

# Effects of vaccine strains of infectious bronchitis virus on egg quality in unvaccinated and vaccinated laying hens

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Abbreviated title: IBV and egg quality

## Summary

The effect of two vaccine strains of infectious bronchitis virus (IBV - VicS and A3 strains) on internal and external quality of eggs was studied in Isa Brown hens in full lay. Birds were either unvaccinated for IBV or had been vaccinated during rearing. The main effects of the vaccine viruses were that VicS resulted in paler coloured shells, mainly in the unvaccinated birds and the eggs from the hens challenged with VicS were more elongate than the other groups. These findings are consistent with our earlier findings with field strains of IBV and differ from those reported in the literature for different strains of IBV.

Keywords: infectious bronchitis virus, egg quality, vaccine, vaccinated, unvaccinated

## Introduction

Infectious bronchitis virus (IBV) is a viral disease of poultry which affects epithelia in a number of parts of the body including the respiratory system, kidneys and oviduct. IBV is reported to cause drops in egg production and reduced egg quality. Australian field strains of IBV have been shown to have negative effects on the oviduct (Chousalkar and Roberts, 2007 a,b; Chousalkar *et al.*, 2007 a,b) and thereby on egg quality (Chousalkar and Roberts, 2008). However, little is known of the effects of vaccine strains of IBV on the oviduct and therefore on egg quality. The present study was undertaken to study the effects of IBV on egg and egg shell quality in unvaccinated laying hens and hens which were vaccinated during rearing.

## Materials and Methods

Day-old Isa Brown hens (250) were obtained directly from a commercial hatchery and transferred to isolation sheds at the University of New England. Half of the birds were vaccinated according to the standard UNE protocol of VicS at day-old, A3 at 4 weeks and VicS at 13 weeks. Vaccine was administered by eyedrop. All birds were reared under strict isolation and biosecurity with vaccinated and unvaccinated birds being maintained completely separate. The birds were divided into six groups: unvaccinated control (UC), vaccinated control (VC), unvaccinated and exposed to VicS (UV) vaccinated and exposed to VicS (VV), unvaccinated and exposed to A3 (UA) vaccinated and exposed to A3 (VA). At 30 weeks of age, birds were exposed to one of two vaccine strains of IBV at a dose 10 times the usual vaccination dose: VicS strain (at the dose rate of  $10^{5.5}$  embryo infective dose (E.I.D.<sub>50</sub>) or A3 strain (at the dose rate of  $10^{4.9}$  embryo infective dose (E.I.D.<sub>50</sub>), or left unchallenged as a control. Vaccines were obtained from Fort Dodge, Australia. All eggs were collected at 3 and 2 weeks prior to challenge and then daily during the week immediately before infection to determine any inherent differences among the groups. Eggs were collected and analysed daily up to 5 weeks post infection (p.i.) and again at weekly intervals 6, 7, 8, 9 and 10 weeks p.i. All eggs were analysed for the internal quality parameters albumen height, Haugh units and yolk colour score.

Egg shell quality was measured as shell reflectivity, egg weight, deformation, breaking strength, shell weight (from which percentage shell was calculated), shell thickness, egg length and breadth (from which shape index was calculated as  $\text{breadth} \times 100 / \text{length}$ ). Data were analysed by ANOVA and Fisher's protected LSD was used to distinguish differences between means. Significance was assumed at  $P < 0.05$ .

## Results

Egg production was not significantly different among the treatment groups. In addition, some measures of egg quality were not significantly different among the treatment groups. There was a significant effect of time on all variables measured except percentage shell and these effects were generally consistent with the increasing age of the flock. There were no main effects of the treatments on percentage shell, and no main effect of vaccination treatment on any indicator of egg shell quality except shell colour. In addition, there was no main effect of challenge treatment group on shell breaking strength, deformation, shell breadth, shell thickness or percentage shell.

