Dietary administration of chestnut extract in chicken broilers

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Some breeders refer that dietary use of chestnut extract could improve broiler chicken performances. However it is commonly accepted that dietary tannins reduce digestibility of crude protein and consequently the growth rate. A chestnut extract (obtained by chestnut wood, Castanea sativa) was fed to broiler chickens (Cobb 508) to test the effects on in vivo performances. The same basal diet was supplemented with 0% (CE 0), 0.15% (CE 15), 0.20% (CE 20) and 0.25% (CE 25) of chestnut extract. All the diets were added with 1% celite (external marker) in order to study the digestibility in vivo by means of acid insoluble ash (AIA). During the trial the digestibility test was performed twice: at the age of 44-46 days and 58-60 days. Each experimental diet was fed to 8 birds individually caged. The animals were fed the experimental diets from the age of 37 days to 61 days, previous one week pre-adaptation. Nor feed conversion ratio neither final body weight were affected by dietary treatments. Crude protein digestibility was affect by age but not by dietary treatment.

Key words: chicken; tannin; chestnut extract; digestibility; nitrogen

Introduction

Some breeders refer that dietary use of chestnut extract could improve broiler chicken performances. However it is commonly accepted that dietary tannins reduce digestibility of crude protein and consequently the growth rate. Tannins are widespread in the plant kingdom, and are often found in woody, lignified tissues. Tannins are chemically classified as condensed tannins (CT) and hydrolysable tannins (HT). Several reports have suggested that the presence of CT at < 6% dry matter of the ruminants diets may result in improved animal performance because less plant protein is lost as ammonia during ruminal digestion. More protein, therefore, passes to the abomasums and small intestine, where dissociation of tannin-protein complexes can occur under acidic conditions (Barry and Manley, 1986). In monogastric farm animals it is commonly accepted that dietary tannins reduce digestibility (in particular of crude protein) and consequently growth performances (Smulikowska et al., 2001; Treviño et al., 1992). In the last years the dietary role of tannins is receiving increasing interest as they act in reducing gastro-intestinal parasites in mammalians (Athanasiadou et al., 2000; Butter et al., 2001; Min et al., 2005) and pheasants (Marzoni et al., 2005) these effects appear of great interest as in the European Community the use of drugs to control coccidiosis is progressively banned.

Materials and methods

32 male broiler chicken, individually caged, were used for the present trial. The birds were provided with ad libitum access to feed (Metabolisable Energy: 2950 kcal/kg; crude protein: 20%) and water. The basal diet was supplemented with 0.03% avilamycin as coccidiostatic in order to avoid interferences for the digestibility of nutrients due to coccidiosis. The same basal diet was supplemented with 0% (CE 0), 0.15% (CE 15), 0.20% (CE 20) and 0.25% (CE 25) of chestnut extract.
(CE). All the diets were added with 1% celite (external marker) in order to study the digestibility in vivo by means of acid insoluble ash (AIA) (Sales and Janssens, 2003). During the trial the digestibility test was performed twice: at the age of 44-46 days and 58-60 days. Each experimental diet was fed to 8 birds individually caged. The animals were fed the experimental diets from the age of 37 days to 61 days, previous one week pre-adaptation.

Diets and excreta were analysed for standard chemical composition (AOAC, 1980) and insoluble ash (Vogtmann et al., 1975). The Apparent digestibility (Ad) of Organic Matter (AdOM), Crude Protein (AdCP) and Ether Extrac (AdEE) was calculated from the following formula:

\[
\text{Apparent digestibility (\%) = 100 -}\left[100 \times \frac{\%\text{AIA}_{\text{diet}}}{\%\text{AIA}_{\text{excreta}}} \times \frac{\%\text{X}_{\text{excreta}}}{\%\text{X}_{\text{diet}}}\right]
\]

where X represents OM, CP or EE in order to evaluate AdOM, AdCP and AdEE respectively.

Data were analysed by analysis of variance using the dietary treatment and the age of birds (for data concerning apparent digestibility) as sources of variation.

Results and discussion

Growth performances were not affected by the dietary treatments (table 1). Average final body weight ranged between 3621.4 g (group CE 25) and 3718.7 (group CE 20) according to the expected performances for broiler chickens. Similarly daily intake and feed conversion ratio were not affected by chestnut extract supplementation with average values ranging between 131.1 g (CE 25) and 139.5 g (CE 15) and 1.4 (CE 20 and CE 25) and 1.5 (CE 0 and CE 15) respectively. These results appear of great interest as it is commonly accepted that dietary tannins reduce digestibility (in particular of crude protein) and consequently growth performances (Smulikowska et al., 2001; Treviño et al., 1992).

These results may be related both to the low amount of chestnut extract supplementation and to the quality of tannins of the used extract. The chestnut extract of the present study is mainly rich in hydrolysable tannins than condensed tannins, the latter displays the higher activity in protein precipitation and denaturation of protein which is believed to be responsible of the reduction of protein digestibility. In ruminants the microbial degradation of condensed tannins is less than hydrolysable tannins (Bhat et al., 1998).

