The True Metabolizable Energy Values of 15 Pacific Northwest Poultry Feeds

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THE TRUE METABOLIZABLE ENERGY VALUES
OF 15 PACIFIC NORTHWEST POULTRY FEEDS

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ABSTRACT

Apparent, true and nitrogen-corrected metabolizable energy values of 15 selected poultry feedstuffs grown in the Pacific Northwest were determined.

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INTRODUCTION

Accurate and precise data describing the concentration of bioavailable nutrients in feedstuffs are required for the formulation of economical diets. Metabolizable energy (ME) is a measure of the energy available to birds from their diets (Vohra, 1966). The term ME can be expressed as either apparent (AME) or true (TME) metabolizable energy (Harris, 1966). For several years, the ME values used in the formulation of poultry feeds have been AME. Since Sibbald (1976) developed a bioassay for true metabolizable energy, a considerable amount of research has been conducted to investigate the assay's applicability.

Generally, AME assays have been conducted with young chicks of meat-type strains (Hill and Anderson, 1958) while TME assays have been conducted with Single Comb White Leghorn (SCWL) adult males (Sibbald, 1976). The bioassay for TME is faster and less expensive than conventional AME assays and incorporates a correction for metabolic fecal energy (FEm) plus endogenous urinary energy (UEe) losses.

Sibbald and Slinger (1962) observed a close relationship between the classical AME and N-corrected AME (AMEn) values based on rapidly growing chickens. Muztar et al. (1978a, 1978b) and Muztar and Slinger (1981) showed that most AMEn values obtained with mature roosters were lower than the corresponding AME values by about 0.01 to 0.03 Kcal/g.

In several studies using the TME bioassay (Boldaji et al., 1981; Bilgili et al., 1982), TME values of several feedstuffs available in the Pacific Northwest were determined.

There is limited information concerning the effect of adjusting TME estimates to zero nitrogen N balance (TMEn). Shires et al. (1980) found that correction, on the average, reduced TME estimates obtained with chicks and adult cockerels by 8 and 6%, respectively. In a similar study, Sibbald and Morse (1983) reported that the application of an N-correction had a profound effect on TME by substantially reducing experimental error and was strongly recommended. Michael and Kenneth (1984) reviewed ME concepts and suggested that only AME values obtained from test birds fed at maintenance levels should be used for energy analyses.

In several studies using the TME bioassay, we have determined the AME, TME, AMEn and TMEn values of several feedstuffs grown in the Pacific Northwest which we report here.

MATERIALS AND METHODS

Fifteen feedstuffs available in the Pacific Nowthwest were assayed. Several varieties of wheat, barley, fababeans and yellow peas were obtained from the Department of Crop Science, Oregon State University. Four experiments were conducted involving the TME bioassay of Sibbald (1976).

Adult SCWL roosters housed in individual wire cages were fasted for 24 hours to ensure that no feed residues remained in their alimentary tracts. Four males were assigned to each treatment. In addition, four males received no feed and were negative controls for the measurement of metabolic plus endogenous energy excretion.

Four roosters per feedstuff were then force-fed 30 g per rooster of air dry ground feedstuff. The roosters were provided water ad libitum after force feeding. No ad libitum feed was provided during the test period. The excreta voided during the subsequent 24 or 48 hours were collected quantitatively, and dried in a forced-draft oven at 90° C for 24 hours, equilibrated, weighed and ground in a coffee grinder (Model Braun Aromatic KSM_2). Samples of feedstuffs were ground in a Wiley mill to pass a 1 mm screen. Dry matter and crude protein were determined using the Association of Official Analytical Chemists (AOAC, 1975) procedures. Gross energy of feedstuffs and excreta were measured using a Parr adiabatic oxygen bomb calorimeter. The resulting data were used to calculate AME, TME, AMEn and TMEn values for each feedstuff fed to each bird.

