DIGESTIBLE AND METABOLIZABLE ENERGY CONTENT OF VARIETIES OF MILO FOR RATS

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Summary

Six varieties of milo were assayed with rats to determine their digestible and metabolizable energy contents. These varieties differed in tannin content and amino acid availability as determined with chicks. Variable digestible and metabolizable energy values were obtained for the different varieties of milo. The correlations between digestible energy and tannin and metabolizable energy and tannin were 0.38 and 0.39 indicating that tannin content had no influence on the utilizable energy content of milo. The increase in the digestible and metabolizable energy content of the varieties of milo tested with the rat were analogous to the biological availability of the amino acids to the chick. The ability of the rat to utilize the energy of milo may be influenced either by factors that affect amino acid availability or amino acid availability itself.

Introduction

Variable results have been reported on the feeding value of milo for poultry (Ozment et al., 1963; Kemmerer and Heywang, 1965; Deaton and Quisenberry, 1967). Amino acid availability and balance are considered factors contributing to the variability in the feeding value of milo. The protein content of the supplement was more critical in a sorghum grain ration than in a corn ration for swine (Peo and Hudman, 1958) and milo was inadequate as the sole source of protein for finishing pigs (Jensen, Becker and Harmon, 1965). Pond, Hillier and Benton (1958) found lysine improved the growth of rats fed milo as the sole source of protein. Stephenson et al. (1971) reported differences in the availability of amino acids in varieties of milo for the chick.

Tannin, associated with seed coat color and bird resistant characteristics, has also been implicated in the variability of the feeding value of milo. Thayer, Sieglinger and Heller (1957); Stephenson, York and Bragg (1968) and Damron, Prince and Harms (1968) found color and bird resistance were not accurate indices of feeding value. Fuller, Potter and Brown (1966) and Conner et al. (1969) showed that high tannin content milo depressed growth of chicks. Tannic acid also depressed growth of chicks (Chang and Fuller, 1964) and reduced dietary metabolizable energy (Vohra, Dratzer and Joslyn, 1966). Fuller et al. (1966) showed the metabolizable energy of milo varied directly with extremes of low to high levels of tannin.

The objective of this work was to determine digestible and metabolizable energy for the rat of varieties of milo differing in tannin content and amino acid availability as determined with chicks.

Experimental Procedure

Three balance experiments were conducted to determine the digestible and metabolizable energy content of six varieties of milo. These varieties, ARK 61002, AKS 614, RS 617, RS 608, TE 66 and ARK 62002, were selected on the basis of average amino acid availability to the chick which was determined by Stephenson et al. (1971). Most of the experimental methods and the diet used have been described (May and Nelson, 1972). Each treatment consisted of three replicates of four rats each. The rats were fed the test diets for a 4-day adjustment period followed by a 4-day test period. The treatments in each experiment were basal diet and 50% basal diet plus 50% milo. Two varieties of milo were assayed in each experiment. Records were maintained on total feed intake of the individual rats. Total fecal and urine collections from each rat were composited by replicate at the end of the experiment. Feed, feces and urine were assayed in triplicate for nitrogen (A.O.A.C., 1965). The milo samples were assayed for moisture (A.O.A.C., 1965) and for tannin by a modification of the method of...
determining chlorogenic acid reported by Lieberman, Craft and Wilcox (1959). Gross energy (G.E.) of the feed and feces was determined in a Parr oxygen bomb calorimeter.

The digestible energy (D.E.) of each diet in calories per gram was determined as follows:

\[
\text{D.E.} = \frac{(\text{g feed consumed} \times \text{G.E.}/\text{g feed})}{\text{g feed consumed}} - \frac{(\text{g feces} \times \text{G.E.}/\text{g feces})}{\text{g feed consumed}}
\]

Gross energy of the urine was estimated from total urinary nitrogen using the equation reported by May and Nelson (1972):

\[
\text{M.E.} = \text{D.E.} - \left( \frac{\text{g urinary N} \times 7.00}{\text{g feed consumed}} \right) + 6.56
\]

The metabolizable energy was corrected for nitrogen balance by using the same equation to calculate the energy value of the retained nitrogen. The digestible and metabolizable energy values for milo were then determined using the equation of Sibbald, Summers and Slinger (1960). The product moment correlations of tannin content to digestible and metabolizable energy corrected for nitrogen balance were obtained.

