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Control of IBD in the South Pacific

Eduardo Bernardi
Technical Services Manager - Pacificvet

Infectious Bursal Disease (IBD), also known as Gumboro Disease, is one of the most devastating poultry diseases worldwide. This is an avian virus that targets and destroys one of the main components of the immune system of the chicken: the bursa of Fabricius (also known as *Bursa cloacalis*). It is the organ that is responsible for an antibody response to an infection. When the bursa is affected by the IBD virus, the whole immune system of young chicks could be severely affected. The disease is locally notable in the South Pacific for allowing secondary infections such as Inclusion Body Hepatitis (IBH) and *E. Coli*. Moreover, it directly affects feed conversion and mortality figures.

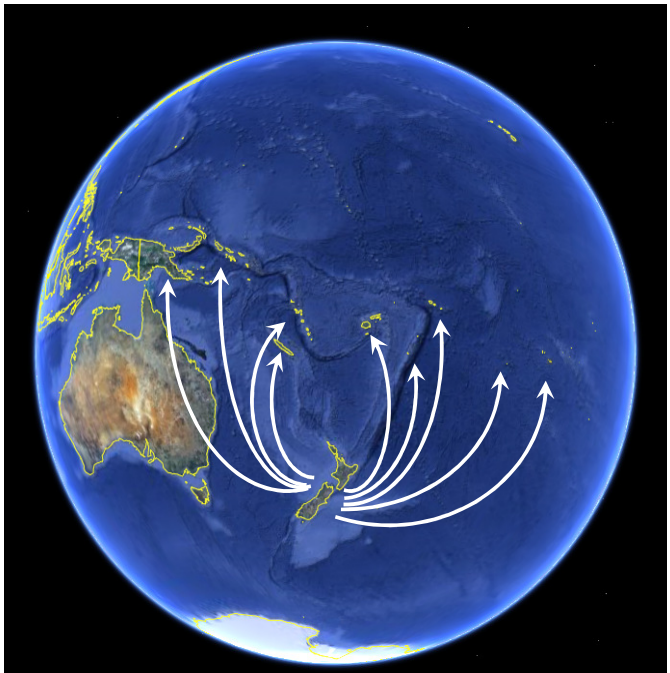
In the control of IBD, vaccination is vital. Active immunisation of the birds plays a key role, taking into account that the high resistance of IBDV to environmental conditions and its wide distribution make hygienic measures alone insufficient.

Except for New Zealand, the IBD virus is present in the South Pacific countries. Their geographical locations and industry particularities make control of IBD a different challenge than in the rest of the world, but in reality it should be a relatively easy task, as compared to the potentially massive losses that the IBD virus can cause.

What is so special about the South Pacific in terms of IBD control?

The "IBD situation" in the South Pacific region is unique. But before we understand better the local scenario; we should discuss and appreciate how the bird's immunity works against IBD (see insert on page 3).

With the understanding of the immunisation against IBD, we need a geographical appreciation of the region: The poultry industry in the South Pacific countries has elected to outsource its genetic stock – breeders, broilers and commercial layers – out of New Zealand. The reason for this is not only because of the availability of the world's best genetic lines by reputable suppliers, but also the fortunate geographical isolation of New Zealand and its strict rules of biosecurity. This results in an enviable disease-free status, putting New Zealand in a unique category worldwide, in terms of freedom from poultry diseases. The country is free of Highly Pathogenic Avian Influenza, Newcastle Disease, Infectious Bursal Disease, Infectious Coryza, Avian Pneumovirus (TRT/SHS) and several serotypes of Salmonella that have affected poultry and the food chain in other countries.



New Zealand is a strategically-safe source of livestock and biologicals for the South Pacific.

Another factor to be taken into consideration is that most chicken sheds in the South Pacific nations will inevitably have some challenge of field IBD virus. These challenges can be of higher or lower intensity, but they justify a dedicated concern towards an effective method to reduce them and properly immunise the birds to prevent any ill effects.

There are records of Infectious Bursal Disease at least since 1991 in the region. The latest survey (published in 1996) conducted by the South Pacific Commission – now the SPC / Secretariat of the Pacific Community – indicates that a strain of low pathogenicity was known to be present (endemic) in most countries in the region. The virus was then considered to be widespread, especially based on serological results. Serological evidence and/or virus isolation was confirmed in Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Niue and Tonga; and clinical disease in Nouvelle-Calédonie, Polynésie Francaise and Vanuatu.

