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COMPARISON OF NUTRIENT DIGESTIBILITY AND ENERGY UTILIZATION OF WHEAT, BARLEY AND HULL-LESS BARLEY IN BROILER CHICKEN FEEDING

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Introduction

Wheat and barley are just inexpensive source of energy for poultry, however use of barley should be limited because of high content of non-starch polysaccharides (NSP) and β− glucans (Saki, 2005). In poultry nutrition it is necessary to take into consideration crude protein and energy contents but especially crude fibre content when replacing in diet of wheat by mixtures with barley (Hetland and Svihus, 2001). Furthermore nutrient utilization depended on dietary and detergent fibre and also the amount and type of antinutritional factors contained in cell wall of cereals (Virkki et al., 2005). Non-starch polysaccharides are responsible for increasing intestinal content viscosity, inhibition of enzymes diffusion and nutrient absorption decreasing (Yin i in. 2001). Negative correlation between energy value of mixtures with high content of fibre and obtained performance was found (Hetland et al., 2002). Therefore, it is important to detremine metabolizable energy and nutrient digestibility of feedstuffs (Hetland et al., 2003). Increasing the crude fibre content in diet to about 1% above recommended level caused decrease of energy utilization coefficient by about 4% (Barteczko, 1988).

The aim of the study was to comparison the nutrient digestibility and energy utilization of wheat, barley and hull-less barley in broiler chickens.

Materials and methods

The experiment was carried out on fifteen broiler chickens line Ross 308 at the age of 14-42 days. Broilers were divided into 3 groups of 5 birds each and were fed *ad libitum* a diet with 70% of wheat grain (Vinjett cultivar) in 1st group, 35% of wheat + 35% hull-less barley (Rastik cultivar) in 2nd group and 35% of wheat + 35% barley (Stratus cultivar) in 3rd group. Diets were supplemented with soybean meal, fish meal and vitamin-mineral premix.

In vivo digestibility was measured by a standard method (combined) on 42 days old birds. Crude protein (CP) digestibility was calculated using the α-amino nitrogen method (N-α-NH_2) (Pahle et al., 1985 modified by Barteczko et al., 1993). During digestibility trial nitrogen retention (RN) and apparent metabolizable energy corrected to zero nitrogen balance (AME_N) were measured

The chemical composition of the diets and feaces was determined according to standard method (AOAC, 2000). Furthermore, starch (Faisant et al., 1995), detergent fibre- NDF, ADF and ADL (Goering and Van Soest, 1970) as well as dietary fibre- IDF (insoluble dietary fibre) and SDF (soluble dietary fibre) (Englyst and Cumming, 1988) were determined.

Data were evaluated statistically by the one way analysis of variance using SAS (1996). Differences between treatment means were tested using Duncan's test.

Results

The chemical composition of grain is given in Table 1. The content of basic nutrients, as well as starch, dietary and detergent fibre fractions were different among cereals. The highest

content of crude protein was found in hull-less barley (166 g/kg DM) but the lowest in normal barley (142 g/kg DM). Differences in crude fibre content were about 3,5 percentage unite between barley cultivars. Content of SDF in hull-less barley was a little higher than normal barley, whereas the content of IDF was by half lower. In comparison with barley cultivars the content of SDF in wheat grain was about 5 percentage units lower and also ADF and NDF was lower too.

Table 1

Chemical composition of grains (%)

Items	Wheat	Hull-less barley	Barley
Dry matter	88,7	88,3	88,2
Crude protein	12,0	14,7	12,5
Crude fat	2,1	1,9	1,2
Nitrogen free extract	79,5	77,3	77,9
Starch	60,0	54,3	48,6
Crude fibre	2,6	1,4	4,4
IDF	10,9	8,0	16,6
SDF	1,9	6,1	5,4
ADF	4,3	6,0	6,2
ADL	0,7	0,4	0,8
NDF	12,0	17,2	25,0

Digestibility coefficient of nitrogen free extract of hull-less barley was significantly lower than wheat grain whereas crude protein, crude fat and fibre were digested similar (P>0,05) (Table 2).

