Vaccination Against *Salmonella enteritidis* and Monitoring Vaccination Success

Armando Mirande
DVM, MPVM, MAM, ACPV

Biomune Co.
Lenexa, KS 662 15
USA

INTRODUCTION

Ever since the late 1980's, when grade A shell eggs were associated for the first time with cases of human illness caused by *Salmonella enteritidis (Se),* the commercial layer industry in the United States has been presented with numerous and variable difficulties in presenting its product, the table egg, for what it is: a completely natural food item of excellent nutritional value, with undoubtedly the highest quality protein of animal origin, and at the absolutely lowest cost. The key words in this statement are "of animal origin", because in todays regulatory environment this implies that safety may be at risk.

By understanding the biology and current practices of food animal agriculture we acknowledge that many times it is impossible to produce certain food products in a sterile manner. The dairy industry exists today only because of pasteurization, a further process. Because it is the responsibility of our government to ensure the safety of our generally safe food supply it is also the right of our government to determine what microorganisms and how many of them should be allowed to enter the food chain. For example, in the case of processed broilers, the new USDA Pathogen Reduction Final Rule or MegaReg has established a critical limit of 12 positive broilers for any Salmonella out of 5 1 broilers sampled (23.5%) as determined by the whole bird carcass rinse test. Implementation of MegaReg standards began in January of 1998 and compliance is immediate. If contamination rates exceed the set standards, USDA reserves the right to suspend inspection until the problem is solved. Since uninspected meat cannot be sold, the economic consequences of such suspensioncan be rather significant. However, USDA will not go into the field to inspect the farms.

In the case of shell eggs there are significant differences. First, there is zero tolerance to Se. Whether one or one million Se are recovered out of one pool of eggs tested, the entire flock (house) is considered positive and all eggs produced by that flock are considered contaminated and therefore must be diverted to "breakers" (pasteurization plants) until there are four consecutive negative results in 1,000 eggs tested every two weeks. This process usually takes a minimum of ten weeks, assuming there are no more positive findings. Depending on the access to the breaker market, diversion of eggs originally intended for the shell egg market would normally represent a net loss of 5 to 30 cents US per dozen. The economic impact of this practice can be devastating.

Secondly, FDA will go into the field to inspect the farms suspected to be the source of contaminated eggs and will conduct bacteriological testing of the eggs as well as of the layer house environment. FDA took over the traceback program in 1996 (originally implemented by USDA) and it appears to be conducting it in a more thorough and aggressive manner.

Thirdly, egg diversion only comes as a result of finding Se, not any other paratyphoid as is the case with broilers. However, there is a major change in the FDA traceback program as compared to the original USDA program. There is no need anymore to find and match in the farm the phage type (PT) of the Se involved in a human outbreak. For example, if illness is caused by Se PT-13a and FDA finds Se PT-8 in a flock environment or eggs, the same procedure of egg diversion and testing applies. Epidemiological phage type link to a farm is no longer necessary because potentially one type of Se is as pathogenic as another. This obviously makes most egg producers feel that they are being unfairly targeted and persecuted.

CONTROL

The commercial layer industry has reacted with responsibility for the most part. Most egg producers have entered into voluntary industry programs that are co-sponsored by producers, State poultry associations/federations, Universities, State Departments of Agriculture, etc. Generally these programs require that producers observe good hygiene and management practices, in other words, good husbandry. The majority of programs also require bacteriological testing of the premises on a pre-determined schedule. Is in this testing area where most variation between voluntary programs occurs.

Although the statement of purpose of these programs is, usually, to provide its members with the management tools necessary to minimize the likelihood of producing Se-contaminated eggs, to my knowledge none of them today mention vaccination as an alternative. By talking to many egg producers I have come to believe that the reason for this obvious omission is the natural resistance they present towards financing a disease/problem which most feel is not theirs. Few of them question the efficacy of vaccination, whether from their own experience or from the opinion of others who have used it. Recently a major University has published a manual titled “Preharvest HACCP in the Table Egg Industry" which includes Se vaccination as an integral part of Biosecurity and as a mean to deal with flocks at high risk of Se exposure.

