REPLACEMENT OF SOYBEAN MEAL WITH FERMENTED THEVETIA CAKE IN LAYERS DIET: EFFECTS ON PERFORMANCE, EGG QUALITY AND NUTRIENT RETENTION

O.A.ADEYEMI¹ AND ADELEKE A.ADEYEMI²

¹ Temi "D" Ventures Limited, Akaka Road, Ode-Remo, Ogun State.

² Murtala Mohammed Memorial Botanical Garden, Epe, Lagos State.

Received 24 August 1998; Accepted 04 November, 1999

ABSTRACT

80, Olympia laying hens that had been in lay for 20 weeks were randomly allocated to 5 dietary treatments and fed over a 10 week period. The birds were individually caged thus there were 16 replicates per treatment. The dietary treatment contained expeller pressed thevetia cake which had undergone anaerobiosis. The cake replaced soybean meal in the ratio of 0:100, 25:75, 50:50, 75:25 and 100:0. Dietary treatments significantly decreased ($P<0.05$) feed intake, egg production, feed efficiency and egg weight. The treatment however had no effect ($P>0.05$) on weight gain, mortality and egg quality parameters. Egg production and average egg weight was however not affected by replacement up to 50:50 substitution ratio ($P>0.05$). Nitrogen and fat retention decreased ($P<0.05$) with increasing thevetia cake concentration, while fibre was not affected. It was concluded that fermented expeller pressed thevetia cake can replace up to 50% of the soybean in layers diet.

Keywords: Thevetia cake, soybean meal, diet anaerobiosis, substitution value, laying performance.

INTRODUCTION

Previous investigations on feeding of thevetia seed cake which is obtained from *Thevetia peruviana* (Apocynaceae), (Common name: Yellow oleander) seed after fat extractions to guinea pigs, broiler and rabbits (Paul, 1963; Atteh *et al.*; 1995 and Olupona *et al.*, 1998) had indicated that the raw cake is toxic to these stocks and need further processing before it can be used as an ingredient in feed formulation. Bisset and Bogor (1962) indentified the toxic compounds as thevetin A, thevebioside, glucoperuvoside, acetylated monoside and other

cerebrosides. According to Datta and Goppa (1981) thevetin, a major isolate of thevetia seed is a cardiac glycoside.

It becomes imperative therefore that processing methods be found that will overcome the toxic compounds in thevetia cake so that feed millers and poultry farmers can take advantage of this potentially useful plant protein source. Atteh *et al.* (1995) subjected thevetia cake to amino acid analysis and reported that fat-free thevetia cake has a protein content comparable to that of soybean meal and is rich in lysine while its calcium, phosphorus, magnesium and sodium content are comparable to those found in other plant protein feedstuffs.

Glycosides are known to be acid labile (Conn and Stumpf, 1978). Since pH tend to decrease during the process of fermentation this study was designed to investigate the effect of fermentation as a processing method of thevetia cake on performance, nutrient retention and egg quality of laying hens.

MATERIALS AND METHODS

Thevetia fruits were collected from plants on the premises of Ode-Remo High School, Ogun State where they were planted as an hedge. The fruits were depulped and the endocarp cracked to obtain the seed. The seeds were pressed in a commercial screw press to extract the oil. The residual cake was milled and mixed with water to form a slurry. The slurry was placed in a double layer polythene bag and tied up. The material was placed in an empty plastic drum and sealed to ensure an airtight system for a period of 7 days, after which it was removed, sundried for 3 days and used in diet preparation. The proximate composition of the fermented cake, raw cake and soybean meal is shown in Table 1.

Eighty Olympia hens of a commercial strain that had been in lay for 20 weeks were selected from a

Current Address: Department of Animal Production,
Ogun State University, P.M.B. 2002 Ago Iwoye, Ogun state.