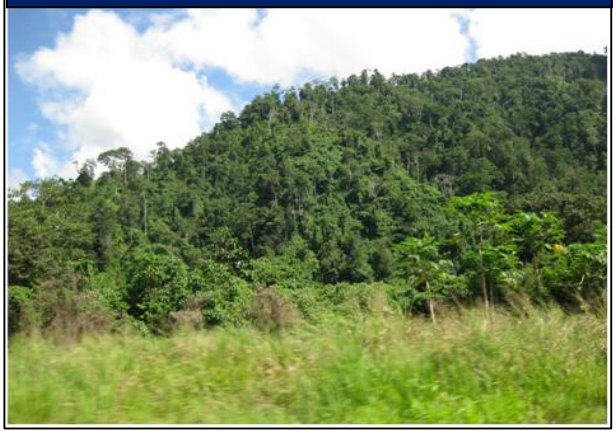
Currently, there is strong serological evidence of the presence of an IBD virus causing clinical signs and immunosuppression in poultry operations in Papua New Guinea and Fiji.

Reduction of a field challenge by means of **cleaning procedures** and disinfection is always an essential part of IBD control:

- delays the contact of the young flocks with the field virus
- reduces the number of birds to have an earlier contact with the field virus.
- maximises the number of birds to develop immunity from vaccination, with no damage to their bursas.

Unfortunately, **effective disinfection** is a difficult task when it comes to the IBD virus. This highly contagious virus is shed in the droppings and it may stay infected in the litter material for a long time. Moreover, the fact that most sheds in the region have no cement floors makes the cleaning and disinfection procedures even more difficult, starting from total removal of the used litter material, which is virtually impossible. This particular virus is very stable, and resistant to various disinfectants, acidic media and variable temperatures. It's worth quoting a famous anecdotal reference to an-all cement chicken shed in a research institution in North America. It was thoroughly washed and disinfected, and remained empty – free of birds – for over a year; but still, when specific-pathogen-free chicks were placed next, they soon became infected with IBD virus. Literature refers to iodine, chloramines and invert soaps as having the most potent effect in the inactivation or inhibition of the virus.

Wood shavings are a rare commodity, even in heavily wooded areas, where conservation efforts have been determined as a priority over logging.



The scarcity of litter material for new bedding obliges broiler producers to re-use old litter (below), thus increasing the field challenges of IBD.

Field challenges of IBD virus can always be minimised and delayed by utilisation of **new litter material**. Geographical particularities in the region however, make the availability of bedding material such as wood shavings or rice hulls scarce and uneconomical, especially when it comes to raising broilers at competitive costs. Poultry producers usually save the limited supply of wood shavings for the breeder sheds, given the higher value of each individual breeder. This leaves broiler chicks to face higher challenges of IBD waiting for them in the sheds and operations resorting to re-utilise old litter. An expected percentage of birds in a flock will be infected earlier, opening way for secondary diseases such as Infectious Body Hepatitis or *E. coli* infections. In addition, the shedding of virus will continue in these birds, leading to a steady build-up to massive and early challenges of IBD after a few broiler cycles. Complete cleanout procedures and preparation of the shed with new litter becomes essential to minimise losses in these cases. In addition, treatment of old litter (composting) is recommended between each flock. However, due to unexpected market demands, schedules may change and composting/resting time between flocks will likely be shortened due to immediate financial opportunities.

Producers must keep in mind that breeding stock in New Zealand is not vaccinated against IBD, therefore these birds do not have antibodies against IBD. As a further consequence, there are no such antibodies incorporated into the yolk during egg formation and all chicks that are hatched from eggs produced in New Zealand have no antibodies against IBD.

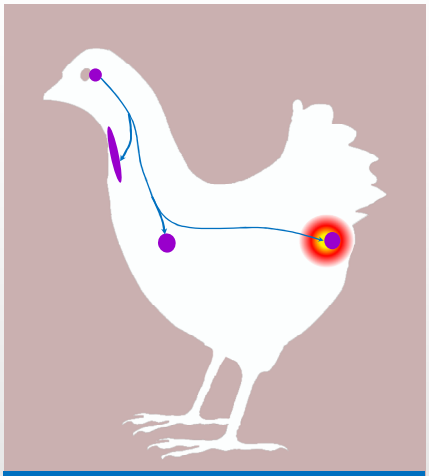
This should not be an obstacle to a vaccination programme for birds to be placed in IBD-infected areas. On the contrary, knowing that all birds produced from New Zealand breeders are consistently seronegative (no antibodies for IBD), **vaccination at the first day of age becomes a must**. It should be a relatively easy decision, to expose all birds, as soon as possible, to a uniform amount of IBD virus of the correct type and by methods that will not be of any harm to their young, still-developing bursas.

