# HUMORAL AND CELLULAR IMMUNOCOMPETENCE IN TWO POULTRY STRAINS FED DIFFERENT PROTEIN CONTENT DIETS

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## SUMMARY

The objective of the paper was to determine the effects of strain and diet on antibody production to 2 vaccines (Newcastle-NC and Inf. Bronchitis-IB) and to sheep red blood cells (SRBC), cell-mediated response to phytohemagglutinin (PHA), and bursa-spleen (BU-SP) weights. A commercial (COM) and a "country"(CTY) strain of poultries were fed a high (HP) and low (LP) crude protein diets. SRBC response 15 days post-inoculation was higher for COM with HP and for CTY with LP, and no difference was found 15 days later. No differences were found for NC, IB, PHA and BU-SP. Phenotypic correlations between live weight (LW) and humoral responses were low. These correlations within strain were negative higher for COM and positive higher for CTY. Between LW and PHA the association was medium and positive and, correlations were close to 0 between PHA-humoral responses. Correlations between humoral responses were medium and positive, and with BU-SP were not different from 0 except for IB.

**Keywords**: poultry strains, food protein, immune response, sheep red blood cells, antibodies.

## INTRODUCTION

In recent years there has been renewed interest in improving genetic resistance to infectious diseases. The immune system of an individual consists of three major components: antibody response, T-Cell mediated immunity and phagocytosis (Cheng and Lamont 1990). Selection for increased humoral response has been demonstrated by several authors (Kean *et al.* 1994), who determined the existence of additive variability for the character and also, some of them, reported it was specific for the antigen utilized (Gross *et al.* 1980; Pitcovsky *et al.* 1987). The difference in response can be that the principal components against the antigen were not necesarily associated (Afraz *et al.* 1994).

Afraz *et al.*(1994) and Martin *et al.*(1988) reported a negative correlation in poultry strains between immunological response and live weight but, Pitcovsky *et al.*(1987) found the opposite. The intensive selection in commercial strains determined lower heritabilities for the weight-gain, which, in association with the not high ones for immune traits (Siegel and Gross 1980; Cheng and Lamont 1990; Shukla *et al.*1996), may indicate the genetic-environmental(GxE) interactions possibility when strains with different level of selection are considered(Zijp *et al.*1990) .

The present experience was undertaken to determine the performance of humoral and T-cell mediated immunity in different poultry strains, its relationship with bursa, spleen and live weight, and the existance of GxE using different crude protein diets.

## MATERIALS AND METHODS

The experimental birds, males, belonged to two strains, a commercial (COM) one and a "Country"(CTY) strain from a private enterprise, which is utilized for a more "natural" production and poorly selected for gain weight. Hundred and sixty from each one were placed in the FCV's Experimental Poultry Unit, randomly assigned to isocalorics High Crude Protein (HP) or Low Crude Protein (LP) diets, with 20.5% and 16.9% CP, respectively, from birth up to the 6th week, and a common grower diet from then until the 10th week. Four pens for each strain x diet treatment were assigned. Three assays were used to evaluate the immunocompetence of the same random poultries.1) The enzime-linked immunoabsorbant assay(ELISA) was used to evaluate antibody responses to Newcastle La Sota vaccine (NC) and Infectious Bronchitis Masachusetts vaccine (IB). Both were administered at 21 days of age and 8 blood samples by pen were taken immediatly, 3 and 7 weeks post-immunization. Antibody levels were determinated by ELISA test kits.2) On day 40, the same 128 poultries were inoculated intravenously with 1.0 ml of 5% suspension of packed sheep red blood cell's (SRBC) in phosphate buffered saline. They were bled from wing vein on 15th and 30th day post-inoculation and collected sera used for antibody titer determination by the haemagglutination test.3) The phytohemagglutinin (PHA) wing web assay, carried out at 6 weeks of age, in a 1 mg/ml concentration, was used to evaluate in vivo cell-mediated inespecific immune response of poultries, expressed as index (Kean *et al.* 1994). Four of the 8 poultries used per pen were randomly slaughtered at 10 weeks of age to register the bursa (BU) and spleen (SP) weights. Live weights(LW) were recorded at same time as immunological registrations were done. Data were analized by GLM and CATMOD(SRBC) procedures of SAS. The statistical model included: strain, diet, interaction(SxD) and replicate nested within interaction. The model included as a covariate trait the previous level when the phenotypic correlation was important. The humoral response was tranformed to log for assay 1 and to log-2 for the reciprocal highest dilution for assay 2. Phenotypic correlations between humoral and cellular responses, immunological organs and live weight were also estimated.

## RESULTS AND DISCUSSION

Response to NC, IB and PHA at the 6th week, were not different($P>.05$) for strain and diet (Table 1). COM and HP birds were heavier at this age ($P<0.05$). SxD response to SRBC at 15 days post-injection was significant($P<.01$), with a higher titer for COM($3.42\pm0.23$) than CTY($3.30\pm0.23$) in the HP diet and a higher titer for CTY($2.73\pm0.23$) than COM($2.55\pm0.24$) in the LP diet. These were not associated with the LW on the 8th week, where COM and HP were heavier than CTY and LP($P<0.01$), and disagreeing with Praharaj *et al.* (1995) and Zulkifli *et al.* (1993), who found the inverse interaction and no interaction for SRBC, respectively. These results suggests that rapid growth strains can produce a better antibody response with more protein than less selected birds, and that the first ones reduces the ability to adjust the immunoresponse when diet is sub-optim.