It is safe to assume that if Se would generally affect egg production, shell quality, livability, or any other production parameter of the commercial layer, Se vaccination would be a widely used management practice. But Se almost never seems to affect the chickens and the likelihood of a “clean” pullet flock becoming infected (and detected) with Se during its production cycle appears remote to most producers, so vaccination seems like an unnecessary expense and many choose to “play the odds”.

Those egg producers who have been involved in a traceback or even in a case of egg diversion or have had an Se positive pullet flock are generally the same producers vaccinating for Se today.

Vaccination against Se (as would be for any other vaccination) should be done as a preventative practice rather than as a treatment of a pullet flock that turned positive for Se during grow-out or even arrived infected with Se from the hatchery. As a prevention measure it is extremely effective but field experience has also shown that vaccination of a flock after Se infection is of great value in decreasing shedding of Se into the environment and in significantly reducing lay of Se-contaminated eggs.

Vaccination against Se provides protection in chickens by stimulating production of very high levels of humoral antibodies that reduce colonization of internal organs by Se, including the ovary and reproductive tract, therefore preventing vertical (transovarian) transmission. In the case of Biomune's Layermune SE vaccine reduction in the colonization of the intestinal tract has also been demonstrated with the consequent reduction in fecal shedding, shell contamination, and invasion of the egg by Se. This protection has been observed against different phage types, including those not contained in the bacterin (heterologous). Additionally, a vaccine's "third line of defense" has been shown by researchers of the USDA's Southeastern Poultry Research Laboratory in Athens, Georgia, USA. They measured specific, antibody-dependent retardation in the growth of Se inoculated into contents of eggs laid by vaccinated hens. Such an effect could provide invaluable "extra time" if some type of abuse by food handlers occurs. Several laboratory challenge trials results and extensive field data supporting vaccine efficacy will be presented at the meeting.

Layermune SE administration is recommended by subcutaneous injection in the neck of chickens 12 weeks of age or older. A second injection should be administered at least four weeks later for optimum protection, Revaccination during molt is recommended.

Although vaccination with Layermune SE has an impressive track record in the field since it became the first federally licensed product to aid in the control of Se six years ago, and although it carries great expectations of success from producers, it is not intended to be the only measure of control against Se infection/contamination. Disease control measures accepted as standard in the egg industry should still be implemented, including sanitation, isolation, Se-free stock, a sound rodent control program, etc. Se is a multiple source threat and today it must be dealt with multiple solutions, both good husbandry and vaccination. It should never be a matter of one or the other. Such an approach carries a much greater risk of failure.

MONITORING

Normal monitoring and evaluation of an Se vaccination regime should include serology, either plate agglutination, microagglutination, or ELISA tests, conducted four weeks after the last injection. Results following correct administration of two doses of Layermune SE vaccine at least four weeks apart should be as follows: 100% of birds with a strong positive reading in the plate agglutination test utilizing the commercial pullorum-typhoid stained antigen (K Polyvalent). On the microagglutination test the titer should average 9 (Log 2) or 512 (range 7-11 (Log 2) or 128-2048). On a commercial ELISA test the expected titer group average is 17 (range 16-18) although most serum samples "max out" at group 18.

Plate agglutination and microagglutination tests detect mainly Ig-M type antibodies that are short lived. Sera from vaccinated birds turn negative on these tests after eight to ten weeks. The ELISA test detects mainly Ig-G type antibodies that are long lasting and can be detected throughout the entire lay cycle or until molt, when antibodies of any type usually disappear.

For egg producers serology only means that the injecting crew did its job right. Their true evaluation of the Se vaccine depends on the isolation (or lack) of Se from eggs mainly, but also from internal organs of birds such as liver, spleen, ovary, and cecae, and from the environment; whether it is manure, egg belts, fans or mice. Because of the multitude of sources of Se in the environment and because of the mechanisms of protection of Layermune SE bacterin, finding Se anywhere else other than the eggs should not be interpreted necessarily as vaccine failure. People do not eat chicken manure, mice or belt swabs, only eggs. So contamination of eggs by Se should be the only way in which to judge the vaccine. Reisolation from the environment of such an ubiquitous microorganism should never be the sole criteria. If this were the case there would be no chance for many otherwise successful vaccines.

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