

Poultry Industry Strategies for Control of Immunosuppressive Diseases

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ABSTRACT Immunosuppression has historically cost the poultry industry in increased mortality and in performance factors during rearing. In addition, immunosuppression has had a negative impact on the ability of the poultry industry to process chickens due to associated health problems. Industry strategies for controlling immunosuppression are not consistent be-

tween broiler companies. The broiler industry is refining their strategies for controlling immunosuppression based on research and field observations. However, strategies to control immunosuppression are largely based on vaccination programs for broiler breeders and broiler progeny, and management to minimize stress during rearing.

(*Key words:* immunosuppression, vaccination, infectious bursal disease, chick anemia virus)

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INTRODUCTION

The U.S. poultry industry is in a constant battle with immunosuppressive diseases. Immunosuppression may result in increased mortality and morbidity from associated diseases. Morbidity is exhibited through increased processing plant condemnations, higher feed conversions, and depressed average daily weight gains. The industry is generally satisfied with the aforementioned performance and health parameters, but continuous improvements are desired. Minimizing immunosuppression and its impact is an important strategy for success in the broiler industry.

Although many conditions are considered immunosuppressive to chickens, the focus of this discussion is limited to infectious bursal disease (IBD) and infectious chicken anemia.

INFECTIOUS BURSAL DISEASE (GUMBORO)

Infectious bursal disease virus (IBDV) is ubiquitous. Current control strategy involves protection of broilers against IBD via passive and in many cases active immunity.

Passive Immunity: Hen Hyperimmunization

The most popular strategy for IBDV control is hen hyperimmunization (Sharma and Rosenberger, 1987). Poultry integrators use live IBDV vaccines and two or more inactivated vaccines in replacement pullets and hens in order to hyperimmunize hens. Passive immunity to IBDV is then transferred to broiler progeny providing some level of early protection against field challenge. Some companies rely on passive immunity only for broiler protection and do not use any live vaccines in progeny (Fussell, 1995).

Active Immunity: Broiler Vaccination

In addition to passive immunity, live IBDV vaccines may be given in an effort to gain active immunity against IBDV (Giambrone, 1995; McMurray, 1995; Putnam, 1995). Live IBDV vaccines are administered either *in ovo* or at hatching, and in the field through booster vaccinations. Live Delaware variant and classic combinations are often recommended (Miller Heins, 1995).

There is much written on the timing of live IBD vaccine administration in broiler progeny, usually depending upon antibody titer levels as measured by ELISA or other techniques (Ather, 1993). It is difficult to arrive at an appropriate time to vaccinate because of the myriad of titer levels seen in progeny from different breeder flocks. Exclusive placements from individual breeder flocks are the exception rather than the rule.

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Abbreviation Key: CAV = chicken anemia virus; IBD = infectious bursal disease; IBDV = infectious bursal disease virus.

Repeated vaccination of commercial broiler flocks reared in houses associated with frequent poor performance and in which subclinical IBD has been identified is effective in significantly increasing flock performance (McIlroy *et al.*, 1992). It is often stated in poultry industry circles that live IBDV vaccine displaces the field virus after multiple vaccinations. Persistent efforts to demonstrate replacement of field Delaware variants with "classic" vaccine strains suggests that this displacement does not occur (Fussell, unpublished data). There is disagreement among poultry health professionals as to the efficacy of live IBDV vaccinations in the broiler industry.

Part of the strategy in selecting inactivated IBDV vaccines involves knowledge of the propagation technique for IBDV antigens and the type of IBDV antigen. The method of IBDV propagation affects the immunogenic characteristics of the virus. Antibody induced by IBDV that has been adapted to cell culture or embryos is generally less capable of neutralizing pathogenic virus *in vitro* than antibody that has been induced by bursal-derived pathogenic IBDV (Sharma and Rosenberger, 1987). Knowledge of the behavior of this virus in different propagation settings has led biologics suppliers to respond in the market with a menu of IBDV vaccines produced under a variety of propagation conditions.

