METABOLISABLE ENERGY VALUES OF WHOLE PALM KERNEL AND PALM KERNEL OIL SLUDGE USING LAYING HENS AND ADULT BROILER CHICKENS.

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Received 08 June, 1998; Accepted 09 August 1999

ABSTRACT

A series of four experiments were conducted in which 30g DM of whole palm kernel (WPK) and of Palm Kernel Oil Sludge (PKOS) were force-fed to laying hens and adult broiler chickens. The length of the collection periods was the same (24, 30, 48 and 60hr) for both ingredients. The ingredients and their faecal materials were used to determine the apparent metabolisable energy (AME) and the true metabolisable energy (TME) and their nitrogen (N) corrected forms (AMEn and TMEn).

Results showed that in both ingredients, at the 48 hr collection period, no difference in the AME and AMEn, TME and TMEn were found in the bird types. Complete passage of the test ingredients was ensured at the 48 hr collection period. The AME and AMEn values of WPK with laying hens were: 5.08 and 4.98 Kcal/kg DM; while those for the broiler chickens were: 4.88 and 4.31 Kcal/kg DM; those for PKOS AME and AMEn with laying hens were: 3.14 and 2.98Kcal/kg DM ,with the broiler chickens the values were 3.12 and 2.96Kcal/kg DM respectively. TME and TMEn values of WPK with laying hens were 6.42 and 6.11Kcal/kg DM; corresponding values with broiler chickens were: 6.41 and 6.09 Kcal/Kg DM. TME and TMEn for PKOS with laying hens were 4.37. 4.12 Kcal/kg DM. 4.36 and 4.13 Kcal/kg DM, respectively were the corresponding values for broiler chickens. No interaction between ingredients and birds was found but there were interactions among the bioavailable energy systems and the bird types.

Keywords: Metabolisable energy, palm kernel layers, broilers.

INTRODUCTION

Apparent metabolisable energy (AME) determination can be carried out with either broiler chickens (Hill and Anderson, 1958), laying hens (Erikson and Hartfiel, 1967) or adult cockerels (Sibbald, 1976; Farrell, 1978). True metabolisable energy (TME) assays are routinely carried out with cockerels but can also be performed with broiler chickens and laying hens (Johnson and McNab, 1983). Differences between broilers and laying hens (Peterson et *al.*, 1976 and adult cockerels) Mollah *et al* 1983) have been reported. These differences may be a result of differences in nitrogen (N) balance between the different bird types (Askbrant, 1988).

However, a possible deficiency in the rapid bioassay for determining TME using adult rooster (Sibbald, 1976) is that a portion of the feed may be retained, explaining some of the differences observed between AME and TME values. Extension of the collection period, depending on the specific ingredient being tested, was recommended for feeds which exhibit slow rate of passage, from various studies (Sibbald 1979a, b, c). This suggestion was based on the reasoning that the control bird may be in a state of tissue catabolism which could increase the metabolic faecal energy (FEM) plus endogenous urinary energy (UEE) with extended fasting period (Kessler and Thomas, 1981). Since high fat diets exhibit slow rate of passage (Mateos and Jerry, 1981), it becomes necessary to investigate the time required for whole palm kernel meal and its sludge to be completely cleared from the alimentary tract of birds while determining their unknown bioavailable energy levels.

The purpose of the present study was, therefore to determine the bioavailable energy (AME and TME) of whole palm kernel and palm kernel oil sludge, and the time required for their complete passage when they are force-fed to chickens and laying hens. In addition, the difference between the AME and TME systems were examined.