Results and Discussion

The digestible and metabolizable energy values of the varieties of milo are summarized in table 1. Variability occurred in the energy content of the different samples of milo. The digestible energy values ranged from 3.49 kcal/g for ARK 61002 to 4.19 kcal/g for TE 66. The metabolizable energy values, corrected for nitrogen retention, ranged from 3.30 kcal/g for ARK 61002 to 4.01 kcal/g for TE 66. These ranges represent approximately a 20% difference in the digestible and metabolizable energy of these varieties of milo.

The tannin content of the varieties of milo did not influence the energy utilization by the rat as indicated by its low correlation to digestible and metabolizable energy. This is in agreement with Chang and Fuller (1964) who stated that the metabolizable energy of milo for the chick did not appear to be related to the tannin content. In a subsequent report, Fuller et al. (1966) summarized the tannin and metabolizable energy values of 23 varieties of milo for the chick. The correlation of tannin to metabolizable energy was 0.08. They did find, however, that levels of tannin in milo depressed growth.

Vohra et al. (1966) tested tannin preparations extracted from various sources and found that metabolizable energy was depressed by the addition of 2% tannic acid. This level was higher than the amount of natural tannin found by Fuller et al. (1966) to affect chick growth. Earlier work (Chang and Fuller, 1964) indicated that the growth depressing effect of equivalent levels of tannin in milo and tannic acid was similar.

While it is apparent that tannic acid can affect metabolizable energy of diets, the tannin content of milo is apparently too low to exert an adverse effect on the utilization of the energy it contains.

The digestible and metabolizable energy content of the varieties of milo tested with the rat tended to increase as the biological availability of the amino acids to the chick increased. Limited data are available on the biological availability of the amino acids in feed ingredients. Stephenson et al. (1971) reported the availability of 17 amino acids in 24 varieties of milo for the chick. The average absorption of these 17 amino acids for each variety ranged from 50 to 94%. Previously Stephenson et al. (1968) indicated that color classification was not an accurate index for estimating the feeding value of milo. Since seed coat color is associated with tannin con-

<table>
<thead>
<tr>
<th>Variety</th>
<th>Seed type</th>
<th>Tannin %</th>
<th>Amino acid absorption %</th>
<th>Digestible Energy, kcal/g b</th>
<th>Metabolizable Energy, kcal/g b</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARK 61002</td>
<td>Brown</td>
<td>0.25</td>
<td>50</td>
<td>3.49 ± 0.022</td>
<td>3.30 ± 0.058</td>
</tr>
<tr>
<td>AKS 614</td>
<td>Brown</td>
<td>1.08</td>
<td>83</td>
<td>3.75 ± 0.023</td>
<td>3.56 ± 0.009</td>
</tr>
<tr>
<td>RS 617</td>
<td>Brown</td>
<td>0.55</td>
<td>60</td>
<td>3.67 ± 0.025</td>
<td>3.72 ± 0.016</td>
</tr>
<tr>
<td>RS 608</td>
<td>Yellow</td>
<td>0.84</td>
<td>91</td>
<td>3.92 ± 0.020</td>
<td>3.74 ± 0.021</td>
</tr>
<tr>
<td>TE 66</td>
<td>Yellow</td>
<td>0.88</td>
<td>89</td>
<td>4.12 ± 0.060</td>
<td>4.01 ± 0.061</td>
</tr>
<tr>
<td>ARK62002</td>
<td>Yellow</td>
<td>0.76</td>
<td>87</td>
<td>4.13 ± 0.024</td>
<td>3.95 ± 0.024</td>
</tr>
</tbody>
</table>

* Chick availability (Stephenson et al., 1971).  
* Dry matter basis, S.E.  
* r of D.E. to tannin, 0.38.  
* r of M.E. to tannin, 0.39.  
* Corrected for nitrogen balance.
tent, this suggests that the differences in amino acid availability to the chick are not associated with tannin. The biological availability of the amino acids in the varieties of milo tested in this study was not determined with the rat. Therefore, it is not known if (a) the chick availability values are applicable to the rat, (b) the absolute availability differs but the relative utilization is similar or (c) there is no similarity between the utilization of amino acids by the chicks and the rat. Nevertheless, the pattern of increase in rat energy utilization and in chick amino acid availability of these varieties of milo suggests that either (a) or (b) would apply. If true, then the ability of the rat to utilize the energy in milo is influenced by either the factor(s) that affect amino acid availability or by amino acid availability itself.

Literature Cited


