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## Influence of Broiler Breeder and Laying Hen Breed on the Apparent Metabolizable Energy of Selected Feed Ingredients

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**Abstract:** An experiment was conducted to investigate the effect of genotype (meat-type or egg-type) on the AME digestibility of selected ingredients. The practice of using only one value for apparent metabolizable energy (AME) of feed ingredients for all classes of poultry has been questioned. The ability to convert nutrients to the final products depends on a variety of factors, such as age, sex, genetic and housing system. Some studies have indicated that broiler breeders are less able to metabolize diet energy, than are Leghorn birds. In this study, the ingredients included samples of cereals (corn, wheat and barley), one sample of plant protein (soybean meal) and one cereal by-product (wheat bran). Forty adult males (20 per breed) were randomly assigned to five feedstuffs. Each feedstuff was fed to four birds per breed. The AMEn values were determined using a classical total collection method (Sibbald method). The AME of each feed ingredient was calculated from the difference between GE intake and GE losses in the droppings. The AME values were corrected to zero nitrogen balance (AMEn). The results were showed the average AMEn digestibility in wheat (egg-type : 2785, Kcals/Kg ; meat-type : 2750 Kcals/Kg) and barley (egg-type : 2715 Kcals/Kg; meat-type : 2675 Kcals/Kg) samples were similar in two breeds. The AMEn digestibility in White Leghorn birds was significantly greater for corn (egg-type : 3065 kcals/Kg ; meat-type : 2842 kcals/Kg) , soybean (egg-type : 2185 Kcals/Kg ; meat-type : 2040 Kcals/Kg) and wheat bran (egg-type : 1440 Kcals/Kg ; meat-type : 1333 Kcals/Kg) compared to the broiler strain. In this study, considerable differences were also noted between the two breeds that were tested in their ability to utilize the AME of feed ingredients. In mature broiler breeder hens excess ME intake can cause fat deposition; consequently, accurate representation of the energy content of a breeder diet is important. On the other hand, deficiencies of energy around the time of peak egg production will likely reduce egg production at this time, or production will fall after peak by definition. Since tables concerning ingredient composition usually contain ME values determined with White Leghorn, further research is needed if energy content of broiler breeder diets is accurately represented.

**Key words:** AME, digestibility, meat-type chicken, egg-type chicken

### Introduction

The practice of using single value for apparent metabolizable energy (AME) of feed ingredients for all classes of poultry is open to criticism. The calculated AME content may be regarded as a potential energy value of feeds, which depending on the bird's ability to utilize nutrients will result in different amount of energy retained in final products. The ability to convert nutrients to the final products depends on a variety of external and internal factors, such as age, sex, genetic background and housing system. For several decades geneticists have selected animals for maximum body size and growth rate, however they have paid little attention to physiological changes which underlie or are correlated with observed genetic advances. Some researchers have reported differences in energy utilization between different strains of chicks (Proudman *et al.*, 1970; March and Biely, 1971). Sibbald and Slinger (1963) found that White Leghorn chicks derived more ME from feed than did White Rock chicks when either high or low energy diets. Sibbald (1976) found no strain differences by

using roosters, laying hens, turkey hens and broiler breeder hens in true metabolizable assay either of wheat bran or of a complete diet. Genotype and sex influence the metabolizable energy and digestibility of feedstuff that may be attributable to variations in the endogenous energy losses relative to the excreta energy of feed origin (Sorensen and Chawalibog, 1983; Jorgensen and Sorensen, 1990). Similar results regarding the difference in metabolizable energy and nitrogen digestibility related to genotype to have been described by Leenstra and Pit (1987). The importance of bird type in bioavailable energy assay was investigated by Spratt and Leeson (1987). They reported that broiler breeder hens were less efficient in deriving ME from feed than Single Comb White Leghorn (SCWL) hens, irrespective of the protein and energy content of the diet. Cornish (meat line) female and male gave higher AME values for high energy low protein diet and low energy high protein diet than Rhode Island Red (layer line) female and male (Yaghobfar *et al.*, 2000).

In mature broiler breeder hens excess ME intake can

cause fat deposition. Consequently, accurate representation of the energy content of a breeder diet is important (Spratt and Leeson, 1987). On the other hand, the most limiting nutrient for production is likely energy. As in Leghorn pullet, the broiler breeder pullet is in somewhat delicate balance regarding energy input and energy expenditure. The problem of energy availability may well be confounded by the nutrition's overestimation of that portion of diet energy available to the broiler breeder. Most energy levels of diets and ingredients, when assayed, are derived using Leghorn type birds. Research conducted at the University of Guelph found that ad libitum feed intake of broiler breeders are less able to metabolize diet energy, than are Leghorn birds. Regardless of diet specifications, it would appear that broiler breeder metabolize about 2.5% less energy from feeds than do Leghorns. This amount may be in the range of to some 70 Kcal/Kg for most breeder diets (Leeson and Summers, 2000). Also, Spratt and Leeson (1987) reported that ad libitum versus restricted feeding of broiler breeder had no effect on hens ability to metabolize energy diet. Deficiencies of energy around the time of peak egg production will likely reduce egg production at this time.

