EFFECT OF WHITE LUPINE SEEDS INCLUSION ON BROILER CHICKENS PERFORMANCE, DIGESTIBILITY AND VILLI STRUCTURE

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Abstract

480 male broiler chickens were used in a 35-day study to determine the influence of white lupine inclusion (0, 100, 150, 200, 250 and 300 g/kg) on their performance and diet utilization as well as on ileal villi height and crypt depth. One-day-old male Ross 308 chicks were randomly assigned to six dietary treatments (ten replications per treatment). Birds fed diets with 150 g/kg white lupine were characterized by lower BWG, FI and higher FCR than the control birds. The use of 300 g/kg of white lupine decreased BWG by 400 g in comparison with the control (P<0.05). White lupine seeds were found to exert a negative effect on dietary AMEn and ileal crude fat digestibility as well as on crude protein (P<0.05). Ileal digesta viscosity increased together with the increase of white lupine seed content in experimental diets. The inclusion of 150 g/kg of white lupine seeds in experimental diet increased digesta viscosity from 1.76 cP (control treatment) to 2.41 cP (P<0.05). The highest digesta viscosity was determined when 300 g/kg of white lupine seeds was used – 3.74 cP. Villi height and villi surface area decreased as white lupine seeds content increased (P<0.05). The shallowest (P<0.05) crypts were determined in the control birds.

Keywords: broiler, villi, protein, viscosity

Introduction

Soybean meal (SBM) is the most common vegetable protein source in poultry diets but the inclusion of homegrown legume seeds in diets for non-ruminant animals as an alternative to soybean products has been receiving growing attention in countries that are not climatically suited to soybean production (NALLE et al., 2012). Good nutritional value of white lupine for broilers was reported previously by many authors. The AME of white lupine was determined to range from 8.0 to almost 15 MJ/kg. White lupine protein and amino acid (AA) ileal digestibility are similar to those obtained for soybean meal SBM (NALLE et al., 2012). NALLE et al. (2012) reported that average digestibility for white lupine AA ranged from 0.85 to 0.87. RAVINDRAN et al. (2005) showed that white lupine AA digestibility ranged from 0.75 to 0.88.

On the other hand, whole lupin seeds contain substantial concentrations of oligosaccharides, phytate or NSP limiting the use of white lupin in poultry feeding. Phytate in plant feedstuffs can interact electrostatically with dietary (and possibly endogenous) proteins and amino acids which negatively influences protein utilization and increases endogenous protein loss (SELLE et al., 2012). Additional, non-starch polysaccharides may increase viscosity of digesta affecting negatively nutrients absorption and consequently AME.

The aim of the study was to determine the effect of white lupine seeds dose on growth performance, nutrient utilization and villi structure in broiler chickens.

Material and Methods

The experiment was conducted with 480 broiler (Ross 308) chicks (initial individual weight: 40±2 g) divided into six dietary treatments, including a maize –SBM control diet (CON) and five experimental diets containing; 100, 150, 200, 250 and 300g/kg white lupine seeds. Each comprised 10 replications of 8 birds. Apparent total tract digestibility and AMEn value of the diets were calculated relative to the ratio of TiO2 to the content of the nutrient in question in the feed, digesta or excreta. Data were analyzed by ANOVA using GLM procedure of R environment. The cage was the experimental unit and orthogonal contrasts were used to establish the difference between treatments. The contrasts used were the CON treatment versus the remaining 5 dietary treatments (100, 150, 200, 250 or 300 g of lupine seeds per kg of feed) as well as the contrast for linear (L) and quadratic (Q) effects. All data are presented as means.
Results

It was evident that feeding diets containing 200 g/kg WL seeds had a negative effect on the BWG and FCR of birds (0-35d), (BWG: CON – 2100 g/bird, 200 – 1917 g/bird). Similarly, VIVEROS et al. (2007) reported that WL seeds had deleterious effects on the performance of broiler chickens. On the other hand, NALLE et al. (2012) found that broiler diets could contain up to 200g/kg of WL without a negative effect on growth. These discrepancies between above studies may reflect differences in cultivars or feed formulation strategies (NALLE et al., 2012). In our study, the observed decrease in the feed intake after WL addition could be partially explained by probable high insoluble NSP content. JØRGENSEN et al. (1996) reported that digesta retention time and nutrient digestibility are adversely affected by insoluble NSP content. The depression in birds’ performance observed in our study may be attributed to determined increase in ileal viscosity. (Table 1). It is generally accepted that the high viscosity of digesta is associated with soluble NSP content in the diet. Adverse effects of soluble NSP are primarily associated with the viscous nature of these compounds. The modes of action include altered intestinal transit time, and changes in microflora composition and nutrient absorption (CHOCT and ANNISON, 1992).