How birds can fight against IBD:

As the IBD virus is a very resilient organism, it is usually present in the chicken shed already at the moment when the birds are first placed. Normally, the first line of specific immunity the chicks have against these early challenges is a high level of **maternally-derived antibodies (MDA)**. The chicks inherit this level of antibodies from their immune mothers, as they are incorporated into the yolk during egg formation.

During their first days of life, the chicks absorb the yolk sac, so the antibodies go to their circulatory system. So far, the chicks are not making antibodies on their own yet. Even though they may encounter the field virus, it does not reach the bursa in time, being immediately neutralised by the MDA. Nevertheless, the level of this maternal immunity decreases with time and the chicks become more and more susceptible to the virus as they age. To start developing its own protective levels of antibodies, the chick must be exposed to the IBD virus – either by a field challenge (which could be problematic) or by a vaccine. The early MDA levels (higher) not only protect against the field challenge, but they also neutralise live IBD vaccines when these vaccines are given too early. Vaccination timing is critical for IBD, then. If the vaccine is given too early, it could be neutralised by high levels of MDA. If not early enough, it may miss the immune system, because the field virus gets established first.

When the vaccine reaches the bursa - the main target for the virus and also the main organ producing antibody-making cells - it will trigger a fairly quick immune response and subsequent production of antibodies. Once the bird is protected, there is little chance for the disease to affect the bird.



The IBD virus attacks the main source of antibodies in the chicken: the bursa. This is also the organ that is needed by the bird to produce protection against the same IBD.

However, if we want adult birds to pass their protection onto the progeny, we must boost this immunity. Breeders transfer protective antibodies to their offspring. It is recommended to vaccinate breeders with an inactivated IBD vaccine in an oil emulsion before start of production. This should induce high, uniform and long-lasting antibody titres (levels of antibodies) in the mothers, which will result in a high level of protection in the offspring.

When birds have no antibodies, the day-of-age vaccination is effective. The virus from the live vaccine will easily reach the bursa and multiply, thus triggering the production of antibodies against IBD.

- use a mild strain of IBD vaccine (see table page 4), which does not cause damage in the young bursa of the young chicks
- distribute the vaccine evenly throughout the whole flock

It is important to understand though that once a bird is exposed to a vaccine, effective immunity does not appear immediately. The cascade of immune reactions, with several different components and cells of the immune system participating takes a few days. It is therefore essential to maintain strict measures of cleanliness and biosecurity, rigid clean-up and disinfection of brooder sheds before placement and utilisation of new litter. The placement of birds in re-utilised litter will always offer a heavier challenge of field virus and a larger percentage of chicks will not be able to develop immunity before they are challenged with these harmful field strains.

In case of shipments of day-of-age chicks to the South Pacific countries, the early exposure for the so-called naïve birds (a term utilised for birds without those MDA) cannot be done by vaccination in the New Zealand hatchery. That's because strict biosecurity guidelines do not allow any live IBD vaccines to be utilised in New Zealand. Therefore, whenever the birds are hatched in New Zealand, exposure should be initiated upon arrival in the country of destination. IBD vaccination with a mild strain can be applied, either in the hatchery (by eye-drop, subcutaneous injection, cabinet spray or manual spray) or upon arrival at the farm (by eye drop, manual spray or drinking water).

Birds coming from parents raised and maintained in the South Pacific are expected to hatch mostly with a protective level of MDA. This is because parents that were raised locally are exposed to various field challenges of IBD and receive a robust vaccination programme against IBD, including an inactivated vaccine, which provides high, uniform and long-lasting titres. Knowing that they do have antibodies, we must treat these flocks of locally-produced birds as in any other country which has a "normal" field presence of IBD.

Live IBD vaccines

In addition to the management procedures (use of new litter, thorough clean up and disinfection of the sheds), the poultry industry in the South Pacific nations has currently two different types of live vaccines that cover the basics on IBD protection for broilers and layers:
The success of a vaccination programme against IBD depends on a number of factors. This includes the level of maternally derived antibodies (MDA) in the chicks, the capability of the vaccine to break through this maternal immunity, the choice of the vaccine type and, of course, the field challenge. This means in short that **the effectiveness of an IBD vaccine depends heavily on whether it is given at the right time**.

Live IBD vaccines are categorised by the OIE (Office International des Epizooties) by their breakthrough titre, virulence and potential to induce immunosuppression (see insert on the right).

According to these factors, the vaccines are divided into the groups:

- Mild
- Intermediate
- Intermediate plus

What is "breakthrough titre"?

It is a measurable capacity of the vaccine to invade the bursa and produce immunity, in spite of the presence of maternally derived antibodies. Vaccines with higher breakthrough titre will be able to overcome higher levels of MDA, although they will likely cause more damage to the bursa.