Beginning in 1984, evidence was presented on the circulation of the new variant IBDV in commercial broiler flocks on the Delmarva Peninsula (Rosenberger *et al.*, 1985). At the time, the variant "Delaware type" IBDV were implicated as an underlying factor in respiratory disease prevalent in the area. Additional antigenic variants were subsequently described (Snyder *et al.*, 1988). Some parts of the world experience a more virulent form of "classic" IBDV (Chettle *et al.*, 1989; Nakamura *et al.*, 1992; Tsukamoto *et al.*, 1994). There has been a shift from "classic" strains of IBDV to more of the variant strains. The Delaware variants cause early immunosuppression and subclinical disease. The "classic" or standard virus challenge that may induce clinical disease is of lower incidence in the U.S. (Snyder *et al.*, 1992). This antigenic shift has made IBD a less formidable enemy of our industry.

Use of the variant viruses in vaccines in addition or instead of the "classic" or standard strain have minimized early immunosuppression and subsequent health problems as seen on Delmarva in 1985 (Rosenberger *et al.*, 1986). These viruses continue to be used in inactivated and live IBDV vaccines in the U.S. broiler industry.

Monitoring IBDV vaccination program efficacy is at best crude, but poultry industry health professionals attempt to measure results of their programs.

Hen IBDV Titers

The IBDV serum antibody titers are commonly tested from various ages of pullets and hens by using one of the ELISA kits. The ELISA titer monitoring is intended to measure accuracy of vaccination and is generally not intended to measure protection.

Progeny Challenge Studies

Progeny challenge studies are a tool to evaluate protection elicited by inactivated vaccines used in hens. Although criticized by many, progeny challenge studies offer a relative comparison of passive protection against an intensive challenge from a battery of pathogenic IBD viruses.

Broiler Performance and Condemnation

Broiler performance and condemnation data provide additional information to measure the relative efficacy of an IBDV control program.

IBDV Isolation and Identification. Isolation and identification of IBDV is another means of determining the efficacy of vaccination. DNA fingerprinting of new isolates identifies shifts in the indigenous virus population. New isolates can be used in challenge studies to determine whether current vaccination programs are effective. The response to finding new IBDV isolates may result in the inclusion of new IBDV vaccine isolates in immunization programs. The industry is concerned about antigenically different viruses that may elude current vaccination strategies.

INFECTIOUS CHICKEN ANEMIA

The chicken anemia virus (CAV), the cause of infectious chicken anemia, is ubiquitous in all major chicken producing countries of the world as evidenced by serology and virus isolation (Bulow, 1991; McNulty, 1991; Zhou *et al.*, 1997). Clinical CAV is easily diagnosed in broilers because age of onset and clinical signs allow accurate field diagnosis.

Clinical disease due to CAV infection in broilers can be prevented by ensuring that breeder flocks have seroconverted before coming into lay (McIlroy, 1994), which normally occurs under field conditions. However, some flocks do not seroconvert prior to egg production. These flocks usually will begin seroconversion while in egg production and will shed the CAV to progeny for a 4- to 6-wk period. Shedding will result in clinical CAV in the progeny. Affected progeny have increased mortality and poorer performance than progeny of "normal" flocks (McIlroy *et al.*, 1992a).

The strategy for control of clinical CAV in the U.S. broiler industry has been to allow natural infection of breeders to CAV, hopefully prior to the onset of egg production. This strategy for control of clinical CAV has been slowly changing; U.S. broiler companies that have experienced CAV in the past have attempted to find negative CAV pullet flocks *via* serologic testing. Pullet flocks found negative after 12 to 15 wk of age have been exposed to CAV. Controlled exposure has been accomplished by placing litter from known CAV-positive farms into the environment of birds testing negative for the virus. This practice of deliberately adding litter from