Table 4. Apparent metabolisable energy of diet, ileal digestibility (CF - crude fat, crude protein and starch), viscosity (Vi) of ileal digesta, excreted NANA, villi height (VH) and area (VA) of broiler chickens fed diets with different doses of WL.

<table>
<thead>
<tr>
<th>WL dose g/kg</th>
<th>AME&lt;sub&gt;N&lt;/sub&gt; [MJ/kg]</th>
<th>Apparent ileal digestibility:</th>
<th>Ileal</th>
<th>Total NANA [µmol/gTiO&lt;sub&gt;2&lt;/sub&gt;]</th>
<th>ileum</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>CF</td>
<td>CP</td>
<td>S</td>
<td>Vi [cP]</td>
</tr>
<tr>
<td>0 [CON]</td>
<td>12.8</td>
<td>0.74</td>
<td>0.74</td>
<td>0.99</td>
<td>1.76</td>
</tr>
<tr>
<td>100</td>
<td>11.5*</td>
<td>0.68</td>
<td>0.74</td>
<td>0.94</td>
<td>2.18'</td>
</tr>
<tr>
<td>150</td>
<td>11.6*</td>
<td>0.68</td>
<td>0.74</td>
<td>0.96</td>
<td>2.41*</td>
</tr>
<tr>
<td>200</td>
<td>11.2*</td>
<td>0.68</td>
<td>0.73</td>
<td>0.96</td>
<td>3.06*</td>
</tr>
<tr>
<td>250</td>
<td>10.9*</td>
<td>0.56*</td>
<td>0.70*</td>
<td>0.90*</td>
<td>3.08*</td>
</tr>
<tr>
<td>300</td>
<td>10.4*</td>
<td>0.56*</td>
<td>0.68*</td>
<td>0.90*</td>
<td>3.74*</td>
</tr>
<tr>
<td>Contrast L</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Q</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>

* - different from control treatment at P<0.05, ' - different from control treatment at P<0.1
L - linear contrast, Q - quadratic contrast, NS – P>0.05

The increase in ileal viscosity following WL addition determined in our study is in agreement with the findings of OŁKOWSKI et al. (2005) who reported that 400g/kg addition of WL to the diet caused an increase in digesta viscosity (from 1.8 to 4.2 cP). The diet utilization in our study was negatively affected by relatively low (100g/kg) WL inclusion. The increase in ileal digesta viscosity and high insoluble NSP content were probably the main factors affecting nutrient AID. NSP content was not determined in this study but the observed increase in ileal digesta viscosity after WL inclusion indicate that soluble and insoluble NSP content was increasing together with the increasing content of WL seeds in experimental diets. Ether extract, crude protein and starch AID (Table 1) were affected only by 250 and 300g/kg WL inclusion. The EE and CP AID could have been depressed by increasing ileal viscosity as well as insoluble NSP content. The use of over 150 g of WL depressed VH and VA (Table 1) with may explain the depression in nutrient utilization and, consequently, AME<sub>N</sub> reduction. Additionally, we observed a quadratic increase in excreted NANA together with WL inclusion. These increase in NANA excretion may have been caused by leved mucin secretion, resulting in higher endogenous losses. The increased mucin production associated with diets containing WL meal may be due to an increase in bacterial numbers in the distal gut linked to an increase in substrate availability. As suggested by COWIESON et al. (2003), diets that increase mucin secretion are nutritionally expensive for birds with may explain the depression in birds’ performance determined in our experiment.
Conclusions
It could be concluded that the inherent variability of seeds may partially explain why birds did respond differently across trials (including this experiment) after similar dose of WL seeds. The NSP present in WL seeds caused high intestinal viscosity affecting nutrient absorption and, probably, endogenous losses.

Literature