Table 2

Nutrient digestibility of grains(%)

Items	Wheat	Hull-less barley	Barley
Organic matter	69,7 [c]	66,0 [b]	62,8 [a]
Crude protein	78,6 [b]	74,9 [b]	70,3 [a]
Crude fat	58,9 [b]	54,7 [ab]	52,8 [a]
Crude fibre	14,7 [ab]	16,8 [b]	12,6 [a]
Nitrogen free extract	77,9 [c]	68,9 [b]	62,7 [a]

Note: Means marked with different letters differ (a, b, c) significantly (P<0,05).

At the same time digestibility coefficient of nutrients both wheat and hull-less barley were significantly higher in comparison with normal barley. The reduction content of crude fibre and total dietary fibre in diet with hull-less barley increased level of energy utilization about 8% in comparison with normal barley (P<0,05). The highest digestibility coefficient of crude fibre was found in diet with hull-less barley. Nitrogen retention was significantly higher (P<0,05) in broilers fed wheat-diet in comparison with normal barley diet.

Discussion

Hull-less barley had lower crude fibre content and higher crude protein content in comparison with normal barley, so according to Bekta and Fabiańska (2004) hull-less barley could be commonly used in mixture for broiler chickens. The present study confirmed that hull-less barley obtained higher nutrient digestibility and energy utilization in comparison with normal barley, furthermore this results were closed to received in broiler chickens fed wheat-diet. However hull-less barley comprise a lot of β- glucans which should decrease nutrient and energy utilization (Virkki et al., 2005). According to Campbell (1986) and Saki (2005) nutrient digestion is more correlated with content of selected fractions of cell walls like NSP, β− glucans than crude fibre content. According to Virkki et al. (2005) the large part of NSP in barley is insoluble fraction (IDF) and present study confirmed that the highest IDF content in normal barley significantly reduced nutrient digestibility and energy utilization (Table 3).

Table 3

Energy utilization and nitrogen retention of grains by broiler chickens

Items	Wheat	Hull-less barley	Barley
Gross energy — kcal/kg — MJ/kg	 4039 16,9	 3979 16,6	 4183 17,5
AME_N — kcal/kg — MJ/kg	 3105 13,0	 3008 12,6	 2832 11,8
$q = EM_N/EB$ (%)	76,9 [a]	75,6 [a]	67,7 [b]
RN (%)	48,8 [a]	46,7 [ab]	43,4 [b]

Note: Means marked with different letters differ (a, b, c) significantly (P<0,05).

In conclusion, hull-less barley cultivars had higher nutritional and energy value (AME_N) in comparison to normal barley cultivars. Nutrient digestibility and energy utilization of hull-less barley is similar to wheat grain in broiler chickens and in consequence should be used in broiler chickens diets. Normal barley should be limited because of higher content of crude fibre and dietary fibre which reduced nutrient and energy utilization.

S u m m a r y

The aim of the study was to comparison the nutrient digestibility and energy utilization of wheat, barley and hull-less barley in broiler chickens.

The experiment was carried out on fifteen broiler chickens line Ross 308 at the age of 14-42 days. Broilers were divided into 3 groups of 5 birds each and were fed ad libitum a diet with 70 % of wheat grain (Vinjett cultivar) in 1st group, 35% of wheat + 35% hull-less barley (Rastik cultivar) in 2nd group and 35% of wheat + 35% barley (Stratus cultivar) in 3rd group. Diets were supplemented with soybean meal, fish meal and premix. *In vivo* digestibility was measured by a standard method (combined) on 42 days old birds. The chemical composition of the diets and feaces was determined according to standard method (AOAC, 1995).

The content of basic nutrients, as well as starch, dietary and detergent fibre fractions were different among cereals. Digestibility coefficient of nutrient of hull-less barley and wheat grain were similar (P>0,05). At the same time digestibility coefficient of nutrients both wheat and hull-less barley were significantly higher in comparison with normal barley. In conclusion, hull-less barley cultivars had higher nutritional and energy value (AME_N) in comparison to normal barley cultivars. Nutrient digestibility and energy utilization of hull-less barley is similar to wheat grain in broiler chickens and in consequence should be used in broiler chickens diets. Normal barley should be limited, because of higher content of crude fibre and dietary fibre which reduced nutrient and energy utilization.

