 hours post infection to determine oocysts per gram (OPG). Performance (feed consumption, feed conversion efficiency (FCR), and weight gain) was measured on day 14 and day 20; all birds were lesion scored on day 20.

All birds fed AlgamuneTM AM and ZPC-2 and challenged with Eimeria demonstrated a trend towards improved D0-20 FCR compared to the infected control. Birds receiving 50 or 100 g/MT AlgamuneTM AM and 200 g/MT Algamune ZPC-2 demonstrated statistically significant FCR improvement of 16 to 19 points (cf. 1.856 FCR for infected control vs. 1.676, 1.692, and 1.660 for AM 50 g/MT, AM 100 g/MT, and ZPC-2 200 g/MT, respectively). Birds fed AlgamuneTM AM at 50 and 100 g/MT demonstrated a strong trend of improved D0-20 weight gain compared to the infected control, though no differences were statistically significant. Birds fed AlgamuneTM AM at 50 and 100 g/MT and AlgamuneTM ZPC-2 at 50 g/MT demonstrated a trend for reduced lesion scores compared to the infected control, but there were no statistically significant differences among the treatment groups. Finally, birds fed Algamune AMTM at 200 g/MT and AlgamuneTM ZPC-2 at 100 g/MT demonstrated significantly reduced OPG (63% reduction compared to infected control). Overall, these data suggest that low inclusion levels of beta-1,3-glucan derived from algae can promote improved performance and gut health while reducing oocyst shedding in commercial broilers challenged with Eimeria.

Key Words: beta glucan, Coccidiosis, Eimeria, broiler performance, lesions

M6 Experimental co-infection of SPF chickens with low pathogenicity avian influenza virus (LPAIV), subtypes H9N2, H5N2 and H7N9, and infectious bronchitis virus (IBV) Mar Costa-Hurtado1, Diane Smith1, Mark W. Jackwood2, Erica Spackman3, Eric Shepherd1, Mary Pantin-Jackwood1

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Avian influenza virus (AIV) and infectious bronchitis virus (IBV) are two of the most important respiratory viruses affecting poultry worldwide, but little is known about the effect of co-infection with these two viruses in poultry. Low pathogenicity (LP) AIV can produce from mild to moderate upper respiratory disease that can be exacerbated by other factors in the field. Since commercial poultry is routinely vaccinated with live IBV vaccines we evaluated the dynamics of LPAIV-IBV co-infections and the effect on disease outcome in chickens. Four-week-old specific pathogen free (SPF) white leghorn chickens were intraocular and intranasally inoculated with a live IBV Mass strain vaccine and with one of three different subtype LPAIV’s: A/chicken/Egypt/12/2013 (H9N2), A/chicken/HK/2212982/2014 (H7N9), and A/chicken/Mexico-Coahuila/1A20/11/2011 (H5N2), by simultaneous or sequential inoculation (LPAIV given 3 days after IBV). Viruses were also given individually. No clinical signs were observed in any of the experimental groups. However, differences in the titers of viruses shed by the oropharyngeal route were observed and depended on the LPAIV strain used. No effect on H5N2 LPAIV shedding was observed in co-infected birds, this virus being shed in high titers from all inoculated birds. However, birds previously or simultaneously inoculated with IBV shed higher titers of the H9N2 LPAIV when compared to the single LPAIV infected birds. On the other hand, lower titers of the H7N9 LPAIV were shed by birds previously infected with IBV, but titers were higher in birds simultaneously inoculated. In conclusion, the effect of co-infection in chickens with IBV and LPAIV varies depending on the LPAIV and the timing of co-infection, with exacerbation, reduction, or no effect on virus shedding.

Key Words: Low pathogenicity avian influenza, Infectious Bronchitis Virus, co-infection, chickens

M7 Effects of Fermentation Product of S. cerevisiae XPC™ in Chicken Diets on Resistance against Infectious Bronchitis Virus

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The commercial Saccharomyces cerevisiae fermentation product XPC™, often used as feed additive in poultry production, has been associated with enhanced immune functions. We evaluated immune responses and protection after IBV challenge in naïve and infectious bronchitis virus (IBV)-vaccinated specific-pathogen-free white leghorn chickens (groups n=50 each) receiving XPC at feed-additive concentrations of 2 lb/ton or 3 lb/ton. Naïve chickens receiving XPC and challenged at 21 days of age showed reduced respiratory signs and a tendency of less histological damage in the trachea 5 days after challenge. Treated birds also showed increased IgA+ and CD44+CD8+ lymphocytes in the spleen 10 days after challenge. Viral load in the trachea, serum IBV antibody levels, and numbers of splenic CD3+CD8+ and CD3+CD4+ lymphocytes did not show significant differences between treated and untreated challenged controls. In experiment 2, birds received the same XPC treatments but were vaccinated with a live attenuated IBV vaccine at 10 days of age and subjected to homologous challenge at 25 days of age. Evaluations performed 5 days after challenge showed reduced adverse respiratory reactions and significantly increased IgM+ and IgA+ lymphocytes in the Harderian gland in XPC-treated chickens. XPC-treated chickens also showed significantly increased serum IBV antibody levels 20 and 27 days post challenge. Tracheal histopathology and viral load, and numbers of spleen CD44+ and CD3+ cells did not differ significantly between treated and untreated challenged controls. Some of the differences in response to IBV vaccination and/or challenge observed.
between XPC-treated and untreated chickens provide evidence for a beneficial effect and thus merit further study.