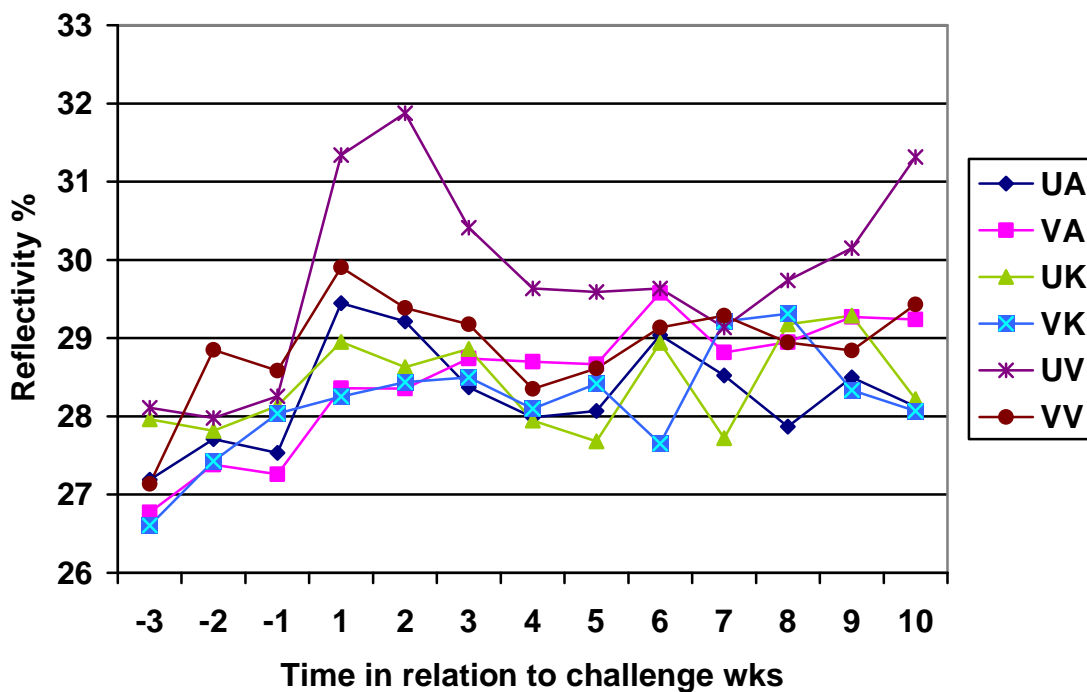
Egg weight was highest in the control groups (62.0 g), lowest in the A3 groups (61.1 g) with the VicS groups intermediate (60.5 g). The main effects on egg shell quality were changes in shell colour and egg shape. For shell reflectivity, a measure of shell colour lightness, there were significant main effects of time in relation to challenge, challenge treatment and vaccination treatment. Over the entire experimental period, shell colour was lightest in the VicS challenged birds, due to the increased shell reflectivity in the unvaccinated birds exposed to VicS (Figure 1). The control and A3 challenged groups had darker shells than the VicS group and were not significantly different from each other. Shell colour was significantly lighter for the unvaccinated treatment groups than for the birds which had been vaccinated during rearing. There were also significant interactions between time postchallenge and challenge treatment, time and vaccination treatment, and challenge treatment and vaccination treatment. There was a significant main effect of time in relation to challenge, and challenge treatment, on shape index with eggs being more elongated in the VicS challenged groups (Shape Index 77.9%) than in the Control groups (77.5%) and A3 groups (77.6%). Over the entire experimental period, there was no significant effect of vaccination treatment although the eggs in the unvaccinated birds tended to be more elongate (Shape Index 77.8%) than in the vaccinated groups (77.5%). Differences in shape index were due primarily to differences in length, rather than breadth. Shell weight was highest in the control groups (6.21 g), lowest in the VicS groups (6.07 g), with the A3 groups intermediate (6.15 g). For egg internal quality, Haugh Units were higher in the vaccinated groups (94.0%) than in the unvaccinated groups (93.1%). However, Haugh Units were highest in the VicS groups (94.3%), followed by the A3 groups (93.5%) with the control birds having lower Haugh Units (92.6%). Yolk colour score was significantly higher for the unvaccinated groups (12.11) than for the vaccinated groups (11.85) and highest for the A3 groups (12.12), lowest for the VicS groups (11.86) with the control intermediate (11.94).

## Discussion

The results presented here are consistent with those reported earlier from our laboratory concerning the effects of field strains of IBV on egg quality (Chousalkar and Roberts, 2008, in press). Effects of IBV on egg quality are also consistent with our previously reported findings of histopathological effects on parts of the oviduct and virus localisation in the oviduct (Chousalkar and Roberts, 2007a,b; Chousalkar et al., 2007a,b; Chousalkar and Roberts, 2008 in press; Roberts, 2005). It is important that these findings are documented as they are at odds with the published literature on effects of IBV on egg quality in other countries (Sevoian and Levine, 1957; Cook, 1971).

The mechanisms whereby exposure to IBV results in paler coloured egg shells and more elongate eggs are not understood. The factors affecting deposition of the porphyrin pigment in the cuticle of the egg shell are poorly defined.

Figure 1: Shell reflectivity (%) in eggs collected during the experimental period



Reductions in albumen quality following exposure to field strains of IBV might have contributed to the production of more elongate eggs (Chousalkar and Roberts, 2009). However, this is unlikely to have been the case in the present study where albumen height and Haugh Units were higher for the vaccine challenged groups than for the control. The reasons for this are not clear. In addition, the cause of the effects of vaccination during rearing and challenge with

vaccine strains of IBV on yolk colour is not known but may be the result of effects on lipid metabolism. Further work is needed to clarify this.

It is important to understand how the effects of Australian strains of IBV differ in their effects on egg quality from IBV strains which are common in the U.S. and Europe. Textbooks on disease describe production drops and the appearance of thin-shelled, shell-less and rough-shelled eggs, in addition to reductions in shell colour (Cook, 2008; Cavanagh and Gelb, 2008) and earlier textbooks talked about the classic "IB egg" which was wrinkled and corrugated. The differences between the effects of IBV on egg quality reported in the literature and those found in our laboratory may be due to differences in the strain of IBV used. It is also possible that the strain of bird has an influence. Even within our own laboratory, we have observed that unvaccinated or vaccinated White Leghorns exposed to IBV show more severe histopathology in the oviduct than do Isa Brown hens.

Reduced shell colour and decreased albumen height result from exposure to both Australian and overseas strains of IBV. However, the gross changes in egg shell quality reported for overseas strains have not been demonstrated experimentally in Australia. In addition, the changes in egg shape which have resulted from exposure to Australian field strains of IBV (Chousalkar and Roberts, 2009) have not been reported for overseas strains.

## Acknowledgements

This study was supported by a grant from Australian Egg Corporation Limited which also funded a Postdoctoral Fellowship for Kapil Chousalkar. Robert Turner assisted with the animal trial and was supported by a Postgraduate Scholarship from the Australian Poultry CRC.

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