DETERMINATION OF THE APPARENT AND TRUE METABOLISABLE ENERGY VALUE OF THEVETIA OIL

O.A. ADEYEMI^{1*}, J.O. ATTEH¹ and S.A. IBIYEMI²

¹Department of Animal Production,

²Department of Chemistry,

University of Ilorin, P.M.B. 1515, Ilorin, Kwara State, Nigeria

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ABSTRACT

An experiment was designed to evaluate the metabolisable energy value of solvent extracted thevetia oil for the chicken. Apart from the metabolisable energy value, the productive performance and nutrient retention was also examined. Day-old broiler chicks were fed diets with 0.0, 2.5, 5.0 or 10.0% thevetia oil over a 2-week period. There was no significant difference ($P < 0.05$) of the treatments on feed intake, weight gain, feed efficiency or mortality rate. The apparent metabolisable energy (AME) and the true metabolisable energy (TME) values of thevetia oil were determined to be 7846 and 8016 Kcal/Kg respectively.

Keywords: Thevetia oil, productive performance, metabolisable energy, broiler starter.

INTRODUCTION

Fats are used fairly freely in the temperate countries as energy boosters in monogastric diets. However, there has been much controversy as to their use in the tropics because of the high ambient temperature. The reservation about the use of fats stems from the higher tendency for peroxidation to occur in storage at high temperature with the products of fat oxidation adversely influencing nutrient availability and hence utilisation.

Fetuga (1983), however pointed out that there is no experimental basis for this suggestion, rather the reality of the situation is that the production of oil seeds have been on the decline in many areas hence the unit cost of available oil sources does not justify their inclusion in animal feeds.

Fats and oils are reported to contain an "extra caloric effect". Summers and Leeson (1985) explained that this means that the bird derives more energy from the fat than would be indicated by the metabolisable energy (ME) values of the fat. Similar reports had been presented by Agunbiade *et al.* (1999) in a study with growing pigs. Fuller (1981) stated that it was possible to alleviate to a great extent the growth depressing effect of heat stress by the use of high level of dietary fat in poultry rations. Other advantages include an improved general appearance and palatability (Speer, 1976; Dale and Fuller, 1978). Fats are valuable in dust control and aid in pelleting as well as being a source of essential fatty acids (Summers and Leeson, 1985).

The main fats and oils commonly available in Nigeria are palm oil, groundnut oil, together with melon seed oil and coconut oil in rather small quantities (Babatunde *et al.*, 1976), however the inclination now is to search for alternative sources of oil that are not only cheap but are also not consumed by man. Thevetia oil seems to satisfy these conditions.

Thevetia oil is obtained from *Thevetia peruviana* [(Apocynaceae) Yoruba: Kaminko] which is abundant in the tropics, where it is grown as an ornamental plant. It flowers and fruits all the year round, providing a steady supply of seeds. Preliminary analysis at this

*Current Address:

Department of Animal Production,
Ogun State University,
P.M.B. 2002,
Ago-Iwoye.

station showed that the seed contains 64.10% fat on a dry matter basis.

Knowledge of the available energy content of feedstuffs is essential if we must provide the most economical diet for our birds. This study was conducted to determine the metabolisable energy values of solvent extracted thevetia oil and to investigate the effects of graded levels of the oil on performance and nutrient retention of starting broilers.

MATERIALS AND METHODS

Oil Extraction

Cracked thevetia seeds were mashed and subjected to solvent extraction (petroleum ether, 60-80°C, bp). The extracted oil and ether was separated by distillation while remaining traces of petroleum ether was removed by use of a rotary vaporizer over a steam bath.

Experimental Procedure

Seventy-two, day-old broiler chicks were housed in electrically heated battery brooder and fed the experimental diets shown in Table 1. The treatments consisted of the control diet and diets containing 2.5, 5.0 and 10.0%

thevetia oil. The four dietary treatments were each replicated three times, with six birds per replicate cage.

The diets and water was supplied *ad libitum* during an 18-day trial period. The 18 days were made up of a 14-day pre-collection period, a 1-day fast and a 3-day total collection period. At the end of each week of the adjustment period, birds were weighed while feed intake was also determined. Prior to the collection period, a total of six birds were separated from those on the basal ration to a separate cage. These birds were starved of feed for 24 hours to clear their gut, after which their excreta for the subsequent 24 hours were collected over a 72-hour period using the total collection procedure. The excreta were oven-dried at 60°C, weighed and ground before chemical analysis.