What is "immunosuppression"?

As more virulent (hot) IBD virus attacks the bursa, it leads to a restraint of the activities of the immune system, leaving the bird defenceless against other infectious diseases. It opens the door for problems such as *E. coli* infections and IBH by adenovirus.

While the mild IBD vaccines show the lowest invasiveness, the intermediate plus vaccines have the highest virulence, breakthrough titre and potential to induce immunosuppression.
Below is a table with classification of live vaccines and some examples.

Vaccine Strain	Mild	Intermediate	Intermediate Plus (hot)
Can it break through MDA?	Cannot break through MDA	Able to break through moderate levels of MDA	Able to break through higher levels of MDA
Bursa Lesions *	None	Temporary	Causes considerable bursa lesions
Immunosuppression	None	Mostly negligible	Yes, sub-clinical IBD
Use	In chickens with no or low levels of MDA or in 1st vaccination for uneven flocks	Under "normal" conditions	In presence of vvIBD **(emergency only)**
Examples (not all of these vaccines listed as examples are available nor recommended for local use in the South Pacific)	**AviPro ViBursa L (**)** **Izovac Gumboro II (**)**	**Bursine 2 (*)** AviPro Precise D78	Bursavac; Bursine Plus; AviPro Xtreme; Bursaplex

(*) Bursa lesions according to Jungbäck & Nutolo.
(**) Products available to the South Pacific through Pacificvet Limited

Why do we recommend a mild live IBD vaccine for the South Pacific?

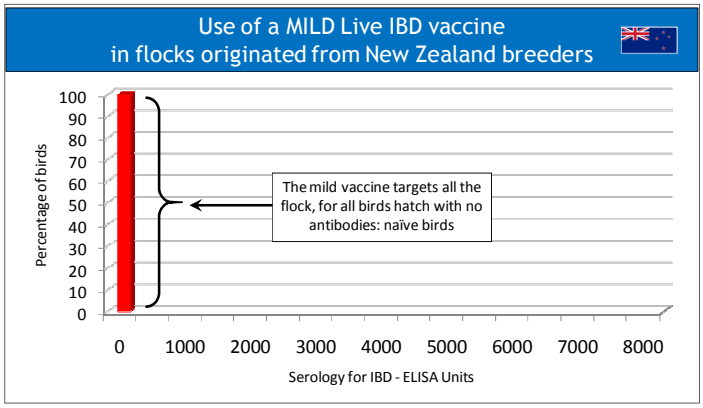
We have seen in the previous page that live IBD vaccines can be classified as mild, intermediate and intermediate plus.

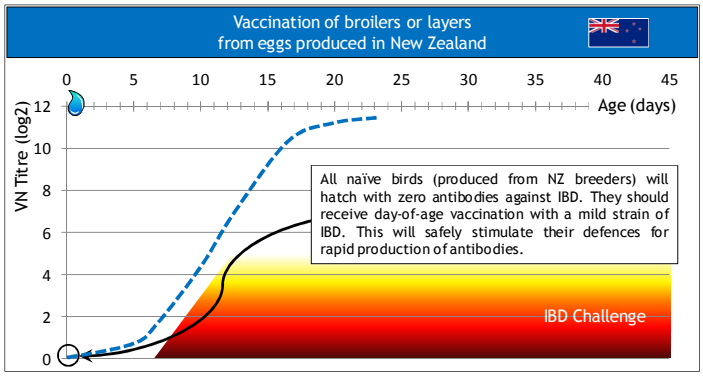
Moreover, we know of no reports of vvIBD virus in the South pacific countries. That already excludes the need of intermediate plus (hot) vaccines in the region. Therefore we can use mild or intermediate vaccines, depending on the situation.

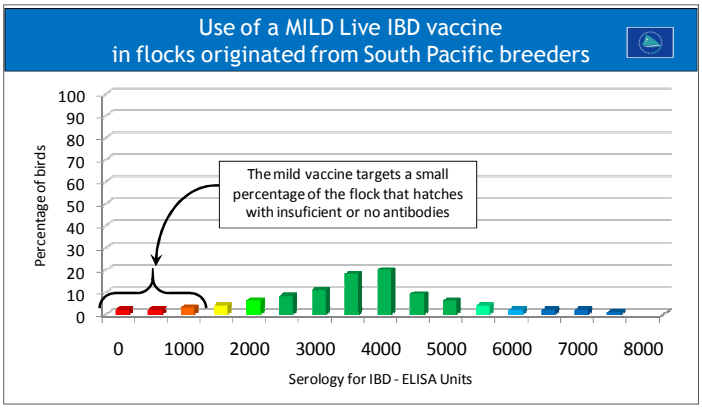
Here we have some good reasons for the use of mild vaccines in flocks housed in the South Pacific.