Response to NC, IB and SRBC, BU and SP in g and relative to LW, at 10 weeks were not different($P>.05$) but LW was($P<.01$) for strain and diet. COM and HP were also heavier at this

**Table 1. Predicted least squares means and standar errors at the 6th week**

| Strain-Diet | LW(g) | Antibody titer for response | | PHA(mm) | |
|---|---|---|---|---|---|
| | | NC log(value) | IB log(value) | 24(hs) | 48(hs.) |
| COM | 1269±30 | 8.03±0.07 | 8.36±0.04 | 6.81±0.81 | 4.07±0.62 |
| CTY | 745±30 | 8.23±0.07 | 8.40±0.04 | 4.30±0.77 | 2.07±0.59 |
| HP | 1185±30 | 8.07±0.07 | 8.32±0.04 | 6.30±0.83 | 3.12±0.63 |
| LP | 829±30 | 8.19±0.07 | 8.43±0.04 | 4.81±0.76 | 2.96±0.58 |

age(Table 2). These SRBC results were not in agreement with Martin *et al.*(1988) and Praharaj *et al.*(1995), who found titer differences in lines selected for divergent weight. Results on organ relative weights were in agreement with Praharaj *et al.*(1995), who reported a higher proportion of immunological organs relative to LW(RSP,RBU) on strains poorly selected for growth, but differences between diets, disagreeing, at this point, with the present report.

**Table 2. Predicted least squares means and standard errors at the 10th week**

| Strain-Diet | LW(g) | SP(g) | BU(g) | Antibody titer for | | |
|---|---|---|---|---|---|---|
| | | | | NC log(value) | IB log(value) | SRBC log2(value) |
| COM | 3704±64 | 4.17±0.02 | 6.03±0.42 | 7.05±0.07 | 8.24±0.03 | 2.01±0.27 |
| CTY | 2529±68 | 3.90±0.21 | 5.63±0.44 | 7.06±0.07 | 8.25±0.03 | 2.06±0.29 |
| HP | 3373±67 | 4.05±0.21 | 5.90±0.44 | 6.95±0.07 | 8.23±0.03 | 2.00±0.27 |
| LP | 2860±65 | 4.02±0.20 | 5.75±0.42 | 7.16±0.07 | 8.26±0.03 | 2.06±0.28 |

The total phenotypic correlations estimated between two measures after antigen inoculation for the same immunological trait were medium-high and positive(0.30-0.76). Correlations between LW and the humoral reponse traits were low, in agreement with Shukla *et al.*(1996) and in desagreement with Pitcovsky *et al.*(1987), Martin *et al.*(1988) and Afraz *et al.* (1994), between LW and PHA was medium and positive, and between PHA and humoral traits arround 0 (Table 3), which suggests, in agreement with Cheng and Lamont (1990), Afraz *et al.*(1994) and Kean *et al.* (1994) the unassociation of the different components of the immunological response. The same correlations within strain gave different results between humoral traits and LW, which were negative higher for COM and positive higher for CTY(not shown). Correlations between humoral traits were medium and positive in agreement with Gross *et al.*(1980), Cheng and Lamont(1990) and Kean *et al.*(1994). Within strain the LW-SRBC and NC-IB correlations were higher for COM, and SRBC-NC higher for CTY(not shown). The correlations between LW and

immunological organs weights were low and positive but between LW and relative organ weights were medium and negative. Within CTY and LP correlations between LW-organ weights were positive higher and closer to 0 for relative weights than total ones, agreeing with Praharaj *et al.*(1995). Correlations between organ weights or relative weights with NC and SRBC were close to 0, but with IB were positive higher. This can be explained by a positive and medium correlation for COM because it was close to 0 for CTY(not shown).

**Table 3. Total phenotypic correlations between measured traits**

| | 5th week | | | | | | 10th week | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LW | NC | IB | PHA-24 | PHA-48 | | LW | NC | IB | SRBC | SP | BU |
| LW | 1 | -0.12 | -0.13 | 0.49** | 0.38** | | 1 | 0.08 | 0.14 | 0.14 | 0.20 | 0.06 |
| NC | | 1 | 0.39** | 0.00 | 0.04 | | | 1 | 0.20* | 0.24 | - 0.06 | 0.06 |
| IB | | | 1 | -0.05 | 0.10 | | | | 1 | 0.30* | 0.31* | 0.19 |
| PHA-24 | | | | 1 | 0.76** | SRBC | | | | 1 | 0.11 | -0.03 |
| PHA-48 | | | | | 1 | RSP | -0.52* | -0.12 | 0.18 | -0.01 | 0.70** | 0.00 |
| | | | | | | RBU | -0.45* | 0.01 | 0.07 | -0.11 | -0.09 | 0.81* |

*(P<0.05) **(P<0.01)

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