Control of infectious bronchitis viruses

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It is widely known that infectious bronchitis (IB) viruses are able to mutate easily. Current detection methods (RT-PCR and sequencing) detect very small changes in the genome of the IB virus. The question for IB control in the field is do we require a new vaccine for each new emerging IB variant? Or can existing IB vaccines induce sufficient levels of cross protection against these newly emerging serotypes or variants (protectotype).

The protectotype approach determines whether existing IB vaccines or combinations of existing IB vaccines induce sufficient levels of cross protection.

Results of cross protection studies show that new vaccines are often unnecessary. Using the protectotype approach can help to advise the poultry industry much quicker in comparison to the time required to develop and register a new IB vaccine.

Score	Ciliary activity
0	All cilia beating
1	75% cilia beating
2	50% cilia beating
3	25% cilia beating
4	No cilia beating

Table 2. Ciliostasis scores (Cook et al, 1992).

A standard cross protection study is developed to determine IB protectotypes.

For the protectype research trials a standard IB vaccination programme, based on a Massachusetts type (IB ma5) in combination with a variant IB 4/91 type, is used to check the level of cross protection against new emerging IB variants.

Protection after vaccination is measured by assessing ciliary activity of the tracheal epithelium 5-7 days after a challenge with a new emerging IB variant. These type of challenge trials enable us to quickly determine the efficacy of existing IB vaccines against new emerging IB variants.

This article proves effective broad protection against different IBV variants from all over the world by using a combination of Massachusetts (Ma5) and 4/91 serotype vaccines.

The protectotype approach shows that development of new IB vaccines is not necessary in most cases of small changes in the IB virus genome.

The development of a new IB vaccine against a new IB variant can take 6-8 years including registration. By utilising the broad cover provided by existing vaccines, IB losses are minimised through a quick response.

Details of a reseach trial are presented in Table 1.

Group	1 day	14 days	35 days IB challenge
A	Ma5	-	Yes
B	-	4/91	Yes
C	Ma5	4/91	Yes
D (control: no vaccine – challenged)	-	-	Yes

Table 1. Experimental design for protectotype research trial.

- Four groups (A, B, C, D) of 10 day-old specific pathogen free (SPF) chicks are housed in separate negative pressure isolators.
- Group A+C: vaccinated by the oculo-nasal route with 10^3 EID_{50} of the Nobilis IB Ma5 vaccine at one day old.
- Group B+C: vaccinated with $10^{3.6}$ EID_{50} of Nobilis IB 4/91 at two weeks of age.
- One unvaccinated group (D) used as control group (challenge controls).

At five weeks of age, the control group D (no vaccinations) and groups A, B, C (vaccinated with Ma5 and/or 4/91) received a very high challenge by oculo nasal route with $10^{7.5}$ EID_{50} of a new emerging IB variant.

At 5-7 days post-challenge, chicks in each group were euthanised. The tracheas were removed and examined for ciliary activity as described by Cavanagh et al, (1997).

From each trachea 10 rings were prepared and examined under low-power microscopy, ciliary activity was scored as shown in Table 2.

The maximum ciliostasis score for each trachea is 40 (max 10 x 4 = 40). A chicken is considered to be sufficiently protected if the ciliostasis score for the trachea is less than 20. The ciliostasis score is used to calculate a protection score according to the formula shown in Table 3.

$$\text{Protection score} = \left(\frac{1 - \text{mean ciliostasis score for vaccinated/challenged group}}{\text{mean ciliostasis score for challenged controls}}\right) \times 100$$

Table 3. Protection score.

The higher the protection score, the better the level of protection provided by the vaccination programme.

The concept of protectotypes, which from a practical point of view is more relevant than serotypes, shows that in vivo protection is much broader than the result of in vitro testing (PCR and sequencing or virus neutralisation tests) might suggest.

The enhancement of cross protection against isolates belonging to antigenically different serotypes/genotypes can be achieved with the use of a combination of existing live attenuated IB vaccines (IB Ma5 + IB 4/91) belonging to different serotypes. This prototype approach shows that vaccination programmes based on existing IB vaccines or combinations of existing IB vaccines induce broad protection in the case of possible new emerging IB variants of economic significance. ■

Table 4. Protection scores.

Country of origin of the challenge strain	Protection following challenge at five weeks of age of SPF chicks vaccinated with various vaccination programmes							
	Unvaccinated controls		Vaccinated groups					
			Group A		Group B		Group C	
			Day 1 Ma5	Day 14 -	Day 1 -	Day 14 4/91	Day 1 Ma5	Day 14 4/91
	Score*	%**	Score	%	Score	%	Score	%
Italy nephropathogenic	39.4	-	35.8	9.1	5.6	85.8	3.4	91.4
Netherlands D1466	39.6	-	31.8	22.2	29.4	25.8	16.1	59.4
Arkansas, USA	39.1	-	9.8	74.9	11	71.9	5.8	85.2
Brazil	40.0	-	7.1	82.3	7.8	80.5	5.3	86.8
South Africa	39.6	-	21.2	46.5	31.5	20.5	4.5	88.6
Taiwan	36.5	-	17.3	52.6	20.7	43.3	3.5	90.4
Japan TM86	37.5	-	7.8	78.6	10.9	70.1	2.5	93.2
Japan FB3	38.0	-	8.9	76.6	2.8	92.6	2.2	94.2

** Mean ciliostasis score for 10 chicks/group. ** Percentage of protection of the challenged group. The lower the mean ciliostasis score, the higher the level of cross protection.*