TABLE 1: UNCORRECTED AME DATA AND CORRECTED AMEn VALUES IN kcal / g DM OF INGREDIENTS TESTED WITH LAYING HENS AND ADULT MALE BROILER CHICKENS (MEANS ±SD)

	Laying hens			Adults chickens (broiler)		
Ingredient	collection period(hr)	AME	AMEn	collection period (hr)	AME	AMEn
WPK	24	5.80±0.31	5.30±0.45	24	5.21±0.47	4.97±0.32
	30	5.50±0.33	5.09±0.37	30	5.10±0.44	4.83±0.31
	48	5.08[a]±0.29	4.98[b]±0.29	48	5.06[a]±0.46	4.92[b]±0.21
	60	4.98±0.37	4.59±0.37	60	4.88±0.41	4.31±0.27
PKOS	24	3.98±0.35	3.42±0.31	24	3.45±0.37	3.12±0.35
	30	3.72±0.30	3.22±0.26	30	3.32±0.35	3.11±0.34
	48	3.14[a]±0.28	2.98[b]±0.21	48	3.12[a]±0.31	2.96[b]±0.33
	60	3.100.16	2.83±0.22	60	3.35±0.33	2.05±0.34

[ab] Means within rows with like superscripts are not significantly different (P>0.05).

MATERIALS AND METHODS

Five pairs of birds were arranged for each of the four experiments. Each pair of bird was of the same weight. All the birds, for the bioavailable energy bioassays, were fasted for 24 hr to ensure complete emptying of their alimentary tract of previous feed residues. One bird from each pair, serving as the control, continued to fast throughout the experimental period, and was used to measure the metabolic plus endogenous energy (Sibbald, 1979a). The birds used were 17 week-old broiler chickens (males) and 53 week-old laying hens, and the test ingredients were whole palm kernel (WPK) and palm kernel oil sludge (PKOS). Correction was made for moisture content of the test feeding stuffs such that 30g dry matter (DM) of each was weighed out into five places to force-feed five test birds in each experiment. The two test ingredients were all fed to the two bird types. Accordingly, the experiment was arranged as a factorial in the completely randomised design with the model:

$$Y_{ijk} = u + A_i + B_j + (AB)_{ij} + E_{(ij)k}$$

where Ai and Bj represent average of the ith and jth type of ingredient or bioavailable systems and bird, respectively; and $(AB)_{ij}$ is the effect of interaction of ingredient and bird or bioavailable energy system and bird interaction.

The length of the collection periods for each experiment was as follows: 24, 30, 48, 60 hrs post-prandium. The collection period was extended by collecting the excreta at 24 hr and replacing the trays under the birds in the metabolic cages. Six hours later a second collection of excreta was made to represent a 30-hr collection. This procedure was followed for extending the collection period up to 60 hr post-prandium. Feacal materials were quantitatively collected to ensure a complete passage of the test feed as possible (Sibbald, 1981; McNab and Fisher, 1981).

A simulated oven made of a metabolic cage and electric bulbs were used to dry the faeces at the farm before they were transferred to a force draft oven in the laboratory for final drying. The dried faeces were weighed, bagged in small plastic bags and stored in desicators. The gross energy (GE)analyses of both the feedstuffs and faeces were determined using Parr adiabatic oxygen bomb calorimeter (Gallenkamp).

Bioavailable energy values were calculated based on caloric contents of the feedstuffs and faeces using various methods for AME (Mutzar and Slinger, 1981); for TME (Sibbald and Wolynetx, 1985); for kilocalories excreted per hour (Kessler and Thomas, 1981); for (AME n and TMEn) apparent metablisable energy and true metabolisable energy corrected to nitrogen balance (Askbrant, 1988).

