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Original Paper

Effect of heat treatment during pelleting on metabolisable energy values of chicken diet

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Pelleting is the most prevalent heat treatment in the production of poultry feed. Metabolisable energy values of mash and steam pelleted complete maize-type broiler finisher diet was investigated in an experiment with 24 individually followed Ross hybrid male chickens. Altogether four balance periods were compared. Heat treatment significantly (P <0.001) increased classical metabolisable energy and nitrogen-corrected metabolisable energy values by 3.00 % and 2.99 %, respectively.

Keywords: chickens, metabolisable energy, heat treatment of feed

1 Introduction

Steam-conditioning of mash prior to pelleting is a major step in the pelleting process. In three experiments reported by Reddy et al. (1961), apparent metabolisable energy (AME) contents of the pelleted ration were significantly higher than those of the same diet offered in the mash form. McIntosh et al. (1962) observed after pelleting an increase in nitrogen-corrected apparent metabolisable energy (AME_n) by 4.3 % in a diet containing 60 % of maize. In experiment described by Negm (1966), pelleting of feed mixture increased the content of AME by 2.17 % (P <0.05). Auckland and Fulton (1972) mentioned that for crumbles the AME value was about one percent higher than that for mash. In experiment reported by Urdaneta-Rincon et al. (2005) the values of AME_n was higher by 2.2 % (P <0.01) in crumbles than in mash feed. Hussar and Robblee (1962) and Calet and Albessard (ex Calet, 1965) found the same contents of AME_n in mash and pelleted feed. In experiments performed by Bayley et al. (1968a,b) the effect of pelleting on AME_n of complete feed mixtures was not quite explicit. The aim of present experiment was to study the influence of steam pelleting on the AME and AME_n of commercial maize-type feed mixture.

2 Material and methods

The effect of steam pelleting on apparent metabolisable energy values of the feed mixture was studied in four two-day balance periods using 24 Ross hybrid male chickens. At the age of 65 d the chickens were kept in individual balance cages. Chickens were fed a practical-type broiler finisher diet of the following composition (in g kg^{-1}): maize meal (600), wheat meal (110), soyabean meal (220), sunflower meal (20), torula yeast (30), supplementary premix (10), mineral premix (8) and sodium chloride (2). The mixture contained 20.750 MJ gross energy per 1 kg dry matter. In the first part of the experiment, i. e. till the age of 78 days, chickens in even-numbered cages were fed on an unprocessed mash diet while those in odd-numbered cages received pellets made of the same batch of feed mixture. In the second part of the experiment, both diets were changed. Pellets with the diameter of 5 mm were manufactured in a commercial technological line Bühler in which the feed passed through a conditioning chamber where it was subjected to steam, injected at a temperature of 150 °C. Feed remained in the conditioning chamber between three and five seconds and the rate of steam addition was regulated to heat the feed to approximately 90 °C.

Values of apparent metabolisable energy were determined by the total collection method. Excreta were collected daily for each 48 h balance period (Day 75 and 76; 77 and 78; 82 and 83; 84 and 85). This means that each bird received the mash diet in two balance periods and the pelleted diet also in two periods. The combustion heat of feed and freeze-dried excreta was determined by oxygen bomb calorimetry. The values of apparent metabolisable energy were calculated either according to the classical formula (AME) or on the basis of a correction for nitrogen equilibrium (AME_n). In the first case, total energy of excreta is subtracted from gross energy of feed

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Table 1 Apparent metabolisable energy values (MJ kg DM^{-1})

Determined value	Feed mixture		Average difference ± standard error of the difference	t-value
	not pelleted	pelleted		
	$\bar{x}$ ± s. e.	$\bar{x}$ ± s. e.		
AME_n	14.525 ±0.0872	14.961 ±0.083	0.436 ±0.0664	6.49***
AME_n	13.861 ±0.0768	14.276 ±0.0768	0.415 ±0.0664	6.31***

AME_n – apparent metabolisable energy
AME_n – nitrogen-corrected apparent metabolisable energy
n = 24
*** P <0.001

while in the second one a correction factor of 36.55 kJ g^{-1} retained nitrogen was used (Titus et al., 1959).

Average values of metabolisable energy were calculated using data recorded in 24 birds always in two balance periods for the mash diet and two for the pelleted feed. Average values for mash and pelleted diets were compared in individual birds. The paired t-test was used to determine the significance of average difference.

3 Results and discussion

Apparent metabolisable energy of pelleted mixture was highly significantly (P <0.001) higher than that of unpelleted one (Table 1).

We could not corroborate data presented by Hussar and Robblee (1962) and by Calet and Albessard (ex Calet, 1965), who observed that pelleting did not influence AME_n of the feed mixture. Our results agree with data published by Reddy et al. (1961), McIntosh et al. (1962), Negm (1966), Auckland and Fulton (1972) and Urdaneta-Rincon et al. (2005). This means that steam pelleting of commercial feed mixture resulted in an increase of its energy content.

The unpelleted and pelleted feed mixtures (with 88 % DM) used in our experiment contained 12.198 MJ AME_n kg and 12.563 MJ AME_n kg, respectively; this means that the content of AME_n in the pelleted diet was higher by 3 %. This increase, which of course is not the only positive result of pelleting, compensates a great part of costs associated with pelleting.

Nutritional value observed in mash diet cannot be mechanically transferred to pelleted diet. When formulating diets it is also necessary to take into account if they will be fed unpelleted or in the form of pellets. If the pelleted mixture has a higher energetic value, the content of amino acids and other nutrients must be also increased to preserve a correct energy/nutrients ratio.

4 Conclusions

Heat treatment significantly increased classical metabolisable energy and nitrogen-corrected metabolisable energy values. Nutritional value observed in mash diet cannot be mechanically transferred to pelleted diet. When formulating diets it is also necessary to take into account if they are fed unpelleted or in the pellets form. If the pelleted mixture has a higher energetic value, the content of amino acids and other nutrients must be also increased to preserve a correct energy/nutrients ratio.

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