TABLE 1: PROXIMATE COMPOSITION OF RAW, FERMENTED THEVETIA CAKE AND SOYBEAN MEAL. (% DM BASIS)

Constituents	Raw Thevetia cake	Fermented Thevetia cake	Soybean meal
Crude Protein	40.02	43.07	42.03
Crude Fibre	6.65	6.45	6.50
Ether Extract	8.02	8.31	5.36
Total Ash	8.63	8.97	6.95
NFE	36.68	33.30	39.16
Gross Energy (Kcals/kg) calculated	4899.14	4950.61	4860.49

TABLE 2: COMPOSITION OF EXPERIMENTAL DIETS (G/KG)

	1	2	3	4	5
Fixed Ingredients	800.0	800.0	800.0	800.0	800.0
Soybean Meal	200.0	150.0	100.0	50.0	0.0
Thevetia cake	0.0	50.0	100.0	150.0	200.0
	1000.0	1000.0	1000.0	1000.0	1000.0
Analysed Composition					
Dry Matter	910.6	909.2	910.8	909.9	910.1
Crude Protein	180.6	176.3	173.1	172.5	173.5
Crude Fat	70.9	71.8	71.6	70.9	71.0
Crude Fibre	55.6	56.8	52.9	53.3	55.7

*Maize 460.0, Maize Offal 56.8, Fishmeal 10.0, Oyster shell 75.0, Bonemeal 22.5, Salt 5.0, Premix 2.5.

larger flock. The birds were individually caged in a standard poultry house which was illuminated at night and fed the experimental diets consisting of a control diet (0% thevetia cake) and diets in which 25, 50, 75 or 100% fermented thevetia cake was quantitatively added at the expense of soybean meal (Table 2).

Sixteen hens were randomly assigned to each diet. The trough in front of each hen was partitioned so that the birds can be individually fed, thus each bird served as a replicate. The trial lasted for 10 weeks. Hens were individually weighted at the commencement and termination of the experiment. Feed consumption was measured on a weekly basis, while eggs were individually collected, labelled and weighed on a daily basis. Two eggs were collected weekly (Tuesdays and Saturdays) from each replicate, labelled, weighed and broken out for egg quality measurement. The parameters studied are shell thickness, shell weight, yolk height, yolk weight and albumen weight. Yolk was separated from the albumen

with the aid of a yolk separator while the shell was washed and dried at room temperature. The yolk and dry shell were weighed separately on a Mettler (R) electric balance and the albumen weight obtained by subtraction. Shell thickness was determined by the use of a micrometer screw gauge.

Mid way through the experiment, a nutrient retention trial was carried out using 8 birds from each treatment. Weighed quantity of feed were supplied and excreta collected over a 72 hour period. Samples were dried in an oven at 70°C and ground prior to chemical analysis. Fermented thevetia cake, feed samples and excreta were analysed using the methods of AOAC (1995). Gross energy of major ingredients was calculated using Weende regression equation as described by Wiseman (1994).

$GE = 57.2CP + 95.0EE + 47.9CF + 41.7NFE + Di$
Data collected were subjected to one way analysis of variance using the completely randomised design as described by Steel and Torrie (1980).

FERMENTED THEVETIA CAKE IN LAYERS DIET

TABLE 3: PERFORMANCE OF LAYING HENS AS INFLUENCED BY DIETARY TREATMENTS

Parameters	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Feed intake (g/hen/day)	100.76 ± 6.13 ^a	97.61 ± 6.21 ^{ab}	96.91 ± 5.06 ^b	92.42 ± 7.41 ^c	88.06 ± 6.52 ^d
Body weight Gain (g/hen/day)	3.37 ± 0.90	3.08 ± 0.62	3.50 ± 0.56	2.71 ± 0.76	3.19 ± 0.96
Hen-day Egg Production (%)	77.84 ± 5.61 ^a	77.28 ± 6.72 ^a	74.11 ± 4.54 ^a	66.9 ± 8.81 ^b	63.31 ± 7.24 ^b
Egg weight (g)	60.77 ± 3.13 ^a	61.31 ± 2.77 ^a	60.00 ± 2.48 ^a	56.50 ± 3.81 ^b	53.57 ± 3.15 ^b
Feed Efficiency (Feed/Doz.eggs)	1.58 ± 0.18 ^d	1.59 ± 0.4d	1.69 ± 0.12 ^c	1.93 ± 0.39 ^b	1.98 ± 0.35 ^a
Mortality (%)	0.0	0.0	0.0	0.0	0.0

Values (mean ± SD) within rows followed by different superscripts were significantly different (P < 0.05).