The resultant data were analyzed by analysis of variance and treatment means were separated

TABLE 2: TIME AND TMEn VALUES OF INGREDIENTS kcal/gDM OF INGREDIENTS TESTED WITH LAYING HENS AND ADULT MALE BOILER CHICKENS (MEANS ± SD)

	Laying hen			Adult Chickens		
Ingredient	collection Period(hr)	TME	TMEn	Collection Period(hr)	TME	TMEn
WPK	24	6.63±0.47	6.92±0.55	24	6.52±0.53	6.87±0.57
	30	6.53±0.42	6.38±0.51	30	6.44±0.49	6.22±0.55
	48	6.42±0.50	6.11b±0.47	48	6.41[a]±0.39	6.09[b]±0.51
	60	6.40±0.48	6.06±0.37	60	6.21±0.37	6.12±0.52
PKOS	24	4.70±0.37	4.98±0.36	24	4.61±0.31	4.98±0.51
	30	4.66±0.44	4.48±0.43	30	4.50±0.29	4.32±0.49
	48	4.37[a]±0.47	4.12[b]±0.39	48	4.36[a]±0.37	4.13[b]±0.41
	60	3.32±0.29	3.28±0.33	60	3.30±0.39	3.26±0.55

[a,b] Mean within rows with like superscripts are not significantly different (P>.05)

TABLE 3: EXCRETA OUTPUT AND KILOCALORIES EXCRETED PER HOUR FOR WPK AND PKOS AT 24,30,48 AND 60 HR COLLECTION PERIODS.

	WPK	PKOS	WPK	PKOS	WPK	PKOS	WPK	PKOS
	Fed layers		Control layers		Fed Broiler Chickens		Control Broiler Chicken	
Collection period(hr)								
24								
Excreta[1]	17.5	10.55	2.88	2.87	17.54	11.11	2.89	2.88
kcal/hr[2]	2.33[a]	4.55[a]	0.35[a]	0.35[a]	2.34[a]	4.62[a]	0.36[a]	0.35[a]
30 Excreta	5.44	9.79	0.89	0.89	5.52	10.67	0.75	0.75
kcal/hr	0.95[b]	4.62[a]	0.39[a]	0.38[a]	0.97[b]	4.81[a]	0.34[a]	0.34[a]
48Excreta	4.79	9.55	2.05	2.01	4.78	9.48	2.08	2.08
kcal/hr	0.59[c]	2.98[b]	0.34[a]	0.33[a]	0.58[c]	3.04[b]	0.36[a]	0.36[a]
60 Excreta	1.52	2.43	0.65	0.66	1.50	2.05	1.36	1.37
kcal/hr	0.58[c]	2.45[b]	0.33[a]	0.34[a]	0.57[c]	2.50[b]	0.35[a]	0.38[a]

[a,b,c] Means within a column with different superscript are significant (P<0.05)

2 Total grams of excreta voided at 24,30,48,60 hr

3 Gross energy divided by the hours within each collection period.

by Turkey pairwise comparisons (Gills , 1978).

RESULTS

The calculated estimates of AME and the respective AMEn values for the tested ingredients are presented in Table 1 In both ingredients , at the 48hr collection period, no difference in the AME and AMEn were found in the birds (laying hen and broiler chicken) used in the experiments. The AME was higher in all the calculated data than AMEn indicating that the birds were in negative nitrogen (N) balance. The calculated estimates of TME and TMEn values of the tested ingredients are presented in Table 2 . As it was in the AME and AMEr estimate, no differences in TME and TMEn were observed in both bird types used in the studies at the 48hr collection period. The birds were in negative N balance except the chickens at the 24hr collection periods in both ingredients.

The mean excreta output and kilocalories excreted per hour for WPK and PKOS at the various collection periods are presented in Table 4

Complete passage of the test feeds was ensured at the 48hr collection period.There was no interaction found between ingredients and birds in the experiments but there were AME or AMEn by birds , and TME or TMEn by bird, interactions.

