Nig. J. Anim. Prod. 2010, 37(2):264 - 270

Short Communication

Incidence of sperm Abnormalities in Ejaculates of Breeder cocks fed Rations Containing Different Levels of Cottonseed Meal

M. Abdulrashid,[1] *O.P. Akinpelumi,[2] G.N Akpa[1] and I.R. Muhammad[3]

[1] *Department of Animal Science, Ahmadu Bello University, Zaria, Nigeria*

[2] *National Animal Production Research Institute, Shika-Zaria, Nigeria*

[3] *Department of Animal Science, Bayero University, Kano, Nigeria*

Corresponding author: P.O. Box 1084, Zaria.
e-mail: amaamoon@mail.com
Phone:+234-802-477-3333
*Posthumous

Abstract

A seven week study was conducted to determine the effect of three dietary levels of cottonseed meal (0%, 15%, 30%) on the occurrence of spermatozoa morphological abnormalities in mature Rhode Island White (RIW) breeder cocks. Abnormalities of the acrosome, sperm head, cytoplasmic droplets and mid piece and sperm tail were investigated in 180 ejaculates collected between October and November. All types of abnormalities were variable between treatments and between extent of feeding (weeks). The values (2.90, 5.30 and 8.63) on sperm head abnormalities were significantly different ($P<0.01$) between treatments and increased linearly with higher levels of cottonseed meal (CSM) in the diets. Abnormalities of the sperm tail were significantly variable ($P<0.05$) within treatment weeks with a linear increase from baseline value (2.00) to about the 3rd week post feeding (5.00). The mean total sperm morphological abnormalities in the treatment groups significantly increased linearly ($P<0.01$) as duration of feeding increased. It is suggested that breeder cocks should not be fed rations containing more than 15%CSM.

Keywords: Cotton seed meal, Breeder Cocks, Gossypol, Ejaculates, Sperm Abnormalities

Introduction

The increasing demand for dietary protein intake due to population increase has placed much emphasis on exploitation of non conventional feedstuffs in poultry production. Feed constitutes the largest cost item in poultry production in Nigeria (Ogundipe, 1987). The high cost and scarcity of conventional feedstuffs in the country

has led to the search for alternative feedstuffs which are not consumed directly by man and which could be generally utilized by livestock. Groundnut cake and soyabean meal are the conventional sources of protein in poultry diets in Nigeria. Recently however, prices of these ingredients have become prohibitive. In order to reduce production costs, alternative sources of protein which can substitute soyabean meal (SBM) and groundnut cake (GNC) are being included in poultry rations (Nzekwe and Olomu, 1984; Ogundipe *et al.*, 1990). Cottonseed meal is readily available in Northern Nigeria and is relatively cheaper than other protein concentrates. However, cottonseed meal contains gossypol, a toxic biochemical compound that is known to possess anti-fertility properties (Chang *et al.*, 1980; Ikurior and Fetuga, 1984; Lim *et al.*, 1986) and which may limit its use in poultry rations. However, existing reports on the anti fertility effects of gossypol contained in cottonseed meal have been mostly on large animals (Medway, 1969; Randel, 1992; Roca *et al.*, 1992). It is therefore necessary to assess the implications of CSM inclusions in breeder cock diets as it affects sperm morphological characteristics in order to determine the safe dietary limits for optimum breeding and fertility. The objective of this study therefore, was to determine the effects of dietary inclusions of cottonseed meal on the incidence of sperm abnormalities in breeder cock semen.

Materials and Methods

Location of Study:

The study was conducted at the poultry research farm of National Animal Production Research Institute (NAPRI) Shika, Zaria. Shika lies between latitude 11° 12'N and longitude 7° 33'E at an altitude of 640m above sea level. The area falls within the Northern Guinea Savannah zone with an annual rainfall of 1092mm. Mean maximum temperature ranges from 27-35°c depending on season (Akpa *et al*, 2002).