TABLE 4: THE EFFECT OF DIETARY TREATMENT ON EGG QUALITY PARAMETERS

Parameters	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Shell Thickness(mm)	0.36 ± 0.04	0.35 ± 0.02	0.36 ± 0.02	0.37 ± 0.08	0.36 ± 0.03
Shell Weight (g)	7.35 ± 0.21	7.40 ± 0.35	7.38 ± 0.29	7.34 ± 0.22	7.42 ± 0.18
Yolk Height(mm)	16.45 ± 0.55	16.56 ± 0.48	16.66 ± 0.66	16.62 ± 0.51	16.43 ± 0.60
Yolk Weight (g)	17.64 ± 0.62	18.21 ± 0.82	18.16 ± 1.10	17.95 ± 1.05	18.01 ± 1.12
Albumen Weight (g)	30.24 ± 1.25	30.51 ± 1.10	30.30 ± 1.08	31.02 ± 1.21	29.85 ± 2.05

Values (means ± SD) within rows followed by different superscripts were significantly different (P < 0.05).

RESULTS

Table 3 shows the influence of increasing the concentration of dietary fermented thevetia cake on laying hens performance. Average daily feed intake decreased as the quantity of fermented thevetia cake increased in the diet (P < 0.05). The highest amount of intake was recorded for birds on the control diet. The intake of birds in the control diet did not however differ from that of birds on diet with 25:75 thevetia cake to soybean meal. Dietary treatments did not have any effect (P > 0.05) on weight gain across treatment. Replacement of soybean meal with thevetia cake up to 50:50 ratio did not significantly (P > 0.05) affect egg production, however inclusion ratio above 50:50 resulted in decreased egg production (P < 0.05). A similar result was observed for average egg weight. Increasing the amount of thevetia cake in diet above 25:75 ratio led to a decrease in feed efficiency (P < 0.05).

The result of the nutrient retention trial is presented in Table 5. Dietary treatment had no effect on fibre retention (P > 0.05). Nitrogen and fat retention however showed a decreasing trend (P < 0.05) as the concentration of thevetia cake increased in the diets.

DISCUSSION

The productive performance of hens as determined in this experiment gave an indication that the birds were able to give an appreciable

performance on fermented cake up to 50:50 inclusion ratio i.e. 10% of the total diet. Atteh *et al* (1995) reported that some of the glycosides in thevetia seed are not soluble in ether, hence seed cake will be expected to contain a substantial quantity of residual glycosides. Thevetia cake and oil are known to have a bitter taste which is thought to be related to the presence of glycosides [Atteh and Ojo (unpublished); Adeyemi, (1990)]. Perhaps, this single factor is the major cause of reduced feed intake associated with thevetia based diets.

Glycosides are known to be acidlabile (Conn and Stumpf, 1978). Stanton (1976) reported the biotransformation of thioglycosides and isothiocyanate in rape and linseed meals when the pH was decreased during the process of fermentation. The performance of birds used in this study is an indication that the nutritive value of thevetia cake was improved by the process of fermentation when compared with earlier works of Atteh *et al.*, (1995) and Olupona *et al.* (1998) using raw cake and cooked or toasted full fat thevetia. These workers reported an inverse relationship between inclusion rate and weight gain for broilers and rabbits on thevetia cake based diets, a converse situation to the result of

TABLE 5: THE EFFECT OF DIETARY TREATMENT OF NUTRIENT RETENTION OF LAYING HENS (%)

DIETS	NITROGEN	FAT	FIBRE
1	64.33 ± 4.12 ^a	77.05 ± 6.19 ^a	40.62 ± 2.40
2	59.10 ± 1.98 ^b	77.72 ± 8.52 ^b	39.71 ± 1.85
3	56.79 ± 4.48 ^c	69.43 ± 5.58 ^b	39.20 ± 2.56
4	54.39 ± 3.39 ^d	62.62 ± 2.42 ^c	40.65 ± 3.76
5	53.43 ± 1.43 ^d	60.46 ± 2.64 ^c	41.77 ± 2.11

Values (mean ± SD) within columns followed by different superscripts were significantly different ($P < 0.05$).

this experiment where body weight was not affected by dietary treatment. However increasing the concentration of thevetia cake in the diet led to a reduced feed intake and reduced feed efficiency, this observation is similar to that of Atteh *et al* (1995). But it can be argued that with an hen day production of between 63.31±7.24 (Diet 5) and 77.28±6.72 (Diet 2) for birds between 20 - 30 weeks in lay, thevetia cake was able to give a satisfactory performance when compared to the figure of 77.84±5.61 (control diet). Eka (1979) opined that during fermentation of foodstuffs, there may be an enrichment of the product as fermented products tend to exhibit a relative increase in protein, lipid and ash content even though the product may have a decreased carbohydrate content.