DISCUSSION

Correction to Zero N retention is often used because of protein retention of laying hens and male chickens (Askbrant 1988: Jonsson and Mcnab, 1983). A nitrogen correction to allow adjustment to be made for differences between the fed and the fasted birds has been proposed and recommended (Mutztar and Slinger, 1981; Fisher, 1982; Wolynetz and Sibbald, 1984). In this study, AMEn values of WPK derived from hens and broiler chickens differed significantly ($P<0.05$) in all the collection periods except at the 48hr (Table 1).The differences may be attributted to distinct differences between the amounts of excreted energy at the collection periods(Table 3)although both hen and broiler chicken AME values were corrected to N balance. This would explain why differences still existed in this study. In both bird types, the AMEn values were significantly ($P<0.05$) less than the AME in the tested ingredients, thus indicating that the animals were in negative N balance.. However, although differences existed in the bird types and in the ingredient types between AME and AMEn , at the 48hr collection period the AME or AMEn in the laying hens did not differ from the AME or AMEn of the broiler chicken (Table1) . Again, this could be explained by the results of excreted energy at the 48hr collection period (Table 3) . Indeed this results demonstrated that energy output stablised at 48 hr and that complete passage of the test feeds was ensured at this period of collection.

Results showed that the AME and AMEn values of the two test ingredients were different at all collection periods and with the two bird types. Whereas the difference could obviously be due to the difference in the energy output (Tables 1 and 3) at the 48hr collection period could be due to the fact that their crude fibre contents, 8.0 to 8.4% are similar (Devendra and Hutagalung, 1977) . Considering that the rate of passage is not only a function of fat content of feed ingredients but also that of crude fibre, it appeared that the observed similarity in energy output was caused by crude fibre because incomplete clearance would lower energy output (Sibbald 1976).This would in turn produce higher AME values, as demonstrated by Sibbald (1979b) and Chame *et al.* *1980) . Crude fibre, it appeared may be an explanation, considering that although WPK has 56% fat (Oruwari *et al* 1995) and PKOS has 23.5% fat (Devendra and Hutagalung, 1977) The fat of WPK is within the granular matrix of the kernel particles (Oruwari *et al* 1995) while PKOS is rather sprayable . Tenesaca and Sell (1978) and Farrel (1981) have shown metabolisable energy (ME) to be strongly correlated with the content of indigestible materials such as dietary fibre. This supports the conclusion that the endogenous energy output at the 48hr collection period of the test ingredients could be equally affected because of the similarity of their crude fibre (Table 1 and 3) . Indeed the observed difference in AME and AMEn values in this study was not due to the bird types but rather due to the bioavailable energy of the test ingredients which contain variable amounts of fat but of the same fibre content.

For the TME and TMEn estimates, the observed positive N balance at the 24hr collection period may be explained by the excreta output of this period (Table 3). In all the four series of experiments conducted the excreta output of the 24 hr collection period was the highest, and may have not included endogenous output substantially based on the excreta output of the control birds(table 3) .This is supported by the finding that the control birds may be in a state of tissue catabolism which could increase the metabolic faecal energy plus edogenous urinary energy (Kessler and homas, 1981) which may not be the case for the fed birds.

However , the case was not the same at the 48hr collection period when N balance was negative in the tested ingredients and in the bird types. It was also at this collection period that no differences were observed between the TME or TMEn in the bird types in each of the tested ingredients (Table 2) thus indicating that complete passage of the residues of these feeds was ensured at the 48hr collection period. Accordingly, it tended to show that much of the energy output at the 60hr collection period was due to tissue catabolism (Kessler and Thomas. 1981).

In this study, no interaction between the

ingredients and the birds was found because the rate of passage of the two ingredients were similar in the two bird types. It appeared that each feed type had exhibited its characteristics as previously discussed above and not because of the bird type. Accordingly , the excreta and energy output of the birds differed in the different collection periods. Moreover, WPK is a bulkier ingredient compared to PKOS (Devendra and Hutagalung, 1977) . On the other hand, interactions were observed between the estimated energy systems and the birds because at all collection periods excepts that of 48hr , the data on laying hens differed from those of broiler chickens. The significant differences between the energy systems of the birds may not be due to the increased excreta output when WPK was fed because energy excretion was higher with the PKOS at all data points while that of the control birds was similar (Table3) .Thus, the difference was rather due to the difference in the textural composition of the two ingredients and the capacity of each bird type to digest them (Askbrant , 1988; Tenesaca and Sell, 1978; Farrell, 1981).

