

# III

## FACTORS AFFECTING VACCINATION



Many factors can have a strong impact on the desired effects of vaccination. The sanitary manager and the farmer must take all the necessary steps to control both the practices used during the vaccination operation and external factors.

The first group of factors are thus related to the conditions on the farm, and are based on the principle that only healthy animals should be vaccinated.

The second group corresponds more directly to how the vaccination operation is actually carried out and is based on another key principle, namely that vaccine only confers good protection if it is stored well and administered correctly in accordance with a suitable programme. These various factors complement the technical aspects detailed previously, and relate particularly to the spread of information on the farm, the training of employees, the material means implemented and the controls and tests carried out.

These various factors should be considered with equal importance. In effect, failure to respect any one will compromise the overall quality of the vaccination.

### A. FACTORS RELATING TO THE CONDITIONS ON THE FARM

- 1 - Stress and vaccination
- 2 - Mycotoxicosis and vaccination
- 3 - Infectious diseases vaccination

### B. FACTORS ASSOCIATED WITH VACCINATION

- 1 - The vaccine factor
- 2 - The human factor
- 3 - The bird factor

### 3 Factors affecting vaccination



## A FACTORS RELATING TO THE CONDITIONS ON THE FARM

### 1. STRESS AND VACCINATION

Stress is "the non-specific response to environmental stimulation" or more precisely, "the result of excessive demands placed on the physiological and behavioural abilities of animals to adapt" (DANTZER, 1979).

In fact, any stimulation if it is sufficiently intense and prolonged, causes a non-specific stress reaction as well as a specific reaction which enables the animal to adapt to the change in the environment. In most cases, the physiological responses are non-specific, whereas behavioural responses tend to be specific. Under modern poultry rearing conditions, the birds only have a limited range of behavioural responses available to them that enable them to adapt to the environment and thus to escape from excessive stimuli. This is the reason why stress plays a greater role in more intensive forms of production.

The bird's comfort zone is governed by input from 6 inter-related factors : the farmer, the feed, the building, the microbial flora, the animal and the rearing techniques used on the farm. These inputs change continually during the animal's life. Any sudden change to the balance of these inputs can destabilise the bird and thus generate stress.

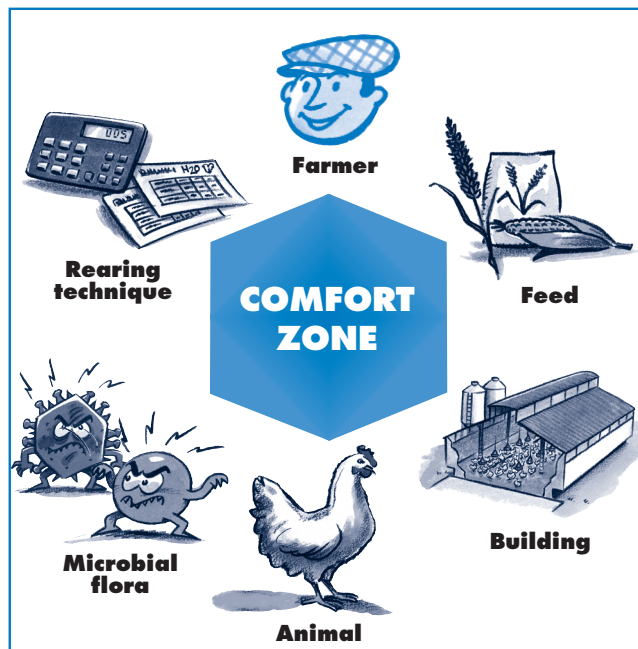
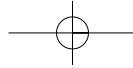


Figure 14 : The comfort zone and six factors which have an affect on it

TABLE XVII : High-risk periods and stress factors	
<b>HIGH-RISK PERIOD STRESS FACTORS</b>	
HATCHING	<ul style="list-style-type: none"> <li>• microbial flora (ambient or micro-organisms carried latently)</li> <li>• handling (sexing)</li> </ul>
START-UP	<ul style="list-style-type: none"> <li>• transporting</li> <li>• debeaking</li> <li>• rearing conditions (temperature, watering, etc.)</li> <li>• handling</li> <li>• vaccinating with live vaccines</li> </ul>
GROWTH	<ul style="list-style-type: none"> <li>• increased bird density</li> <li>• microbial flora</li> <li>• temperature, ventilation</li> <li>• vaccination with live vaccines</li> </ul>
START OF LAY	<ul style="list-style-type: none"> <li>• physiological disturbances</li> <li>• psychological disturbances (light programme, overcrowding, change of building, feeding, etc.)</li> </ul>
LAYING	<ul style="list-style-type: none"> <li>• rearing conditions, overcrowding...</li> <li>• vaccination</li> </ul>



### 3 Factors affecting vaccination

#### (A) FACTORS RELATING TO THE CONDITIONS ON THE FARM



#### 1.1 The consequences of stress

The main consequences of the reaction to stress is the mobilisation of the organism's reserves and immunosuppression. Depending on the intensity and duration of the stress, the animal either recovers its normal state or undergoes a decompensation phase which is characterised by the depletion of the organism's reserves, impairment of the vital organs (kidneys, heart) and suppression of the main functions (notably the immune defence system), which can lead to the death of the animal.

TABLE XVIII :  
Consequences of stress on production performance

<b>Decreased consumption</b>
<b>Digestive disorders</b>
Decreased digestive secretions from the pancreas and of bile
<b>Increased catabolism</b>
Mobilisation of energy reserves
Weight loss
<b>Decreased production of somatotropin (growth hormone)</b>
Growth retardation
Heterogeneity of the grow-out
<b>Decreased calcaemia</b>
Fragile bones and eggshells
<b>Disrupted laying</b>
Retention of the egg in the oviduct
<b>Fertility-related disorders</b>
Inhibited production of sex hormones
Poor hatchability

The adverse consequences of stress on the immune defence system are, as with the disorders mentioned above, mainly due to the effects of glucocorticosteroids.

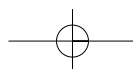
- Inhibition of the synthesis of prostaglandins and leukotrienes; mediators of inflammation which promote the flow of leukocytes.
- Imbalance in the blood cell count : leukocytosis (overall increase in the number of leukocytes), lymphopenia, eosinopenia, heterophilia.
- Qualitative degradation of the leukocyte lines: phagocytosis and the production of bactericidal substances by heterophiles and the macrophages are diminished. Equally, the activity of the T-cells (cell-mediated immunity) is reduced.