Experimental Animals/Data Collection:

Thirty (30) mature Rhode Island White (RIW) breeder cocks (42-45 weeks of age and weighing between 3.5 and 4.0kg) were used for the study. They were managed on deep litter floor pens. A pre-experimental period of two weeks was observed during which all birds were fed a common basal diet. The cocks were randomly allotted to three (3) dietary treatments (A, B & C) containing 0% (control), 15% and 30% cotton seed meal (CSM) respectively (Table 1). Ten (10) birds were allocated to each treatment. Isocaloric and Isonitrogenous diets were formulated and offered *ad libitum*. Water was also provided always. The completely randomized design (CRD) was used for the experiment. Semen was collected once a week using the massage technique as described by Lake and Stewart (1978) from 10 bird per treatment. All ejaculate samples were collected using calibrated centrifuge tubes. Immediately after each collection, smears of semen were made on clean glass slides for morphological studies of the sperm head using eosin-nigrosin stain. Morphological examination of the stained sperm cells were undertaken to determine the type and level of abnormalities in the semen. Fresh semen samples were also diluted and stored in buffered formal saline (1:100) for morphological studies

Table 1: Percentage Composition of Experimental Diets (Breeder Rations)

Ingredients	Treatments (% CSM) 0 A	15 B	30 C
Maize	53.7	46.44	39.15
Rice offals	10.00	10.00	10.00
Groundnut cake	25.50	17.76	10.05
Cottonseed meal	0	15.00	30.00
Bone meal	2.75	2.75	2.75
Limestone	7.50	7.50	7.50
Salt	0.30	0.30	0.30
Vitamin-Mineral premix	0.25	0.25	0.25
Total	100.00	100.00	100.00
Calculated Analysis of the Diets:-			
Nutrients			
ME(Kcal/kg)	2620.00	2680.40	2740.50
Crude protein	16.56	16.56	16.56
Lysine	0.59	0.74	0.91
Methionine	0.23	0.25	0.27
Phosphorus	0.82	0.86	0.90
Calcium	3.92	3.93	3.94
Ash	4.12	4.55	4.97
Crude Fibre	2.75	6.46	9.17

of the acrosome, mid piece and sperm tail. The wet-fixation technique was used to study acrosomal integrity as well as other routine morphological studies like motility (tail abnormalities), sperm head and mid-pieces. Buffered formal saline (10%) as routinely used in NAPRI, Shika (Sekoni *et al*, 1981) was used in the present study. Samples were viewed using phase contrast microscope (x1000) and under oil immersion. Sperm abnormalities were counted in at least 200 spermatozoa per slide. The abnormalities were monitored in a total of 180 ejaculates, collected between October and November.

Statistical Analysis:

The data obtained were subjected to analysis of variance procedures using mixed model least squares and Maximum likelihood computer programme (Harvey 1990).

Results

The effect of dietary treatment on the occurrence of sperm morphological abnormalities is shown in Table 2. Abnormalities of the acrosome (ACR), detached heads (DETH), sperm tail (SPT) and middle piece (MBP) although variable between treatments were not significantly different ($P>0.05$). Sperm head abnormalities increased linearly ($P<0.01$) with higher levels of CSM in the diets. Abnormalities of the sperm tail were significantly affected ($P<0.05$) by dietary treatment. The effect of period (weeks) of feeding CSM containing diets on the incidence of sperm abnormalities in breeder cocks is shown in Table 3. There was a linear increase from the

Table 2:- Effect of treatments on incidence of spermatozoa morphological abnormalities in cocks fed diets containing CSM

ABNORMALITIES TREATMENT	ACR^{NS}	SPH**	DETH^{NS}	MDP^{NS}	SPT^{NS}	TOTAL Abnormalities^{NS}
A (0%CSM)	1.833	2.90^{a}	3.75	2.083	3.83	14.40
B (15% CSM	0.583	5.30^{b}	3.167	1.917	3.50	14.47
C(30% CSM)	1.167	8.63^{c}	2.83	3.25	2.66	18.54
S.E	± 0.625	±2.878	±0.465	±0.726	±0.603	±1.914

