The influence of antinutritive factors from soya bean on n-balance

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Abstract

Raw soybean meal (SBM) or processed SBN, through different thermic, biological and chemical treatments, was included in six broiler chicken groups diet (from 14 days of age to slaughter. A better inactivation of antinutritive factors was obtained by beer yeast fermentation, by seeds germination and by hydrothermic treatment. Urease index (UI) decreased (21-40%) comparative with that one in row SBM, growth rate was higher (4-17.9%) and also feed conversion was better (6.7-19.0%) than that of control group. Protein efficiency ratio was higher in group fed with SBM treated by chemical and biological procedures. There was no direct relationship between UI and pancreas weight.

Keywords: soyabean, N-balance, chickens.

1. Introduction

The nitrogen balance represents the way the nitrogen balance can be established in different living understanding the degree of usefulness of N-balance is establishing the productive effects of fodder is necessary to know the nitrogen turnover in organism.

The nitrogen sources for an organism are food (as organic nitrogen) and inspired air (inorganic nitrogen). Of feed-ingested nitrogen a certain proportion is used by the body for growth, especially for myosin and feathers building up, and the neutralizable portion will be eliminated through faeces, urine and perspiration.

The inorganic nitrogen, from inspired air, is not taking part to the nutritive exchanges of the organism, therefore is not considered when the nitrogen balance is computed. Here it is not found any gaseous substance in the gaseous exchange, which can result from the protein metabolism.

Due to the short experimental time, the amount of nitrogen used for phaners building up and that eliminated through perspiration could be ignored. Therefore, the nutritive balance of the nitrogen roll is established considering exclusively the feed ingested nitrogen and the nitrogen eliminated through feces and urine. According to the method, the short presentation of the N-balance can be determinate with formula:

\[ I_N - Ex_N (urine/feces) = N \text{ kept by organism} \]

Organisms have possibility to establish by there own the so-called “nitrogen balance”, which can be determined by the difference between digested nitrogen and excreted nitrogen. N-balance gives information about the relationship between protein catabolism and anabolism. The dynamic balance between the two antagonistic aspects of the same process (the intermediary metabolism of proteins) is an indicator of the level of protein nutrition and of nitrogen metabolism in the animal organism.
1. Introduction

Generally, the nitrogen is determined for the organism as a whole unit, and could be determined either for the whole organism or for each tissue. In the last case some tissue could have zero or positive balance and others a negative balance. N-exchange depends on several factors. Firstly, it depends on the quality and quantity of digested proteins. The quantity and the ratios (relationships) influence it among glucids (hidrocarbons, lipids, vitamins, minerals, enzymes, hormones and other biological active substances.

The objective of this paper is to present the way in which the presence of anti-nutritive factors in diet influence the N-balance.

2. Materials and methods

The nutritive composition (dry matter, minerals, organic matter, crude protein, crude fiber, crude fat and nitrogen-free extract) was determined both for diet components and diets for broiler chickens. Based on crude composition the diets were prepared according to nutritive requirements.

14-Days old broiler chickens were individuated and weighted and then distributed to 6–15 chickens homogenous groups, in 6 separate batteries. The chickens were weighted weekly.

The culling reasons of chickens were: slaughtering for biochemical and hematological analyses, for morphological and pathological examinations, and accidents.

The components of six diets were: corn, meat meal, blood meal, fish meal, raw soybean meal, treated soybean meal, and mineral and vitamin premix.

The difference among diets was the treatment of soybean meal:
- diet 1 contained raw soybean meal;
- diet 2 contained thermal treated soybean meal (70°C, 30 min.);
- diet 3 contained hydrothermical treated soybean meal (1.2 atm, 30 min.);
- diet 4 contained yeast-fermented soybean meal;
- diet 5 contained natrium bicarbon treated soybean meal;
- diet 6 contained germinated soybean meal

Also has been determined: feed intake, the weight of the main intestinal organs, the length of the long bones.

3. Results and Discussion

Raw chemical analysis showed marked differences compared to literature values regarding the average nutritive value for crude protein, crude fiber and crude fat (tab1).

After the first feeding period (until the age 4 weeks) the average body weight was between 319.33 g and 354.28 in E2 and E6 group, respectively in spite that the initial weight was similar for all groups (182.66 g, Table 7). At the end of experiment (at 8 weeks of age) the highest average body weight (1522.5 g) was in the group fed with yeast-fermented soybean meal (E4).

Feed conversion ratio (g feed/g gain) was the lowest in raw soybean meal food fed group (3.31) and was drastically reduced to the end of experiment. The yeast-fermented soybean meal fed groups (E4) has the highest feed conversion ratio (2.06).

Using the utilization coefficient of the nitrogen (UC) or productive value of the protein (PVP), which was computed for each group (figure 11), expressed the N-balance.
Table 1. Chemical composition of raw materials.