These effects caused by corticosteroids are temporary and reversible. However, prolonged stress in young birds can lead to the premature regression of the lymphoid organs (thymus, bursa of Fabricius, spleen). The combination of these effects on the metabolism and immune system of stressed birds means that a vaccination given during this period will clearly not confer the protection that could otherwise be expected. Therefore, it is very important either to control the stress or to correct its effects.

#### 1.2 Controlling stress

It is easy to differentiate between predictable stress (handling, start of laying) and unpredictable stress (heat stroke, incidents during rearing, etc.)

In the first case, attempts are made to control the causes of the stress and its effects in a preventive manner. However, birds subjected to unforeseen stresses should not be vaccinated until its effects have not been completely resolved.



### 3 Factors affecting vaccination

#### (A) FACTORS RELATING TO THE CONDITIONS ON THE FARM



Two approaches can be used to control stress :

- the simultaneous control of the various input factors (farmer, feed, building, animal, microbial flora, rearing technique) and of the related sources of stress which affect the animal's quality of life. The aim is therefore the non-specific prevention of stresses, which is the tacit objective of any rational rearing programme.
- implementing therapies designed to reduce the intensity of stress and/or to help the animals to cope with its consequences.

In all cases, the anti-stress therapy should not be considered and used as the only means of tackling stress and its effects. On the contrary, it should, wherever possible, accompany a series of corrective hygiene-related and/or zootechnical measures aimed at restoring the comfort of the stressed animals. Once the source of the stress has been identified, this cause should be eliminated wherever possible : i.e. by reducing the bird density, increasing the number of feeders and drinkers, improving the ventilation, etc.

#### • ADMINISTERING VITAMINS

The provision of vitamins to stressed animals is extremely beneficial since the reactions to all types of stress use up vitamins either directly (e.g. vitamin C, which is required for the synthesis of glucocorticosteroids, or indirectly due to the general increase in metabolism which consumes the B-group vitamins which are involved in most intermediate metabolism reactions. Vitamins alleviate some of the adverse effects caused by stress (e.g. vitamins A, E, C and B which strengthen the immune defence system).

How to use vitamins to combat stress :

- administer 24 hours before a predictable stress, and for the entire duration of the stress.
- administer via fresh drinking water, to prevent any degradation.

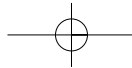
Types of vitamin and multi-vitamin mixtures :

- Vitamin C : via drinking water, dosage : 1 gram / litre of water. Use a form of vitamin C which is stable in water.
- Multi-vitamin mixtures (A, D3, E + B-group water-soluble vitamins) : "attack" doses, much greater than normal nutritional requirements are the most effective.

TABLE XIX :

The role of vitamins in overcoming stress

FUNCTION	VITAMIN	MODE OF ACTION
• synthesising glucocorticosteroids	Vitamin C	hydroxylation of the steroid hormones
• stimulating metabolism	B-group vitamins	co-enzymes of intermediate metabolism
• protecting mucous membranes	Vitamin A	enables cell differentiation
	Vitamin E	anti-oxidant
• stimulating immunity	B-group vitamins	participates in the process of cell differentiation and maturation
	Vitamin E	protects macrophages from free radicals




### 3 Factors affecting vaccination

#### (A) FACTORS RELATING TO THE CONDITIONS ON THE FARM



#### • METABOLIC CORRECTORS

The effects of stress on the metabolism are intense, quick-acting and mobilise the organism's reserves of energy. In addition to administering vitamins which act as catalysts for metabolism, it is therefore essential to enable the main physiological functions to return to their correct status and to provide the resources the birds need to help them overcome periods of stress.



### VIGOSINE®

VIGOSINE® is a proprietary preparation that has been specially formulated for this purpose. Carnitine, its innovative ingredient, steers the metabolism towards the use of lipids, thus making energy available to the organism and promoting the elimination of the waste products of anabolism. Sorbitol is an energy source which is immediately available to the birds, especially important when feed consumption levels are significantly reduced. Plant extracts and magnesium sulphate restores correct levels of water and feed consumption. Moreover, they stimulate the elimination of the waste products of metabolism.

VIGOSINE® can be administered before a predictable stress to avert the metabolic effects or after stress to accelerate recovery and to restore correct water and feed consumption levels quickly.

Administer 1 ml per litre of water for three consecutive days. In cases of intense stress (heat stroke), the dose can be doubled.

**THE INGREDIENTS OF VIGOSINE® AND THEIR ACTION**

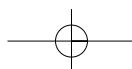
INGREDIENT	MODE OF ACTION	OBJECTIVES
CARNITINE	<ul style="list-style-type: none"> <li>• eliminates excess free fatty acids</li> <li>• decreases the catabolism of proteins</li> <li>• stimulates appetite</li> </ul>	<ol style="list-style-type: none"> <li>1) to prevent the infiltration of fat into the heart, thus protecting the heart muscles</li> <li>2) to counter exhaustion, and to combat the production of toxic waste and weight loss</li> </ol>
SORBITOL	<ul style="list-style-type: none"> <li>• hepatoprotective agent</li> <li>• glucose forming agent</li> </ul>	to support the metabolism of energy (and counter exhaustion)
PLANT EXTRACTS MAG. SULPHATE	<ul style="list-style-type: none"> <li>• a gentle diuretic</li> <li>• stimulates drinking</li> </ul>	<ol style="list-style-type: none"> <li>1) to enable the animals to hydrate correctly and resume drinking</li> <li>2) to eliminate the toxic waste caused by metabolism</li> </ol>

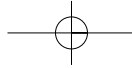
#### • ANTI-INFECTIVES

The main benefit of administering anti-infectives during periods of stress is to prevent opportunistic micro-organisms from infecting animals that are weakened and immunosuppressed by stress.

Moreover, some anti-infectives such as macrolides and more specifically erythromycin also induce an immunomodulating activity, in conjunction with other particularly interesting pharmacokinetic characteristics (POCIDALLO, 1986).