Because there are few published reports, on AME values derived directly with broiler breeders, this study was conducted to compare two strains in their ability to metabolizable energy from various feedstuffs.

### Materials and Methods

Twenty broiler breeder (Cobb) and twenty Single Comb White Leghorn (Hy Line) males housed in individual cages. They had the same age (30 weeks). Broiler breeder males have been selected a commercial farm and Single Comb White Leghorn males have been selected of Isfahan University of Technology farm. Males both breeds reared according to their management guide. Body weight of meat-type males was 3800-4000 grams and 1600-1800 grams was for Single Comb White Leghorn males. Cages had wire floors and aluminum trays were placed on the floor. Water was supplied ad libitum and artificial lighting of the room was continuous (24 h). The environmental temperature was approximately 22°C. A series of feedstuffs were assayed for AMEn by a classical total collection method of Sibbald (1976). The feedstuffs included samples of cereals (corn, wheat and barley), one sample of plant protein (soybean meal) and one sample cereal by-product (wheat bran). Samples were finely ground prior to feeding. All of the birds were fasted for a 36 h period. After this period, four birds of each strain were force fed with 30 g of one of the five feedstuffs. 36 h after feeding, excreta collected from clean trays. After this, excreta free of feather and scale were dried in a forced air oven at 70°C for 3d, prior to grinding samples to a fine powder. Excreta samples were equilibrated with atmospheric

condition for 24 h, and then finely ground and weighed prior to laboratory analysis. Protein was measured (Kejeldahl nitrogen x 6.25) (Association of Official Analytical Chemists, AOAC, 1990) (Table 1). Feed and excreta samples were analyzed for gross energy using a adiabatic oxygen bomb calorimeter (Gallenkamp Autobomb, 1992). The AME values were calculated by subtracting GE intake from GE excreta and then dividing this values by GE intake. The AME values were corrected to zero nitrogen balance by Sibbald and Slinger equation (AMEn = 0.009 + 0.948 AME, 1963). A completely randomized experimental design was used, with two treatments (breed). Each treatment was included five feedstuffs, with four replicates per feedstuffs, with total of 20 birds for each breed. Data were analyzed using the general linear model (GLM) procedures of SAS (SAS Institute, 1995). When significant differences were obtained, means were separated by Duncan multiple range test. Statistical significant was assessed at P<0.05.

### Results

The mean AMEn values of the five feedstuffs, as measured in two breeds of chickens, are presented in Table 2. The AMEn values show marked differences between feedstuffs, as expected. In this study, broiler breeder males metabolized less energy of corn, soybean meal and wheat bran that did Single Comb White Leghorn birds (Table 2). SCWL males derived about 7.2, 6.6 and 7.4% more ME from corn, soybean meal and wheat bran, respectively, than broiler breeder males. The results were showed the average AMEn digestibility in wheat (egg-type: 2785, Kcals/Kg; meat-type: 2750 Kcals/Kg) and barley (egg-type: 2715 Kcals/Kg; meat-type: 2675 Kcals/Kg) samples were similar in the two breeds. Within each grain (wheat and barley) the differences associated with the assay birds were considered to be too small to be of practical significance. Broiler breeder males were less efficient in deriving ME from feed than SCWL, of the corn, soybean meal and wheat bran. Generally SCWL hens derived more ME from each feed than broiler breeder strain.

### Discussion

The results of this study indicate that the differences found between the two genotypes were in agreement with the results of Sorensen and Chawalibog (1983), Spratt and Leeson (1987), Jorgensen and Sorensen (1990) and Tendoeschate *et al.* (1993), who reported that genotype influences digestive efficiency. Sibbald and Slinger (1963) found that White Leghorn chicks metabolized more dietary energy than did White Rock chicks while Boldaji *et al.* (1981) found grains to contain less total ME when tested in adult dwarf rather than when normal SCWL roosters were used in the assay. Similar results regarding the difference in metabolizable

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Table 1: Crude protein of feedstuffs base on as fed

Ingredient	(%)Protein
Corn	7.5
Wheat	11.0
Barley	12.0
Soybean meal	42.0
Wheat bran	14.0

