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SHORT COMMUNICATION

ANTIBODY RESPONSE TO INFECTIOUS BURSAL DISEASE VACCINATIONS IN FASTED BROILERS UNDER HIGH TEMPERATURE AND HUMIDITY

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SUMMARY

Relationships among short-term fasting, heat stress and response to infectious bursal disease (IBD) vaccinations were studied in broiler chicks. Commencing from 28 days of age, birds fasted from 0900 h to 1700 h or fed *ad libitum* were exposed to high ambient temperatures (36 ± 2°C) from 1200 h to 1700 h or unheated (minimum 25°C; maximum, 34°C) as controls. Live IBD vaccine (Nobilif strain D78, Intervet International, B.V. Boxmeer, Holland) was given intraocularly at 14 and 28 days of age. On Day 35, while feeding regimen had negligible effect on immune response, the heat treatment suppressed antibody titers. On Day 42, feed-restricted chicks had higher antibody response to IBD vaccinations than those fed *ad libitum* in response to the heat exposure.

Keywords: Fasting, heat stress, infectious bursal disease, vaccine, immune response, broilers

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Evidence is accumulating which suggests that fasting may enhance tolerance of broilers to high ambient temperatures (McCormick *et al.*, 1979; Smith and Teeter, 1987, 1988; Zulkifli and Fauzi, 1996). Smith and Teeter (1987, 1988) reported that fasting intervals commencing 3-6 h prior heat treatment improved survivability. In a companion study (Zulkifli and Fauzi, 1996), we found that shifting the birds' feed intake from the period of highest sustained temperature to the cooler period in the evening improved feed efficiency and lowered body temperature of heat-stressed broilers.

Studies of feed deprivation influences on heat tolerance typically examined its effect on performance and body temperature. There is a paucity of information on the impact of short-term fasting on the immune response of heat-stressed broilers. Studies in laboratory and domestic animals suggest that environmental insults leave an individual vulnerable to neuroendocrine alterations, thereby may hinder immunity (Thaxton, 1978; Kelley, 1985; Siegel, 1985; Zulkifli, 1995). The current study was conducted to evaluate the effect of short-term fasting on response to infectious bursal disease vaccination in heat-stressed broilers.

A more complete description of husbandry can be found elsewhere (Zulkifli and Fauzi, 1996). Briefly, 144 straight run day-old broiler chicks were randomly assigned in groups of six to 24 battery cages with wire floors. The batteries were in conventional open-sided house with cyclic temperatures (minimum, 25°C; maximum, 33°C). Relative humidity was between 75 to 90%. Feed and water was available at all times and given intraocular administration of live infectious bursal disease (IBD) vaccine (Nobilif strain D78, Intervet International,B.V. Boxmeer, Holland).

On Day 28 and thereafter, an equal number of chicks was subjected to either *ad libitum* feeding (AL) or feed deprivation from 0900 h to 1700 h (for the duration of 14 days) (FR). For each feeding regimen there was control (NT) and heated (HT) groups. Heated chickens were exposed to ambient temperatures of 36 ± 2°C from 1200 h to 1700 h for 14 days. Heat was imposed by electric brooders and cages were partially covered to trap the heat. Relative humidity of the heated cages was not controlled but measurements showed that it was similar to the unheated pens. Two blocks of batteries were designed to be heated and the remainder as unheated controls.

Eight birds were randomly chosen and bled on Days 0, 7, 14, 21, and 28. On Days 35 and 42, blood was collected from eight birds per feeding regimen-temperature subgroup. Serum samples were analysed for IBD antibodies using ELISA kit (IDEXX Laboratories Incorporation, USA).

Prior to analyses, antibody titers were transformed to common logarithm. Data (antibody titer on Days 35 and 42) were analyzed each day with feeding regimen and temperature as the main effects. Data were subjected to ANOVA in factorial arrangement in a fixed effect model with the aid of General Linear Model (GLM) of SAS software (SAS Institute, 1982). When interactions were significant, separate analysis was conducted within each main effect. Multiple mean comparisons were assessed by Duncan's multiple range test. Statistical significance was considered as $P<0.05$

Mean antibody titers on Days 0, 7, 14, 21 and 28 were 2889 (± 662.3), 1058 (± 390.0), 762 (± 275.7), 183 (± 48.0), and 83 (± 34.3), respectively. There was no interaction between feeding regimen and temperature for antibody response to IBD vaccinations on Day 35. Broilers that were subjected to heat treatment had lower titer than their unheated counterparts (35 ± 8.9 versus 77 ± 18.0). Mean antibody titers for AL (59 ± 18.7) and FR (51 ± 10.7) were similar.

Feeding regimen by temperature interactions were significant for antibody response at 42 days of age (Table 1). The interactions were caused by different effects of temperature on FR and AL birds. Within AL birds, the heat treatment suppressed antibody titer, whereas, the high ambient temperature had no influence on the measurement in FR chicks.