Erythromycin stimulates the secretion of interleukins by leukocytes, which is expressed as a marked immunostimulating action, due to the increase in the phagocytosis of the bacteria by macrophages as well as by an increase in the cytotoxic activity of the NK cells (Natural Killer). (HIRAKATA, 1992. BAILLY, 1991 ; KITA, 1990 ; EYRAUD, 1986 ; FRASCHINI, 1986)





### 3 Factors affecting vaccination

#### (A) FACTORS RELATING TO THE CONDITIONS ON THE FARM



Anti-infectives can be used before and after vaccination when there is a high risk of secondary bacterial infections developing. This may be the case, for example, when there is a risk of a post-vaccinal reaction (booster Newcastle disease at 21 days old with a lentogenic La Sota-type vaccine) for birds carrying mycoplasmas.

Anti-infectives should never be mixed with the vaccine. They should be administered for two days before the vaccination, on the day of the vaccination after administering the vaccine, and then for two days after the vaccination. Even in this particular case, it is important to respect the correct dosage.

Moreover, the anti-infectives should be compatible with the immune defence system and should include within their spectrum of activity the potentially pathogenic opportunistic bacteria concerned. Therefore, it is preferable to choose macrolides, and especially erythromycin which has proven efficacy in this context in addition to a positive action on the immune defence system of birds.

## 2. MYCOTOXICOSIS AND VACCINATION

The toxic risks relating to the growth of moulds in foodstuffs were illustrated dramatically in 1960 in Great Britain when a contamination killed more than 100,000 young turkeys and ducks. Although, since then, acute cases of food poisoning of this type have been rarer in intensive rearing, poor performance relating to fungal degradation are still very frequent (LE BARS, 1992).

They cause severe immunosuppressive effects, which can compromise the protection conferred by the vaccination.

**MOULDS :** small fungi, living on raw materials and manufactured feed or products.  
**MYCOTOXINS :** toxins produced by moulds in feed.  
**MYCOTOXICOSIS :** the poisoning caused by the ingestion of feed containing the mycotoxins produced by moulds. Mycotoxicosis is neither infectious nor contagious.

### 2.1 The growth of moulds in feed

The initial contamination by moulds of plant substances and seeds intended for consumption is difficult to prevent : for example, in most cases *Aspergillus* contaminates the plant whilst it is still growing in the field. However, the development of fungi and the production of mycotoxins by these fungi are then highly dependent on the environmental conditions.

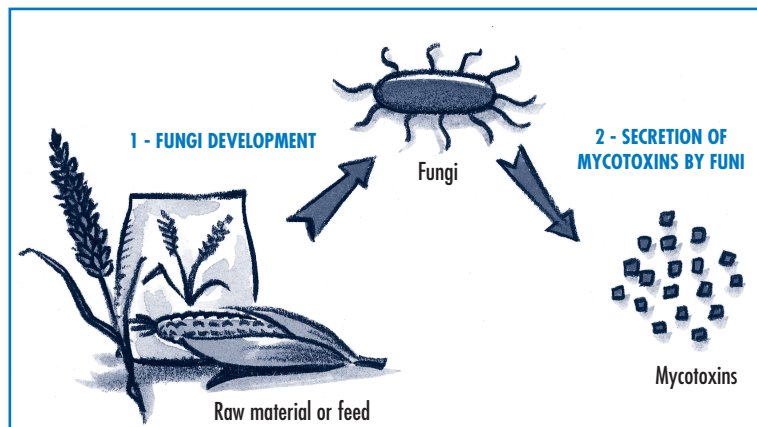
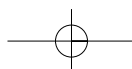
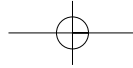


Figure 15 : The various stages of feed contamination by mycotoxins





### 3 Factors affecting vaccination

#### (A) FACTORS RELATING TO THE CONDITIONS ON THE FARM



Water and the ambient temperature are the two main parameters.

The minimum humidity level that allows moulds to grow is 13.5% for cereals and 7 to 8% for oilseeds.

Any temperature heterogeneity in the storage vessel (e.g. : where one side of a silo is exposed to the sun and the other side is in shade) causes water vapour to migrate to the cooler areas. A local increase in the humidity initiates the growth of mycoflora which can then develop.

However, granulating the feeds causes a significant reduction in the mycoflora, although some species resist better than others (*Aspergillus group glaucus*).

The development of the moulds changes the appearance, taste and smell of the feed, in addition to its nutritive value. It may also lead to mycosis, allergies and mycotoxicosis as a result of the production of mycotoxins which contaminate the feed.

#### 2.2 The production of mycotoxins

Since all moulds are not toxinogenic, then although the growth of moulds is a necessary condition, it is not sufficient in itself to allow mycotoxins to develop.

Mycotoxins may be present in the feed even when the moulds which produced them are no longer present, either due to the mycoflora evolving, or due to technological treatments (e.g. extrusion...).

Mycotoxins are the secondary metabolites of the micro-organism : they are often fairly specific to the strain. Most mycotoxins induce a toxic effect and cause specific organic lesions.

The conditions that allow toxins to form are more specific than those which allow the fungi to grow :

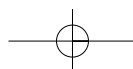
- A temperature-humidity profile can be determined for each mould-mycotoxin pair which defines the high-risk hydro-thermal conditions to avoid.
- A reduction in the partial pressure of O<sub>2</sub> and especially an increase in the CO<sub>2</sub> content has an inhibiting effect on the formation of toxins.
- The formation of toxins is much more dependent on the nature of the substrate than on the fungal growth itself. For example, the preferred ingredients for the biogenesis of aflatoxins and of ochratoxin A are, in decreasing order of preference : carbohydrates, lipids and proteins. Thus, cereals are much more likely to be affected by toxins than soya and proteins of animal origin.

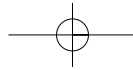
**TABLE XX :**  
Sources of the main mycotoxins responsible for mycotoxicosis in poultry farming (LE BARS, 1992)

MYCOTOXIN	MOULD	FEED	FAVOURABLE ENVIRONMENTAL FACTORS
• Aflatoxins	<i>Aspergillus flavus</i> <i>A. parasiticus</i>	Peanuts, cotton, sorghum, oats, barley, soya	Wet heat : 1. tropical zones 2. poor storage conditions
• Zearalenone	<i>Fusarium spp</i>	Maize, sorghum, barley	Alternating cold and mild weather, temperate climates.
• Ochratoxin A	<i>Penicillium granulosum</i> <i>Aspergillus ochraceus</i>	Barley, oats, maize, wheat	Cold and damp climates, humidity during storage
• Fumonisin B1	<i>Fusarium moniliform</i>	Maize	Wet heat
• Trichothecenes	<i>Fusarium tricinctum</i> <i>Fusarium spp.</i>	Cereals	Alternating freeze-thaw, cold climates.

