Village Chicken Production in Vietnam and Newcastle Disease Control with Thermostable Vaccine

Tran Dinh Tu[1]

Abstract

Village or garden chickens are important items in the economy of Vietnamese villages. Newcastle disease is the major constraint to improved production. Conventional Newcastle disease vaccines are used successfully in Vietnam to protect commercial chickens. Their use in villages is limited because of their heat sensitivity. The I-2 strain of thermostable Newcastle disease vaccine is now made in Vietnam. Initial laboratory and pilot village trials indicated the suitability of this vaccine for village use. The present report describes field trials that indicate the efficacy of I-2 vaccine when given by eye drop or on cooked white rice and the thermostability of the vaccine. I-2 vaccine was superior to La Sota vaccine for village use because of its ready spread by contact. Large-scale trials indicated a considerable drop in the incidence of Newcastle disease in villages that used I-2 vaccine. Navetco intends to produce 10 million doses of the vaccine for village use in 2000.

VIETNAM is a tropical country in Southeast Asia, S-shaped and stretching 2000 km from north to south. The area of 329 566 square km supports a population of 78 million of whom 80% live from agriculture. Agriculture accounts for 30% of the GDP and is based mainly on rice production, followed by other crops such as maize, sweet potato, cassava, groundnuts, soya beans and sugar cane. There are also fruit trees and other perennial trees like coffee, rubber, tea and coconut.

Livestock production, mainly buffalo, cattle, pigs and poultry contributes 25% of the agricultural output. Animals and poultry form an integral part of village life and have important social functions in Vietnam. They are an important source of income for village families and provide a cheap source of protein for rural people.

Village Chicken Production

The poultry population of Vietnam increased during the past decade (Table 1). Chickens are raised in every village in Vietnam, and 75% of the national flock is kept under traditional village conditions. Villagers use free-range, backyard or semi-intensive systems but not intensive systems. Most farmers keep chickens, but the smaller flocks contain only a few birds. Other poultry such as ducks (including Muscovies) and geese are also kept in villages.

Table 1. Poultry population and production in Vietnam[a].

Year	Chickens (millions)	Ducks (millions)	Meat production (thousand tonnes)	Egg production (millions)
1993	95	31	170	2300
1994	101	32	186	2600
1995	108	34	197	2800
1996	115	38	230	—

[a] Source. National Extension Service Department, 1997.

Chicken meat made up 16% of the total meat production in Vietnam in 1996. Chicken production per capita (3.5 kg of meat and 46 eggs in 1996) is anticipated to reach 6.6 kg of meat and 63 eggs in 2000.

During the past three decades, the Vietnamese government has encouraged the industrialisation of poultry production. Exotic breeds of broilers (Plymouth, Hybro, Cobb, Hubbard, Ann Arbor) and layers (Leghorn, Hubbard, Comet, Moravia, Goldline-54, ISA-brown, Brown Nick) were imported.

[1] National Veterinary Company, 29 Nguyen Dinh Chieu St, District 1, Ho Chi Minh City, Vietnam

Industrial production required not only exotic breeds, but access to concentrates, vaccines and excellent management. The dense industrial populations of chickens encourage the transmission of infectious diseases. Some of these were exotic diseases that spread to local flocks. The intensive industry with its high costs had to compete with chickens produced in villages at lower cost.

Local chicken meat is perceived to be more tasty and of higher quality than that of many exotic breeds. This has led to an increased demand for 'garden chickens' in Vietnam. Consumer judgement of quality, and the effect on market price, is indicated in Table 2.

Table 2. Ranking of quality, price and market potential of some broiler breeds in Vietnam.