Comparing AME and and TME systems in these experiments, TME and TMEn values for WPK and PKOS were consistently higher than the corresponding AME and AMEn values (Table3, 1 and 2) .The correction from AMEn to TMEn accentuated the ranking of the two ingredients tested. However, the TMEn values (Table 2) did not show reducing variation, a feature which has been demonstrated (Minaar and Erasmaus, , 1981; Sibbald and Morse, 1983;Sibbald,1981; Wolynetz and Sibbald , 1984).It appeared that TMEn determination of WPK and PKOS were equally sensitive as AMEn values, and both are capable of detecting differences between laying hens and broilers. To improve the validity of TME determination and to overcome difficulties in estimating endogenous energy, Sibbald (9181) proposed that more than one feeding level between 20 and 60g should be used but in this study 30g were used according to the method of Kessler and Thomas (1981) .Studies have shown that AME is strongly influenced by the level of feed intake, and that the influence of endogenous energy loss in AME is considerable at feed intake lower than 50 to 60g (Sibbald, 1975; Sibbald and Wolynetz, 1985). .As the inert components (for example ,fibre) in feed increase the endogenous energy loss (Askbrant, 1988) , it would be more accurate to charge this maintenance cost to the feed rather than the bird.

Although Hartel (1986) demonstrated that the Sibbald (1975) procedure delivered incorrect AME and TME values for broilers and cockerels because energy metabolism is regarded as related to feed energy intake, and that the errors were caused by the use of starved birds, the modified method of Kessler and Thomas (1981) that was used in this study appeared to be a compromise. In this study, the starved birds did not give artificially high estimates of endogenous energy loss and thus excreta energy output (Table 3) compared to the fed birds contrary to the report of Hartel (1986). Accordingly, the present study demonstrated differences in ME values. Theses were not eliminated when correction were made for differences in N balance between types of birds.

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ERRATUM

Page: The Reproductive performance of N'Dama and Muturu cattle in Nigeria I : Oestrus behaviour patterns Nig. J.Anim Prod. 24(2) 110 - 115

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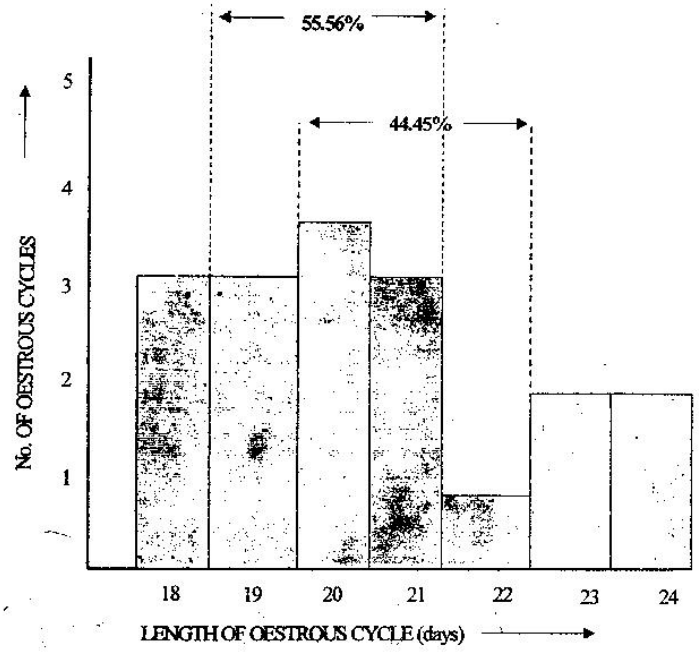
Pages 112 Fig 1b Titled: Frequency distribution of Oestrus Cycle Length (Muturu) was omitted.



Page 111 of the same paper: Under RESULTS (Oestrus Cycle Length) the last line. Fig 1a should read Fig 1b