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Research Article

Apparent Metabolizable Energy of Pure and Crude Glycerol for Roosters

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A B S T R A C T

Backgorund/Aim: An experiment was conducted with roosters to determine the apparent metabolizable energy (AME) content of glycerol, a co-product of biodiesel production. One pure and two crude glycerol samples which obtain from a commercial biodiesel production facility were investigated in present study.

Material and Method: For this aim, twenty of 30 weeks aged Hy-Line roosters were placed in individual metabolic cages and birds had access ad libitum to diet and water before measurements. The determination of AME of glycerol from different sources consisted of a 24 hours preliminary fasting period and a 24 hours excreta period. After the preliminary fasting period, 45 g of testing material was given by funnel. Thereafter gaita samples were collected with help of harness (collection bag) and all excreta dried at 60 ^{0}C and gross energy determined of samples use with bomb calorimeter.

Results and Conclusion: At the end of experiment, the AME values for pure and crude glycerine (two samples from different sources) were 4170, 5587 and 6763 kcal/kg of dry matter, respectively.

Keywords: Apparent metabolizable energy, glycerol, gross energy, rooster.

Horozlarda Saf ve Ham Gliserolün Belirlenebilir Metabolize Olabilir Enerji Değeri

Ö Z E T

Özbilgi/Amaç: Bu çalışma biyodizel yan ürünü olarak açığa çıkan gliserolün horozlardaki belirlenebilir metabolize olabilir enerji (AME) değerinin tespit edilmesi için düzenlenmiştir. Çalışmada ticari olarak biyodizel üretimi yapan bir tesisten temin edilen bir saf iki ham gliserol örneği incelenmiştir.

Materyal ve Metot: Bu amaçla 30 haftalık yaşta 20 adet Hy-line horozu bireysel kafeslerde barındırılmış ve ölçümler öncesinde su ve yeme sınırsız ulaşmalarına izin verilmiştir. Farklı kaynaklardan temin edilen gliserolün AME değerinin belirlenmesi için horozlar 24 saatlik test süresinden önce yine 24 saat süreyle aç bırakılmıştır. Açlık süresinin sonunda 45 g test numunesi bir kanül yardımıyla verilmiştir. Sonrasında dışkı örnekleri örnek toplama poşetleri ile toplanmış ve 60 ^{0}C'de kurutularak bomba kalorimetresi yardımıyla ham enerji değerleri belirlenmiştir.

Bulgular ve Sonuç: Denemenin sonunda saf ve ham gliserollerin (iki ayrı kaynaktan toplanan) AME değerleri kuru maddede, sırasıyla 4170, 5587 ve 6763 kkal/kg olarak belirlenmiştir.

Anahtar kelimeler: Belirlenebilir metabolize olabilir enerji, ham enerji, horoz, gliserol.

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Introduction

There is a growing interest in biodiesel production from grains in worldwide (Windhorst, 2007). The primary co-product of biodiesel production is crude glycerol (glycerin) may become available for use as a feed for poultry because of it is a valuable source of dietary energy and relatively economical cost (Bregendahl et al., 2008).

Glycerol is used as an ingredient for producing food, cosmetics, and pharmaceuticals (Thompson and He, 2006). Once it digested and transferred to liver in metabolism, glycerol is converted to glucose via gluconeogenesis (Emmanuel et al., 1983) or oxidized for energy production via glycolysis and the citric acid cycle (Rosebrough et al., 1980).

Even though some studies have declared that glycerin is an acceptable feed ingredient for poultry (Campbell and Hill, 1962; Lessard et al., 1993; Simon et al., 1996; Cerrate et al., 2006), there is a lack of information describing the apparent metabolizable energy (AME) values of glycerol from different sources for nonruminants (Bartell and Schneider, 2002; Dozier et al., 2008, Lammers et al., 2008).

To our knowledge, AME value of pure and crude glycerol from different sources for roosters has not been previously reported. So, the object of present study was to determine the apparent metabolizable energy values of pure and crude glycerol from variant sources.

Materials and Methods

Feedstuff and animals

The feedstuffs investigated were pure and crude glycerol (glycerine) with and without methanol. The chemical composition of the feedstuffs used in trial is given Table 1.

Twenty roosters were used in the experiment. They were a white egg – laying strain (Hy-Line 98) at the age 30 weeks. The roosters were kept in individual cages with individual feed and water facilities. Room temperature fluctuated between 18 and 22 ^{0}C. When not under experiment the birds had access *ad libitum* to diet, the composition of which is given Table 2.