Breed (origin)	Quality	Price	Market potential
NAGOYA (Japan)	Very good	Highest	Local and export
RI (Vietnam)	Good	Medium	Local and export
TA VANG (Vietnam)	Good	Medium	Local and export
TAMHOANG (China)	Good	Medium	Local
SASSO (France)	Fair	Medium	Local
AA (USA)	Poor	Lowest	Local

There is a diversity of local breeds raised for different purposes. The most popular local breeds are Ri, raised in the North, and Ta Vang or Tau Vang in the South. These are dual-purpose breeds, slow growing but adapted to local feeds and the hot climate. They have high resistance to diseases and parasites. Other well-known breeds for meat production (Dong Cao, Dong Tao and Mia) previously raised in North Vietnam are now becoming rare. Consumers prefer some breeds because of the yellow colour of feathers and skin, features that are favoured for the frequent spiritual festivals held in Vietnam and for family offerings. Some breeds are raised for specific purposes: Choi and Tre breeds for village cockfights; and Ac for making traditional tonics to benefit people who are old or sick.

Although village chicken production has increased in response to consumer preference for local birds, there remain major constraints. The productivity of village chickens is low and needs to be improved. Limited production has led to a high price for the product. Most are sold live and consumed locally. In remote areas, there are no good facilities for slaughtering and processing. Infectious disease and parasitism cause substantial losses and disease control is difficult in unconfined chickens.

Newcastle Disease and its Control

Newcastle disease (ND) has probably been present for a long time in Vietnamese chickens. However, the first official confirmation of the disease by laboratory diagnosis was not until 1949. Since then, ND has been considered as the major fatal disease of chickens in Vietnam. Outbreaks are frequently reported in village chickens but until recently there were few firm data on incidence, morbidity, mortality and nature of the causative virus. There are few scientific reports on ND in the Vietnamese literature, and these are mostly concerned with single surveys. ND is still endemic throughout Vietnam and is especially significant in remote areas where disease control is rarely practised by villagers. Provincial veterinary services recognise that ND occurs throughout the year, peaking in the period November to March. ND is apparently the highest cause of loss in village chickens, and even farmers with good management skills agree that, unless ND is effectively controlled, all efforts to increase chicken production will be wasted.

A survey conducted in An Giang province by Mai Hoang Viet (1988) showed that the incidence of ND in village chickens varied from 6.7% to 38.6%, apparently depending on the knowledge and experience of the individual farmer in applying preventive vaccination. The mortality in affected chickens varied from 69.1% to 88.6%. Losses were greater in chickens less than 7 months of age. Mortality was many times higher in freely scavenging village chickens than in confined village chickens, as the latter were more readily vaccinated. During his survey, 36 isolates of ND virus (NDV) were isolated from 134 samples from sick chickens. Isolations were made in embryonated eggs and the presence of NDV confirmed by haemagglutination and heamagglutination inhibition tests. Diagnostic laboratories frequently reported the viscerotropic velogenic form of ND in chickens presented for autopsy.

The characters of some Vietnamese isolates of NDV established at Navetco are shown in Table 3.

Table 3. Pathogenicity indices of some Vietnamese isolates of Newcastle disease virus.

Virus designation	MDT[a]	ICPI[b]	IVPI[c]	ELD_{50}[d]	LD_{50}[e]
VN 91	57	1.77	2.67	9.4	7.8
AK	38–48	—	—	8.0	7.8
Navetco virulent	<50	—	—	7.5	6.1

[a] Mean embryo death time in hours.
[b] Intracerebral pathogenicity index.
[c] Intravenous pathogenicity index.
[d] 50% embryo lethal dose per mL of allantoic fluid.
[e] 50% chicken lethal dose per mL of allantoic fluid.

Methods to control ND commenced as early as the 1960s, and are based mainly on vaccinations of a lentogenic vaccine given at an interval of three weeks followed by a booster with mesogenic vaccine 4 to 6 months later. This program is effective and controls ND on commercial farms and in villages if applied routinely. In remote areas, most farmers do not use the vaccines. This is due partly to lack of knowledge and partly to the lack of vaccines suitable for use in scavenging chickens.