The post-harvesting period, especially when combined with poor storage conditions, is a particularly favourable time for the production of toxins and is characterised by the formation of "hot spots", i.e. zones within the stored volume in which the concentration of toxins is very high.

Once produced, the toxin is stable and remains in the cereal and feed even after the fungi have disappeared.





### 3 Factors affecting vaccination

#### (A) FACTORS RELATING TO THE CONDITIONS ON THE FARM

### 2.3. The three main types of immunosuppressive mycotoxicosis

Mycotoxicosis is caused by acute or chronic ingestion of mycotoxins. Sub-clinical poisoning is by far the most common. A more accurate understanding of their impact has been made possible by the recent developments in assaying techniques (ELISA) and by monitoring the zootechnical performance of flocks. Of the five main families of mycotoxins, there are three which cause immunosuppression.

- aflatoxins,
- trichothecenes (mainly T2 toxin and Diacetoxyscirpenol),
- ochratoxins

All these infections have an adverse effect on vaccination either by acting directly on the immune system or by weakening the birds and by mobilising their immune defences, thus making them less receptive to vaccination.

#### • AFLATOXICOSIS

The B1, B2, G1 and G2 aflatoxins are highly carcinogenic. Aflatoxin B1 is the most widespread and the most toxic. They are metabolised in the liver and induce a progressive disruption to the cell functions resulting in hepatic insufficiency with vacuolisation and necrosis of the liver cells.

The effect and severity of the symptoms vary depending on the ingested dose, the duration of the poisoning and the species affected.

Ducks are by far the most susceptible, although young chickens are extremely susceptible. Generally speaking, young animals are more vulnerable than adults.

In practice the maximum dose of aflatoxin B1 that can be tolerated by animals is 50 to 20 ppb (50 to 20 mg/tonne of feed). (GLAVITS, 1998 ; LEBARS, 1992 )

<b>PPB :</b> part per billion	<b>1 ppb is equivalent to 1 µg/kg or 1mg/tonne</b>
<b>PPM :</b> part per million	<b>1 ppm is equivalent to 1 mg/kg or 1 g/tonne</b>

In broiler chickens, aflatoxins produce a high degree of immunosuppression with a drop in the number of lymphocytes contained in the follicles of the bursa of Fabricius. The thymus and the spleen are also affected and atrophied (ESPADA et al. 1992). Marked reductions in immunity have also been observed in laying hens.(Figures 16).

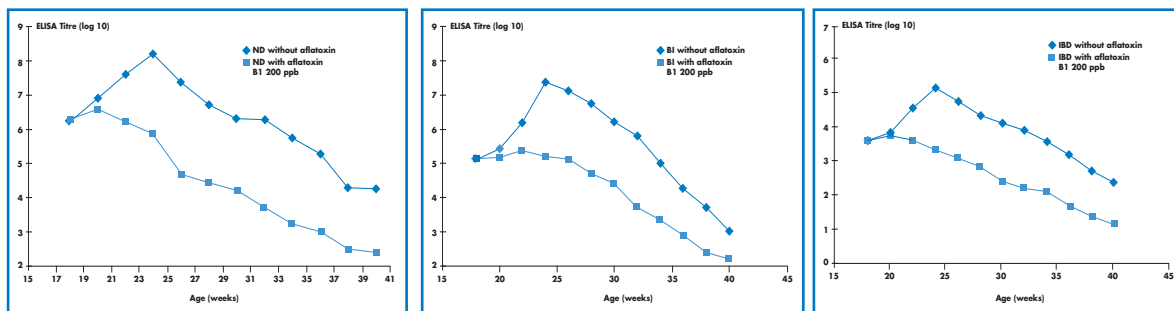
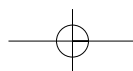
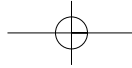


Figure 16 a , b et c: Changes in average ELISA ND, IB and IBD titres in laying hens vaccinated at 18 weeks old (combined inactivated ND-IB-IBD vaccine) and fed with feed contaminated by aflatoxin B1 (200 ppb from 18 to 40 weeks). (AZZAM, 1998).





### 3 Factors affecting vaccination

#### (A) FACTORS RELATING TO THE CONDITIONS ON THE FARM



Contamination by mycotoxins during lay has a significant adverse effect ( $p < 0.05$ ) on the antibody titres induced by the administration of an oily adjuvanted inactivated vaccine. In proportion to these reductions, the protection conferred by the vaccine is significantly affected and diminished.

The aflatoxins also have a deleterious effect on cell-mediated immunity (GIAMBRONE, 1985) (Figure 17).

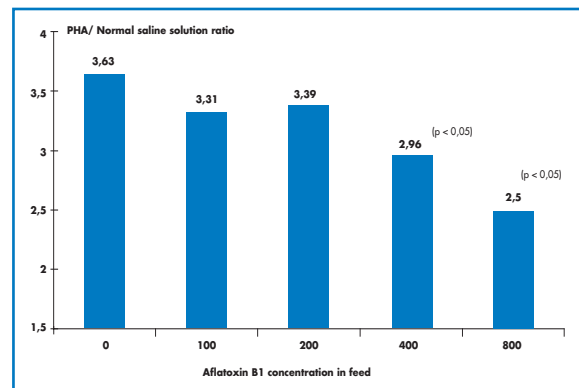


Figure 17 : Impact of aflatoxins on cell-mediated immunity, evaluated by the delayed hypersensitivity reaction to PHA (phytohaemagglutinin) in broiler chickens : ratio of the cutaneous thickness after an intradermal injection of PHA to the thickness after an injection of normal saline solution (negative control) (GIAMBRONE., 1985).

The intensity of the delayed hypersensitivity reaction to PHA is significantly reduced by aflatoxin levels of over 200 ppb, which indicate a significant impact on cell-mediated immunity.

Chronic poisoning is very frequent and is expressed in non-specific forms such as anorexia, lameness and a drop in performance. The immunosuppressive effect degrades the operation of the immune defence system, making the birds more susceptible to infections and less receptive to vaccinations. They contribute to the failure of the vaccination.

Only careful daily monitoring of the production performance can suggest that sub-clinical aflatoxicosis is present.

When the risk is continuous and omnipresent, only preventive treatment of the feed with products able to restrict fungal development and to inactivate the mycotoxins present in the feed can effectively counter chronic sub-clinical contamination.

