Trop. J. Anim. Sci. 1 (2): 29-33 (1999)
ISSN: 1119-4308

DETERMINATION OF THE TRUE METABOLIZABLE ENERGY VALUE AND DIGESTIBILITY OF SARDINE FISH MEAL

B.M. ORUWARI*, U.I. OJI AND R.O. IWUAGWU,
Animal Science Department Rivers State University of Science and Technology, Nkpolu, P.M.B. 5080, Port Harcourt

Target Audience: Feed millers, poultry farmers, animal nutritionists.

ABSTRACT

Ten mature broiler chickens paired on equal weight basis were starved for 24h to void completely previous feed residues. Five of the birds were force-fed 30g dry matter(DM) of sardine fish meal as slurry. Before forming the slurry, the meal was sampled for proximate analysis. The other five birds were starved throughout the experimental period as a control group for the estimation of the metabolic faecal and endogenous urinary losses.

Excreta were quantitatively collected at 24, 48, and 60h post-prandium, and part of each sample was taken for proximate analysis for the calculation of their percent digestibility, while the other part was bombed along with the meal for gross energy (GE) determination.

Results showed that the different energy estimates differed ($P < 0.05$) at different collection periods. The true metabolisable energy (TME) was greater ($P < 0.05$) than the AME, AMEn and TMEn while apparent metabolisable energy corrected to zero nitrogen balance (AMEN) was the least. The TME and true dry matter digestibility of sardine fish meal were 3.4cal/g and 69.30%, respectively.

Key words: True metabolism energy, digestibility, sardine meal, broilers.

DESCRIPTION OF PROBLEM

Ideally, bioassay for evaluating feed ingredients involves bioavailable energy and nutrient digestibility studies which furnish information quicker. Integration of these two bioassays has been successfully used in feed evaluation. Accordingly, true metabolisable energy (TME) and apparent metabolisable energy (AME) bioassay have been extended to incorporate assays for true available amino acids (1) and lipids (2).

Sardine is a type of fish that is very common in Rivers State, Nigeria. Some Rivers State common fishes such as sardine, tilapia, mullet, mudskeeper, along

* Author for correspondence

with imported commercially prepared fishmeal have been analysed (3). It was found that the local ones compared favourably with the imported types in crude protein, ether extract and ash content, and also on performance of chickens fed on these fish meals (3). Good quality fish meals such as those containing not less than 55% protein have been classified (4) and they could serve as sole protein source in poultry diets. It was further reported that beside being a good source of protein and essential amino acids, fish meal can also furnish vitamin B12, choline, calcium and phosphorus (4). Comparison of the effects of blood meal, chicken offal meal and fish meal as sources of methionine and lysine in starter cockerels diets have been done (5).

Some workers (6) reported 3.06 and 3.40 kcal/g AME on 90 and 100% dry matter (DM) basis, and protein content of 64.74% on "as fed" basis for anchovy (fishmeal). Some earlier work reported 3.28kcal/g (7) and 3.35kcal/g AME (6), respectively.

Since fishmeal is a very important dietary component, local ones should be fully exploited to ascertain their potentials in furnishing nutrients. Thus, the objectives of this study were to determine the proximate composition, TME and digestibility of sardine fish meal.

MATERIALS AND METHODS

Ten 17-week old commercial broiler chickens were selected on equal weight basis to determine the bioavailable energy and nutrient digestibility of dried sardine fish meal.

The birds were removed from the rearing units in deep litter to the metabolic cages where they were placed in an open-sided house. They were kept in the cages for one week before the balance trial commenced to enable them adapt. The experimental layout was the completely randomised design, each bird representing an experimental unit. Five birds served as the control group and were starved throughout the experimental period while the other five were fed.

The sardine fish caught from the creeks of Rivers State was dried over charcoal-fire and ground through 2mm screen using an electric milling machine. Some sample was taken for proximate analysis (8). Correction was made for moisture content such that each of the five test birds was fed 30g (DM) of sardine fish meal devoid of crop intubation (9). By this token, each of the five birds was force-fed 30g DM sardine in slurry by careful introduction. Before feeding the test group, all the birds were starved without water for 24hr to completely clear undigested materials in their digestive tracts. While the five test birds were force-fed, thereafter the other control five birds were starved throughout the experimental period. The control group furnished data which were used to estimate the metabolic faecal and endogenous urinary

energy. Water was added to the troughs attached to the metabolic cages when the birds were fed.

Faecal materials were quantitatively collected at 24, 48 and 60h post-prandium. Polythene sheets were spread on top of the faecal receptacles located beneath the metabolic cages from which the faeces were completely scooped with a spoon into empty cans. A simulated oven made of metabolic cage and electric bulbs was used to dry the faeces on the farm before they were transferred into the force-draft oven in the laboratory for final drying at 100^{0}C to constant weight.