The decrease in nitrogen and fat retention with increase in the concentration of fermented cake is thought to be related to the accumulation of residual toxic properties that may still be remaining in the fermented cake. The result of the nutrient retention trial showed that both the fat and protein are still efficiently utilized by the birds when compared with the results of Atteh *et al*. (1995), these workers reported that nitrogen retention for starting and finishing broilers on 5% dietary raw thevetia cake were 47.9% and 45.3% respectively while 15% cake resulted in 10.2% and 9.1% retention of nitrogen for starting and finishing broilers respectively. A similar trend was also observed for fat retention by these workers. The fact remains even in this study that with an increase in thevetia cake concentration, fat and nitrogen retention showed a decreasing trend. However, the values for this study were not as low as that reported by Atteh *et al*. (1995).

It appeared from this experiment that the

fermentation process probably reduced the quantity of unpalatable substances in the thevetia cake. Walter *et al*, (1984) showed that lactic fermentation improves palatability besides upgrading the nutrient composition of the fermented material. Lactate fermentation is associated with the production of lactic acid, butyric and propionic acid (MacDonald *et al.*, 1982). It is thought that these series of acids could likely lower the pH of the cake been fermented and hence led to degradation of the glycoside complexes thus making nutrients available in fermented cake for conversion in the birds.

It is concluded that fermented thevetia seed cake can replace up to 50% soybean meal in the diet of laying hens without any adverse effect on performance and egg quality measurements.

ACKNOWLEDGEMENT

The authors are grateful to the management of Temi-D-Ventures Limited, for the use of all facilities on the poultry farm. We also thank the management of Thomas Oil Mills, Ode-Remo especially Dr. A. Ralumah for helping us to press the thevetia cake. The assistance of Miss Esther Akinfenwa and Miss Omolara Aina of Ogun State University, Ago-Iwoye in data analysis is gratefully acknowledged.

REFERENCES

- ADEYEMI, O.A. (1990). Evaluation of the metabolizable Energy Value of Thevetia Oil for chicken. M.Sc. Thesis University of Ilorin.
- AOAC (1995). Official Methods of Analysis. 16th edition. Washington, D.C.
- ATTEH, J. O., IBIYEMI, S.A. and OJO, A.O. (1995). Response of broilers to dietary levels of thevetia cake. Journal of Agric. Sci. Cambridge, 125: 307 -

310.

- BISSET, N. and BOGOR, G. (1962). A preliminary paper on the chromatographic study of the glycosides from *T. peruviana*. Chem. Abstr. 60: A 9864.
- CONN, E.E. and STUMPF, P.K. (1973). In outlines of Biochemistry. 4th Edn. John Wiley and Sons Inc. New York. 629 pp.
- DATTA, P.C. and GOPA, S. (1981). Differentiation and loss of thevetia in *Thevetia peruviana* (callus). Chem. Abstr. 94: A 205549.
- EKA, O.U. (1979). Effect of yeast fermentation of rice and sweet potatoes on their nutritive status. Nig. Jour. Sci. 13: 243 - 250.
- MAC DONALD, O.C., EDWARD, R.A., GREEN HALGH, J.F.D. (1982). Animal Nutrition. 3rd Edn. Longman Publishers. New York.
- OLUPONA, J.A., NWORGU, F.C., ODEJIMI, O.O. and OMOLE, A.J. (1998). The effect of some conventional processing techniques for *Thevetia peruviana* seed on performance of rabbits. Proc. Silver Anniversary Conference. Nigerian society for Animal P. 204 - 205.
- PAUL, R.V. (1963). Pharmacology of Cardiac glycosides - thevetin chemical Abstracts 62. Abs. 9644E.
- STARTON, T. (1976). Biological detoxification of rapeseed cake, Nutr. Abstr. and Rev. 63, 3.
- STEEL, R.G.D. and TORRIE, J. H. (1980). Principles and Procedures of Statistics. A Biometrical Approach. 2nd Edn. New York. McGraw Hill Book Co.
- WALTER, E., COLLINS, E., PHILLIPS, R. and GOODRICH, M.V. (1984). In: Understanding Agricultural Waste Recycling. Technical Review. 1984.
- WINDHOLZ, M. (1983). The Merck Index. An Encyclopedia of Chemicals, Drugs and Biologicals. 10th edn. Rayway, N. Jersey. Merck & Co.
- WISEMAN, J. (1994). Energy value of feeds for non-ruminants. In: Feeding of non-ruminant livestock. Translated and edited by J. Wiseman. pp 8: 160.