#### • TRICHOHECENES (FUSARIOTOXICOSIS DUE TO T2 TOXIN)

The trichothecenes are a large family (over 70 members) of fungal metabolites produced by *Fusarium*. The T2 toxin and Diacetoxyscirpenol are the principal problem compounds in poultry farming. They can grow on a large number of seeds (corn, wheat, barley, rice, sorghum).

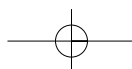
The disorders are caused by their powerful ability to inhibit structural lipids and the synthesis of proteins. Moreover, they badly irritate the various mucous membranes and any areas of skin which come into contact with the mycotoxin, as revealed by local lesions of the oral mucosa and the beak which are characteristic of the disorder (HOERR, 1997).

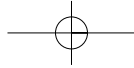
In cases of clinical poisoning, the birds refuse to eat, and show asthenia, diarrhoea as well as caseous deposits around the commissure of the beak after a few days. Occasionally there are also nervous symptoms.

Cases of chronic poisoning lead to growth retardation, feathering abnormalities and reduced egg production.

Some of the more commonly-observed lesions are necrosis of the oral mucosa and liver, haemorrhaging of many tissues and organs (intestines, kidneys, heart, lungs) and the covering of most of the internal organs by a chalk-like substance.

In terms of immunity, this type of poisoning causes marked and rapid lesions of the lymphoid organs and of the bone marrow.





### 3 Factors affecting vaccination

#### (A) FACTORS RELATING TO THE CONDITIONS ON THE FARM



#### • OCHRATOXICOSIS

Ochratoxins are produced by various strains of *Penicillium* (*P. viridicatum*) and by *Aspergillus ochraceus*. Ochratoxin A is more toxic than ochratoxins B and C and is the most common in poultry farming. It is remarkably stable. The feed types most frequently contaminated are barley, maize, oats and wheat. They initially cause lesions of the renal tissues, followed by damage to the hepatic tissues and the immune system.

In day-old chicks, they can cause sudden death. In clinical terms, they are characterised by dehydration, catarrhal enteritis and anaemia.

Chronic poisoning leads to impaired performance (growth retardation, delayed sexual maturity, egg drop, reduced hatchability) as well as increased susceptibility to infection as a result of the immunosuppression. The kidneys are discoloured and hypertrophied, and centres of necrosis are observed in the liver. Haematoma is present in the carcass, with atrophy of the thymus, bursa of Fabricius and spleen. This leads to a significant decrease in the number of lymphocytes, which causes marked changes in cell-mediated immunity and in levels of circulating antibodies (DWIVEDI et al., 1984a, DWIVEDI et al., 1984b).

Because of the lesions it causes, ochratoxin A, can lead to failure of the vaccination and low levels of induced immunity (EL-KARIM, 1991).

#### 2.4 Controlling mycotoxicosis

The control of mycotoxicosis is based on preventing fungal development in the foodstuff (to limit the original production of mycotoxins) and on detoxifying toxin-contaminated feed (NAHM, 1995).

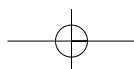
There are two aspects to this control. On the one hand, it is important to prevent fungal growth and the associated production of toxins by optimising the conditions under which the feed is stored, and by adding preservatives or antifungal agents.

On the other hand, the feed is often contaminated before it arrives at the farm, or even before it arrives at the factory.

#### • ANTIFUNGAL AND DETOXIFYING AGENTS USED ON CONTAMINATED FOODSTUFFS

The occasional (10 days to few weeks) or systematic preventive addition of antifungal and/or detoxifying products to the feed reduces the risk of mycotoxicosis.

- Oxyquinol :
  - Antibacterial, antiprotozoal and antifungal action (notably on *Candida albicans*, *C. stellatoidea*, *Aspergillus fumigatus*, etc.).
  - Detoxifying effect due to reducing the aflatoxin levels.
- Di-chloro-thymol :
  - Powerful detoxifying effect, notably on mycotoxins (over 85% reduction of aflatoxins after twelve hours of contact).
  - Inhibitory effect on the production of mycotoxins
  - Antifungal action, on *Aspergillus flavus*, *A. versicolor*, *A. parasiticus*.
  - Bacteriostatic action on *Staphylococcus spp.*, *Streptococcus spp.*
  - Potentiates oxyquinol.
- Organic acids :
  - The combination of propionic, formic or acetic acid adsorbed onto an inert medium such as zeolite or vermiculite, induces a fungistatic activity which prolongs the shelf-life of the foodstuff.



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#### (A) FACTORS RELATING TO THE CONDITIONS ON THE FARM



- Adsorbent treatments :  
Adsorbents (bentonite, zeolite, kaolin, aluminosilicates...) adsorb and neutralise the mycotoxins. However, if the degree of contamination is very high, adsorbents are not very effective and moreover, can also adsorb vitamins from the feed so that they are not available to the animal. Furthermore, the bonds with the mycotoxins are not definitive and the toxins can be released subsequently in the gastrointestinal tract.
- Treatments with enzymes :  
Enzymes are available which can degrade certain groups of mycotoxins into non-toxic metabolites.

#### • TREATING ANIMALS

The basic treatment for birds suffering from mycotoxicosis consists of hepatoprotective agents and choleragogues (sulphured amino acids, choline, betaine), anti-oxidants such as the combination of vitamin E and selenium, and multi-vitamin mixtures.

Complementary symptomatic and/or aetiological treatment (to counter opportunist infections) can be administered simultaneously.



### MYCOTOX®

MYCOTOX® is a combination of two active ingredients, Oxyquinol and its potentiator Di-chloro-thymol, formulated into a preparation based on micronised yeast. It can be administered via the feed.