The high IBD antibody titer prior to the vaccinations could be attributed to maternal antibody (Hair-Bejo *et al.*, 1995). The results of this study, where HT chicks had lower antibody response than their NT counterparts on Day 35, confirmed previous observations that high ambient temperatures suppressed immune response (Thaxton *et al.*, 1968; Donker *et al.*, 1990). Modulation of immunosuppression during heat stress could be associated with elicitation of the hypothalamic-pituitary-adrenal axis which increases circulating levels of glucocorticoids. This notion was strengthened by alleviation in the immunosuppressive effect of high ambient temperatures when chicks were given pre-stress treatment with metyrapone, an inhibitor of adrenal steroidogenesis (Thaxton and Siegel, 1973; Gross, 1989). Glucocorticoid-elicited immuno-suppression could be ascribed to lymphatic involution, inhibition of cytokines liberation and selective destruction of lymphocytes (Siegel, 1985; Kelley, 1985; Sapolsky, 1992).

The observed significant feeding regimen by temperature interaction for antibody response on Day 42 suggests that the short term fasting may have profound impact on immunocompetence in heat-stressed broilers. In the present study, regardless of temperature, FR birds had similar antibody titers and suggests enhanced tolerance to high ambient temperatures. In contrast, two weeks of heat exposure attenuated antibody response of AL chicks. Hence, it is evident that short-term fasting may ameliorate heat stress-elicited immunosuppression.

Previous findings on the effect of feed restriction on the immune system are conflicting. Ben Nathan *et al.* (1977, 1981) indicated that 24 and 48 h of starvation reduced antibody response to sheep red blood cells (SRBC). Induced molting which involves prolonged fasting impeded humoral responsiveness in laying hens (Giambrone, 1986). On the contrary, Klasing (1988) demonstrated that when SRBC were injected during the onset of 24 h of feed deprivation, anti-SRBC titers were higher in fasted birds than those fed *ad libitum* or force fed additional feed. Similarly, Spalatin and Hanson (1974) indicated that 24 h of feed and water withdrawal heightened antibody response to Newcastle disease virus. Zulkifli *et al.* (1992) and Holt (1993), however, reported that feed restriction had negligible impact on humoral immunity. Data presented here suggest that, while fasting had no effect on antibody response on Day 35, such procedure reduced antibody titers of NT birds but not their HT counterparts on Day 42. Thus, it is evident that stress attributable to short-term fasting could be detrimental to immunocompetence in broilers raised under tropical conditions (as in the condition of NT in the present study). Chickens, however, readily habituate to fasting of moderate duration (Freeman *et al.*, 1981; Zulkifli *et al.*, 1993). Based on heterophil to lymphocyte ratios (a physiological indicator of stress), Zulkifli *et al.* (1993) reported that the effect of adapting to feed restriction (60% of *ad libitum*) dissipated between 12 to 16 days after initiation. In view of this, birds should be allowed for habituation to short-term fasting to occur prior to vaccination.

Table 1. Mean (± SEM) antibody titers on Day 42 where temperature[1] by feeding regimen[2] interactions were significant

Feeding regimen	Unheated	Heated
Ad libitum	857 ± 434.0^a	29 ± 17.8^b
	*	NS
Fasted	386 ± 348.4	81 ± 31.0

Means within a row with no common letters differ significantly ($P \leq 0.05$).
*A significant difference ($P \leq 0.05$) between means within a column.
[1]On Day 28 some pens of chicks were exposed to ambient temperatures of 36 ± 2°C from 1200 h to 1700 h for 14 days.
[2]All chicks were fed *ad libitum* from Days 0 to 27. On Day 28, some pens of chicks were fasted from 0900 h to 1700 h.

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RINGKASAN

GERAKBALAS ANTIBODI TERHADAP PEMVAKSINAN PENYAKIT BURSA BERJANGKIT DALAM AYAM PEDAGING BERLAPAR DI BAWAH SUHU TINGGI DAN KELEMBAPAN TINGGI

Perkaitan di antara berlapar tempoh singkat, tekanan haba dan gerakbalas terhadap pemvaksinan penyakit bursa berjangkit (IBD) telah dikaji dalam anak ayam pedaging. Bermula daripada umur 28 hari, ayam dilaparkan dari 0900 j hingga 1700 j atau diberi makan ad libitum telah didedahkan kepada suhu ambien tinggi (36 ± 2°C) dari 1200 j hingga 1700 j atau tidak terdedah haba tinggi (minimum 25°C; maksimum 34°C) sebagai kawalan. Vaksin IBD hidup (strain Nobilif D78, Intervet International, B.V. Boxmeer, Holland) telah diberi secara intraokulus pada umur 14 dan 28 hari. Pada hari 35, sambil regimen makan memberi kesan paling sedikit terhadap gerakbalas imun, perlakuan haba meninidas titre antibodi. Pada hari 42, anak ayam terhad makanan menunjuk gerakbalas imun lebih tinggi terhadap pemvaksinan IBD daripada yang diberi makan ad libitum dalam gerakbalas terhadap pendedahan haba