Table 1: growth performances between day 37 and day 61 (mean ± standard deviation)

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<th>CE 0</th>
<th>CE 15</th>
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<tr>
<td>Initial body weight (d37) (g)</td>
<td>1493.7 ± 174.10</td>
<td>1475.0 ± 128.17</td>
<td>1468.7 ± 153.38</td>
<td>1421.5 ± 246.04</td>
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<tr>
<td>Final body weight (d61) (g)</td>
<td>3656.2 ± 284.65</td>
<td>3647.6 ± 327.82</td>
<td>3718.7 ± 125.18</td>
<td>3621.4 ± 333.99</td>
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<tr>
<td>Daily intake (d37-61) (g)</td>
<td>134.1 ± 17.20</td>
<td>139.5 ± 15.27</td>
<td>135.5 ± 10.42</td>
<td>131.1 ± 21.57</td>
</tr>
<tr>
<td>Daily gain (d37-61) (g)</td>
<td>88.8 ± 6.49</td>
<td>91.1 ± 8.39</td>
<td>93.2 ± 5.31</td>
<td>91.1 ± 10.81</td>
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<tr>
<td>Feed conversion ratio (FCR)</td>
<td>1.5 ± 0.15</td>
<td>1.5 ± 0.14</td>
<td>1.4 ± 0.09</td>
<td>1.4 ± 0.13</td>
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Results of growth performances are partially in accordance with those of Karunakaran and Kadirvel (2001) who demonstrated that diets supplemented with 0.05% of a tannin extracted from sweet chestnut wood did not affected growth performances while the rate of 0.10% negatively affected growth performances and feed conversion ratio. In the study of Karunakaran and Kadirvel (2001) the advantage of dietary administration of chestnut tannins was mainly in respect to droppings consistency, which resulted firmer in treated groups. Similarly Marzoni et al. (2005) studied the dietary effects of Quebracho tannins in growing pheasants and the inclusion of 2% in feed did not affected growth performances.

Apparent digestibility of organic matter, crude protein and ether extract was not affected by chestnut extract supplementation (table 2). In the first digestibility trial (between the age of 44 and 46 days) mean values ranged between 82.77% and 84.68% for AdOM; 71.90% and 76.90% for AdCP; 88.14% and 90.78% for AdEE. During the second digestibility trial (between the age of 58 and 60 days) mean values ranged between 77.85% and 80.11% for AdOM; 58.40% and 63.13% for AdCP; 89.82% and 91.03% for AdEE. Apparent digestibility of crude protein was affected by the age
(p<0.05), with lower values measured during the second digestibility trial. This finding could be expected as with increasing age the growth rate is reduced and in tissues the accumulation of lipids take precedence rather than muscle growth, consequently protein absorption is reduced.

Table 2 Apparent digestibility (Ad) of organic matter (AdOM), crude protein (AdCP) and ether extract (AdEE) (mean ± standard deviation)

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<th>CE 0</th>
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<th>CE 20</th>
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<tr>
<td>Digestibility (%) d44-d46</td>
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<tr>
<td>AdOM (%)</td>
<td>82,83 ± 2,49</td>
<td>82,77 ± 2,37</td>
<td>84,68 ± 2,04</td>
<td>82,92 ± 2,88</td>
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<tr>
<td>AdCP (%)</td>
<td>74,65 ± 4,00</td>
<td>71,90 ± 3,19</td>
<td>76,90 ± 4,06</td>
<td>72,08 ± 5,70</td>
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<tr>
<td>AdEE (%)</td>
<td>89,34 ± 2,73</td>
<td>89,75 ± 3,25</td>
<td>90,78 ± 3,08</td>
<td>88,14 ± 2,32</td>
</tr>
<tr>
<td>Digestibility (%) d58-d60</td>
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<tr>
<td>AdOM (%)</td>
<td>77,85 ± 2,83</td>
<td>78,41 ± 5,06</td>
<td>80,11 ± 3,66</td>
<td>78,34 ± 2,47</td>
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<tr>
<td>AdCP (%)</td>
<td>59,46 ± 8,26</td>
<td>63,13 ± 10,21</td>
<td>58,40 ± 12,71</td>
<td>58,82 ± 5,05</td>
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<tr>
<td>AdEE (%)</td>
<td>90,25 ± 1,50</td>
<td>91,03 ± 3,20</td>
<td>90,54 ± 4,51</td>
<td>89,82 ± 2,29</td>
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The role of tannins in poultry nutrition needs to be better investigated. It seems that condensed tannins of sorghum are not absorbed but completely excreted (Jimenez-Ramsey et al., 1994), while it is not well known the fate of hydrolysable tannins. In the last years the dietary role of tannins is receiving increasing interest as they act in reducing gastro-intestinal parasites in mammalians (Athanasiadou et al., 2000; Butter et al., 2001; Min et al., 2005) and in pheasants (Marzoni et al., 2005). In the present study animals’ diets were supplemented with a coccidiostatic drug in order to reduce sources of variation to determine digestibility of nutrients. In the practice, the advantage of chestnut extract supplementation may be due to the contribution in controlling intestinal subclinical infection and coccidiosis. In addition some breeders referred that treated animals resulted cleaner than untreated, probably due to the firmer consistence of droppings which positively affect the litter status.

The present study showed that, in experimental conditions, the dietary administration of a chestnut extract did not affect growth performances and digestibility of nutrients, consequently this ingredient could be safety included in poultry diets to test the effect on intestinal microbial and parasite populations.

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References