^{a,b,c}Means with different superscripts in the same column are significantly different(P<0.01)
NS=Not significantly different
ACR= Acrosome
SPH= Sperm Head
DETH= Detached Head
MDP= Mid Piece
SPT= Sperm Tail

Table 3:- Effect of period of feeding CSM containing diets on occurrence of spermatozoa morphological abnormalities in breeder cocks

ABNORMALITIES WEEKS	ACR^{NS}	SPH^{NS}	DETH^{NS}	MDP^{NS}	SPT*	TOTAL Abnormalities^{NS}
0	1.00	3.13	2.83	1.83	2.00^{b}	10.78
1	0.67	4.30	3.00	1.50	4.83^{a}	14.30
2	1.50	5.67	2.67	2.33	3.00^{e}	15.17
3	1.67	6.37	4.00	2.00	5.00^{a}	19.04
4	1.33	6.87	3.67	4.50	2.40^{c}	18.77
5	1.00	7.33	3.33	2.33	2.75^{d}	16.74
S.E	0.152	0.658	0.210	0.436	0.520	1.261

^{a,b,c}Means with different superscripts in the same column are significantly different(P<0.05)
NS =Not significantly different
S E = Standard Error
ACR= Acrosome
SPH= Sperm Head
DETH= Detached Head
MDP= Mid Piece
SPT= Sperm Tail

Table 4: Mean percentage weekly and total spermatozoa morphological abnormalities in cocks fed graded levels of cotton seed meal in their diets

	Dietary treatment groups		
WEEKS (p.t)	A(0%)	B(15%)	C(30%)
0	10.6	12.0	9.8
1	12.0	12.4	13.1
2	9.0	15.4	19.8
3	16.7	15.3	23.7
4	12.5	17.7	25.1
5	12.0	15.2	23.0
Mean	12.13[a]	14.67[b]	19.08[c]
± SD	± 2.352	± 1.944	± 5.706

a,b,c: Means with different superscripts on the same row differ significant (P<0.01). P.T: = Post treatment, WKO = Pre treatment baseline values.

baseline value to about 3rd week post treatment and a reduction on the incidence of abnormalities thereafter. The mean total sperm abnormalities in the treatment groups within a 5-week period is shown in Table 4.The mean total sperm abnormalities also increased linearly (P<0.01) in treatments B (15% CSM) and C (30% CSM) as the duration of feeding (weeks) increased.

Discussion

The general trend was for total sperm abnormalities to increase with increasing dietary levels of CSM and increased exposure of the cocks to the diets. This increase was both dose (amount) and time dependent as reported in earlier findings with rodents (Hahn *et al.*, 1981) . The increase in sperm head abnormalities with higher levels of CSM inclusion as well as length of feeding suggest that CSM may be injurious to this section of the sperm cell. The predominant abnormalities of the sperm head observed in this study included ruffled heads and knobbed heads. Abnormalities of the sperm head probably resulted from impaired spermatogenesis in the testes of the affected males (Roca *et.al.*, 1992). Thus, it seems that CSM has detrimental effects on the spermatogenic tissues of the male chicken. This may be attributed to gossypol damage of the germinal epithelium within the testes of bulls (Randel *et al.*, 1991). The significant effect of CSM based diets on abnormalities of the sperm tail with time may affect the motility of spermatozoa in the fresh semen of such birds. The cause of sperm tail abnormalities such as bent tails, coiled tails, double tails and cytoplasmic droplets on tails has been related to disturbance with sperm maturation process and to faulty/improper smear preparation and staining techniques (Harasymowycz *et al.*, 1976; Sekoni *et al*, 1981). Fertility is occasionally impaired by improper management techniques, poor nutrition and frequent ejaculation (Nwoko and Ibe, 2005).

Conclusion

It was therefore concluded that feeding cocks with rations containing high levels of CSM significantly increased incidence of sperm abnormalities which could adversely affect the fertility status of such cocks.Thus, the dietary

inclusion level of CSM in breeder cocks ration should not exceed 15% in order to maintain optimal reproductive capacity and fertility.