Measurement of apparent metabolizable energy (AME)

Apparent metabolizable energy values were obtained from a total of 20 birds. The birds had been starved of feed for 24 hours before force feeding. Then they were tube fed 45 g of pure and crude glycerol (two samples from different sources) by a feeding device. A harness was attached to the bird immediately after feeding. The time was recorded and the bird was placed in a cage. Smooth – surfaced plastic trays were inserted underneath of cage. Collection bags were removed after 24 hours and the trays underneath the birds were examined for regurgitated feed.

Harness

The harness technique used is similar to method which was described by Sibbald (1978). A labeled plastic bag was attached to a harness. The harness for holding plastic collection bag was modified for use in this trial. A plastic fecal collection bag (300 mm length x 160 mm width) was maintained by a harness. The harness consisted of a rubber ring (90 mm outer diameter) with cotton threads (350 mm length) were attached to two adjacent points of the ring while short cotton threads (150 mm length) were adjacently attached to the opposite side of the ring.

Analytical methods

After drying at 60 ^{0}C, all excreta samples were weighed and ground through a 0.3 mm sieve. Gross energy of glycerol and excreta samples was determined with Gallenkamp Balistic Bomb Calorimeter (Anonymous, 1970).

Calculation

The following equation was used to calculate apparent metabolizable energy value (AME);

$$AME = \frac{GEI - GEE}{FI}$$

Where GEI = gross energy intake, GEE = gross energy in excreta, and FI = feed intake.

Results and Discussion

Apparent metabolizable energy values of pure and crude glycerol samples are presented in Table 2. The AME value for pure glycerol sample 4352 kcal/kg, which was higher to those, obtained by Dozier *et al*. (2008), who evaluated a glycerine

Table 1. Composition and calculated analysis of the basal diet.
Tablo 1. Temel rasyonun hammadde ve hesaplanan besin madde içeriği.

Ingredients (g / 100 g)	
Maize	45.93
Barley	30.00
Soybean meal	20.00
Limestone	2.00
Dicalcium phosphate	1.50
Salt	0.30
Vitamin and mineral premix*	0.17
DL-methionine	0.10
Calculated composition	
Metabolizable energy, kcal/kg	2780
Crude protein	16.10
Ether extract	1.45
Crude fiber	4.10
Calcium	1.08
Available phosphorus	0.41

* Vitamin and mineral premix include per kilogram of diet: all-trans-retinyl acetate 12500 IU, cholecalciferol, 5000 IU, DL-α-tocopherol 75 mg, menadione 4 mg, cobalamin 0.016 mg, folic acid, 2.0 mg, D-pantothenic acid 25 mg, riboflavin 8 mg, niacin 70 mg, thiamin 3 mg, pyridoxine 0.07 mg, manganese, 90 mg, zinc, 83 mg, iron, 121 mg, copper, 12 mg, iodine, 0.5 mg, selenium, 0.3 mg.

Table 2. Metabolizable energy levels of pure and crude glycerol samples.
Tablo 2. Saf ve ham gliserol örneklerinin metabolize olabilir enerji düzeyleri.

	Pure glycerol	Crude glycerol sample 1	Crude glycerol sample 2
1	4076	5685	6338
2	4182	5749	6482
3	4258	5683	6527
4	4280	5676	6578
5	3947	5703	6601
6	4268	5763	6706
7	4336	5691	6745
8	4352	5576	6752
9	4079	5696	6801
10	4309		6846
11	4079	5625	6852
12	3842	5351	6859
13	4156	5306	6861
14	4310	5569	6867
15	4276	5162	6872
16	4002	5784	6872
17	4330	5425	6879
18	4101	5402	6925
19	3903	5696	6939
20	4306	5530	6960
Mean	4170	5587	6763
Minimum	3842	5162	6338
Maximum	4352	5784	6960
Standard deviation	157.56	171.46	171.46
Coefficient of variation, %	3.78	3.07	2.54

Table 3. Characterization of pure and crude glycerol fed to cockerels in experiment.
Tablo 3. Denemede horozlara yedirilen saf ve ham gliserolün niteliği.