The dried faeces were weighed, packed in small plastic bags and stored in desiccators. Part of each sample was taken for proximate analysis for calculation of the percent digestibility of sardine fish meal, while the other part was used to obtain the gross energy (GE). Using the Parr adiabatic oxygen bomb calorimeter fitted with a digital thermometer, the GE values of both the sardine meal and the excreta were determined. Bioavailable energy values and the percent nutrient digestibility of the sardine fish meal were calculated using different methods (2, 10, 11, 12, 13).

All data were subjected to analysis of variance and differences between treatment means were separated using Tukey's pairwise comparisons (14).

RESULTS AND DISCUSSION

The proximate analyses of sardine fish meal showed for moisture 40%, crude protein 64.55%, ether extract 8.0%, ash 23.75%, calcium 2.15% and phosphorus 0.96%,. The bioavailable energy values which include AME and apparent metabolisable energy corrected to zero nitrogen balance (AMEn), TME and true metablisable energy corrected to zero nitrogen balance (TMEn) of sardine fish meal obtained at 24, 48 and 60h post-prandium are presented in Table 1. The AME estimates decreased ($P<0.05$) with time. The 24h energy data of AMEn and TME differed significantly from those at 48 and 60h, while the TMEn data were not affected ($P<0.05$) by time of collection. The different energy estimates differed significantly at different collection periods. The TME was greater ($P<.05$) than the rest while AMEn was the least.

The percent digestibility in relation to time of excreta collection for sardine meal is presented in Table 2. Apparent protein digestibility (APD) ranged from 51.88 to 65.91%. There was a time effect ($P<.05$) in APD estimates.

The apparent and true dry matter digestibility (ADMD and TDMD) ranged from 46.25 to 71.70%. Whereas the ADMD differed significantly with collection period, TDMD profile was not affected ($P>0.05$) by time. The TPD and TDMD were significantly greater than APD and ADMD, respectively.

Table 1: Energy values of sardine fish meal at different faecal collection periods[2] (Kcal/mg)

Collection periods (hr)	AME	AMEn	TME	TMEn
24	$3.25^{c} \pm 0.04$	$2.66^{b} \pm 0.02$	$3.55^{d} \pm 0.03$	$2.88^{b} \pm 0.02$
48	$2.91^{b} \pm 0.02$	$2.41^{a} \pm 0.03$	$3.47^{c} \pm 0.01$	$2.83^{b} \pm 0.03$
60	$2.81^{b} \pm 0.02$	$2.34^{a} \pm 0.01$	$3.47^{c} \pm 0.01$	$2.83^{b} \pm 0.03$

a, b, c, d Means within the columns not bearing the same superscripts are significantly ($P < 0.05$) different. *Values are ± standard error of means.*

Table 2: Digestibility values of protein and dry matter contained in sardine meal at different collection periods[3]

Collection period (hr)	APD	TPD	ADMD	TDMD
24	$65.91^{c} \pm 1.83$	$74.32^{d} \pm 2.651$	$61.95^{a} \pm 1.23$	$71.70^{c} \pm 1.03$
48	$55.67^{b} \pm 2.33$	$70.76^{d} \pm 2.624$	$50.23^{b} \pm 0.81$	$69.30^{c} \pm 1.06$
60	$51.88^{a} \pm 2.65$	$69.87^{d} \pm 2.68$	$46.25^{c} \pm 1.35$	$68.67^{c} \pm 1.16$

a, b, c, d, Mean within the columns not bearing the same superscripts are significantly ($P < 0.05$) different.
[3]Values are ± standard error of means

The crude protein of sardine fish meal was within an acceptable range and comparable with some locally available fish meals analysed in Rivers State of Nigeria which ranged from 56.70 to 62.40% (3). However, the ether extract (8.0%) was higher than other reported values (5,15). This difference may be due to the source of heat and drying time.

The bioavailable energy data of sardine fish meal were not consistent in terms of period of complete passage through the intestine. The TME and AMEn suggested 48h to be adequate for total recovery of faeces of sardine origin. In contrast, TMEn and AME suggested 24 and 60h, respectively. This was because there was no significant difference in TMEn values obtained at the periods of collection. This trend may have occurred because of the nitrogen-balance correction made for nitrogen balance (16).

In the case of AME estimate, the energy computed continued to decrease ($P<.05$) at succeeding faecal collection periods. The reason for the decrease may be explained by an observed drastic fall in AME at 24 or 30h compared with TME (13). Probably, the unabsorbed sardine meal residue had passed completely through the intestine at 24h, indicating that, thereafter, the faecal materials were only of metabolic and endogenous origin. Since these non-sardine faecal materials were regarded as of sardine fish origin, such an assumption resulted in lowered AME values. However, when non-sardine losses were corrected, the resultant TME was not significantly affected by time of faecal collection. Accordingly, 48h was chosen as the appropriate period of

total passage of sardine fish residue through the intestine with respect to TME estimate.