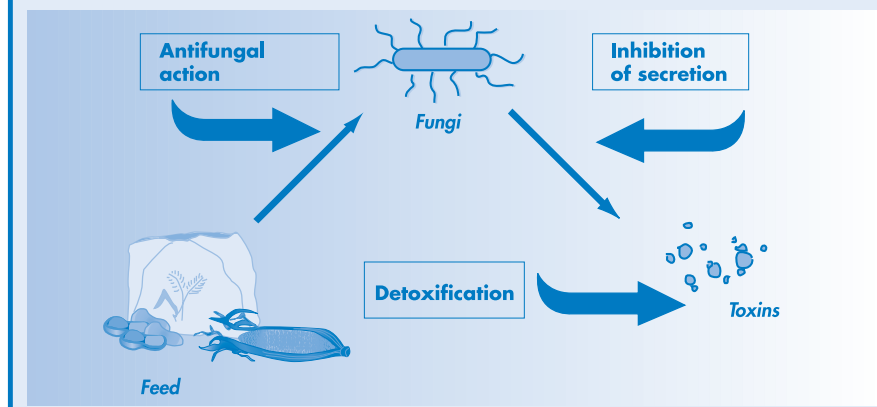
#### MYCOTOX® ACTS ON SEVERAL LEVELS :

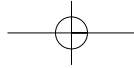
- its antifungal action reduces the mycoflora that produce toxins,
- it inhibits the production of toxins by any remaining mycoflora,
- and finally, its detoxifying action definitively neutralises the mycotoxins by binding irreversibly.

Moreover, the micronised yeast provides an additional source of B-group vitamins.

MYCOTOX® can also be used to treat mycological infections (candidiasis and aspergillosis) and to control the bacterial contamination of the feed (Staphylococci and Streptococci).

MYCOTOX® can be used curatively to treat the clinical forms of mycotoxicosis, candidiasis and aspergillosis. The supplementation can be stopped once the symptoms are in remission ; For sub-clinical infections, MYCOTOX® is administered continuously, at least up until the first vaccination against infectious bursal disease, in order to limit the immunosuppressive effects of the mycotoxins. The supplementation can either be maintained, or continued on an occasional basis (e.g. 1 week out of 2 ), or be stopped depending on the degree of contamination of the feed.





## 3 Factors affecting vaccination

### (A) FACTORS RELATING TO THE CONDITIONS ON THE FARM

## 3. INFECTIOUS DISEASES VACCINATION



### 3.1 Bacterial infections

In accordance with the principle that one should only vaccinate healthy animals, vaccinations should be avoided when an antibiotic treatment is being given to control an infectious bacterial disease. The justification for this approach is as follows :

- When fighting an infectious disease, the immune defence system is focused on and monopolised by the infection. Under these conditions, it is impossible to predict the quality of the induced immunisation, although it will certainly be inferior to that produced on a healthy animal.
- Since the vaccine stimulates a specific part of the immune system, it may adversely affect the course of the current infectious disease, making it more difficult to treat.
- Since the immune defence system has been mobilised and is occupied by the infectious disease, the vaccine virus may multiply at an abnormally high level, thus causing a severe post vaccinal reaction. This reaction will then aggravate the pre-existing infection.

If the period during which the bird is fighting the infectious disease extends over the vaccination date calculated previously, it is necessary and important to delay this vaccination. The birds can be vaccinated once the disease is considered to be completely controlled.

Even for vaccinations which are normally given at an exact, pre-determined date, e.g. for infectious bursal disease, it is essential to delay the administration of the vaccine for sufficient time (4 to 5 days) to allow the antibiotic treatment to produce a sufficient improvement.

Moreover, some bacteria induce an immunosuppressive effect of varying severity (mycoplasmas, *E. coli*, salmonellae, etc.).

Bacterial infections are not the only means by which the birds' immune system is mobilised, the effects of a clinical or sub-clinical coccidiosis are similar to those caused by a bacterial infection.

### 3.2 Immunosuppressive viral infections

Birds are susceptible to infection by a large number of viruses that induce immunosuppressive effects, such as infectious bursal disease, Marek's disease, infectious avian anaemia, avian adenovirus, avian reovirus, avian leukosis (serotype j) and reticulo-endotheliosis.

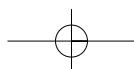
These viruses express their immunosuppressive effects over a long timescale, particularly when they affect young animals (except for avian leukosis (serotype j) and reticulo-endotheliosis which are transmitted vertically).

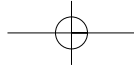
Since these virus infections induce long-term immunosuppression, they may cause marked and persistent failures of vaccination to induce immunisation.

The prevention of these diseases is based on vaccinating breeders or on slaughtering any contaminated birds (e.g. there is an eradication policy for avian leukosis) in addition to vaccination and the careful disinfection of all the buildings on the farm.

Vaccinating breeders prevents contamination during laying and thus the vertical transmission of the disease (e.g. : infectious anaemia). Vaccination also passes on high levels of maternal antibodies to the chicks, and thus protects them during the period of maximum susceptibility (first 2 to 3 weeks of life, infectious bursal disease and avian reovirus infection)

The eradication by screening and slaughtering of entire flock of contaminated breeders provides an





### 3 Factors affecting vaccination

#### (A) FACTORS RELATING TO THE CONDITIONS ON THE FARM



efficient and long-term solution to those diseases for which there is neither a vaccine nor a treatment.

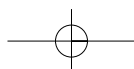
In some cases, it is necessary to vaccinate chicks.

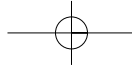
Quality of disinfection is a key factor in controlling these diseases.

Moreover, although it is difficult for a farmer or a producer to influence the vaccination and eradication strategy of his suppliers of chicks, he can totally control his own disinfection policy. Good disinfection significantly reduces the viral pressure to which the chicks are exposed when they arrive on the farm, and thus limits the degree of contamination during the first 2 or 3 weeks of life.

Thus, the combination of good disinfection of farm buildings and the selection of good quality chicks provides a means of managing the risk of infection due to immunosuppressive diseases.

The bird is then perfectly able to be vaccinated.





### 3 Factors affecting vaccination



## B FACTORS ASSOCIATED WITH VACCINATION

Several factors have a considerable influence on the success of vaccination, i.e. on its ability to protect the birds from infection. They can be arranged into three groups of factors : vaccine, human and bird.

The vaccine factor relates to the intrinsic value of the vaccine, strain selection, the vaccination program and the preservation of the vaccine.

The human factor relates to the preparation and execution of the operation and the monitoring of the effects of the vaccination.

The bird factor relates to the receptivity of the animals, their environment and the conditions on the farm. This section does not repeat the technical data described elsewhere in this guide ; its aim is to analyse, in a practical manner, the key factors required for successful vaccination so as to attain maximum protection as effectively as possible.