	Ash	Ether extract	Salt	Methanol	pH
Pure glycerol sample	3.99	0.02	1.98	5.00	5.32
Crude glycerol sample 1	6.26	20.00	0.18	9.80	8.06
Crude glycerol sample 2	4.13	36.25	0.17	0.45	9.11

sample containing 3.625 kcal/kg gross energy in 38 to 45 days old broilers. Crude glycerol samples were also higher values presented in the study, which were 5587 and 6760 kcal/kg AME, respectively. These high energy values can be explained by the high levels of ether extract content of crude glycerol samples (36.25 and 20 %, respectively). Similarly, the AME results for all samples were higher than Lammers et al. (2008), working with 40-wk-old layers, obtained 3.800 kcal AMEn/kg; and Swiatkiewicz and Korelebskib (2009) obtained 3970 kcal AMEn/kg. These differences in metabolizable energy values are probably due to the age of the chickens used in the trials and/or glycerol composition.

The chemical composition of samples is summarized in Table 3. The results show that the composition of glycerol produced in Turkey is widely variable and does not comply with the national standards issued by the Republic of Turkey Ministry of Food, Agriculture and Livestock, which determines 0.2 % maximum methanol content in glycerine. These differences in the chemical composition of glycerol samples may be associated with the raw material and the lack of process standardization.

The results from the present study showed that there is big variation of AME values for different glycerol sources in Turkey. Because of energy value of glycerol depends on fat and methanol content, it is critically important that analyze of glycerol samples before addition to animal diets.

As a result, in present study apparent metabolizable energy values of pure and crude glycerol samples from different sources were determined 4352 kcal/kg for the pure and 5587 and 6760 kcal/kg for the crude glycerol, respectively.

References

Anonymous, Ballistic Bomb Calorimeter, A. Gallenkamp and Co. Ltd., Gallenkamp, London, (1970).

Bartelt J and Schneider D (2002). Investigation on the energy value of glycerol in the feeding of poultry and pig. Pages 15-36 in Union for the Proijiotion of Oilseeds. Sehriften Heft 17. Union zur Fördernng von Oel- and Proteinplafalzen e.V.. Berlin, Germany

Bregendahl K, Lammers PJ, Kerr B, Honeyman MS, Stalder KJ (2008). Metabolizable energy value of crude glycerol for laying hens. Animal Industry Report, AS 654, ASL R2333, available at: http://lib.dr.iastate.edu/ans_air/vol654/iss1/82.

Campbell AJ, and FW Hill (1962). The effects of protein source on the growth promoting action of soybean oil, and the effect of glycerine in a low fat diet. Poultry Science, 41, 881-882.

Cerrate S, Yan F, Wang Z, Coto C, Sacakli P, Waldroup PW (2006). Evaluation of Glycerine From Biodiesel Production as a Feed Ingredient for Broilers, International Journal of Poultry Science, 11, 1001-7.

Dozier III, WA, Kerr BJ, Corzo A, Kidd MT, Weber TE, Bregendahl K (2008). Apparent Metabolizable Energy of Glycerin for Broiler Chickens, Poultry Science, 87, 317-22.

Emmanuel B, Berzins R, Robblee AR (1983). Rates of entry of alanine and glycerol and their contribution to gluceose synthesis in fasted chickens. British Poultry Science, 24, 565-571.

Lammers PJ, Kerr BJ, Honeyman MS, Stalder K, Dozier III WA, Weber TE, Kidd MT, Bregendahl K (2008). Nitrogen-Corrected Apparent Metabolizable Energy Value of Crude Glycerol for Laying Hens, Poultry Science, 87, 104-7.

Lessard P, Lefrancois MR, Bernier JF (1993). Dietary Addition of Cellular Metabolic Intermediates and Carcass Fat Deposition in Broilers, Poultry Science, 72, 535-45.

Rosebrough RW, Geis E, James P, Ota H, Whitehead J. (1980). Effects of dietary energy substitutions on reproductive performance, feed efficiency and lipogenic enzyme activity on large white turkey hens. Poultry Science, 59, 1485-1492.

Sibbald IR, Summers JD, Slinger SJ (1960). Factors affecting the metabolizable energy content of poultry feeds, Poultry Science, 39; 544-56.

Simon A, Bergner H, Schwabe M (1996). Glycerol-feed ingredient for broiler chickens. Archive of Animal Nutrition, 49, 103-12.

Swiatkiewicz S, Koreleskib J (2009). Effect of crude glycerin level in the diet of laying hens on egg performance and nutrient utilization, Poultry Science, 87, 104-7, (2009).

Thompson JC, He BB (2006). Characterization of crude glycerol from biodiesel production from multiple feedstocks, Applied Engineering in Agriculture, 22, 261-265.

Windhorst HW (2007). Bioenergy production, a threat to the global egg industry? World's Poultry Science Journal, 63, 365–379.