The APD and ADMD differed significantly ($P<0.5$) at the three collection period indicating that a collection period beyond 48h was needed for complete passage of the sardine fish residue through the intestine. Although this was the trend observed in calculating AME, correcting the data for metabolic and endogenous losses eliminated time effects.

Accordingly, the observed lack of significant difference in TPD and TDMD was caused by the correction made on the APD and ADMD. By the same token, the higher percent TPD and TDMD compared with APD and ADMD was due to the correction for metabolic and endogenous losses. Thus, confirming that apparent values are not reliable (17).

Generally, the apparent digestibility was lower ($P<0.5$) than the true digestibility estimates. This was because the metabolic and endogenous losses were taken care of in calculating the true digestibility values. Indeed, the AME of sardine fish follows the pattern of the apparent digestibility as TME result follows the true digestibility estimates. These results strongly demonstrate that corrections made for apparent digestibility values and bioavailable energy values are necessary to enhance highly precised data.

CONCLUSIONS AND APPLICATIONS

1. The TME and TDMD values of sardine fish were 3.4kcal/g and 69.30%, respectively.
2. The TME was greater that the AME, AMEn and TMEn while AMEn was the least.
3. Simultaneous determination of TME and digestibility proved to be convenient.
4. Digestibility studies may be used to enhance the accuracy of bioavailable, energy data.

REFERENCES

1. Sibbald, I.R 1979. A bioassay for available amino acids and true metabolisable energy in feeding stuffs. Poultry Sci. 668.675.
2. Sibbald, I.R and J.K.G. Krammar. 1980. The effect of the basal diet on the utilization of fat as a source of true metabolisable energy, lipids and fatty acids. Poultry Sci. 59:316 - 324.
3. Olomu, J.M. and D.A. Nwachukwu. 1977. Nutritive Value of locally prepared fishmeal for broiler chickens. Nig. J. Anim. Prod. 4:24 - 30.
4. Feltwell, R. and S. Fox. 1980. Practical Poultry Feeding. ELBS. Publ. Co. London, Pp. 128 - 129.

5. Nwokoro, S.O. 1993. Effects of blood meal, chicken offal meal and fish meal as sources of methionine and lysine in starter cockerels diet. Nig. J. Anim. Prod. 20: 86-95.

6. Rojas, S.W. and C.M. Arana. 1981. Metabolisable energy values of Anchovy fishmeal and oil for chicks. Poultry Sci. 60:2274 - 2277.

7. A.O. A.C. 1990. Association of Official Analytical Chemists. Official Methods of Analysis. Arlington, VA, USA.

8. Matterson, L.D. L.M. Otter, M.W. Stutz and E.P. Singsen. 1965. The true metabolisable energy of feed ingredients for chickens. Univ. of Connecticut Agric, Exp. Stn. Res. Rep. 7: 1 -11.

9. Sibbald, I.R. 1976. A bioassay for true metabolizable energy in feedingstuffs. Poultry Sci. 55:303 - 308.

10. Sibbald I.R. and M.S. Wolynetz. 1985. Relationships between estimates of bioavailable energy made with adult cockerels and chicks: effect of feed intake and nitrogen retention. Poultry Sci. 64:127 - 138.

11. Kessler, J.W. and O.P. Thomas. 1981. The effect of cecectomy and extension of the collection period on the true metabolisable energy value of soyabean meal, feathermeal, fishmeal, bloodmeal. Poultry Sci. 60:2639 -2647.

12. Schneider, B.H. and W.P. Flatt. 1975. The Evaluation of Feed Through Digestibility Experiments. The University of Georgia Press, Athens

13. Muztar, A.J. and S.J. Slinger. 1980. Effect of length of collection period on the metabolisable energy value in short term assays. Nutr. Rep. Int. 22: 589 - 595.

14. Gill, I.J. 1978. Design and Analysis in Animal and Medical Sciences. 1st Ed. Vol. 3 Iowa State University Press. Ames, Iowa, USA.

15. Okon, B.I and B.K Ogunmodede. 1995. Effects of replacing dietary fishmeal with periwinkle flesh on the performance of broiler chickens. Nig. J. Anim. Prod. 22(1): 37 - 43.

16. Wolynetz, M.S. and I.R. Sibbald. 1984. Relationships between apparent and true metabolisable energy and the effects of nitrogen correction. Poultry Sci. 63: 1386 - 1399.

17. Mc Donald, P., P.A. Edwards and J.F.D. Greenhalgh. 1981. Animal Nutrition. 3rd Ed. Longman. Publ. Co., London. Pp 139.