Key Words: infectious bronchitis, chickens, immune response

M8 Cytokine and chemokine gene expression in footpad dermatitis in chickens affected by incubation temperatures and litter conditions

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Footpad dermatitis (FPD) incidence can be affected by litter conditions, and it was recently demonstrated that suboptimal incubation temperature profiles (INC) make chicks more susceptible to FPD. The objective of this experiment was to measure cytokine (IL-1β, IL-6, IL-8, IL8L2) and interferon-γ (IFN-γ) gene expression (GE) in the footpad skin of 4 d-old Cobb 500 chicks coming from eggs incubated under 3 INC and placed in floor pens with either new wood shavings or used litter. The first INC maintained eggshell temperatures close to 38.0°C (S) for 21 d. The second profile (LH) had low (36.9°C) eggshell temperatures for the first 3 d and standard INC until the last 3 d when eggs were subjected to elevated (38.9°C) eggshell INC (H), as is observed in multistage machines. The third INC profile (SH) had S incubation until the last 3 d when eggs had H INC. At hatch, 180 chicks, 60 per INC treatment, were placed in 18 pens with either new pine wood shavings or used litter, each with 5 males and 5 females. At 4 d of age, 3 chicks per pen, 18 per treatment, were sacrificed and footpad skin samples were taken. The GE was determined by RT-PCR, and the new litter treatment combination was considered a control for fold-change comparisons. Data were analyzed in a CRBD in a 3x2x2 factorial arrangement with INC (S, LH, SH), litter type (new or used) and sex as main factors. Results indicated two-way interaction effects (P < 0.05). In females, higher fold changes were observed on the GE of IL-1β (22-fold) and IL8L2 (5 to 18-fold) when chicks came from sub-optimal INC (SH or LH) and were exposed to used litter. Additionally, a 5-fold increase on the GE of IFN-γ occurred in females only when they were from the SH or LH profiles and exposed to new or used litter. In males, significant fold-changes were observed on GE of IL-1β (3.7-fold) and IL8L2 (2.7-fold) when LH and SH chickens were placed in new litter, but there was no effect on IFN-γ GE. It was concluded that sub-optimal INC make chicks more susceptible to developing a non-specific inflammatory response, and this effect is mainly observed in females.

Key Words: Footpad dermatitis, Gene expression, Cytokine, Incubation, Litter

M9 An outbreak of Goose Venereal Disease in a commercial breeder operation in California

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Six live male Toulouse breeder geese were submitted to the California Animal Health and Food Safety laboratory, Turlock Branch, due to poor fertility and hatchability during 2014 spring breeding season. The farm is a medium-large scale, multi-age and multi-breed duck and goose breeding commercial operation, which supplies eggs, baloots, meat, and related-products to ethnic markets in California. Only a Toulouse flock was affected, which consisted of approximately 360 birds, 90 males and 270 females. In March 2014 the fertility registered was below 40%, whereas no impact on egg production was observed. Hence, 40 of 90 male geese were removed (44.4%) consequent to phallic alterations. The lesions observed were confined exclusively to the male genital tract and severely compromised the possibility of mating. Severe granulomatous inflammation associated with bacteria and spermatozoa were disrupting the architecture of phalluses. Several multifocal lymphoid nodules were seen histologically in the mucosa around the spermatic and ejaculatory ducts. Three different species of Mycoplasma were isolated from the phalluses, and these isolates were further characterized. In addition, Pasteurella multocida was isolated in combination with other bacteria. The P. multocida isolate was serotyped as well as further characterized. Hence, we report the history, histo-pathological observations, test results, identification and characterization of the microorganisms isolated.

