THE RELATIONSHIP OF PER AND AME MEASUREMENTS WITH THE GROWTH PERFORMANCE OF BROILERS FED THREE DEHULLED SOYBEAN MEALS OF DIFFERENT ORIGINS

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Summary

Protein efficiency ratio (PER) and apparent metabolizable energy (AME) maybe good indicators to differentiate between the performance of different soybean meals (SBM). Broiler feeding trials were conducted to determine the PER, AME and growth performances of three different dehulled SBMs. The results show significant differences in PER and AME between the three different SBMs. Correlations between PER, AME and growth performances were observed, suggesting that AME and maybe PER measurements can be used to differentiate between the broiler growth performances of different SBMs.

I. INTRODUCTION

Soybean meal (SBM) has an excellent reputation for its high amino acid quality. Dehulled SBM is preferred by animal producers due to its better balanced protein, lower fiber and higher energy levels. However, there still remains large variation in the nutritive value of the SBM products available commercially. Due to the high variability of poultry performances among SBMs, there continues to be a great need for assays that are relatively simple, yet sensitive enough to differentiate between SBMs of different quality. Proximate analysis, *in vitro* amino acid digestibility, trypsin inhibitor activity (TIA), potassium hydroxide protein solubility (KOHPS), protein dispersibility index (PDI) and urease activity do not accurately predict the actual performance of different normally processed SBM in poultry and swine nutrition (Neoh, 2003; Parsons *et al*., 1991; Vohra and Kratzer, 1991). However, these tests can detect poorly processed SBM, eg. a SBM with KOHPS of less than 70% is considered over processed and will not perform well (Araba and Dale, 1990). Unfortunately, most SBMs available in the market will have very similar proximate and other chemical analyses. The challenge is to find a simple assay that can differentiate between the qualities of normally processed SBM and correlate it with animal growth performance.

The protein efficiency ratio (PER) assay has historically been used extensively for predicting the protein quality of foods for human consumption (Howe *et al*., 1965). The PER assay is simple in that it consists of feeding the test ingredient as the sole source of dietary protein. The classical PER assay is conducted with rats and to a lesser extent it has been used for poultry to evaluate various feed ingredients (Johnson and Parsons, 1997). The energy content of the diet has a large influence on the growth rate and feed utilization of livestock. Metabolizable energy (ME) is a reliable tool to determine the energy that is available in the diet for maintenance and production (MacLeod, 2002). Logically, biological determinants such as PER (Swick, 2003) and AME should be reliable indicators to differentiate the performance of different SBMs. The purpose of this study is to determine the PER and AME of three dehulled SBMs of different origin and correlate them twith the growth performance of broiler chickens.

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II. MATERIALS AND METHODS

Seven hundred and thirty two day-old, Arbor Acre, male broiler chicks of the same batch were fed a starter diet (Baker and Han, 1994) before the commencement of the PER and AME bioassays. For the PER study, a total of 432 chicks were housed in 24 floor pens. Eighteen eight-day-old birds were randomly allocated to each pen with six replicates for each treatment. The PER diets (Johnston and Coon, 1978) consisted of 300g/kg of SBM as the only protein source and were prepared from three dehulled SBMs originating from Soon Soon Oilmills of Malaysia (SS), United States (US) and Argentina (ARG). The diet with SS SBM was prepared in two forms, one in mash form the other in pellet form. The US and ARG diets were in pellet form. These test diets were fed to the chicks from day 8-17 for the PER determination. Data on initial, day 8 and day 17 body weights, feed intake, feed conversion ratio (FCR) and PER were recorded. PER was calculated as the amount of weight gain per unit of protein consumed (Johnston and Coon, 1978; Johnson and Parsons, 1997).

