ENERGY UTILIZATION AND NUTRITIVE VALUE OF MAIZE GRAIN CULTIVARS FOR BROILER CHICKENS[1]

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ABSTRACT

The purpose of the study was to determine nutrients digestibility and energy utilization of nine maize cultivars (Opoka, Boruta, Nysa, Smok, Pioneer PR39H64, Monada, Rustika Eurostar, Pionier G12, Arobase) in broiler chickens. Cultivars differed in a content of CP and EE. In vivo digestibility was measured by a standard method on ninety 42 days old broilers. CP digestibility was calculated using the α-amino nitrogen method. Furthermore, digestible energy (DE) and apparent metabolizable energy (AME_N) as well as nitrogen balance and retention were determined. Maize grain nutritive value and energy utilization in broiler chickens depended on the cultivars. The cultivars characterized by higher content of CP and EE had higher digestibility coefficient of these nutrients. The cultivar did not influence nitrogen balance and retention. It is recommended to take into a consideration the maize grain cultivars and their chemical composition when a broiler diet is being composed.

Key words: broiler chickens, cultivars of maize, digestibility, AME_N

ABSTRAKT

Celem doświadczenia było określenie poziomu trawienie składników pokarmowych i energii u kurcząt brojlerów Ross 308 żywionych ziarnem kukurydzy- 9 odmian (Opoka, Boruta, Nysa, Smok, Pioneer PR39H64, Monada, Rustika Eurostar, Pionier G12, Arobase). Badania strawnościowe przeprowadzono metodą klasyczną na 90 kurczętach w 6 tygodniu życia. Ponadto oznaczono zawartość energii strawnej (ES), energii metabolicznej z poprawką na zerowy bilans azotu (EM_N) oraz bilans azotu. Wykorzystanie składników pokarmowych oraz energii ziarna kukurydzy jest zróżnicowane i zależy od zastosowanej odmiany. Im większa była zawartość danego składnika pokarmowego w kukurydzy tym lepiej był on trawiony. Zawartość białka w ziarnie różnych odmian kukurydzy nie wpłynął istotnie ma wartość bilansu i retencji azotu. W żywieniu kurcząt brojlerów należy brać pod uwagę odmianę kukurydzy oraz jej skład chemiczny.

Słowa kluczowe: kurczęta brojlery, odmiany kukurydzy, strawność, EM_N

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SZCZEGÓŁOWY ABSTRAKT

Za najlepsze źródło energii dla kurcząt uznać należy śrutę kukurydzianą [4]. Wykorzystanie przez kurczęta brojlery składników pokarmowych zawartych w kukurydzy jest wysokie, co ma korzystny wpływ nie tylko na końcową masę ciała ale i zużycie paszy na 1 kg przyrostu masy ciała [11]. Białko kukurydzy składa się z aminokwasów słabo przyswajalnych, zeina jest uboga w niezbędne aminokwasy takie jak tryptofan i lizyna [4]. W wielu krajach żywienie kurcząt brojlerów oparte na mieszankach zawierających kukurydzę wzbogacane jest mączką sojową, która uzupełnia zawartość białka w mieszance [11].

Doświadczenie przeprowadzono na 90 kurczętach brojlerach (9 grup po 10 sztuk), które żywiono ad libitum mieszankami z 70 % udziałem różnych odmian kukurydzy: Opoka, Boruta, Nysa, Smok, Pioneer PR39H64, Monada, Rustika Eurostar, Pionier G12, Arobase. Badania strawnościowe przeprowadzono metodą klasyczną w 6 tygodniu życia brojlerów. Kurczęta żywiono tylko kukurydzą jako paszą wyłączną. Strawność białka oznaczono metodą azotu-α-aminowego (N-α-NH_2) [7, 2]. Ponadto oznaczono zawartość energii strawnej (ES) i energii metabolicznej z poprawką na zerowy bilans azotu (EM_N) [3], a także bilans azotu.

Wyniki analizy chemicznej ziarna odmian kukurydzy wykazały różnice w składzie chemicznym: białka ogólnego (9,04-13,66% /kg SM), tłuszczu surowego (1,94-5,02%/ kg SM), skrobi (66,48- 76,62 % / kg SM), włókna surowego oraz aminokwasów i frakcji włókna detergentowego. Poziom trawienia białka, tłuszczu, skrobi oraz pozostałych składników różnił się ($P<0,05$) zależnie od odmiany, przy czym największe zróżnicowanie odnotowano w strawności treoniny, tyrozyny oraz związków bezazotowych wyciągowych i w wykorzystaniu energii. Nie stwierdzono natomiast istotnych różnic ($P>0,05$) dla bilansu azotu.

Stwierdzono, że poziom wykorzystania składników pokarmowych oraz energii ziarna kukurydzy zależy od zastosowanej odmiany. Im większa była zawartość składnika pokarmowego w kukurydzy tym lepiej był on trawiony. Natomiast wykorzystanie energii zależało od zawartości włókna pokarmowego w poszczególnych odmianach kukurydzy. Stosując ziarno kukurydzy w żywieniu kurcząt należy zwracać uwagę na wartość pokarmową danej odmiany kukurydzy [4, 6].