Key Words: Goose, Venereal Disease, Mycoplasma, P. multocida, fertility

M10 Effects of in ovo injection of Invocox EM1 vaccine and turn-out times on broiler performance

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The response of broiler chickens to 2 doses of the Invocox EM1 vaccine and 2 turn-out times was determined from 0 d of incubation (doi) to d 35 posthatch (poh). The EM1 vaccine containing Eimeria oocysts was injected on 19 doi into Ross X Ross 708 hatching eggs. Birds were subjected to one of the following 6 treatments: treatment 1- non-injected control and turn-out on d 7 poh (NIC7); treatment 2- non-injected control and turn-out on d 10 poh (NIC10); treatment 3- 1× dose of EM1 vaccine and turn-out on d 7 poh (1× VI7); treatment 4- 1× dose of EM1 vaccine and turn-out on d 10 poh (1× VI10); treatment 5- 10× dose of EM1 vaccine and turn-out on d 7 poh (10× VI7); and treatment 6- 10× dose of EM1 vaccine and turn-out on d 10 (10× VI10). Site of injection (SOI) and embryonic stage score (ES) were determined on 19 doi. Hatchability of injected eggs (HI), hatch BW (HBW), and chick yield were determined on 0 poh. Feed intake (FI), BW, body weight gain (BWG) and feed conversion ratio (FCR) were determined from d 0 to 35 poh. Data were analyzed by the MIXED procedure of SAS 9.3, with global and LS means comparisons considered significant at P ≤ 0.05. There was a significant treatment effect on BWG (P = 0.003) and FCR (P = 0.03) from d 21 to 28 poh. BWG was highest in the NIC7 group, and lowest in the 10× VI7 group. FCR was highest in the 10× VI10 group, and lowest in the NIC10 group. ES score and SOI accuracy were 4.60 ± 0.99 and 81.66 %, respectively. The ES and SOI results suggest that the developmental stage of the embryos corresponded to between 19.0 and 19.5 doi, with vaccine deposition primarily in the right breast muscle. The injection of EM1 vaccine at either a 1× or 10× dose had no detrimental effect on chick quality. However, growth performance may be negatively affected during peak oocyst cycling between d 21 and 28 poh. This effect may be related to the vaccine dose administered rather than the turn-out time employed.

Key Words: broiler, coccidiosis, in ovo injection

M11 Establishing the correlation between broiler body weight gain, gross lesion score, and microscores in three anticoccidial sensitivity tests

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Coccidiosis costs the poultry industry $3.2 billion worldwide every year. Anticoccidial Sensitivity Tests (AST) serve to determine the efficacy of several anticoccidials against Eimeria field isolates by measuring body weight gain, feed conversion ratio, gross intestinal lesions, and mortality in battery pen studies. Microscopic oocyst counts of intestinal scrapings (microscores) are often investigated. The goal of this study was to determine the correlation between broiler body weight, gross lesion score, and microscore in 3 AST. Day old broiler chicks were raised for 12 days on a standard corn-soy diet. On day 13, chicks were placed in Petersime batteries and treatment diets were provided. There were 6 birds per pen, 4 pens per treatment, and 12 treatments for a total of 288 chicks per AST. The treatments were as follows: 1: Non-medicated, non-infected; 2: Non-med-
icated, infected, 3: Lasalocid, 4: Salinomycin, 5: Diclazuril, 6: Monensin, 7: Decoquinate, 8: Narasin + Nicarbazin, 9: Narasin, 10: Nicarbazine, 11: Robenidine, and 12: Zoalene. On day 15, chicks were challenged with oocysts of *Eimeria* field isolates by oral gavage. On day 21, broilers were weighed, and gross lesion scores and microscores for *Eimeria maxima* were classified from 0 to 4 according to the Johnson and Reid (1970) methodology. All data were statistically analyzed using a logistic regression model. There was no correlation (P=0.12) between microscore and body weight gain. There was a positive correlation between gross lesions and microscores (P=0.004). However, there was also an interaction between microscore and isolate (P=0.001). This may be due to the differing pathogenicity of the challenge isolates. These results indicate that gross lesion scores are predictors of microscores. Additionally, the interaction between isolate and gross lesions demonstrates that the significance of the correlation between microscores and gross lesion scores may be dependent of the *Eimeria* strain. Future work should focus on more *Eimeria* isolates to establish a database, which would allow to build a model for population prediction.

**Key Words:** Coccidiosis, gross lesion score, microscore, AST, broiler

**M12 Adaptation of Embryo Attenuated Infectious Bronchitis Virus Arkansas to Kidney Cells**

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The population structure of an embryo-attenuated infectious bronchitis virus (IBV) Arkansas (Ark) Delmarva Poultry Industry (DPI)-derived vaccine was characterized during serial passages in chicken embryo kidney (CEK) cells and after back-passage in embryonated chicken eggs (ECE) and in chickens. Both conventional and deep sequencing results consistently showed population changes occurred during adaptation to CEK cells. Specifically, thirteen amino acid (aa) positions seemed to be targets of selection when comparing the vaccine genome prior to and after 7 passages in CEK (CEKp7). Amino acid changes occurred at four positions in the S gene, and at two positions in the S gene large shifts in frequencies of aa encoded were observed. CEK adaptation shifted the virus population towards homogeneity in S. The changes achieved in the S1 gene in CEKp7 were maintained after a back-passage in ECE. Outside the S gene, amino acid changes at three positions and large shifts in frequencies at four positions were observed. Synonymous nucleotide changes and changes in non-coding regions of the genome were observed at eight genome positions. Inoculation of early CEK passages into chickens induced higher antibody levels and CEKp4 induced increased respiratory signs compared to CEKp7.

