Available online at www.sciencedirect.com
ScienceDirect
Animal Feed Science and Technology
134 (2007) 66–76
ANIMAL FEED SCIENCE AND TECHNOLOGY
www.elsevier.com/locate/anifeedsci

Carry-over effects of early-life supplementary methionine on lymphoid organs and immune responses in egg-laying strain chickens

K. Deng *, C.W. Wong, J.V. Nolan

Animal Science, School of Rural Science and Agriculture, University of New England, Armidale, NSW 2351, Australia

Received 7 June 2004; received in revised form 25 April 2006; accepted 8 May 2006

Abstract

The carry-over effects of supplementing egg-laying strain chickens with methionine until 4 weeks of age on growth, lymphoid organs and immune responses were assessed in a 12-week study. A peanut meal-based diet (2.8 g methionine/kg) supplemented with 0 g (control), 2 g (LM) or 4 g (HM) DL-methionine/kg, was offered to day-old ISA Brown male chicks for 4 weeks, then all birds were offered a commercial pullet grower feed (2.5 g methionine/kg) for another 8 weeks. The methionine contents of the control, LM and HM diets are equivalent to 100, 171 and 243%, respectively, of the NRC-recommended level. Growth rates, feed intake and feed efficiency were improved ($P<0.05$) by additional methionine during the supplementary period, and the effects on growth rates and feed intake were still significant ($P<0.05$) during Weeks 4–8. At Week 4, thymus weight relative to bodyweight (BW) was higher ($P<0.05$) in birds given HM than in control birds, and bursa weight relative to BW was higher ($P<0.05$) in chickens given LM than in control or HM-fed birds. HM-fed chickens tended ($P=0.06$) to have a higher relative bursa weight than control birds at Week 4, and the difference became significant at Week 8 ($P<0.05$). Neither total serum primary antibody levels against sheep erythrocytes nor cutaneous toe-web responses to phytohaemagglutinin (PHA) were affected by supplementary methionine at any time ($P>0.05$). It is concluded that early-life dietary methionine offered beyond the NRC-recommended level had minimal effects on humoral or cell-mediated immunity, but its

Abbreviations: BW, bodyweight; Ig, immunoglobulin; PHA, phytohaemagglutinin; SRBC, sheep red blood cells

* Corresponding author. Present address: College of Biology and Environmental Science, Jishou University, Jishou, Hunan 416000, PR China. Tel.: +86 743 8564416; fax: +86 743 8565323.

E-mail address: kdeng@jsu.edu.cn (K. Deng).

0377-8401/$ – see front matter
doi:10.1016/j.anifeedsci.2006.05.008

stimulatory effects on growth rates and feed intake, and development of the bursa persisted for a short period into a later stage of the chicken's life.

Keywords: Methionine; Lymphoid organ; Immune responses; Chicken

1. Introduction

Methionine is often the first limiting amino acid for growth of poultry given plant protein as the major protein source. Apart from acting as an essential substrate for protein synthesis, a methyl donor and a precursor of cysteine, methionine is also involved in avian immune functions. For instance, dietary methionine promotes antibody production and cell-mediated immune responses in broiler chickens (Tsiagbe et al., 1987a,b; Swain and Johri, 2000). Methionine is also required for production of a cytokine, interleukin-1, in immunologically challenged chicks (Klasing and Barnes, 1988). A more recent study with broiler chickens from 4 commercial genotypes (Rama Rao et al., 2003) has demonstrated that, although considerable variation exists among different genotypes regarding immunity and the influence of dietary methionine levels, both humoral and cell-mediated immune responses, but not growth rates and feed efficiency, are enhanced by increasing levels of dietary methionine, and the requirement of dietary methionine is considered by the authors above to be higher for immunity than for optimal growth.

All the above-mentioned studies, however, have examined only the immediate impacts of dietary methionine on immunocompetence of chickens. Whether there are any carry-over effects of dietary methionine on the immune system is unknown. In this regard, nutritional status in early-life can impose long-term effects on immune function in mammals (Chandra, 1991) and birds (Dibner et al., 1998; Juul-Madsen et al., 2004). Modulation of avian immunity by early-life nutrition is an attractive strategy for health control because not only are birds at their young ages more vulnerable to diseases but also their maturing immune system is more easily manipulated. However, no research has reported the relationship between early-life methionine and its persistent effects on the immune system of avian species, especially egg-laying strain chickens. This study was therefore designed to examine whether short-term dietary supplementation with methionine after hatching would have any immediate or carry-over effects on growth performance, lymphoid organs and immune responses in egg-laying strain chickens.

2. Materials and methods

2.1. Animals, treatments and management

Unvaccinated 1-day-old male chicks ($n = 180$) of an egg-laying strain ISA-Brown from a local hatchery (Baiada Poultry Ltd., Kootingal, NSW, Australia) were weighed individually and randomly allocated to electrically heated battery brooders with 10 birds each. Cage