CAV-positive farms was practiced in Germany in the early 1980s in an attempt to control CAV (McNulty, 1991). In recent years, there has been an increase in use of autogenous live CAV vaccines to insure seroconversion of broiler breeders in the U.S. The CAV vaccine has been used in Europe to mimic natural exposure and has proven successful in preventing vertical transmission (Rosenberger, 1992; Vielitz *et al.*, 1987). There is no USDA approved CAV vaccine for use in the U.S.; however field trials are in progress for approval of a commercial vaccine. New broiler complexes in which broiler breeders are reared in areas geographically distinct from major broiler production areas have greater likelihood to have problems with CAV if not artificially exposed in some manner (Fussell, unpublished data). Vaccination for CAV is a necessity on new start up complexes. In addition, some U.S. companies have experienced recurring cases of CAV after pullet houses were cleaned out and disinfected. In general, CAV is much less likely to occur in progeny from breeders raised on built-up or reused litter than from houses that are extremely well cleaned and disinfected. Once a pullet house is contaminated with CAV, the virus will not necessarily remain on the premises resulting in seroconversion of subsequent flocks. In rare cases in which an excellent job of cleaning and disinfecting is practiced, birds do not seroconvert to CAV before the onset of egg production. Ultimately, we may experience vertical transmission and clinical CAV in progeny in these cases. Danish researchers have shown that a high level of hygiene as part of an eradication program for *Salmonella enteritidis* results in a lower incidence of subclinical CAV in broilers or breeders. The lowest incidence of subclinical CAV in the Danish study occurred during May through July (Jorgensen *et al.*, 1995).

Co-infections with CAV and IBDV enhance the development of disease in experimentally infected day-old chickens, compared with CAV alone (McNulty, 1991). Also, IBDV and CAV act synergistically to produce subclinical immunosuppression in broilers (Yusa *et al.*, 1980).

Subclinical CAV: Does It Cause a Problem in Performance?

Evidence is conflicting on the issue of subclinical CAV and its economic impact. Routine tests for CAV in the U.S. are not quantitative. Without quantifying passive protection and knowledge of the pathotype involved, it is easy to see that evidence based on field performance data for subclinical CAV may be confusing. Work in Europe suggests that birds that do not seroconvert to CAV have significantly better performance (McIlroy, 1994). The ubiquitous occurrence of CAV in the U.S. and worldwide thwarts efforts to maintain negative status for CAV on any single broiler farm. With imminent licensure of a live CAV vaccine in the U.S., we must consider whether we may

reduce the economic impact of this disease with the use of an inactivated CAV vaccine via hyperimmunized hens thus preventing performance declines due to subclinical CAV. Breeder immunization with inactivated CAV vaccine produces progeny less susceptible to artificial challenge by CAV. Progeny derived from vaccinated breeder flocks perform better than unvaccinated flocks based on livability, body weights, and feed conversion. Breeder vaccination with CAV may provide economic benefits to broiler producers particularly on "problem" farms (Rosenberger and Cloud, 1990).

Additional strategies to control immunosuppressive diseases or their effects occur in the management area. Providing an environment relatively free of stress is important to maintain bird health. Poor ventilation and cool temperatures are stressors that make birds more susceptible to disease.

The use of nipple drinkers has had a greater impact on reducing respiratory disease in broilers than any innovation in recent years. This reduction is widely acknowledged in the poultry industry. Most companies have data to support the use of nipple drinkers for respiratory disease control. Do nipple drinkers allow us to maintain performance in the presence of a greater level of immunosuppression than in the past? Do nipple drinkers work because there is less bacterial load or stress on birds? Research is limited on why nipple drinkers improve bird health.

We must increase our knowledge of the effects of immunosuppression on broilers and develop appropriate intervention techniques to optimize performance.

REFERENCES

- Ather, M. A., 1993. Infectious bursal disease in chicken. *Poult. Advisor* 26(12):27-30.
- Chettle, N. J., J. Stuart, and P. J. Wyeth, 1989. Outbreak of virulent infectious bursal disease in East Anglia. *Vet. Rec.* 125: 271-272.
- Fussell, L. W., 1995. IBD vaccination strategies: Tyson Foods, Inc. Pages 15-16 *in*: International Poultry Symposium. Summit on IBD, Athens, GA.
- Giambrone, J. J., 1995. Broiler vaccination-additional protection is often needed. Pages 17-20 *in*: International Poultry Symposium. Summit on IBD, Athens, GA.
- Jorgensen, P. H., L. Otte, M. Bisgaard, and O. L. Nielsen, 1995. Seasonal variation in the incidence of subclinical horizontally transmitted infection with chicken anemia virus in Danish broilers and broiler breeders. *Arch. Geflügelkd.* 59: 165-168.
- McIlroy, S. G., 1994. The epidemiology and control of economically important diseases of broiler and broiler breeder production. *Proc. Soc. Vet. Epidem. Prev. Med.* 124-126.
- McIlroy, S. G., M. S. McNulty, D. W. Bruce, J. A. Smyth, E. A. Goodall, and M. J. Alcorn, 1992a. Economic effects of clinical chicken anemia agent infection on profitable broiler production. *Avian Dis.* 36:566-574.
- McIlroy, S. G., E. A. Goodall, D. W. Bruce, R. M. McCracken, and M. S. McNulty, 1992b. The cost benefit of vaccinating broiler flocks against subclinical infectious bursal disease. *Avian Pathol.* 21:65-76.