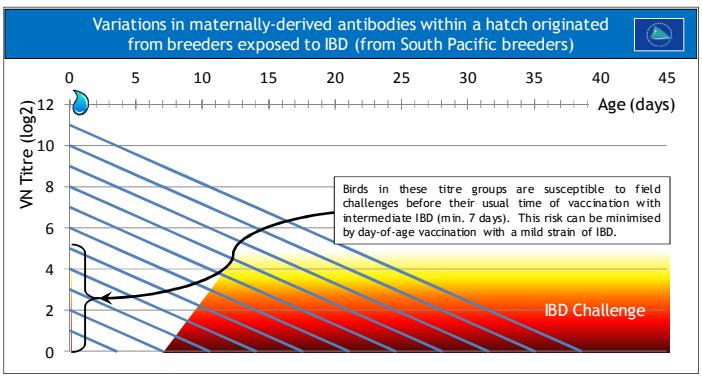
Mild Strain of IBD

- A mild strain does not cause any measurable lesions in the bursa and it does not cause any immunosuppression.
- Mild vaccines should be preferably used for day-of-age vaccination of NZ-produced chicks. (graphs on right), which have no antibodies against IBD.
- It does not mimic or replace the promptness of maternal antibodies. It stimulates the birds to produce their own defences.
- This vaccine is to be used for broilers, layers and broiler breeders.





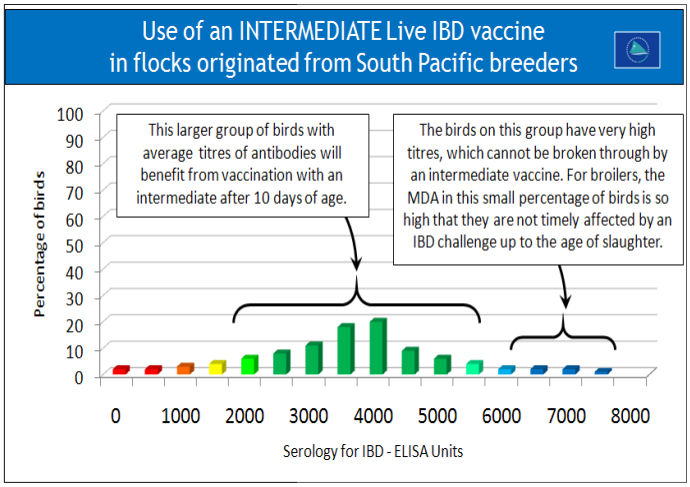


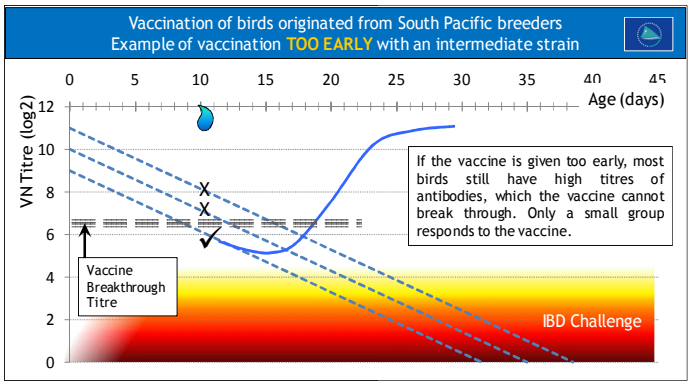


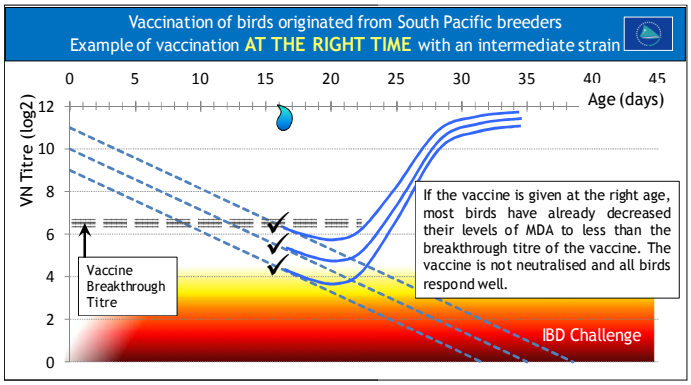
- A uniform distribution of this vaccine among the flocks will certainly reduce the ill effects of a field challenge. Very likely, field challenges will be stronger than the mild vaccine, but remember that the exposure is inconsistent. By vaccinating, we are enabling a large part of the most vulnerable birds to develop their own defences before encountering an infection with the field virus.
- **For locally-produced birds**: We must keep in mind that even within a population of birds hatched from parents that have been immunised against IBD, there is always a percentage that has low titres or no titres of MDA at all (as symbolically represented by the bell curve on left). These birds will decrease their titres quickly to zero and they are susceptible to challenges earlier than the majority of birds (those that will receive an intermediate vaccine after the 7th day of age).
- A mild vaccine can be used in these locally-produced birds to protect this expected percentage of birds that have no or only minimum levels of MDA (left, bottom). But these local birds should always receive an intermediate strain later (12-16 days for broilers and 18-21 days for layers)