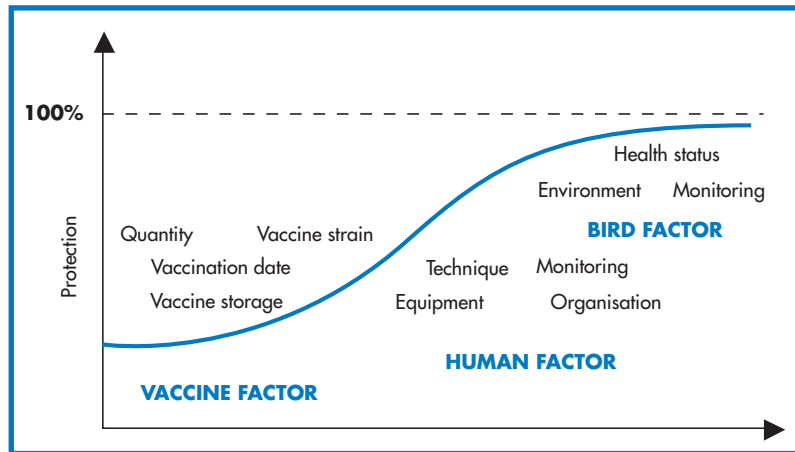


Figure 18 : Factors involved in attaining maximum protection by vaccination.

## 1. THE VACCINE FACTOR

### 1.1. Strain selection

The selected vaccine must be suited to the type of production, to the epidemiological situation and must correspond to the overall risk to which the farm is exposed (e.g.: Intermediate or Intermediate Plus strain of IBD vaccine, depending on the virulence of the wild virus present).

The route of administration of the selected vaccine strain must also match the age of the birds.

The advantages or disadvantages of the various vaccine strains must be taken into consideration when making this choice.

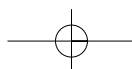
It is therefore advisable to ask the producer or his local representative to provide all the technical information required.

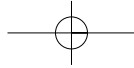
### 1.2 The date of vaccination

The vaccination date must be accurately determined for each vaccination, based either on historical data (the previous production cycles) or on serological analyses.

It is advisable to have serological analyses conducted at least once a year to check for any variations in the epidemiological situation.

The vaccination programme must then be incorporated into the farm's sanitary programme, alongside the





## 3 Factors affecting vaccination

### B FACTORS ASSOCIATED WITH VACCINATION



other treatments (coccidiostats, vitamin supplements and antibiotic) so that they can be integrated without overlap and so that all incompatibilities can be avoided.

#### 1.3 Storage

Live and inactivated vaccines are fragile products. Preservation quality is a factor of paramount importance in ensuring their efficacy. They must be stored at between +2°C and +8°C until used, and the expiry date must never be exceeded.

The cold chain must therefore be respected from production through to utilisation. In practice, special care should be taken to keep the vaccines cool during transport from the local distributor to the farm, using, for example, electrical or static iceboxes, and transporting non-stop during the coolest hours of the day. They are then stored in a refrigerator.

Caution: vaccines in general and inactivated vaccines in particular must never be frozen.

#### 1.4 Quantity of vaccine

The number of doses made available for the vaccination operation must be sufficient and at least equal to the estimated number of birds.

For live vaccines, when the size of the flock cannot correspond to the exact number of vaccine doses (e.g. 19 400 broiler chickens), the next highest number of doses (20 000) can be administered without engendering any risk.

When administering inactivated vaccines, check that the number of injected doses agrees with the number of vaccinated birds by counting the number of bottles that have been used.

Unused doses of inactivated vaccines, in addition to used bottles of live vaccines must be destroyed after use.

## 2. THE HUMAN FACTOR

The human factor is a key factor and can make the difference between success or failure. Its importance can be illustrated by the following saying :

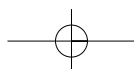
*"The gap between the flour and the cake is the same as that between the vaccine and protection. It takes a good cook to bake a tasty cake".*

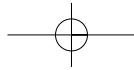
#### 2.1 Technique

Although the techniques used to administer vaccines are not complex, each step may contribute to a certain loss of efficacy if it is not performed according to the rules. It is therefore essential that clear and thorough explanations are given to all the personnel who actually administer the vaccine, and that the instructions are understood. Thus, it is preferable to train all those involved and not simply the team leader. It is also strongly advisable to check that the training has been understood by rehearsing, involving giving blank vaccinations (i.e. with no vaccine).

The training can also be broken down based on the type of task (preparation, administration, organisation, monitoring) or on the administration method so as to enable the persons involved to specialise. The laboratory which manufactured the vaccine, or its local representative, can help or intervene during these training sessions.

Finally, the techniques used evolve, as does the epidemiological situation, and years of experience cannot be replaced by simple training. However, thorough training does prevent bad habits from becoming routine practice.





### 3 Factors affecting vaccination

#### B FACTORS ASSOCIATED WITH VACCINATION



#### 2.2 Equipment

The equipment used must be checked and prepared the day before so that the vaccination operation can be started as early as possible.

It can be useful to draw up procedures that list the necessary administration material (including spares) and that describe how the preparation (cleaning, greasing) and the checks should be carried out (calibrating the syringes, operating the nebuliser).

It is important not to overlook the water used in sprayed administrations, the solvents (for the wing-web and eye drop method) as well as water treatments (for administration via drinking water). It is also preferable to prepare in advance the clothing to be worn by each person.

#### 2.3 Organisation

Vaccination is by essence a stressful event for the bird, and so it must be performed under optimal conditions. Moreover, it is virtually impossible to stop an administration once it has started. Checks must therefore be conducted in advance to ensure that the material is available, that there is a sufficient quantity of vaccine, that the personnel are trained and that the birds are healthy.

This check should be carried out not later than the day before. This is also a convenient time to record the water consumption. The vaccination programmes should not be scheduled for a public holiday, unless this cannot be avoided, since it is important for the entire team to be present.

The preparation can be simplified by breaking down the operation into separate tasks (preparing the material and the vaccines, briefing the teams about the administration technique, monitoring the animals, etc.).

The role of each person should be clearly explained by the person in charge of the vaccination by listing their tasks and when they should be performed.

A blank vaccination can be carried out to check that the organisation works and that the preparation is sufficient.

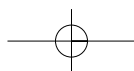
The vaccination operation should start in the morning, as early as possible in hot countries.

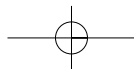
Two or three people are required per building for half a day to administer live vaccines. At least five people (including two vaccinators) are required for a full day when administering injections of inactivated vaccine.