- McMurray, B., 1995. Vaccination strategies: Reflections from the field. Seaboard Farms. Pages 35–37 *in*: International Poultry Symposium Summit on IBD, Athens, GA.
- McNulty, M. S., 1991. Chicken anaemia agent: a review. *Avian Pathol.* 20:187–203.
- Miller Heins, S., 1995. The emergence of the Delaware strain of IBD and its control in the U.S. Pages 99–101 *in*: International Poultry Symposium Summit on IBD, Athens, GA.
- Nakamura, T., Y. Otaki, and T. Nunoya, 1992. Immunosuppressive effect of a highly virulent infectious bursal disease virus isolated in Japan. *Avian Dis.* 36:891–896.
- Putnam, M., 1995. Reflections from the field: Wayne Poultry. Pages 40–41 *in*: International Poultry Symposium Summit on IBD, Athens, GA.
- Rosenberger, J. K., 1992. Chick anemia agent a practitioners guide. *Vet. Diag. Vir.* 23–25.
- Rosenberger, J. K., and S. S. Cloud, 1990. IBDV-CAA Update. Pages 113–114 *in*: Proceedings 25th National Meeting on Poultry Health and Condemnsions, Ocean City, MD.
- Rosenberger, J. K., S. S. Cloud, J. Gelb, E. Odor, and J. Dohms, 1985. Sentinel bird survey of Delmarva broiler flocks. Pages 94–101 *in*: Proceedings 20th National Meeting on Poultry Health and Condemnsions, Ocean City, MD.
- Rosenberger, J. K., S. S. Cloud, and A. Metz, 1986. Update on Delmarva respiratory complex and the use of variant IBDV vaccines. Pages 98–102 *in*: Proceedings 21st National Meeting on Poultry Health and Condemnsions, Ocean City, MD.
- Sharma, J., and J. K. Rosenberger, 1987. Infectious bursal disease and reovirus infection of chickens: Immune responses and vaccine control. *Avian Immun. Basis Pract.* 2:149–150.
- Snyder, D. B., D. P. Lana, P. K. Savage, F. S. Yancey, S. A. Mengel, and W. W. Marquardt, 1988. Differentiation of infectious bursal disease viruses directly from infected tissues with neutralizing monoclonal antibodies: Evidence of a major antigenic shift in recent field isolates. *Avian Dis.* 32:535–539.
- Snyder, D. B., V. Vakharia, and P. K. Savage, 1992. Naturally occurring neutralizing monoclonal antibody escape variants define the epidemiology of infectious bursal disease virus in the United States. *Arch. Virol.* 127:89–101.
- Tsukamoto, K., N. Tanimura, S. Kakita, K. Ota, M. Mase, K. Imai, and H. Hihara, 1994. Efficacy of three live vaccines against highly virulent infectious bursal disease virus in chickens with or without maternal antibodies. *Avian Dis.* 39:218–229.
- Vielitz, E., V. von Bulow, H. Landgraf, and C. Conrad, 1987. Anemia in broilers: development of a vaccine for parent stock. *J. Vet. Med.* B34:553–557.
- von Bulow, V., 1991. Avian infectious anemia and related syndromes caused by chicken anemia virus. *Crit. Rev. Poult. Biol.* 3:1–17.
- Yuasa, N., T. Taniguchi, T. Noguchi, and I. Yoshida, 1980. Effect of infectious bursal disease virus infection on incidence of anaemia by chicken anaemia agent. *Avian Dis.* 24:202–209.
- Zhou, W., B. Shen, B. Yang, S. Han, L. Wei, B. Xiao, and J. Zhou, 1997. Isolation and identification of chicken anemia virus in China. *Avian Dis.* 41:361–364.