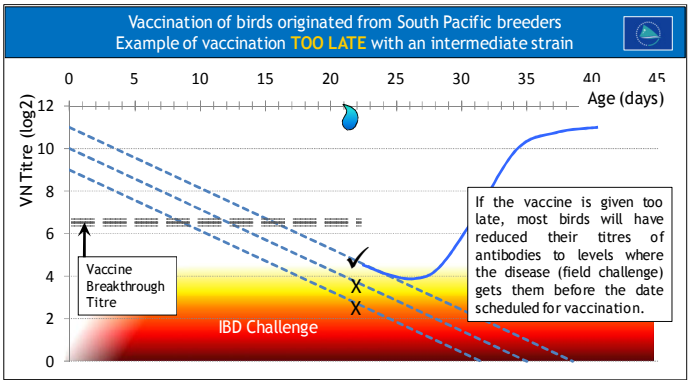
Intermediate Strain

- To be used in locally-produced birds, likely broilers, whose antibodies have decreased to levels that the vaccine can break through, usually after 10-18 days of age.
- The recent use of an intermediate strain in locally-produced broilers at 12 days has proven to be highly effective in improving performance (both liveability and feed conversion).
- Intermediate vaccines have a breakthrough titre of approximately 6.5 - 7 (VN log2). The ELISA Breakthrough titre is around 125 (but we must keep in mind that ELISA titres are less accurate on a range < 500). This information is important for the calculation for best possible date to vaccinate. Knowing the IBD titre at day of age will allow the producer to calculate its decrease. Intermediate vaccines can only be administered under an efficacious programme when titres for the main group of birds have decreased below 7 (VN log2).









- Of course, under a robust vaccination programme for IBD in breeders, most broilers will hatch with high levels of maternal antibodies. But as the bird ages, the levels of MDA decrease, unless they are vaccinated or encounter field infection. For the majority of the flock, the levels of MDA will be low enough for an intermediate vaccine after 18-21 days of age. Those birds, however, do not need to be protected, for the disease will have a short period to develop before the age of slaughter. The main targets are the birds that reach low levels of MDA earlier, catching the field virus and developing symptoms of other diseases due to immunosuppression. So the intermediate could be given earlier, probably between 12 and 16 days. Earlier than 12 days is not advisable, for only a very small fraction of the birds will benefit from it. Most others will neutralise the vaccine with their high levels of MDA.
- "Timing" is the key in proper vaccination against IBD.
- It should be accepted that the effective control of IBD with vaccination always involves some estimation. Adjustments to the programme can be made from experience and constant monitoring of serology.
- Although multiple vaccinations are used in some places such as North America (an effective technique also known as "carpet bombing" see insert on page 8), Pacificvet currently recommends a one vaccination programme.
- **The recent use of an intermediate strain in locally-produced broilers at 12 days has proven to be highly effective in improving performance (both liveability and feed conversion).**

Breeders – Inactivated Vaccines

What is the recommended IBD vaccination programme for breeders in the South Pacific?

Breeder programmes are composed of two main phases:

- First, the breeders themselves must be protected against an infection of IBD during their rearing, when the virus attacks the bursa. These are valuable birds, with a priceless genetic potential that should be maintained integral and protected from diseases. The programme is similar to the live programme described on pages 5 and 6. Proper build up of immunity should be ensured with a mild strain at day of age, followed by an intermediate strain at 7 days. This should cover them all through the first phase when they are most susceptible to field infections.

- Secondly, we aim to provide the breeders with high, uniform and long-lasting antibody titres, which will result in a high level of protection of the offspring. When we say long-lasting, we refer to the maintenance of high levels from onset of egg production to the day of slaughter. Inactivated vaccines will provide these desired levels, but only if injected in birds which have a solid immune base from good priming with live vaccines.

