Vaccine Research Ideas

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THE OPERATION OF SOME FACTORS OTHER THAN VACCINE IN POULTRY IMMUNIZATION

by

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Vaccination is a relatively simple mechanical procedure; immunization, however, is a complex biological response which may differ greatly from one individual to another within a group of birds or animals. The proper and successful use of live virus vaccines requires that we recognize, understand and make provision for these individual differences and variations within the flock or herd.

Let us start with the common generalization: "No two individuals are exactly alike." This is true of living things in general, of members of the same race and of children of the same parents. Superficially we look and act alike but we react differently. The same amount of gin comsumed at the same rate by a dozen persons will produce a dozen different reactions in terms of excitement or stupor, laughter or quarrelsomeness. A class of students assigned the same pages in a textbook and exposed to the same classroom discussion, when examined, will exhibit degrees of learning which may range from excellent to failure.

In just this same fashion, when large numbers of birds are vaccinated with the same vaccine and by the same method of application, some will respond quickly and produce large amounts of antibody which will be retained for long periods. And at the other extreme, some birds will respond slowly or not at all, while the majority of the flock will give a "normal" response that results in intermediate amounts of antibody and varying periods of protection. Our data show that when susceptible birds are vaccinated, between 85 and 90 per cent will fall into the "normal" response group, while the remainder are about equally divided between the abnormally high and the abnormally poor response groups. These data therefore conform very well to the so-called normal or frequency distribution curve which is universally observed in biological phenomena.

In the poultry industry we are constantly dealing with large numbers of individuals, and this means that even under ideal conditions with respect to birds, vaccine and method of application, it is unlikely that 100 per cent immunization will be accomplished. The proportion or percentage that fails to respond is small, but in large flocks the number of such birds may be appreciable. Lack of success in these few out of the many vaccinated should not be taken as an indication of the failure of the vaccine or the method of application.

Just as birds and other animals vary in the degree of their response to primary immunization, so they will also vary in the duration of their immunity as measured by the amount of antibody in their blood serum at various intervals after vaccination. The average duration of immunity may be expressed in weeks or months, but it must be recognized that this <u>average</u> includes both the long and the short intervals as well as the broad middle or median period which characterizes the group as a whole.

Up to this point we have been speaking in general terms about what happens under ideal and virgin conditions. However, with poultry we know that conditions are seldom ideal and that birds are seldom virgin with respect to respiratory troubles like Infectious Bronchitis, Newcastle disease and Chronic Respiratory Disease. These infections are widespread and as a consequence most baby chicks start life with one or more potential strikes on them. One of these is the threat of early exposure and infection, and this is especially true in areas of dense poultry population. Another natural hazard is the dowry of antibody that chicks receive from their mothers. These hand-me-down antibodies come to them by way of the yolk substance of the egg and they seem designed to give immediate and effective protection to the young. However, like other hand-me-downs, these antibodies may be quantitatively too large or too small, so that the chick either ourgrows them too fast and so gets little good from them, or the chick is embarrassed by their superabundance. To make the situation clear, an explanation is required: The amount of antibody a hen puts into an egg is determined by the amount present in her blood at the time the egg is formed. Thus shortly after immunization, either by infection or vaccination, the laying bird will put maximum quantities of antibody into her eggs, and chicks hatched from these eggs will have protection which may last for four or five weeks. Later, as the antibody level in the blood of the layer declines, less and less antibody is put into her eggs. Chicks hatched from these eggs will, therefore, receive correspondingly less antibody and such chicks will have protection for shorter periods. Finally, after some months, although the active immunity of the layer is still adequate to protect her against disease, the eggs which she now lays will contain little or no antibody. In spite of the fact that they came from an immune hen, the chicks hatched from these eggs may be just as defenseless as those laid by a fully susceptible layer.

The operation of this defense mechanism is doubly significant in understanding what takes place following vaccination. First, it means that one may get fully susceptible chicks from immune laying birds. Recalling the variations in response and duration of antibody levels in individual birds, it is also apparent that not all eggs laid on the same day by an immune flock will contain the same amounts of antibody. A few eggs may contain none at all while the majority of eggs laid on a given day will give rise to chicks which will be protected for 2 or 3 weeks.

