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THE BENEFITS OF NEWCASTLE KILLED VACCINES IN BROILERS

HATCHERY

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Newcastle Disease, along with avian influenza, is recognised worldwide as one of the two most destructive diseases in poultry. Newcastle Disease (ND) is found in many parts of the world in well-entrenched epidemic form. It represents a permanent threat to both farm and industrial rearing of poultry.

This disease affects practically all major production zones: either as a direct and significant threat to flocks or through necessitating installation of strict biosecurity measures and monitoring controls.



Figure 1 : Newcastle Disease distribution map in 2008 (source: OIE).



The year 2000 was marked worldwide by the emergence of many very virulent strains (traditionally called velogenic) in or near all the major production areas. The countries directly affected were South Korea, Malaysia, Jordan, Mexico, North Africa and Italy, without counting the countries where extremely virulent forms are already present in chronic form. (*See Fig 1*)

For some countries it is a major impediment to access to international poultry markets. Consequently, the number of Newcastle infection reports is most probably underestimated in official organisations like OIE. Prevention of ND is based, in addition to strict biosecurity measures, on vaccination of birds with live attenuated and / or inactivated vaccines. However, the fragility of attenuated vaccines and the difficulty of regularly carrying out quality vaccination in large numbers can make uniformity of protection uncertain. When birds are reared where ND is widespread and biosecurity measures are difficult to implement or are overlooked, variations in the results obtained from vaccines can lead to heavy losses. The use of inactivated vaccines in long-living animals (laying and breeder hens) has proved for 30 years now the importance and effectiveness of those vaccines which produce high, long-lasting humoral immunity.

Given the upsurge in Newcastle Disease and the importance of inactivated vaccines, many producers have been obliged for a number of years now to turn to the combined use of live and inactivated vaccines in young birds - broilers or future layers. This practice has been widely recognised since the eighties and also has been proven to be highly useful in combating outbreaks of Newcastle disease throughout the world. It consists of early injection (in general during the first week of life) of a suitable dose for young birds of inactivated vaccine with water-in-oil adjuvant against Newcastle Disease at the same time as - or within a week of - the initial vaccination.

This kind of vaccination programme strengthens, stabilises over time and ensures consistency of protection for flocks, even in the most difficult conditions.

USAGE OF KILLED OIL-ADJUVATED VACCINES: BASICS

At the end of the sixties and beginning of the seventies, the importance to poultry farming of inactivated vaccines with mineral oil adjuvants was clearly recognised and highlighted in a number of scientific papers ^(19,20,25,31). These vaccines were then exclusively used for future laying and breeder hens just before the onset of lay, as still nowadays is a common practice.

They are recognised as offering high, long-lasting immunity when they are administered after one or several initial live vaccine injections ^(26, 27, 22, 23).

Since this time, other scientific papers have very clearly shown their importance for young broilers. Indeed, simultaneous administration with a live vaccine produces early, strong and lasting immunity ^(21, 23, 30, 28, 29), while being practically independent of the rate of maternally derived antibodies.

Box (1992) and other authors have underlined the many advantages to poultry of inactivated water-in-oil vaccines:

- Be-stimulation of cellular immunity produced by live vaccines.
- In combination with live vaccines, vaccination of 1-day-old commercial chicks with maternally derived antibodies in regions where ND is endemic. Inactivated oil-emulsion vaccines are not as adversely affected by maternal immunity as live vaccines because the oil adjuvant acts as stimulus of defense mechanism and disperse antigen slowly. In these circumstances, there is a progressive stimulation of the active immunity while the passive immunity declines and the immune system reach full competence ^(21, 30).
- No more use of live mesogenic vaccines and no consequent contamination of the environment by the vaccine strain.
- Immunisation from species resistant to ND infection (viremia): turkeys, pigeons, pheasants...

In 1978, Bennejean et al. clearly established the importance of this combination. They showed the synergy that exists between the live and the inactivated vaccines when administered simultaneously, both with SPF chickens (having no maternally derived antibodies) and with commercial chickens (having maternally derived antibodies). These classical works are summarized in Appendix 2.



ECONOMICAL BENEFITS ASSOCIATED WITH THE EFFICACY OF NEWCASTLE KILLED VACCINES: DOES IT PAY BACK ?

Practically, the economical benefits linked to these laboratory analyses are important to consider: at the end of the day, a vaccination program including killed Newcastle vaccine is a more expensive investment. It has thus to be regarded whether it is worth to implement it.