Table 2: Effect of strain on metabolizable energy (AMEn) of various feedstuffs

Ingredients	Leghorn	Broiler breeder
Corn	3065 <sup>a</sup> ± 27	2842 <sup>b</sup> ± 51
Barley	2715 <sup>a</sup> ± 100	2672 <sup>a</sup> ± 89
Wheat	2785 <sup>a</sup> ± 30	2750 <sup>a</sup> ± 32
Soybean meal	2185 <sup>a</sup> ± 27	2040 <sup>b</sup> ± 21
Wheat bran	1440 <sup>a</sup> ± 23	1333 <sup>b</sup> ± 25

a,b means within a row with different superscripts are significantly different (P<0.05).

energy and nitrogen digestibility related to genotype to have been described by Leenstra and Pit (1987). Tendoeschate *et al.* (1993) reported that a strain of broilers selected for feed conversion showed a significantly higher DM, N and metabolizability of energy than commercial birds and broilers selected for growth rate. They explained that better digestibility shown by the FC line was paralleled by lower relative food intake. This lower food intake might lead to lower passage rate and consequently improved digestion. But in this study, all of birds used as much as each feedstuff. Therefore, effect of this factor on digestibility eliminate completely. The AMEn of the soybean meal and wheat bran was significantly different with two genotypes (Hy Line and Cobb). These findings are in agreement with those of Spratt and Leeson (1987), suggesting that broiler breeder metabolized less energy of high protein diet than SCWL birds.

The ME values of corn, soybean meal and canola meal were, respectively, 4.0, 6.2 and 7.2% greater for Leghorn chicks than broiler chicks (Shires *et al.*, 1987). The studies indicate that Leghorn chicks derive 1 to 7% more AME from feedstuff than broiler chicks, which may be related to differences in form and function of gastrointestinal tract. Kaminiska (1979) found that the weight of gizzard and length of the intestine relative to body weight were greater in Leghorn chicks than in broiler chicks. A larger, more muscular gizzard and a longer intestine may increase the grinding and absorptive capacities of the gut.

From the nutritional viewpoint, feed passage rate is a factor that influences the efficiency of digestion and absorption of nutrients of a diet. Transit time may vary with dietary composition and type and body weight of the chicken. Mean retention time of digesta decrease with body weight in the gizzard. Broilers retained the digesta for shorter periods in the crop and gizzard than the

Leghorn with same feed intake (Shires *et al.*, 1987). A slower passage rate allows more time for microbial fermentation of dietary in the crop in Leghorn birds, which account for the increase in the ME values of feedstuffs.

On the other hand, Sibbald (1976) and Buyse *et al.* (1999) suggested that some of variation in AME values associated with species and strain may be attributable to differences in metabolic fecal and endogenous urinary energy losses. In this study, AME values of corn, soybean meal and wheat bran were remarkably greater for Leghorn compared to broiler breeder birds. But the average of AME digestibility in wheat and barley in two genotypes were similar (exactly same as AMEn values). In our research, all of birds used the same amount of feedstuffs, therefore, there was no effect of passage rate on digestibility of ingredients. On the other hand, AME values all of feedstuffs same as AMEn values. Hence, there is no difference in energy expenditure for nitrogen retention between these two genotypes.

It can be concluded that the manner in which genotype influences digestibility is still not entirely clear. We postulate that the selection of broiler breeders for rapid growth and efficient utilization of highly digestible diets has involved adaptation in form and function of gastrointestinal tract that make it less efficient for the utilization of diets. The oscillation of digesta between the gizzard and duodenum may increase the efficiency of digestion by exposing the digesta longer to digestive enzymes and bile. It is possible that reverse peristalsis occurs more frequently in Leghorns than in broiler breeders. Shires *et al.* (1987) found that mean retention time was 17.2 minutes longer in crop and 33.5 minutes longer in the gizzard of Leghorns than broilers. Retention of digesta in the crop and gizzard may increase the digestibility of nutrients.

These results suggest that broiler breeder hens derive less metabolizable energy from feedstuffs than do SCWL birds. The key nutrient for production is most likely energy. Because as with Leghorn pullet, the broiler breeder is in somewhat delicate balance regarding energy input and energy expenditure. The problem of energy availability may well be confounded by the nutrition's overestimation of that portion of diet energy available to the broiler breeder. Most energy levels of diets and ingredients, when assayed, are derived using leghorn type bird. Deficiencies of energy around the time of peak egg production will likely reduce egg production at this time, or as often happens in commercial situations, production will decline some 2-3 weeks after peak. Since tables concerning ingredient composition usually contain ME values determined with White Leghorn, further research is needed if energy content of broiler breeder ingredients is to be accurately represented.

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