The Effect of Infection with Different Strains of Newcastle Disease Virus on Cellular RNA and Protein Synthesis

(Accepted 10 September 1971)

A large number of Newcastle Disease virus (NDV) strains have been isolated which differ markedly in their virulence for chickens (Waterson, Pennington & Allan, 1967), and which have been classified as velogenic (the most virulent), mesogenic (of intermediate virulence) and lentogenic (the least virulent). Investigation of the virus multiplication cycle in vitro has shown that a correlation exists between virulence and the ability to cause a cytopathic effect and form plaques in chick embryo cells (Schloer & Hanson, 1968; Reeve & Alexander, 1970); and recently Reeve & Poste (1971) have demonstrated a correlation between virulence and the ability to cause polykaryocytosis. It has also been suggested that a correlation exists between virulence and the ability to inhibit cellular protein synthesis (Reeve et al. 1971).

We have examined the effect of infection with 13 strains of NDV on cellular RNA and protein synthesis, and have found several exceptions to the correlation observed by Reeve et al. (1971).

Methods for the growth and assay of the virus strains have previously been described (Lomniczi, Meager & Burke, 1971). Monolayers of chick embryo cells were infected for 1 hr at 37° at a multiplicity of 100 EID₉₀/cell (which corresponded to 2 to 10 p.f.u./cell for the velogenic and mesogenic strains). The monolayers were then washed and incubated with fresh medium. At intervals the rates of RNA and protein synthesis were determined by the amount of [¹⁴C]-uridine and [²H]-valine incorporated during 1 hr at 37° (Skehel et al. 1967).

There was no change in the radioactivity of the fraction extracted from the cells by cold trichloracetic acid when either RNA or protein synthesis was measured. Changes in specific activity of RNA or protein were therefore not due to changes in the specific activity of the precursor pools.

The results (Fig. 1) show that infection with all the velogenic strains caused an inhibition of the rates of protein and RNA synthesis, the strains LAMB, ESSEX and TEXAS being more effective than FIELD PHEASANT, HERTS or WARWICK. Indeed neither the HERTS nor WARWICK strains had a very marked effect despite their extreme virulence. The three mesogenic strains (BEAUDETTE, L and H) also were effective in inhibiting the rates of cellular protein and RNA synthesis, and it was noticeable that the L strain was particularly effective in causing inhibition. The results obtained with lentogenic strains could be divided into two groups; those causing inhibition (strains B₁ and ULSTER) and those causing an inhibitory effect which was later reversed (strains QUEENSLAND and F). The LA SOTA strain caused a similar effect to the F strain. The same results were obtained whether the comparisons were made on a basis of counts/min./culture or counts/min./µg. protein. The effect of varying the multiplicity of infection was examined in a separate experiment, and little difference was found using strains ULSTER and TEXAS when the multiplicities were varied over the range 30 to 100 EID₉₀/cell. The stimulation of the rate of RNA synthesis shown in cells infected with the QUEENSLAND and F strains was investigated further by the addition of actinomycin D (1 µg./ml.) 2 hr before addition of [²H]-uridine. Incorporation in infected cells was depressed to the same extent as in uninfected cells—showing that the RNA synthesis in infected cells at this time was mainly cellular rather than viral.
These results are similar to those reported by Wilson (1968) for strains TEXAS and BEAUDETTÉ C and by Reeve et al. (1971) for strains HERTS, TEXAS, H. WARWICK and FIELD PHEASANT, although they reported greater inhibitory effects than described here. However, the results differ from those of Reeve et al. (1971) in two ways—first we consistently found that infection with the ULSTER strain, over a range of multiplicities, caused inhibition of both RNA and protein synthesis. We have also found that this strain will occasionally form plaques and also cause some cytopathic effect despite its very low virulence. The second difference is that infection with some strains (F and Lasota) can actually cause a stimulation of cellular RNA and protein synthesis.

The results show that although some virulent strains cause a greater inhibitory effect than some avirulent strains, there are important exceptions. Lentogenic strains, such as B₁ and ULSTER, can cause profound inhibitory effects and the mesogenic L strain was the most eflec-
tive inhibitory strain of 13 tested. Thus it appears that the correlation observed by Reeve et al. (1971) between virulence and the viral inhibitory effect is not generally true.

We thank the Agricultural Research Council for a grant which supported this work.

N. F. Moore∗
B. Lomniczi†
D. C. Burke∗

* Division of Biological Sciences
University of Warwick
Coventry, CV4 7AL, Warwickshire
† Veterinary Medical Research Institute of the
Hungarian Academy of Sciences
Budapest, Hungary

REFERENCES


(Received 2 August 1971)