INTRODUCTION

Maize is a main source of energy for broiler chicken because it contains considerable amounts of digestible nutrients [4]. Nutrients utilization of maize grain by broilers is high and it influences final body weight as well as feed conversion ratio [11]. Maize grain, compared with other cereals, gives the best yields of broiler chickens [8]. The chemical composition and nutritive value of various maize cultivars are variable. This is necessary to analyzed chemical composition before feeding [4, 6]. The aim of the study was to determine nutrient and energy utilization of different maize cultivars in broiler chickens.

MATERIALS AND METHODS

The experiment was carried out on ninety broiler chickens line Ross 308 at the age of 14-49 days. Broilers were divided into 9 groups of 10 birds each and were fed ad libitum a diet based on different maize cultivars: Opoka, Boruta, Nysa, Smok, Pioneer PR39H64, Monada, Rustika Eurostar, Pionier G12, Arobase. In vivo digestibility was measured by a standard method on 42 days old birds which were fed maize grain supplemented with premix only. Crude protein (CP) digestibility was calculated using the α-amino nitrogen method (N-α-NH_2) [7, 2]. During digestibility trial nitrogen balance (BN) and digestible energy (DE) were measured and apparent metabolizable energy corrected to zero nitrogen balance (AME_N) were calculated using following equations [3]:

$DE = GE – Efu + Eu$ [kcal/kg]; $Eu = (Nfu – Nf) \cdot 8.73$ [kcal/kg]

- where: GE- gross energy [kcal], Efu- energy of feaces and urine [kcal], Eu- energy of urine [kcal], Nfu- nitrogen in feaces and urine [g], Nf- nitrogen in feaces [g];

$AME = GE – Efu$ [kcal/kg]

- where: AME- apparent metabolizable energy;

$AME_N = AME – (BN \cdot 8.73)$ [kcal/kg]

- where: BN- nitrogen balance [g].

The chemical composition of the diets and feaces was determined according to standard method [1]. Furthermore, starch, water soluble carbohydrates, amino acids, detergent fibre- NDF, ADF and ADL as well as dietary fibre- IDF (insoluble dietary fibre) and SDF (soluble dietary fibre) were determined [1].

Data were evaluated statistically by the oneway analysis of variance using Statistica 7.1. Differences between treatment means were tested using Tukey's test [10].

RESULTS

The chemical composition of maize cultivars is given in Table 1 The contents of basic nutrients, as well as starch, water soluble carbohydrates and detergent fibre fractions were different among cultivars. Differences in CP content were about 4,62 percentage units (9,04% vs. 13,66% DM), ether extract 3%, (1,94 % vs. 5,02 %

DM), N- free extractives (NFE) 7,41% (78,32% vs 85,73 DM) and starch 10,4 % (66,48% vs. 76,62% DM). In comparison with other cultivars, the contents of NFE and starch in Opoka cultivar were the lowest whereas the contents of crude fibre (2,6% DM), ADF (6,54% DM) and NDF (15,91% DM) were the highest. There were no differences among cultivars in AA content however a cultivar Boruta was characterized by the highest content of AA in comparison with other cultivars. Digestibility of nutrients depended on cultivar ($P<0,05$). The highest digestibility coefficients of organic matter (87,96%), CP (82,03%) and EE (80,44%) were observed for a cultivar Pioneer G12. The lowest CP digestibility (73,18%) was found for a cultivar Opoka. The cultivars Pioneer PR39H64 and Moncada were characterized by the lowest EE content and digestibility (41,41 and 40,89%, respectively) in comparison with other cultivars. NFE and starch digestibility by broilers was high and similar for all cultivars. Apparent digestibility of AA was different ($P<0,05$) between cultivars and depended on their content in grain. The higher content of AA caused increasing of AA digestibility. Gross energy content in all cultivars was in a range 3866-3982 kcal/kg however utilization of energy by broiler chickens was different among cultivars ($P<0,05$). In comparison with other cultivars the highest energy digestibility (88,04%) and metabolic coefficient ($q= 87,96$) were found for Pioneer G12 cultivar. Nitrogen balance and retention were similar among treatments .

DISCUSSION

Maize grain cultivars differed in chemical composition, especially there were differences in CP, EE and starch contents. [6] obtained similar results and they suggested that before diet formulation for broiler chicken the chemical composition of maize grain should be determined. The results of present study also shows that nutrient and energy digestibility of maize grain depend on its chemical composition. The higher content of a nutrient means higher digestibility. According to [4] chemical composition and concomitant nutritional value of maize are variable and depend on the variety, growing condition, drying temperature, nutrient structure and the presence of various anti-nutritional factors. High contents of detergent fibre (NDF or ADF) and dietary fibre (TDF) decrease the utilization of nutrients and energy. Present study shows that the highest utilization of CP, EE and energy is caused by the lowest content of dietary fibre in cultivar According to [11], [5], [4] the nutritive value of maize grain may be improved by an addition of specific exogenous enzymes. [8] claimed that CP and energy utilization depended on pentosans and β- glucan contents in the grain. According to [9] high content of dietary fibre caused a reduction in nutrients and energy utilization by growing turkeys (1-4 weeks old), whereas there were no differences in digestibility and energy utilization in older turkeys (6-14 weeks old). In conlusions, it is recommended in diet formulation for broiler chicken to take into the consideration the maize grain cultivar, particularly its chemical composition and AME_N content.

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