Chemical Analysis

All test samples and excreta samples were subjected to proximate analysis using the methods of AOAC (1980). Diets and excreta were analysed for nitrogen by the Kjeldahl's procedure while fat determination was carried

TABLE 1: COMPOSITION (%) OF FOUR EXPERIMENTAL DIETS FED TO BROILER CHICKS

Ingredients	1	2	3	4
Basal Ingredients*	100.00	97.50	95.00	90.00
Thevetia oil	-	2.50	5.00	10.00
<u>Proximate Content</u>				
Dry matter	91.75	87.90	88.50	88.14
Crude Protein	23.69	23.01	22.65	22.09
Fat	5.75	8.21	9.40	12.50
Crude fibre	5.62	5.41	4.95	4.60

*Consisted of: 60.00% maize, 31.68% soybean meal, 5.00% Brewers dried grain, 1.84% Bonemeal, 0.88% Oyster shell, 0.25% salt, 0.10% DL - methionine, 0.25% vitamin - mineral premix (providing IU: vitamin A, 1200 iu D2, 13 iu vitamin E, 2mg vitamin K3, 3mg riboflavin, 10mg nicotinic acid, 7.0mg pantothenic acid, 900mg choline, 0.08mg cobalamin, 1.5mg folic acid, 0.25mg biotin, 125mg antioxidant, 25mg Fe, 80mg Mn, 50mg Zn, 2.0mg Cu, 0.2mg Co and 0.01mg Se/kg diet).

out by subjecting feed and excreta samples to petroleum ether (60-80°C bp) extraction. The gross energy of the diet and excreta samples was determined in a Gallenkamp(R) ballistic bomb calorimeter.

The apparent metabolisable energy (AME) of thevetia oil was determined by the method of Hill *et al.* (1960) while the true metabolisable energy (TME) was calculated using the equation of Sibbald (1976).

$$\text{TME} = \frac{(\text{GE}_{\text{feed}} \times \text{X}) - (\text{Y}_{\text{ef}} - \text{Y}_{\text{ec}})}{\text{X}}$$

Where GE_{feed} = Gross energy of feed
 X = amount of feed consumed
 Y_{ef} = energy voided as excreta by fed birds.
 Y_{ec} = energy voided as excreta by unfed (Starved) birds.

The retention of protein, fat and fibre was determined using the equation.

$$\text{R} = \frac{(\text{FI} \times \text{N}_f) - (\text{FO} \times \text{N}_{fa})}{\text{FI} \times \text{N}_f}$$

Where R = % nutrient retained
 FI = Dry feed intake
 N_f = % nutrient in feed
 FO = Dry faecal output
 N_{fa} = % nutrient in faeces

Statistical Analysis

Data collected were subjected to analysis of variance using the model for completely randomized design (Steel and Torrie, 1980).

RESULTS

Chick Performance

The effects of increasing the dietary level of thevetia oil on the performance of starter broiler are shown in Table 2.

Average daily feed intake tended to be higher with thevetia oil based-diet, this trend did not however show any significance ($P>0.05$). Weight gain by chicks also was not significantly affected although birds fed diets with 5.0% thevetia oil tended to gain more than the other treatments. A similar trend was observed in the feed: gain ratio with chicks on 5.0% dietary thevetia oil having the best feed conversion efficiency among the treatments.

While there was no significant ($P>0.05$) effect of the dietary treatment on mortality, there was however no mortality among birds on the control diet, a converse situation to that observed with the birds on thevetia oil based diets.

Nutrient Retention and Metabolisable Energy

Increasing the dietary level of thevetia oil led to a reduction in protein retention ($P<0.05$, Table 3).

However, the retention of protein was not much different among the thevetia oil based diets. A similar trend of no significant effect of dietary treatment was observed for fat and fibre retention. Increasing dietary thevetia oil

TABLE 2: EFFECTS OF INCREASING DIETARY LEVEL OF THEVETIA OIL ON THE PERFORMANCE OF BROILER CHICKS (0-2 WEEKS OLD)

Thevetia oil in Diet (%)	Feed intake (g/chick/day)	Weight gain (g/chick/day)	Feed: Gain ratio	Mortality %
0.00	11.39	3.20	3.57	0.00
2.50	12.38	2.99	4.21	16.67
5.00	14.70	5.00	3.52	11.11
10.00	13.65	3.83	3.97	5.56
SE (n = 3)	0.79	0.84	0.35	0.62