For the growth trial and AME trial, 3 x 100 day-old chicks were fed respectively with three starter diets (Baker and Han, 1994) which were isonitrogenous and isocaloric and formulated with the above mentioned three SBMs. The chicks were then reared in floor pens until day 21. The weight gains and FCRs were recorded for each treatment. On day 22, five birds were assigned to each metabolism cage with six replicates for each AME diet (Annison *et al*, 1994). From day 25-28, excreta samples were collected daily and oven dried for AME determination. AME was calculated as intake energy minus excretory (fecal and urinary) energy losses (Sibbald, 1980). AME_n = [(GE feed x g feed consumed) - (GE excreta x g excreta) - (NR x K)] / (g feed consumed)]. GE is the gross energy and NR is the nitrogen retention which is assumed to be 6.25 divided by 20% of body weight gain or loss, and K is the constant which is 34.35MJ/kg nitrogen gain/loss (Jiang and Pruekvimolphan, 2003).

III. RESULTS AND DISCUSSION

The results (Table 1) show that the 10 day PER bioassay was able to distinguish between the qualities of the three dehulled SBMs. Significant improvements in FCR and PER were observed for the birds fed diets using SS SBM when compared to their counterparts. The FCR of SS SBM fed birds was significantly improved by 6.2%, 6.7% and PER was increased by 7% and 5% when compared with birds fed diets using US and ARG SBM, respectively. The final body weight and body weight gain of the broilers fed with SS SBM were also significantly higher than those fed with ARG SBM. The improvements were 8.6% and 15.2%, respectively. Broilers fed with US SBM also had significantly higher final body weight and body weight gain than those fed with ARG SBM. These results are in agreement with similar findings reported by Mateo and Swick (2004). In comparison, the mash diet using SS SBM gave a lower body weight gain but significantly better FCR and PER than the equivalent pelleted diet. This suggests that the protein may have been damaged during the pelleting process thus making it less available to the animal.

The answer to the question of whether the PER study can be used to predict the 1-21 day growth performance of broilers fed with the three different SBMs is shown in Figure 1 and 2. These results show that there maybe a correlation between PER and body weight gain as well as FCR for broilers grown to 21 days. More studies will have to be done as there are insufficient data to draw a definite conclusion.

Table 1. Growth performance of broiler chicks fed different SBMs

Parameters	PER trial (day 8-17)						Growth trial (day 1-21)				
	SS(M)*	SS	US	ARG	SE	CV (%)	SS	US	ARG	SE	CV
Initial body weight, g	165.3	165.4	165.3	165.3	-	-	39	39	39	-	-
Final body weight, g	397.9[a]	411.8[a]	407.1[a]	379.2[b]	5.07	3.11	874	850	817	-	-
Body weight gain, g	232.6[a]	246.5[a]	241.8[a]	213.9[b]	5.05	5.30	836[a]	811[ab]	779[b]	8.45	2.38
FCR	1.843[c]	2.023[b]	2.149[a]	2.159[a]	0.04	4.55	1.294	1.319	1.35	-	-
PER	3.62[c]	3.37[b]	3.15[a]	3.21[ab]	0.06	4.41	-	-	-	-	-

[a,b] Means with different superscript within the same row differ significantly, P<0.05