#### 2.4 Monitoring

Monitoring the vaccination is at least as important as its preparation. It involves checking, during the hours following the vaccination: that immunisation has been induced (when administering via the drinking water); the birds' level of stress; and in some cases the early signs of post-vaccinal reactions. The appearance of post-vaccinal reactions or the failure of the vaccination can be monitored by considering the zootechnical performance and the health of the flock. Serological monitoring also provides a means of evaluating the immune response to the vaccination.

The information obtained shows whether the vaccination programme and strain selection were appropriate. Based on the results, the details may be adapted (programme, strain, administration technique) for the vaccination of subsequent flocks. When vaccinating against fowl pox, the appearance of a nodule indicates that the vaccination was given correctly.





### 3 Factors affecting vaccination

#### (B) FACTORS ASSOCIATED WITH VACCINATION



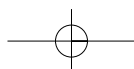
TABLE XXI :

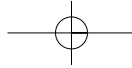
#### Procedure to follow in cases of suspected vaccination failure

STAGES	CHECKS
1 Confirm the cause of the observed pathology	<ul style="list-style-type: none"> <li>Form a certain diagnosis based on clinical and epidemiological elements, as well as on the results of serological examinations and necropsy</li> </ul>
2 If the diagnosis confirms that the cause corresponds to the pathology against which the birds were vaccinated, compare the vaccination date with the incubation period	<ul style="list-style-type: none"> <li>The infection may have started before the vaccination date, or even before the effective period of protection.</li> <li>Since the overall risk to which the flock is exposed may have changed, check the existing biosecurity measures and adapt the vaccination programme accordingly (strain selection, route of administration, vaccination date).</li> </ul>
3 If it is correct, check that the vaccine has actually been administered.	<ul style="list-style-type: none"> <li>Carry out serological monitoring to check for the development of antibodies.</li> <li>Check the administration method used and the technical expertise of the person who administered the vaccine.</li> <li>Count the number of doses actually used by collecting the empty bottles and comparing the total with the total number of vaccinated birds.</li> </ul>
4 If the vaccine has been actually administered, check the quality of the vaccine.	<ul style="list-style-type: none"> <li>Check the means used to preserve the vaccine until its use (was the vaccine exposed to heat whilst being prepared ?)</li> <li>Check the expiry date on all the bottles of vaccine (NB : several batches may be used for the same vaccination)</li> </ul>
5 If the quality of the vaccine is good, check that the administration conditions have not impaired the efficacy of the vaccine and that the material used was in good working order.	<ul style="list-style-type: none"> <li>Check the water quality (for administration via the drinking water) as well as the duration and the quantity consumed. Check that the water did not contain a high concentration of residual chlorine and that the chlorine neutralisers (skimmed milk powder, sodium thio-sulphate, CEVAMUNE®) have been correctly administered.</li> <li>Check that the solvents used were sterile (for the eye-drop and wing-web methods).</li> <li>Check that no disinfectant was used either to clean the material or mixed with the drinking water</li> <li>Check that the material operates correctly (sprayers, syringes, pipette)</li> </ul>
6 If the vaccination had been carried out according to the regulations, check that the programme followed was appropriate.	<ul style="list-style-type: none"> <li>Check the choice of vaccinal strain.</li> <li>Check that there were no potential interactions between the vaccinations (Newcastle and infectious bronchitis, for example) and other treatments.</li> <li>If the suspected vaccination failure started after a booster, check how well the primary vaccination had been given.</li> <li>Check the calculation of the vaccination date and the information on which it was based.</li> </ul>
7 If the vaccination had been appropriately programmed and correctly carried out, check the health status of the flock when the vaccination was given.	<ul style="list-style-type: none"> <li>Check if the birds were receiving any other curative treatment at the same time or just before the vaccination.</li> <li>Check if you knew the immune status of the day old chicks (IBD) and which vaccinations have been given to the breeders.</li> <li>Check if there was any potential contamination of the flock by micro-organisms causing a superimposed infection (e.g. mycoplasma).</li> <li>Check if the feed was contaminated by mycotoxins and if it had been supplemented.</li> <li>Check whether the environmental conditions at the time of the vaccination could have caused significant stress.</li> <li>Check whether the birds were suffering from chronic or sub-clinical coccidiosis.</li> </ul>

This summary table is not exhaustive, and does not mention the correction actions to implement once the cause of the pathology has been clearly defined. It is nonetheless possible to refer to the various sections of this guide when drawing up an action plan.

Whenever a failure is suspected, it is important to keep samples of the empty bottles used : it is also a good idea to consult the laboratory which manufactured the vaccine or its local representative.





## 3 Factors affecting vaccination

### B FACTORS ASSOCIATED WITH VACCINATION

#### • 3. THE BIRD FACTOR



The birds themselves are one of the key factors affecting the success of the vaccination. The quality of their receptivity is dependent on their immune status and on the influence of the environment.

##### 3.1 Health status

The health status of the flock should be checked 1 to 2 days before vaccinating, with particular attention paid to all chronic or sub-clinical pathologies which could either reduce the effect of the vaccination or be the cause of secondary infections encouraged by a post-vaccinal reaction (mycoplasma Pasteurella, E. coli, coccidiosis mycotoxins, etc.). These potential risks should therefore be taken into consideration (known latent mycoplasmal infection), for example by giving a preventive treatment before and after the vaccination.

If the health status of the birds is not acceptable; the vaccination must be postponed until the treatment has had time to take effect.

Moreover, this monitoring can conveniently be combined with measuring the average water consumption.

It is essential to minimise the adverse effects of stress either by avoiding periods of predictable stress (e.g. handling) or by introducing a supplementation programme based on metabolic correctors and/or vitamins before and after the vaccination date.

The stresses induced directly by a vaccination are minimised when the operation is prepared and performed correctly.

The health status of the flock should be monitored for a few days after vaccinating, as mentioned previously.

##### 3.2 The environment

The atmospheric conditions should be adjusted to their optimal values (temperature, lighting, ventilation, etc.) so as to keep the birds calm before, during and after the vaccination.

When mycotoxicosis is suspected, it is a very good idea to analyse the feed at the start of the production cycle. If this is not possible, a supplementation with a high emphasis on curative ingredients should be given continuously from the first day of rearing right up to the vaccination date against infectious bursal disease, or longer. It is then possible to modify this supplementation programme either by giving occasional treatments with the same active ingredient (e.g. 1 week out of every two) or by replacing it with a preventive supplementation (e.g. adsorbents).