At present, all the poultry vaccines produced in Vietnam are freeze-dried live vaccines. The first ND vaccine used in Vietnam was the Asplin F vaccine. This vaccine and fowlpox vaccine were introduced from the Weybridge Institute, UK, in 1956. F strain was followed by the Mukteswar strain (from China in 1964) and La Sota strain from the former Soviet Union in 1968. Recently, a new thermostable ND vaccine has been developed. The vaccine has evolved from a V4-like strain designated I-2 provided to Navetco by Professor P. Spradbrow of The University of Queensland, Brisbane, Australia. This vaccine has been highly appreciated by the farmers and rural development officers because of its preventive efficacy and ease of use. In 1999, nearly 8 million doses of the thermostable vaccine were produced and sold from Navetco. It is expected that 10 million doses will be required in 2000 to meet increasing demand.

Production of I-2 Vaccine

The procedure for producing vaccines at Navetco is relatively simple. Before 1995, the vaccine seeds were passaged serially in commercial eggs, without a proper seed-lot system. However, Navetco always seeks to produce safer and more effective vaccines. After the receipt of the seed stock of I-2 vaccine from Professor Spradbrow in 1994, vaccine production was changed to a seed-lot system. For I-2 vaccine, sound eggs from a commercial farm were used to produce master seed-lot (MSL) and then the working seed-lot (WSL) from which vaccine was produced. Both MSL and WSL were subjected to sterility and potency tests and then stored at –70°C.

Vaccine is produced in clean, fertile eggs from commercial sources. Ten-day-old embryonated eggs are candled and cleaned with 0.5% iodine solution. Through a hole drilled in the shell, the allantoic cavity is inoculated with 10 000 EID_{50} of virus. The diluent is phosphate buffered saline containing 100 IU penicillin and 100Ug streptomycin per mL. The inoculation site is sealed with paraffin wax and the eggs incubated at 37°C. The eggs are candled daily and any with dead embryos are discarded. The infected allantoic fluid is harvested after incubation for 96 hours and overnight chilling at 4°C. Allantoic fluid is collected into 1000 mL bottles. Each is tested for sterility before pooling and titration to allow calculation of a field dose of vaccine. The required titre is 10^7 EID_{50} per bird dose. The vaccine is mixed with 10% skim milk powder, dispensed and freeze-dried in vials containing 25, 50 or 100 doses.

Samples of vaccine undergo quality control tests before the vaccine is sold. Sterility tests are undertaken in duplicate in aerobic nutrient broth, anaerobic nutrient broth, blood agar plates and Saboraud agar for fungi. In vivo tests are made for safety and potency. Ten susceptible chickens less than 10 days of age are each given 10 field doses by eye drop. There must be no observable reaction over the next 10 days, in comparison with 10 control chickens. The potency test uses 10 3-week-old commercial chickens each receiving a single field dose by eye drop. Three weeks later, the vaccinated chickens and 5 control chickens are challenged by intramuscular injection of 10 000 LD_{50} of virulent NDV. The test is valid if 80% or more of the vaccinated chickens survive and 80% or more of the control chickens die over the next 2 weeks.

The resulting vaccine is very cheap. The price of a dose is 60 VND (US$0.005). The small number of doses in each vial is suitable for small village flocks. Even the poorest farmers in Vietnam can now afford the vaccine to protect their backyard chickens.

Field Trials and Technology Transfer

Earlier laboratory and pilot village field trials have already been described (Tu et al. 1998).

The purpose of further field trials was to establish the efficacy of the new vaccine under field conditions and to demonstrate efficient vaccination strategies to the village farmers. Two postgraduate and five undergraduate veterinary students wishing to do their MSc or DVM degree theses were recruited to assist. Three provinces, Ho Chi Minh City, Dong Thap and An Giang, were used for the trials. Provincial staff who were to assist were trained to recognise ND and in various aspects of vaccination. At a later stage, discussions were held in villages to explain ND and vaccination to farmers whose flocks would be used in the trials. Flocks containing 50 to 200 suitable chickens were selected. More than 600 farmers living in 52 villages in 18 districts participated.

Three major trials were undertaken. Basic methodologies were common to the trials. Vaccine was administered to chickens at 3 weeks of age, when about 10% of the birds were bled to establish base line serology. A second vaccine was given two weeks later. Chickens were bled to determine antibody

responses and at the end of the experiment, chickens were purchased for challenge with virulent NDV. Non-vaccinated chickens from other villages served as controls.