<table>
<thead>
<tr>
<th>Material</th>
<th>DM (%)</th>
<th>CA (%)</th>
<th>OM (%)</th>
<th>CP (%)</th>
<th>CF (%)</th>
<th>CF (%)</th>
<th>NFE (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>89.41</td>
<td>1.22</td>
<td>88.19</td>
<td>9.73</td>
<td>3.84</td>
<td>4.31</td>
<td>70.31</td>
</tr>
<tr>
<td>Meat meal</td>
<td>93.35</td>
<td>6.23</td>
<td>87.12</td>
<td>18.31</td>
<td>7.62</td>
<td>17.03</td>
<td>44.16</td>
</tr>
<tr>
<td>Blood meal</td>
<td>70.92</td>
<td>1.35</td>
<td>69.57</td>
<td>57.06</td>
<td>2.02</td>
<td>2.84</td>
<td>7.65</td>
</tr>
<tr>
<td>Fish meal</td>
<td>91.26</td>
<td>5.71</td>
<td>75.55</td>
<td>57.29</td>
<td>5.42</td>
<td>9.21</td>
<td>3.63</td>
</tr>
<tr>
<td>SBM</td>
<td>91.76</td>
<td>5.02</td>
<td>86.74</td>
<td>31.21</td>
<td>10.33</td>
<td>15.05</td>
<td>30.15</td>
</tr>
<tr>
<td>Germinated soybean</td>
<td>90.38</td>
<td>7.70</td>
<td>82.10</td>
<td>34.98</td>
<td>8.61</td>
<td>19.53</td>
<td>19.48</td>
</tr>
<tr>
<td>Yeast fermented SBM</td>
<td>91.03</td>
<td>5.43</td>
<td>85.60</td>
<td>36.93</td>
<td>8.03</td>
<td>14.98</td>
<td>25.66</td>
</tr>
<tr>
<td>Thermal treated SBM</td>
<td>92.48</td>
<td>5.23</td>
<td>87.25</td>
<td>34.82</td>
<td>6.98</td>
<td>15.35</td>
<td>30.10</td>
</tr>
<tr>
<td>Hydrothermal treated SBM</td>
<td>94.78</td>
<td>5.10</td>
<td>89.68</td>
<td>34.42</td>
<td>6.28</td>
<td>15.85</td>
<td>33.13</td>
</tr>
<tr>
<td>Natrium bicarbonate treated SBM</td>
<td>94.21</td>
<td>6.30</td>
<td>87.90</td>
<td>33.06</td>
<td>7.18</td>
<td>15.12</td>
<td>32.54</td>
</tr>
</tbody>
</table>

It has been observed a slight decrease of the fiber level for hydrothermal and thermal treated soybean.

The raw soybean meal fed group had a UC of 42.27%, higher values were observed in E2 and E4, fed with thermal and yeast-fermented soybean meal, respectively. The group fed with hydrothermal treated soybean meal used the nitrogen the most efficiently.

Table 2 shows the determined and calculated values of the urea’s index, biological value of the protein (expressed as protein efficiency of the diet) and pancreas weight.

Table 2. The influence of Urease Index (U.I.) on biological values of protein and pancreas weight

<table>
<thead>
<tr>
<th>Group</th>
<th>U.I. mg N/g/min 30ºC</th>
<th>P.E.R.</th>
<th>g pancreas/100 g body weight</th>
<th>g pancreas/100 g eviscerated carcass</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>1.50</td>
<td>1.22</td>
<td>0.38</td>
<td>0.53</td>
</tr>
<tr>
<td>E2</td>
<td>1.23</td>
<td>1.05</td>
<td>0.44</td>
<td>0.59</td>
</tr>
<tr>
<td>E3</td>
<td>0.91</td>
<td>1.12</td>
<td>0.44</td>
<td>0.60</td>
</tr>
<tr>
<td>E4</td>
<td>0.91</td>
<td>1.13</td>
<td>0.41</td>
<td>0.54</td>
</tr>
<tr>
<td>E5</td>
<td>1.14</td>
<td>1.24</td>
<td>0.41</td>
<td>0.54</td>
</tr>
<tr>
<td>E6</td>
<td>1.20</td>
<td>1.23</td>
<td>0.48</td>
<td>0.63</td>
</tr>
</tbody>
</table>

*P.E.R. – Protein efficiency ratio

The group fed with hydrothermal treated SBM used the nitrogen efficiently.

Urease Index is not correlated with protein efficiency and pancreas weight. Only in E6 group was observed a pancreas hypertrophy.

The urea’s index, although high, is not correlated with protein efficiency and pancreas weight. Only in E6 group was observed a light pancreas hypertrophy, while in the other groups the pancreas weight was between limits, but toward higher limit.

Hematological examinations shows that at the end of experiment the leukocyte number was above maximum limit in E1 group.

Here was a decreased number of neutrophiles in all groups (especially in E4 and E6), and an increased number of eosinophiles, suggesting the existence of a delayed sensitiveness reaction.

The protein profile emphasize an increase of uric acid and creatinine quantities in all groups (especially in E4, E5 and E6) showing an intensification of protein catabolism.

Morphological and histopathological alterations. Here was an obvious reaction of the pancreas to the raw soybean meal showing congestion and perivascular edema. The interlobular excretory canals were narrower compared with those of other groups, having desquamated (exfoliated) unistratificated epithelium, narrowed lumen, tall and cylindrical epithelial cells.
The coproparasitological examination was negative.
A weak bone mineralisation was noted, especially in E1 (29.40% crude ash), probably due to the antagonism trace inhibitors (mainly calcium).
Copper was dosed in feathers and head, cadmium and copper in bones. The values were within limits, indicating that the health of chickens was not affected.

4. Conclusions

The efficiency of hydrothermical treatment, of physical treatments, and of yeast fermentation, of biological treatments, was demonstrated by feed conversion ratio, protein efficiency, blood parameters and urea's index.
Here it is a positive correlation between the average body weight and feed intake (high values in E4).

The incomplete inactivation of antinutritional factors, quantified by urea's index determines: low utilisation coefficients of nitrogen, low protein efficiency of the diet, and hematological, morphological and histopathological alterations.
The urea's index in not directly correlated with macroscopically hypertrophy of the pancreas.

References