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ПОРІВНЯННЯ ПЕРЕТРАВНОСТІ ПОЖИВНИХ РЕЧОВИН ТА УТИЛІЗАЦІЇ ЕНЕРГІЇ З ПШЕНИЦІ, ЯЧМЕНЮ, ТА ОЧИЩЕНОГО ЯЧМЕНЮ У ГОДІВЛІ КУРЧАТ-БРОЙЛЕРІВ

Р е з ю м е

Метою дослідження було порівняти перетравність поживних речовин та утилізації енергії з пшениці, ячменю, та очищеного ячменю у годівлі курчат-бройлерів. Експеримент проводився на 15 курчатах породи Росс 38 віком 14–42 дні. Бройлерів поділили на 3 групи по 5 птахів у кожній і годували ad libitum, раціон включав 70 % зерна пшениці (вид Вінєтт) у 1-й групі, 35 % зерна+35 % очищеного ячменю (вид Растік) у другій групі та 35 % зерна і 35 % ячменю (вид Стратус) у третій групі. До раціону додавались соя, риба та премікс. Перетравність *in vivo* визначалась стандартним методом (комбінований) на птахах віком 42 дні. Хімічний склад раціону визначався стандартним методом (AOAC, 1995).

Вміст базових поживних речовин і крохмалю, частки волокна-детергенту в раціоні відрізняються серед хлібних злаків. Коефіцієнт перетравності поживних речовин очищеного ячменю та зерна пшениці були схожі (P>0,05). В той самий час коефіцієнт перетравності поживних речовин як пшениці так і очищеного ячменю були значною мірою вищі порівняно із звичайним ячменем. Як наслідок, культури очищеного ячменю мали вищу енергетичну цінність порівняно із звичайним ячменем. Поживна цінність та утилізація енергії очищеного ячменю майже така ж як у зерна пшениці у курчат-бройлерів і як наслідок має використовуватися у раціоні курчат-бройлерів. Слід обмежити застосування звичайного ячменю, тому що в ньому є вищий вміст загального волокна та волокна, яке зменшує поживність та утилізацію енергії.

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СРАВНЕНИЕ ПЕРЕВАРИВАЕМОСТИ ПИТАТЕЛЬНЫХ ВЕЩЕСТВ И УТИЛИЗАЦИИ ЭНЕРГИИ С ПШЕНИЦЫ, ЯЧМЕНЯ И ОЧИЩЕННОГО ЯЧМЕНЯ В КОРМЛЕНИИ ЦЫПЛЯТ-БРОЙЛЕРОВ

А н н о т а ц и я

Целью исследования было сравнить перевариваемость питательных веществ и утилизации энергии с пшеницы, ячменя и очищенного ячменя в кормлении цыплят-бройлеров. Эксперимент проводился на 15 цыплятах породы Росс 38 в возрасте 14–42 дня. Бройлеров поделили на 3 группы по 5 птиц в каждой и кормили ad libitum, рацион включал 70 % зерна пшеницы (вид Виннет) в первой группе, 35 % очищенного ячменя (вид Растик) во второй группе и 35 % зерна и 35 % ячменя (вид Стратус) в третьей группе. К рациону добавлялись соя, рыба и премикс. Перевариваемость in vivo определялась стандартным методом (комбинированый) на птицах возрастом 42 дня. Химический состав рациона определялся стандартным методом (AOAC, 1995).

Состав базовых питательных веществ и крохмаля, частицы волокна-детергента в рационе отличаются среди хлебных злаков. Коэффициент перевариваемости питательных веществ очищенного ячменя и зерна пшеницы были похожими (P>0,05). В то же время коэффициент перевариваемости питательных веществ как пшеницы так и очищенного ячменя были намного выше в сравнении с обычным ячменем. Как следствие, культуры очищенного ячменя имели высшую энергетическую ценность в сравнении с обычным ячменем. Питательная ценность и утилизация энергии очищенного ячменя почти такая же как у зерна пшеницы у цыплыт-бройлеров и как следствие должно использоватся в рационе цыплят-бройлеров. Следует ограничить применение обычного ячменя, потому что у него высший состав общего волокна и волокна, которое уменьшает питательность и утилизацию эненргии.

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