* Mash form , others in pellet form

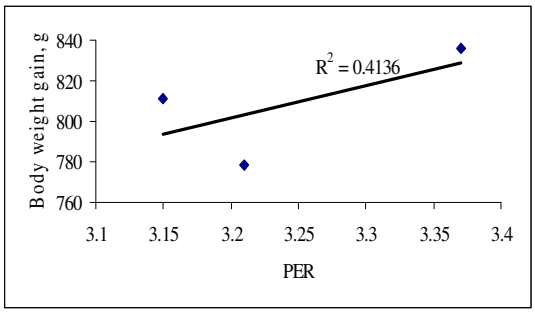

Figure 1. Relationship between body weight gain and PER

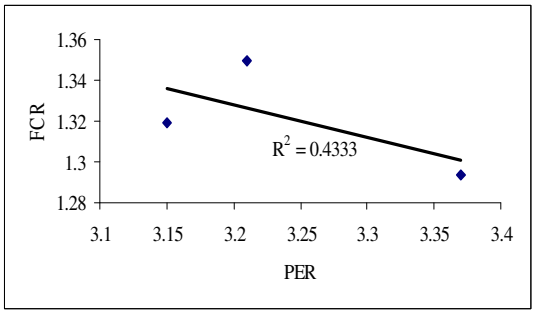

Figure 2. Relationship between FCR and PER

The results of the AME trials are presented in Table 2. Broilers fed the diet using SS SBM had significantly higher AME and AME_n when compared to their counterparts. The AME_n of SS SBM was 7.1% and 7.9% higher than US and ARG SBM respectively. The body weight gain (Figure 3) and FCR (Figure 4) for broilers grown to 21 days were plotted against AME_n. Increasing AME_n values led to improved body weight gains and FCRs. MacLeod (2002) claimed that ME is an index indicating what is available to the bird for maintenance and production, but not a predictor of how efficiently the birds then utilizes what energy is available. However, correlations shown in Figure 3 and 4 imply that the efficiency of feed utilization was improved as more energy was available for growth and production. Interestingly, there appears to be good correlation between PER and AME_n (Figure 5).

In conclusion, it appears that AME and PER measurements can be used to distinguish between SBMs of different qualities, and they may also be able to predict the broiler growth performances of different SBMs.

Table 2. AME and AME_n of different SBM diets

	SS	US	ARG	SE	CV (%)
AME, MJ/kg DM	11.95[a]	11.22[b]	11.13[b]	0.168	3.59
AMEn, MJ/kg DM	10.60[a]	9.90[b]	9.82[b]	0.164	3.97

[a,b] Means with different superscript within the same row differ significantly, P<0.05

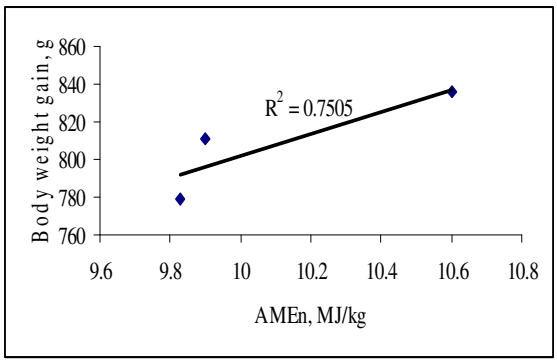

Figure 3. Relationship between AME_n and body weight gain

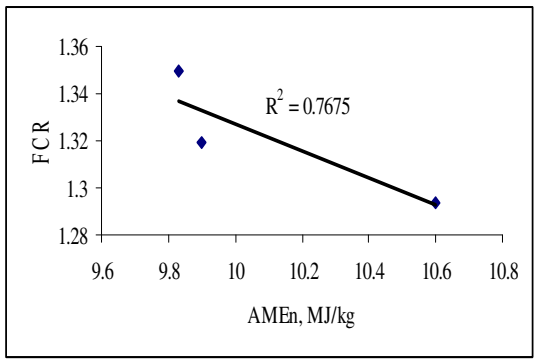

Figure 4. Relationship between AME_n and FCR

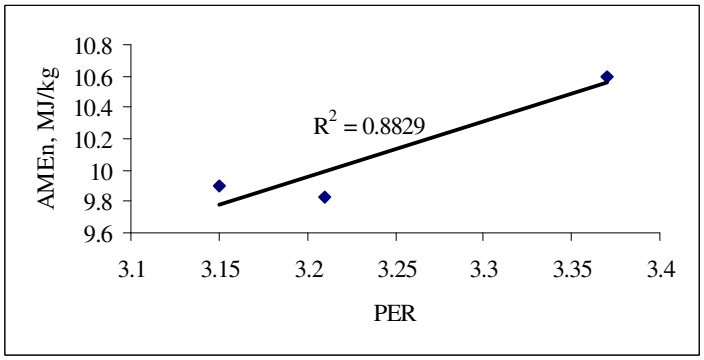

Figure 5. Relationship between AME_n and PER

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