- A "primer" is a previous exposure of antigens, which briefs the immune system for a next exposure. Therefore, we recommend a vaccination with an intermediate after 18 days to establish this solid immune base.

- **At least four weeks before birds enter production, they should be injected with the inactivated vaccine. This will boost the immunity to higher levels of antibodies and to a much longer duration of these levels.**

Vaccination Programmes and Methods of Administration

Broilers (from NZ)	Broilers (locally produced)	Commercial Layers (from NZ)	Breeders (from NZ)
Day 1 **Mild Vaccine** **(upon arrival or in the hatchery)** this mild vaccine can be administered by: **coarse spray** (upon arrival, in the boxes) or **cabinet spray** (hatchery) or **subcutaneous injection** (hatchery) or **drinking water** (brooding shed) or **eye-drop**	**Intermediate vaccine** **(from days 12 to 18)** Drinking water or coarse spray	Day 1 **Mild Vaccine** **(upon arrival or in the hatchery)** this mild vaccine can be administered by: **coarse spray** (upon arrival, in the boxes) or **cabinet spray** (hatchery) or **subcutaneous injection** (hatchery) or **drinking water** (brooding shed) or **eye-drop**	Day 1 **Mild Vaccine** **(upon arrival or in the hatchery)** this mild vaccine can be administered by: **coarse spray** (upon arrival, in the boxes) or **cabinet spray** (hatchery) or **subcutaneous injection** (hatchery) or **drinking water** (brooding shed) or **eye-drop**
(Optional Intermediate at days 8-10, depending on field challenge) Drinking water or coarse spray		(Optional Intermediate at days 8-10, depending on field challenge) Drinking water or coarse spray	**Intermediate at days 8-10,** Drinking water or coarse spray
			(Optional primer for killed vaccine at 12 weeks) Drinking water or coarse spray
			Inactivated vaccine **(at 16-18 weeks)** Injected: intra muscular – breast or subcutaneous – neck

- Due to its mild invasiveness, the mild strain of IBD should be ideally administered via eye drop or subcutaneous injection, as opposed to coarse spray, where precious antigen content can be lost by drifting or evaporations.
- However, the earlier the mild vaccine is given to the birds, the better are chances of fighting against a field challenge, therefore the recommendation to use a coarse spray (manual garden spray) directly on the open boxes upon arrival.
- Intermediate strain vaccination should be ideally done via drinking water. Early morning drinking is ideal, just after first meal. Dissolve vaccine in water with a stabiliser. Use enough quantity of water to allow the birds to drink for no less than 2 hours and no more than 3 hours.

Efficaceous IBD vaccination is a matter of timing.
Given at the correct time, an IBD vaccine will induce protection.
Please consult Pacificvet for the IDEAL TIME FOR VACCINATION in your poultry operation.
Moreover, we can give you specific instructions on drinking water vaccinations;
water stabilisers; vaccination equipment; injection of inactivated vaccines, etc.

What are intermediate-plus strains? Do we need them in the region?

The term "intermediate plus" is no more than a "politically correct" name for hot strains. It is a marketing-designed wording with two purposes: One is to dodge registration obstacles from authorities that may fear the use of hot strains; and the other is to reach a desired portion of the still much larger market for intermediate strains. Hot strains cause immunosuppression and all field data strongly suggests that they affect FCR negatively. They are very useful however in certain geographical areas, on the control of high mortality caused by the so-called very virulent IBD virus (vvIBDV), a more aggressive pathotypic variant of IBD. Once the field challenges decrease, vaccination should be switched back to an intermediate strain. We have no indication so far that there have been any cases of vvIBD in the Pacific Islands. It is safe to conclude that there is no need to use a hot (intermediate plus) vaccine in the region.

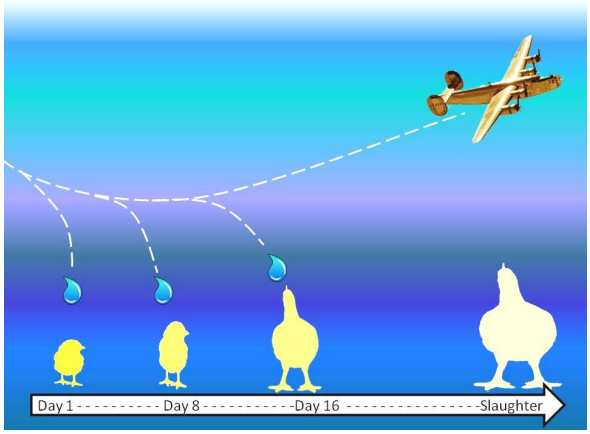
Recently, live vaccines have been developed to be delivered into eggs during the incubation period. The vaccine virus is blended with IBD antibodies and the complex is injected in-ovo at transfer. In this way, the problem of MDA is overcome and the chicks are effectively immunised. However we must remember that once the vaccinated chicks start shedding the virus, it's only the hot strain that is being shed. At this stage, there are no more associated antibodies to be counterbalancing the potentially-ill effects of the hot strain being shed and remaining in the chicken shed.