The AMEn as well as TMEn values were derived from the gross nitrogen contents of feed and excreta using a factor of 8.73 to measure nitrogen retention or loss. This factor was proposed by Titus et al. (1959) [and more truly represents the N-containing excretory products of chickens than that of 8.22, as proposed by Hill and Anderson (1958)]. All values were expressed on a dry weight basis using the determined moisture figures. The following formulae (Sibbald and Wolynetz, 1985) were used to estimate the biological energy (Kcal/g) of several feedstuffs used in these experiments.

$$AME = [IE - (FE + UE)]/I \quad (1)$$

$$AMEn = [IE - (FEn + UEn)]/I \quad (2)$$

$$TME = [IE - (FE + UE)_{+} + (FE + UE)_{0}]/I \quad (3)$$

$$TMEn = [IE - (FEn + UEn)_{+} + (FEn + UEn)_{0}]/I \quad (4)$$

$$(FEn + UEn) = (FE + UE) + 36.53\ RNb \quad (5)$$

$$RNb = IN - (FN + UN) \quad (6)$$

Where: IE is the input energy (Kcal/g);

(FE + UE) is the fecal plus urinary energy;

I is the feed input;

(FEn + UEn) is the nitrogen-corrected fecal plus urinary energy;

$(FE + UE)_{+}$ is the fecal plus urinary energy of the fed bird;

$(FE + UE)_{0}$ is the fecal plus urinary energy of the unfed bird;

$(FEn + UEn)_+$ is the nitrogen-corrected fecal plus urinary energy of the fed bird;

$(FEn + UEn)_0$ is the nitrogen-corrected fecal plus urinary energy of the unfed bird;

RNb is retained nitrogen balanace;

IN is the nitrogen input; and

(FN + UN) is the fecal plus urinary nitrogen of the fed bird.

For TME and TMEn, the subscripts (+ and o) identify the excreta energy outputs of fed and fasted birds, respectively. The constant 36.53 MJ is based on an estimate of E excreted when 1 Kg of tissue N is catabolized (Titus et al., 1959).

RESULTS

The percent dry matter and crude protein (N x 6.25) as well as gross energy, AME, TME, AMEn and TMEn values of several selected feedstuffs grown in the Pacific Northwest are presented in Table 1. Under the conditions of these experiments, these findings confirm the results of Muztar et al. (1978 a, b), Muztar and Slinger (1981), and Shires et al. (1980). The results also indicate little difference between AME and TMEn levels of the feestuffs. This also agrees with the suggestion made by Michael and Kenneth (1984).

It is of interest that the mean TME values (Kcal/g dry matter) of barley, corn, soybean, triticale and wheat obtained in these experiments are similar to those obtained by Bilgili et al. (1982). The feedstuffs used in these experiments were of different varieties.

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Table 1. Summary of analysis of some feedstuffs available in the Pacific Northwest

Feedstuff	Samples No.	Dry Matter %	Gross Energy Kcal g D.M.	Crude Protein %	A.M.E.	T.M.E.	A.M.E.n	T.M.E.n	A.M.E.	T.M.E.	A.M.E.n	T.M.E.n
					Kcal/g D.M.				Kcal/kg D.M.			
Yellow corn	16	88.74	4.43	9.31	3.44	4.04	3.15	3.45	3440	4040	3150	3450
Triticale - Sel-B79-2954	4	91.87	4.30	12.01	2.96	3.56	2.64	2.92	2960	3560	2640	2920
Triticale - 84-76884	4	92.20	4.26	10.29	2.93	3.49	2.60	2.83	2930	3490	2600	2830
8113 - Wheat	4	92.00	4.26	14.31	2.98	3.54	2.74	3.06	2980	3540	2740	3060
8313 - Wheat	4	91.90	4.28	13.14	2.98	3.55	2.69	2.97	2980	3550	2690	2970
Hill - 81	4	91.50	4.29	10.36	3.07	3.67	2.76	3.04	3070	3670	2760	3040
Scio - Barley	4	92.00	4.35	10.71	2.84	3.44	2.57	2.88	2840	3440	2570	2880
Spring Malt Barley kg/M22/Karl	4	91.50	4.34	13.59	2.81	3.37	2.47	2.70	2810	3370	2470	2700
Hesk Barley	4	92.30	4.33	8.72	2.38	3.22	1.86	2.17	2380	3220	1860	2170
Yellow Peas	8	88.92	4.33	23.07	2.63	3.20	2.36	2.68	2630	3200	2360	2680
Fababean (Diana)	8	88.24	4.20	26.26	2.92	3.00	2.15	2.18	2920	3000	2150	2180
Fababean (Fredric)	8	90.27	4.36	29.12	2.58	3.13	2.43	2.85	2580	3130	2430	2850
Soybean - 45% C.P.	8	92.25	4.62	52.00	2.51	2.90	2.18	2.65	2510	2900	2180	2650
Lupin Bean	8	90.18	4.83	32.56	2.26	2.82	2.03	2.37	2260	2820	2030	2370
Meadowfoam	4	89.00	4.62	26.00	2.20	2.78	2.01	2.41	2200	2780	2010	2410