The second significant aspect of the amount of antibody received by the chick is the influence this antibody may have on the bird's response to vaccination. Moderate amounts of antibody do not interfere with successful response to vaccination, but large amounts, such as those received by a chick from a recently infected layer, appear to prevent successful vaccination. Why should lesser amounts of antibody, which are also capable of preventing disease, not interfere with vaccination? The answer appears to lie not just in the presence of antibody but in its distribution in the body. It is known that following certain infections which cause high levels of antibody in the blood, some antibody spills out in the mucous secretions of the respiratory and digestive tracts. This is true in human influenza, poliomyelitis and cholera. There is suggestive evidence both in Pullorum disease and in Newcastle disease that antibodies against the agents of these infections are present in the secretions of highly immune birds. To grasp the importance of this fact it is necessary to understand the mechanism by which live virus vaccines immunize. The live virus of the vaccine is ineffective unless it reaches susceptible cells and grows in them--otherwise the situation is like introducing gasoline into the exhaust manifold instead of the intake of an automobile; it may backfire but it creates no useful power. Antibodies on the mucous membrane of the respiratory surfaces, in effect, insulate the cells against exposure to the vaccine virus and as a result the virus cannot penetrate and grow in them. Thus a baby chick with an overdose of antibody from its mother is an innocent victim with a passive hangover and an even greater potential headache when the effect wears off. However, since it does no more good to cry over spilled antibody than over spilled milk, what can be done about it? The remedy is to vaccinate at a later period when the antibodies have decreased to a point where they no longer spill out in the secretions, or when they have completely disappeared from the blood.

The average poultryman has no practical way of telling whether his chicks have too much antibody to permit a good response to vaccination, or so little that he must vaccinate at the very earliest opportunity. The safest and most economically sound practice, then, is to vaccinate in time to protect those chicks which require early protection, and to revaccinate at 4 or 5 weeks of age so as to take care of those which, either because of their temporary immunity or for other reasons, failed to respond to the primary vaccination.

It is worth emphasizing that the factors and phenomena discussed here are natural, "built-in" mechanisms and that they operate without respect for brand names, advertising catch-words, price or propaganda. The live-virus vaccines produced by various manufacturers are basically similar; all are designed for the same purpose--to immunize. The claims and recommendations of various producers differ in several respects regarding the duration of immunity, the time and frequency of revaccination and the manner of application. Many of these differences are matters of opinion, judgment or emphasis, and they are not determined by the nature or the strain of virus present in the vaccine. A given vaccine may be designed and packaged for a particular method of application, and hence may be ill-adapted for use by another method, but the virus or viruses in it differ (<u>with respect to the operation of the factors discussed above</u>) in no important respect from those of another vaccine. This is not to say that there are no differences in vaccines; there are differences and important ones. The important differences in vaccines may be expressed by the word <u>quality</u> and this means consistant and careful testing for stability, safety and potency. But no vaccine, however carefully it is manufactured, standardized and tested, can be guaranteed to immunize under any and all circumstances. The biological producer at best can only provide the finest product he knows how to make, and then advise or recommend how to use it. When it leaves his hands he has no control over how or when or on what kind and condition of birds his product is used. It is well, then, to remember that while vaccines are highly important and useful tools for minimizing losses from specific causes, they are in no sense to be regarded as a comprehensive crop insurance policy.

One of the other potential strikes on baby chicks today is Chronic Respiratory Disease (CRD) or Airsac Disease. This economic snake-in-the-grass is one of the most vicious threats because it may be present without being suspected. Just as in the case of Pullorum disease, baby chicks may already be infected at the time of hatching because they came from infected layers. CRD infection may smolder along for weeks without appearing in serious or recognizable form and many different factors may cause it to flare up into activity. Exposure and chilling, overheating, too much ammonia and humidity, other infections and even vaccination may contribute to its coming to the surface. The agents of CRD apparently dig themselves into the lining of the respiratory tract and quietly thrive there at the expense of the bird. Later, when some other irritation occurs in this lining membrane, they take advantage of the disorder and grow with vigor. We have already pointed out that vaccination with Newcastle or

Infectious Bronchitis virus immunizes by reason of its ability to cause a mild infection of the lining cells of the respiratory tract. The irritation associated with this is tolerated without difficulty by healthy birds, but a CRD-infected bird is not a healthy one and consequently it may get into trouble. Shall we then condemn vaccination and forego the obvious benefits of it to gamble on the outside chance that the flock will escape exposure to Newcastle Disease and Infectious Bronchitis? Some poultrymen may elect to do so, but it is not necessary to take this dangerous chance.

The agents of CRD are susceptible to the action of broad spectrum antibiotics such as Aureomycin®, but the viruses of Newcastle Disease and Infectious Bronchitis are not. Therefore, by feeding high levels of Aureomycin at the time of vaccination and during the reaction period following it, the agents of CRD can be suppressed and prevented from creating a serious problem while the birds are developing their immunity. This has been shown repeatedly in the known presence of CRD infection and therefore since this infection may be present but unsuspected it seems that good management practice dictates the routine fortification of the diet with an

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effective antibiotic at the time of vaccination.

These varipus factors, then, such as natural variation among birds, differences in natural immunity and the frequency of inapparent infections, either individually or in combination, all operate in one degree or another to influence the course and outcome of vaccination. To recognize these factors and to understand them is to win half the battle, and the rest can be won by the intelligent use of the knowledge and the tools which are already available to us.