

Farm Vaccination - Injection Method Oil Emulsion Vaccines

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Introduction

Oil emulsion vaccines have played a major role in the poultry industry. Vaccinating with oil emulsions produces a high level of immunity that is long lived. The use in breeders allows progeny protection, through maternal antibodies (MAB), which begins at one day of age.

Emulsions are stable mixtures of two immiscible liquids. Emulsions are not unique to vaccines. Milk, rubber latex, mayonnaise, ice cream, lotions, polishes and insecticides are all examples of emulsions. Oil emulsion vaccines are composed of oil, water (containing the antigen) and surfactants. The aqueous phase (the water containing the antigen) is dispersed into microscopic globules. This is the internal or discontinuous phase. The oil surrounds the aqueous phase and is called the continuous or external phase. Most oil emulsion vaccines use mineral oil, a non-metabolizable oil. Surfactants are added to both the oil and aqueous phase to help emulsify the two liquids and provide stability.

The mineral oil serves two purposes. One is to stimulate the immune system to produce an enhanced immune response. The other is to allow a slow release of antigen to stimulate the immune system over a long period. Killed vaccines using lecithin oil (a metabolizable oil) or AIOH (water base vaccine), rather than mineral oil, produce less immune stimulation for a shorter duration. With a single injection of an oil emulsion vaccine, emulsion can still be detected histologically twenty-eight weeks post-vaccination. Giving two injections before production can provide protection throughout the production cycle in breeders and provide high levels of maternal antibodies to progeny. However, antibody titers will gradually decrease and the %CV will increase during the life of a flock. To help maintain uniformity in a flock and the highest level of MAB in the progeny, many producers give a mid-lay injection.

Storage and Handling

Oil emulsion vaccines should be stored between 35° - 45° F (2° - 7° C). Heating and freezing must be avoided. Failure to properly store oil emulsion vaccines can lead to product failure due to a broken emulsion. An oil emulsion vaccine can have four distinct appearances: a) normal, b) creaming, c) antigen settling, and d) broken emulsion. A normal oil emulsion should appear as a homogeneous white to slight off-white liquid. The off-white appearance is usually noticed when the antigenic content is high, as with multiple antigen vaccines, or when tissue culture antigen is used. This off-white appearance is normal for those products. Creaming occurs due to excess, free oil floating on the top of the emulsion. A vaccine that has creamed will have two layers, a light white or clear top layer above the normal white colored oil emulsion. This is a normal process that occurs sporadically during shipment. If the vaccine is gently shaken, the normal appearance will return and creaming will probably not occur again during storage. Settling usually occurs with vaccines of high antigenic content. The small globules of water (antigen) surrounded by oil are heavier than the oil alone; therefore, they settle toward the bottom. The vaccine will be white from top to bottom with a gradual increase in darkness toward the bottom. This is not a broken emulsion. This product can be gently shaken and used. A broken emulsion occurs when the aqueous and oil phases of a vaccine separate from each other. The vaccine will have two, well-defined layers. There will be the normal emulsion, white color, with a tea to coffee colored water layer at the bottom. If a broken emulsion is shaken, it will appear normal but within a few hours the two phases will separate again. When an emulsion breaks the vaccine should not be used. If injected, the broken emulsion will initially produce a high immune response, but the response will be short-lived.

Before use, oil emulsion vaccines should be removed from refrigeration the night before use and slowly warmed to room temperature (25° C). Do not apply heat to warm the vaccine or place in direct sun light. Prior to use, oil emulsion vaccines should be gently shaken. Remove the metal cover and clean the rubber stopper with alcohol. Use a clean, sterile injection set up. Insert the needle through the rubber stopper and prime the injector. Each bird must be vaccinated with a full dose of vaccine.

Method of Application

To achieve the maximum potential from killed vaccines, each bird must be properly injected with a full dose of vaccine. Vaccine can be injected intramuscularly (IM) in the breast, wing, leg or tail head or subcutaneously (SQ) in the neck. When injecting SQ, use an 18-gauge, 1/2 inch needle. An 18-gauge, 1/4 inch needle should be used when injecting IM.

Neck - The skin on the back of the neck should be lifted up to create a pocket between the skin and neck muscles. Insert the needle through the skin into this pocket with the needle pointing toward the bird's body. The site of injection should be the middle to lower neck region on the dorsal mid-line of the neck. There will be resistance as the needle passes through the skin followed by free movement into the SQ space. If this difference is not noticed or is followed by resistance again, the needle may be in the skin, the neck muscle or the spinal cord. Avoid injecting vaccine into the neck muscles, intradermally or too close to the head.