The first trial examined in replicate routes of vaccination (eye drop, drinking water and feeding on cooked white rice). The results are shown in Table 4. Eye drop vaccination gave the best results, but vaccination with feed was the most convenient for uncontrolled scavenging chickens.

The second trial tested freeze-dried vaccine that had been kept at room temperature for 1, 2 or 3 weeks. The results are shown in Table 5. The vaccine was stable at room temperature for at least 3 weeks.

The third trial allowed a comparison of I-2 and La Sota vaccines as shown in Table 6. I-2 was the preferred vaccine because of its capacity for horizontal transmission.

A fourth trial was for demonstration and extension purposes. During 1996–1997, 300 000 doses of I-2 vaccine were distributed free to farmers in the three provinces. Efficacy of vaccinations was evaluated by monitoring the incidence of ND before vaccination and 6 months after vaccination. The results for 10 villages in Dong Thap province are shown in Table 7. In all 10 villages, the incidence of ND was lower after vaccination. The I-2 vaccine was effective in chickens that were also receiving fowl cholera vaccine.

Table 4. Efficacy of I-2 vaccine applied twice by various routes to village flocks.

Route	Province	Before vaccination[a]	Two months after vaccination		
		HI antibody[a]	HI antibody[a]	% = 3[b]	Survived/challenged
Eye drop	Dong Thap	1.6	4.5	88.4	9/9
Eye drop	HCM City	1.2	5.1	96.0	10/10
Feed	Dong Thap	2.2	4.4	78.2	10/10
Feed	An Giang	1.1	2.4	56.8	ND[c]
Water	An Giang	1.1	2.5	45.6	ND
Water	HCM City	1.1	3.2	74.8	9/10
None	Dong Thap	—	2.0	0	1/10
None	HCM City	—	2.0	0	0/5

[a] Geometric mean titre, $\log_2$. [b] Presumed protective titre. [c] Not done.

Table 5. Response to I-2 vaccine stored for various periods at room temperature in Dong Thap province.

Storage time (weeks)	Number of chickens	Before vaccination HI[a]	One month after HI[a]	Two months after	
				HI[a]	Survived/challenged
1	162	0.6	5.1	4.1	11/12
2	128	1.0	4.1	4.3	12/13
3	204	0.6	5.8	4.9	11/12
No vaccine	12	—		1.9	1/12

[a] Geometric mean titre, $\log_2$

Table 6. Comparison of efficacy of I-2 vaccine and La Sota vaccine under village conditions in An Giang province.

Vaccine	Route	Number of chickens	Before vaccination HI antibody[a]	Two months after vaccination		
				HI antibody[a]	% = 3[b]	Survived/challenged
La Sota	Eye drop	129	0.5	4.5	88	19/20
La Sota	In contact	29	0.3	0	0	3/20
I-2	Eye drop	152	0.8	3.4	70	19/20
I-2	In contact	38	0.4	3.5	72	20/20
None	—	5	—	0	0	0/5

[a] Geometric mean titre, $\log_2$. [b] Presumed protective titre.

Table 7. Efficacy of I-2 vaccination campaign in Dong Thap province.

District	Incidence of Newcastle disease in flocks	
	Before vaccination	6 months after vaccination
Hong Ngu	65.0	17.1
Tan Hong	60.0	18.0
Tam Nong	50.0	20.0
Thanh Binh	40.0	5.8
Thap Muoi	80.0	30.4
Than Hung	86.0	7.1
Lai Vung	85.0	11.0
Chou Than	65.0	11.5
Sa Dec Town	35.0	9.2
Cao Lanh Town	70.0	23.3

Conclusion

Village chicken production will only advance if there is effective disease control practised by farmers. The control of ND will require suitable vaccines and appropriate technology. Experience in Vietnam indicates that I-2 is a suitable vaccine that can be produced locally and at a price that allows full cost recovery. I-2 vaccine is preferred for village use in Vietnam. Its advantages over the other ND vaccines produced in Vietnam are thermostability and ability to spread between chickens. Even remote areas lacking refrigerated transport can be reached by the vaccine and farmers can be taught the simple methods of application.

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