Can we use an intermediate vaccine at day-of-age?

Preferably not! Intermediate strains do affect the bursa to a higher degree than mild strains, and immunosuppression may occur. At day of age, the bursa is not developed enough to withstand an infection of an intermediate strain without consequences which could affect broiler performance and/or growth. It may be difficult to access specific deterioration of flock performance when an intermediate is given at day-of-age, but out of common sense, general knowledge and field experience, we recommend a mild strain.

How affordable is the "carpet bombing" method?

This is an effective method to timely protect different groups with different levels of MDA with a flock of broilers. A mild vaccine is given at the first day of age to protect any chickens in the flock that may have no or only minimal levels of MDA. This also establishes a reservoir of vaccine virus within the flock that allows lateral transmission to other chickens when their MDA decay. Second and third applications are usually administered, with an intermediate strain, the timing depending on the antibody titres of the parent birds at the time the eggs were laid (usually 2nd is given at 10–14 days of age and the 3rd dose 7–10 days later. Affordability can be calculated with the extra percentage of birds protected with the additional vaccinations.



References

- Bernardi, E. *Gumboro- It's Quite Simple* – Product Presentation for Lohmann Animal Health; Germany, Ukraine, Spain.
- BioChek. 2007. *Interpretation and Applications of BioChek Results*. BioChek. The Netherlands.
- De Witt, J.J.. *Gumboro Disease:Estimation Of Optimal Time Of Vaccination By The Deventer Formula*, Animal Health Services, Deventer, The Netherlands.
- Deitemeyer, K. & Rollin, B.E. 2005. *Intuitive Immunology*. Christchurch, New Zealand.
- Fort Dodge Animal Health. 2008. *VaxFacts. Vaccination programming Guide*.
- Jungbäck, C. , Nutolo, S., 2001. *The degree of bursa damage as a possible parameter to define the virulence of IBDV vaccine strains.* II. International Symposium on Infectious Bursal Disease and Chicken Infectious Anaemia, Rauischholzhausen, Germany
- Lohmann Animal Health. 2007. *AviPro Vibursa-L – Product brochure*. Germany
- Lohmann Animal Health. 2007. *IBD Vaccination Guide – Product brochure*. Germany
- Lohmann Animal Health. Avian Insight. November, 2008.*The Benefits of Immunising Broilers Against IBD Using Live Vaccines*. Newsletter.
- Lukert, P.D. and Saif, Y.A. 2003. *Infectious Bursal Disease*. In: Diseases of Poultry (11th edition). 721-738.
- Pacificvet, 2008. *Immunity and Poultry Health – Poultry Vaccination Programmes for the South Pacific*, pamphlet.
- Rinaldi, A; Cessi D; Cervio G; Lodetti E; 1974. *Attenuation of infectious Bursal disease virus and vaccination trials under laboratory and field conditions*; Istituto Zooprofilattico Sperimentale della Lombardia a dell'Emilia, Brescia, Italia
- South Pacific Commission - *The Animal Health Status of The Pacific Island Countries and Territories* – 1994; by Peter Saville, Animal Health Advisor; 1996, Noumea New Caledonia.
- South Pacific Commission - *The Animal Health Status of Niue*; by Peter Saville, Animal Health Advisor; 1996, Noumea New Caledonia.
- South Pacific Commission - *The Animal Health Status of the Cook Islands*; by Peter Saville, Animal Health Advisor; 1996, Noumea New Caledonia.
- South Pacific Commission - *The Animal Health Status of Kiribati*; by Peter Saville, Animal Health Advisor; 1996, Noumea New Caledonia.
- South Pacific Commission - *The Animal Health Status of Tonga*; by Peter Saville, Animal Health Advisor; 1996, Noumea New Caledonia.
- Van Dijk, P.M. 2004 – *Gumboro Vaccination: a matter of timing*.

Special thanks to Ken Rudd, Thijs van Dijk, and the Pacificvet team.

Pacificvet Limited, 3 Hickory Place, PO Box 16-129 Hornby, Christchurch, New Zealand
Tel: +64 (03) 349 8438 National Tollfree 0508 388 388 Fax: +64 (03) 349 8863
Website: www.pacificvet.co.nz Email: pacificvet@pacificvet.co.nz

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