As part as the full package implemented in CEVAC Hatchery Vaccination, it is possible to analyse the results from the field through the **cost-benefit calculator** developed by CEVA ; the following trial performed in Philippines can very comprehensively illustrate it.

In this trial, 16 556 broilers were vaccinated with CEVAC Broiler ND K + Vitabron + CEVAC Transmune IBD and 41,832 broilers with conventional program in the field.

The same booster was kept at the farm in order to compare with accuracy to the conventional program of vaccination, as described here.

VACCINATION IN	THE FIELD	HATCHERY VAC	
<u>Day 1 :</u> VG / GA + H120	Spray	Day 1 – Hatchery :	
Day 7 :		Vitabron L Broiler ND K	Spray
Ma5 Clone 30	Spray	Transmune IBD	Subcut
Day 14 :			
W2512	DW	<u>Day 12 :</u>	
Day 21 :		Clone 30 + Ma5	Spray
W2512	DW		
Day 28 :			
Clone 30	Spray		

The results obtained were analyzed through the cost-benefit calculator in order to compare all the economic factors leading to the most important and final one: **the margin per bird.**

Broiler Perfomance Input		Group A Hatchery Killed + Live Vaccines	Group B Conventional Vaccine	
			00	00
Number of Chicks Placed			16 556	41 832
Age of Depletion (days)			38	39
Average Liveweight (g)			1 580	1 620
FCR			1.7	1.76
Livability			97.1%	95.8%
Sex			As Hatch	As Hatch
Carcass Yield			70%	70%
Bone-in Breast Yield			27%	27%
Breast Meat Yield			20%	20%
Leg Quarter Yield			23%	23%
Wing Yield			8%	8%
Condemnation at Processing		0.33%	0.96%	
Liveweight corrected same age	38	days	1 580	1 558
FCR corrected for same age	38	days	1.7	1.744
FCR corrected for same weight	1580	g	1.7	1.766
Vaccine Cost (\$/chick)		1.45	0.8	
Other Costs (\$/chick)		1	1	
Margin / bird		45.31 \$	43.64 \$	

(*) In this table, \$ is used as symbol for local currency (Philippino Pesos).



Including all the costs, taking into account almost all the benefits, the group vaccinated with the full package including CEVAC Broiler ND K, a ND killed vaccine, performed much better than the conventional program with a final margin per bird of 45.31 PhP.

It is necessary to mention that these results didn't include the medication cost. Had these cost been considered, this difference could have been amplified since respiratory viruses are strongly linked to C.R.D. (Mycoplasma *Chronic Respiratory Disease*) and E. coli infection.

Paramyxoviruses have for major route of contamination the respiratory tract. Consequently, a poor quality of local vaccination OR a poor level of blood circulating antibodies may not withstand fully the viral pressure, and prevent the viremia to impair partially or definitely the health of the broilers. Such a synergistic hatchery vaccination program has been able to demonstrate its efficacy in building an efficient "wall of protection" in front of different wild pressure levels, from subclinical to clinical infection.

CONCLUSION

The intensity and uniformity of seroconversion are important criteria when assessing the protection given by any ND vaccination program. Indeed, unlike live vaccines against Newcastle Disease used alone, intensity and quality of vaccine intake can be very clearly linked to the antibody titres produced by ND Killed vaccines.

The protection against Newcastle must be sufficiently high, homogenous, stable (to face any immunosuppressive factors) and lasting to cover the broilers' entire production cycle against subclinical and clinical PMV-infections.

At the end of the day, the vaccination program must be regarded as an investment, whose benefits are of the utmost importance for such a major threat.



APPENDIX 1 (RECOMMENDED VACCINATION PROGRAMMES)

Broilers

VACCINATION IN THE HATCHERY

Age	Vaccines	Route
1 day	CEVAC VITAPEST L + CEVAC BROILER ND K	SPRAY IM or SC / 0.1 ml
18 days	CEVAC VITAPEST L Or CEVAC NEW L(*)	SPRAY Or DRINKING WATER

(*) For high viral pressure area

VACCINATION ON THE FARM

Age	Vaccines	Route
1 day	CEVAC VITAPEST L	SPRAY
Between 1 and 7 days	CEVAC BROILER ND K	IM or SC / 0.1 ml
	CEVAC VITAPEST L	SPRAY
18- 21 days	Or	Or
	CEVAC NEW L(*)	DRINKING WATER

(*) For high viral pressure area

These vaccination programmes are only given as guidance and must be adjusted to local epidemiological conditions, feasibility of implementation, and any other vaccines recommended.