**Key Words:** infectious bronchitis virus, coronavirus, virus adaptation, genetic variation, Arkansas

**M13 Evaluation of the infection and transmission of wild type and recombinant strains of Newcastle Disease Virus in Japanese Quail**

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Newcastle disease virus (NDV) causes a range of clinical disease ranging from asymptomatic infection to severe disease with high mortality. Vaccination for NDV is practiced almost worldwide in commercial chickens. Attenuated live vaccines are most commonly used, with recombinant vaccines becoming increasingly popular. The target species for a NDV vectored vaccine are poultry species. However, since NDV infects at least 250 bird species, non-target species (wild birds) could be exposed and infected with these vaccine viruses. In spite of that, the infectivity and transmissibility of recombinant NDV and recombinant NDV vectored vaccines have not been examined in any species besides chickens. The widespread use of these vaccines and the routes of administration—which include aerosol or drinking water, pose an extremely high risk of exposure of the vaccine to wild birds. This study is part of a series of pathogenesis studies that aims to evaluate the infection and transmission of wild type and vaccine strains of NDV in non-target species. If these species can transmit the virus, this could result in the unrestricted spread of potentially pathogenic variants to other poultry farms and to wildlife. In this portion of the study, Japanese quail are being evaluated. Quail are often kept with other poultry species, and could potentially increase transmission and magnify outbreaks. In fact, ND outbreaks have occurred in Japanese quail in Nigeria in 2004 and in 2008. Two experiments were conducted. The first experiment aimed to study transmission and replication of recombinant NDV. In this experiment, 4 week old Japanese quail were divided into groups of 5 birds and infected with either virulent recombinant ZJ1-L, lentogenic recombinant ZJ1 (ZJ1-L), recombinant LaSota (rLaSota) or recombinant LaSota containing the H5 influenza insert (rLaSota-H5) at day 0 post infection (dpi). At 2 dpi four un-inoculated birds were placed with each group of inoculated birds. Clinical signs and mortality were recorded daily and birds were swabbed every other day until 14 dpi. The second experiment aimed to study the transmission and clinical signs caused by wild type strains of NDV. 4 week old Japanese quail were divided into groups of 7 birds and each group was infected with either CA02, Nigeria 2, Nigeria 23, Pl/karichi/33 or Israel 826. 3 un-inoculated birds were placed with each of the groups at 0dpi. Similar to the first experiment, clinical signs and mortality were recorded daily and birds were swabbed every other day until 14 dpi. Clinical disease, mortality, number of birds shedding, number of contact birds infected, amount of virus shed and seroconversion rates were examined.

**Key Words:** Newcastle Disease Virus, Japanese Quail, vaccine, recombinant

**M14 Use of histomorphometric area measurements for determination of intestinal villus/ crypt ratios in broiler chickens: comparisons to routine linear methods and documentation of age-associated intestinal changes**

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The determination of intestinal villus to crypt ratios [V:C ratio] is a common method utilized to evaluate effects of various diet regimens on gut microanatomy and for the histologic quantification of intestinal responses to disease processes. Two methods for the determination of small intestinal V:C ratios were compared for early age chickens. A standard method for ratio determination based on ten length measurements of the two intestinal regions was compared to a new approach based on a single histomorphometric determination of the crypt and total mucosa areas using image analysis software. Subtraction of the crypt area from the total area provided the villus area and allowed for subsequent calculation of the V:C ratio. Villus micro-anatomic changes were also evaluated using scanning electron microscopic methods and those results for villus height were compared to the routine histological data. In general very close agreement was observed between ratio results using both the routine length and the new area method measurements. A similar major and highly significant reduction in the V:C ratio was observed occurring between hatch and day 7 using the two methods. The area method has the advantage of reduction in measurements required [only two area measurements required, compared to twenty length measurements]: and also facilitates a larger intestinal segment evaluation; which is of particular advantage for studies on intestinal disease conditions resulting in marked multifocal variation in villus stature. The study also further documents age-associated changes occurring in the V:C ratios of the small intestine during early post-hatch periods.

**Key Words:** Intestine Key Words: Intestine, Histomorphometrics, Poultry, Broiler, Aging, Histomorphometrics, Poultry, Broiler, Aging