NITROGEN CORRECTED TRUE METABOLIZABLE ENERGY VALUE OF PROPIONIC ACID, GLYCEROL AND LUPROSIL™ FOR BROILERS

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Story in Brief

Broilers were employed to evaluate the nitrogen corrected true metabolizable energy (TMEn) value of propionic acid, propylene glycol and luprosil™, a mold inhibitor, administered at two inclusion levels. Bomb calorimetry measurement determined the gross energy content of feed grade propionic acid, propylene glycol and luprosil™ to be 2,134, 2,542 and 1,634 Kcal/lb, respectively. Nitrogen corrected TME, averaged over inclusion level, was 2,088, 2,497 and 1,680 Kcal/lb for the propionic acid, glycerol and luprosil™, respectively. Energy from these three compounds had a high bioavailability.

(Key Words: Energy, Caloric Density, True Metabolizable Energy.)

Introduction

Numerous chemical preservatives are used to prevent or inhibit mold growth on feedstuffs during storage or while residing in feeders. Propionic acid is an effective mold inhibitor for corn (Christensen, 1973; Moran et al., 1974), hay products (Lacey and Lord, 1977), liquid media (Stewart et al., 1977) and poultry feed (Paster, 1979). Propylene glycol also has mold inhibitory action and is included along with propionic acid in mold inhibitor products such as luprosil™ to reduce mycotoxin contamination.

Inclusion of mold inhibitors in poultry rations means that the inhibitor displaces other nutrients. Modern poultry rations are formulated to provide specific quantities and ratios of energy to other nutrients. Thus knowledge concerning the utilization of energy from propionic acid and propylene glycol is needed so that the ration can be adjusted to reflect the energy content of these substances. Jensen and Chang (1976) indicated that propionic acid is readily metabolized by animals; inclusion of up to .8% propionic acid in the ration did not adversely impact egg production, egg weight or body weight of hens.

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However, little quantitative information is available regarding the energy utilization of either propionic acid or propylene glycol. The purpose of our study was to determine the true metabolizable energy (TME) and nitrogen corrected true metabolizable energy (TME_n) of propionic acid, propylene glycol and luprosil™.

Materials and Methods

This experiment was conducted to estimate the TME and TME_n of propionic acid, propylene glycol and luprosil™ (a mixture of propionic acid (53.5%), propylene glycol (11.5%), ammonium hydroxide (9.5%) and water (25%)). Twelve weeks posthatching, Vantress X Arbor Acre male broilers were allotted to seven treatment groups as follows: 1) basal ration (BR); 2) BR+ 1% propionic acid; 3) BR+2.5% propionic acid; 4) BR+2.5% propylene glycol; 5) BR+5% propylene glycol; 6) BR+2.5% luprosil™ and 7) BR+5% luprosil™. Birds were force fed (Teeter et al., 1984) a constant amount of basal ration (6% of body weight) with the test ingredient added on top. Samples of feed and excreta were analyzed for gross energy content, dry matter and protein as specified by the Association of Official Analytical Chemists (1970). The TME and TME_n was determined according to the method of Sibbald (1976) with the exception that excreta samples were dried in a forced air oven at 140°F (Dale and Fuller, 1982). Treatments were arranged in a randomized complete block experimental design (Steel and Torrie, 1960). Ingredient means, inclusion level and interactions were evaluated using the general linear model of the Statistical Analysis System (Barr et al., 1976). When a significant F statistic was indicated by analysis of variance, means were separated by Duncan's multiple range test (Steel and Torrie, 1960).

Results and Discussion

Bomb calorimetry analysis yielded gross energy values of 2,138 and 2,551 Kcal/lb respectively for propionic acid and propylene glycol. Reported gross energy values in The Handbook of Chemistry and Physics (1987) were 2,238 for propionic acid and 2,570 for propylene glycol indicating that the feed grade products have an energy content nearly identical to the pure compound. Estimated from gross energy of its components, luprosil™ has a gross energy content of 1,439 Kcal/lb this contrast with its determined value of 1,634 Kcal/lb. Reasons for this discrepancy are unknown though the product may vary in composition or ingredient stratification may have caused disproportionate sampling.

Nitrogen balance and energy values of the rations and ingredients are summarized in Table 1. All birds were in negative nitrogen balance during the

Table 1. Nitrogen balance[a] and energy value[b] of rations and test ingredients.

Test ingredient	Dietary level(%)	Nitrogen balance x10^{-4}	Ration TME	Ration TME_n	Ingredient TME	Ingredient TME_n
Control	---	-9.9	1,575	1,616	---	---
Propionic	1	-6.6	1,602	1,634	1,670	2,192
Acid	2.5	-4.2	1,625	1,638	1,734	2,011
Propylene	2.5	-3.7	1,661	1,675	2,378	2,655
Glycol	15.0	-4.2	1,684	1,697	2,201	2,333
Luprosil	2.5	-6.2	1,593	1,620	971	1,652
	5.0	-13.4	1,575	1,625	1,044	1,738
Statistical Summary						
Source of variation	DF					
Ingredient	2	**	**	**	**	**
Level	1	NS	NS	NS	NS	NS
I*L	2	**	NS	NS	NS	NS
Residual MS	97	5.7	37.2	28.7	658	522

[a] Nitrogen balance expressed as lbs nitrogen lost per day.
[b] TME and TME_n energy values expressed as Kcal/lb.

TME assay. Birds consuming luprosil™ lost more ($P<.01$) nitrogen during the experiment reflecting its larger nonprotein nitrogen content. Energy availability as TME_n percentage of determined gross energy averaged 98, 98 and 104% for the propionic acid, propylene glycol and luprosil™, respectively. These data indicate that these mold inhibitors contain biologically available energy that should be utilized to calculate caloric density of rations containing these preservatives.

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