Acknowledgement

The authors appreciate the Director of National Animal Production Research Institute(NAPRI) Shika, Zaria, for the approval of the commencement of the study. Professor S.O. Ogundipe and Professor O.O. Oni are appreciated for providing appropriate study environment and providing materials for the trial.The authors also extend their gratitude to Dr. I. Adeyinka for the statistical analysis and technical staff of feedmill, poultry housing unit and also Animal Reproduction Laboratory.

References

Akpa, G.N., Ifut, O.J. and Mohammed, F. 2002. Indigenous management of dystocia in ruminant livestock of northern guinea savannah of Nigeria. *Nig J. Anim. Prod*, 29(2): 264-270.

Chang, M.C, Gu ,Z. Saksena, S.K. 1980. Effects of gossypol on the fertility of male rats, hamspers and rabbits. *Contraception* 21:461.

Hahn, D.W., Ruscus, C., A. Probst, R.Homm and A.A. Johnson, 1981. Anti-fertility and endocrine activities of gossypol in rodents. *Contraception* 24:97

Harasymowycz, Ball, L.J and Sidel, G.E 1976. Evaluation of Bovine spermatozoal morphologic features after staining or fixation. *Am. J. Vet. Res*, 37:1053-1057.

Harvey R.W. 1990. Mixed Model Least Squares and Maximum Likelihood Computer Program PC-2.

Ikurior, S.A and Fetuga B.L.A. 1984b. Chemical and Biological Evaluation of Nigeria cottonseed meal; Protein quality. Abstr. *Trop. Agric*, 13:68651.

Lake, P.E and Stewart, J.M 1978. *Artificial Insemination in Poultry*. Biochemistry of Domestic fowl (3): 1411-1425. Academic Press, London, New York.

Lim, Y.C Rikihisa, Y, Graham P, and Knight J. 1986. Serum testototerone changes and residual gossypol content in reproductive and endocrine organs of male pigs fed a ration containing FDA allowed 450 ppm. Gossypol. *J. Androl*, 7:13.

Medway W, Prier, J.E and Wilkinson J.S. 1969. *A textbook of Veterinary clinical Pathology*, London pp. 497-505.

Nwoko N. and Ibe, S.N..2005. Effect of breed and season on semen quality and fertility of bucks in a humid tropical environment. *Nigerian Journal of Animal Production*, 32(2):327-334.

Nzekwe, H.M and Olomu ,J.M. 1984. Cottonseed meal as a substitute for groundnut meal in the rations of laying chickens and growing turkeys. *J. Anim. Prod. Res.*4:57-71.

Ogundipe, S.O 1987. Non –conventional poultry feedstuffs: From research to Practice.

Paper presented at the poultry farmers workshop. A.E.R.L.S/A.B.U. Zaria.

Ogundipe, S.O., Elukpo, S.M, Olorunju, S.A.S and and Sekoni, AA.1990. Utilisation of underlinted and undecorticated cottonseed cake in poultry rations. 2. Experiment with laying hens. Paper presented at the 15th annual conference of the Nigerian Society for Animal Production held at Ogun State University, Ago-Iwoye, March 1990.

Randel, R.D., Chase C.C Jr. and Wysc S.Y. 1992. Effects of gossypol and cottonseed products on reproduction of mammals. *J. Anim. Sci*, 70:1628-1638.

Roca, J., Martinez, L. Sanche-Volverde M.A., Ruiz, S and Vazguez, J.M 1992. Seasonal variations of semen quality in male goats:-study of sperm abnormalities. *Theriogenology*, 38:115-125.

Sekoni, V.O Gustaffson, B.K and Mather, E.C 1981. Influence of wet fixation, staining techniques and storage time on bull's sperm morphology. *Nord Veterinaermed*, 33:161-166.

(Received 20th October 2008; Accepted 2nd May, 2009)