TABLE 3: EFFECTS OF INCREASING DIETARY CONCENTRATION OF THEVETIA OIL ON NUTRIENT RETENTION AND DIETARY METABOLISABLE ENERGY (ME)

Thevetia oil in Diet (%)	Retention %			Metabolisable energy	
	Protein	Fat	Fibre	Apparent	True
0.00	67.49 ^a	64.35	52.12		
2.50	55.51 ^b	64.78	50.71	2748 ^a	2872 ^a
5.00	54.43 ^b	64.72	48.99	2797 ^a	2886 ^a
10.00	54.16 ^b	64.72	52.44	3186 ^b	3288 ^b
SE (n = 3)	1.63 [*]	0.84	0.65	0.012 [*]	0.014 [*]

*Figures in the same column followed by different superscripts indicate significant difference (P<0.05).

resulted in increased metabolisable energy. The increase in ME values was not significantly different between the 2.5 and 5.0% inclusion levels. However, the increase was significant when either 2.5% or 5.0% dietary oil level was compared with the 10.0% level. The trend was similar for both the apparent (AME) and true metabolisable Energy (TME) (P<0.05).

The following regression equations were derived for the determination of apparent and true metabolisable energy of thevetia oil from this experiment.

$$Y = 2620 + 52.2x \text{ (AME)}$$

$$Y = 2716 + 53.0x \text{ (TME)}$$

Determination for 100% inclusion level of thevetia oil gives the apparent and true metabolisable energy values of thevetia oil as 7846 and 8016kcal/kg, respectively.

DISCUSSION

The feed intake observed in this experiment is in contrast to earlier reports of Velu and Baker (1974) that as dietary fat increases, there will be a decrease in feed intake. Earlier trials in this station by Atteh *et al.* (1990) showed a decrease in feed intake with increasing level of dietary thevetia oil. It was explained by these workers that since they used mechanically extracted thevetia oil, it is possible that the

factors that are responsible for the bitterness in the residual cake might have been present in the oil thus reducing its palatability and hence the reduced feed intake. Although the weight gain by birds on thevetia based diets were not significantly different from those of birds fed the control diet, yet there was a slight gain by these birds over those on the control diet. Many reports (Rand *et al.*, 1958; Griffith *et al.*, 1977; Atteh and Leeson, 1984) have shown that fat increases weight gain of broilers. From the results of this experiment, however, it appeared as if the feed containing thevetia oil was not properly utilized and hence the high feed: gain ratio observed. Mortality rates are low in this experiment, however, in all the cases of mortality recorded the birds showed a peculiar behaviour of ataxia, general sluggishness and body tremor. Similar observations were made by Atteh *et al.* (1995) using thevetia seed cake. It is thought that the factors in thevetia have a mechanism of affecting the central nervous system (CNS) and hence the balance of the chicks. It was observed that with the three different inclusion levels of thevetia oil in this study, the True Metabolisable energy was consistently higher than the apparent metabolisable energy value. It is now a general consensus (Sell *et al.*, 1983; Summers and Leeson 1985; Agunbiade *et al.*, 1999) that supplemental fat contains an

"extra caloric effect". Summers and Leeson (1985) explained that additional fat has synergistic effect on fat that is already present in the diet. It is also believed that fat decreases transit time of food in the digestive tract hence digestive enzymes have a field day to do a more thorough job of digesting carbohydrates and proteins in the diet thus resulting in a higher availability of energy to the animal.

The apparent metabolisable energy value of 7846Kcal/Kg., although within the range of the values reported for animal fats by NRC (1984) was however lower than the values reported for vegetable oils, (i.e. 8,300Kcal/Kg for palm oil, 8,800kcal/kg for soybean oil). The low value of AME observed in this study is thought to be an indication of poor utilization of the thevetia oil based diets.

The work of Atteh *et al.* (1990) showed that thevetia oil contains a higher proportion of unsaturated fatty acids than palm oil. A positive correlation is known to exist between the degree of unsaturation of fatty acid and feed efficiency (Corino *et al.*, 1980). However, this is not the case with respect to the current study hence it appears that there are still some unknown or yet to be ascertained factors in the oil of *Thevetia peruviana* that are responsible for the low metabolisable energy value obtained in this study.

It is concluded that thevetia oil has the potential for utilization in broiler rations but will require further processing.

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