The general principles of these vaccination programmes against Newcastle Disease are as follows:

- Initial vaccination: a live vaccine must always be used in combination with an inactivated oil-based injection. The synergy of the combination of the two vaccines produces a high and stable protection.
- The combination of live vaccine and inactivated vaccine is ideally carried out at 1 day of age in the hatchery. In the situation where injection cannot be carried out in the hatchery, it is recommended that it should take place at the latest at 7 days of age. It is important that the 2 vaccines are administered in the same week.
- The first booster vaccination is carried out at around the 3rd week of age. It re-stimulates local immunity and gives uniformity of protection throughout the flock through its booster effect and thanks to the additional protection it offers birds which may not have received a complete or successful injection of CEVAC BROILER ND K.
- Booster vaccines containing safe strains like PHY.LMV.42 (Vitapest, Vitabron) should always be applied by spray with specific devices, allowing uniform and relevant size of droplets.



APPENDIX 2 (BENNEJEAN AT AL, 1978):

Vaccination of 1-day-old chicks, with an inactivated vaccine combined with a live vaccine.

In the two following studies, four groups of 300 1-day-old chicks were created and received the following treatment:

Group 1	"Non vaccinated control" :	No vaccination
Group 2	"Live vaccine"	D1 (eye-drop) Live Attenuated (*) at 10 ^{6.5} EID50 per dose
Group 3	"Inactivated vaccine"	D1 (intramuscular injection inactivated oil- based vaccine (0.1 ml – 50 PD / dose).
Group 4	"Live + inactivated"	D1 (eye-drop) Live Attenuated (*) (as for group 2) and 0.1 ml of inactivated ND vaccine (as for group 3).

(* ICPI < 0.2)

Close serological monitoring was carried out by means of a blood sampling at 1, 5, 10, 15, 20, 30, 40, 50 and 60 days and HI analysis tests.

The results of these experiments on SPF birds are shown in figure 2 below:



Figure 2: Progression of titres in HI antibodies by live, inactivated vaccines administered in isolation or in combination, to 1-day-old SPF chicks²¹

From the serological perspective (fig.2), the highest titres are obtained when live and inactivated vaccines are administered together. Serological maximums are achieved 25 days after vaccination of SPF chickens.

The live vaccine produces appreciably lower and clearly less stable titres than the combination of live and inactivated vaccines or the inactivated vaccine alone.





The same study was then carried out on four groups of 300 one-day-old commercial chicks.

Figure 3 : Progression in protection of live, inactivated vaccines administered in isolation or in combination, to 1-day-old commercial chicks²¹.



Figure 4 : Progression of titres in HI antibodies produced by live, inactivated vaccines administered in isolation or in combination to 1-day-old commercial chicks²¹.

With commercial chicks, maternally derived antibodies offer 80% to 90% protection at 5 days, whichever vaccination is used (fig. 3).



However, after 5 days:

- The protection given to non-vaccinated animals markedly decreases as the maternal origin antibodies disappear. This protection is nil at 30 days.
- The protection given by the live vaccine alone is very good between 10 and 15 days of age, ranging from 90% to 95%, but decreases very rapidly to 70% between 20 and 30 days, then to around 40% up to 80 days of age. This explains and justifies the need for a booster vaccination against ND around 18-21 days.
- Lastly, the protection given by the combination of live and inactivated vaccines is undisputedly the best. It is both fast-acting due probably to the action of the live vaccine, then perfectly stable between 90% and 95% up to 80 days of age due to the synergy between the live vaccine and the inactivated vaccine.

From a serological perspective, the HI monitoring test (fig 4) shows that vaccination at 1 day of chicks with a high level of maternally derived antibodies (8.5 log2 on average) does not lead to secretion of antibodies, although protection at 20 days is 70%. The decrease of these maternally derived antibodies is exactly the same in the live vaccinated group as that observed in the non-vaccinated group.

Injection of an inactivated vaccine <u>alone</u> can produce titres at 20 days slightly above these last 2 groups, but real seroconversion will occur later.

In the case where a live vaccine is <u>combined</u> with an inactivated vaccine, seroconversion occurs early and the minimum titres achieved are around 4 log2 (4 HAU) at 20-30 days and do not stop growing until 60 days, then level out at 80 days at 6 log2.



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