Breast - Vaccine is injected into the superficial pectoral muscle about 1 to 1.5 inches lateral to the keel bone, depending on the age of the bird. The needle should be directed caudally at a 45° angle to the body. This will help avoid injecting the vaccine through the muscle and into the body cavity.

Leg - When using the leg muscle for vaccination, the injection should be made in the lateral side of the gastrocnemius muscle mid-way between the stifle joint and the body. The needle is directed proximally. Avoid major vessels, nerves, joints and the bone.

Wing - The wing muscle (medial side of the biceps) can be used as an alternative IM site. The injection is made into the large muscle group on the under side of the wing. The needle is pointed toward the body. Avoid major vessels and the bone.

Tail Head - This injection is made into the underside of the tail head. The needle is directed to the side of the tail bone and pointed cranially. Care should be taken to not withdraw the needle too quickly. A fast withdrawal can lead to leakage of vaccine out of the injection site.

There is always the concern that one injection site may produce superior immunity to another. Research has shown that all common injection sites can give satisfactory results if done properly. Mutalib et. al. found only minor differences in antibody titers in birds vaccinated in the thigh, breast, wing and neck with Newcastle (ND) vaccine and no difference in titers with Infectious Bronchitis vaccine. Glisson et. al. vaccinated birds with *Pasteurella multocida* bacterin in the tail, wing, leg, breast and the neck. There was no significant difference in ELISA titers or in protection when challenged. When selecting the injection site, consideration should be given to ease of application, reaction at the injection site and human safety. Comparisons to decide which injection site gives the best result in an individual operation may be helpful.

Monitoring

Vaccination should be monitored to ensure the full potential of the vaccine is achieved. Serology is useful in evaluating the birds' response to vaccination. ELISA is the most widely used test. Virus neutralization (VN) is another valuable test. VN shows the level of neutralizing, or protective, antibodies. Hemagglutination inhibition (HI) can be used for ND, paramyxovirus - type 3 and avian influenza. The antibody level and uniformity of the flock's immune response will help give some indication of the vaccination crew's technique.

Evaluation should also include visits to the field to work with the vaccination crew. Vaccination crews should be educated in proper technique and vaccine handling. To evaluate the crew's vaccination technique, the injection site should be examined shortly after vaccination. With the SQ neck injection, the feathers at the injection site can be separated to allow visualization of the vaccine under the skin. To see vaccine through the skin, examination should be done within an hour of vaccination. As the time between vaccination and examining birds increases, the vaccine will disperse into the SQ tissue and be difficult to see. The feathers around the injection site should be dry. Wet feathers may be the result of early retraction of the needle, vaccination through both layers of skin or vaccine leakage out of the injection site. Vaccine will leak back if a large bore needle is used, the needle has a spur or the vaccine is not injected deep enough into the tissue.

Other potential vaccine injection errors may include the following. Intradermal injections may occur during the SQ neck injection. If vaccine is injected intradermally, the vaccine will cause the skin to bulge, like a blister, at the injection site. The bird's body will respond by walling off the vaccine. With time, the skin will rupture releasing the vaccine. When vaccine is injected into the neck muscle rather than the SQ space, birds will be slightly depressed post-vaccination. As the area heals and scar tissue forms, the bird's neck may become permanently twisted. If the needle passes through the neck muscle, vaccine can be injected into the spinal cord. Birds will usually die within an hour if vaccinated into the spinal cord. Vaccinating too close to the head can result in swollen heads since there is little SQ space for inflammation as the immune system responds to the vaccine.

Vaccination with the other methods can also cause problems if not performed correctly. Improper injection into the leg can cause sore legs and joints. If the needle is inserted into the medial side of the leg, there is a chance of damaging vessels and nerves. Vaccination through the breast muscle into the body cavity can occur during the IM breast injection. This is usually the result of inserting the needle perpendicularly into the breast rather than at 45° angle. The result of injecting vaccine intraperitoneal is the formation of adhesions. When performing the tail head injection, the spinal cord must be avoided. To further evaluate injection technique, cull birds can be necropsied to evaluate the injection site with all the methods described. Visits to evaluate the vaccination crew should be unannounced to assure you are getting a true picture of the vaccination technique.