

STUDIES ON COCK SEMEN. I. EFFECTS OF FREQUENT EJACULATION AND BREED ON PHYSICAL CHARACTERISTICS

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Target audience: Poultry farmers and breeders, animal scientists, veterinarians.

ABSTRACT

The effects of frequent ejaculation and breed on the semen characteristics of cocks were studied using eighteen cocks made up of twelve nine-month old exotic cocks (six Harco and six Anak strains) and six mature local cocks of unknown ages. The cocks were ejaculated once, twice or thrice per day for a seven-day period in a change over design. In all the breeds, the colour of the ejaculates was creamy, milky white or watery while significant ($P < 0.05$) breed differences were observed in ejaculate volume, sperm concentration, sperm output and sperm motility with the heavier breeds being superior to the lighter indigenous cocks. Percentage dead sperm was not influenced by breed. Frequent ejaculation resulted in a significant ($P < 0.05$) decrease in semen volume, sperm motility, sperm concentration and sperm output and a significant ($P < 0.05$) increase in % abnormal sperm. The study showed that frequent ejaculation could have adverse effect on the quality of ejaculates and thus fertilizing capacity, with the exotic cocks however having a higher quality semen over the local cocks.

Key words: Frequent ejaculation; breed; cock; semen characteristics.

DESCRIPTION OF PROBLEM

The potential for increased poultry production has continued to be of considerable concern to Nigerians in view of the numerous problems facing the industry in recent times. This concern is borne out of the fact that the developing poultry industry is the fastest means to close the animal protein deficiency gap prevailing in the country possibly because a rapid increase in its production can be achieved in a relatively short time compared to what obtains in other livestock.

Reproductive inefficiency is recognised as the costliest and most limiting constraint to efficient animal production. Fertility and hatchability are the

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major items among the many management and production constraint faced by commercial poultry breeders. Semen consists essentially of sperm cells suspended in a liquid or semi-gelatinous medium known as the seminal plasma (1). Extensive studies in several mammalian and avian species have shown considerable variations in its physical and chemical composition from one breed to another and also among individuals within the same breed (2, 3, 4, 5, 6). This is attributable to the capacity of the epididymides as observed in rams and chickens (7). The efficiency of sperm production tends to remain uniform throughout the reproductive life of an animal and may be significantly altered by season, bioclimatic factors, hormones, chemicals and drugs (8, 9, 10). Significant individual variations in the cock's semen is mostly reflected in sperm concentration and total live and abnormal sperm per ejaculate (11). Heavy poultry breeds have recorded higher values in terms of semen volume, sperm concentration, daily sperm output and progressive motility than the light breeds (2, 4, 5, 9).

It is not clear how often and for how long a cock can be used for mating without having a depression in the stock fertility. For use in artificial insemination, semen collection involves a proper scheduling and sexual preparation of the male as well as the use of proper techniques (12), while maximum numbers of usable sperm per unit time is greatly influenced by frequent semen collection (1, 13). In turkeys, semen volume and sperm cell numbers decrease with successive ejaculation and very few sperm cells are observed within a sixty-minute period (14).

The objective of this study was to determine semen characteristics of different breeds of cocks at three ejaculation frequencies. An inclusion in the study of the local chicken, known for its hardiness, is aimed at providing sufficient information on the study of technological intervention geared towards improving the reproductive and productive potentials of the chicken.

MATERIALS AND METHODS

Experimental animals : A total of eighteen cocks, comprising of six Nigerian indigenous breed (1.49 ± 0.07 kg live weight) and twelve nine-month old exotic ones, made up of six Harco strains (2.57 ± 0.03 kg live weight) and six Anak stains (2.33 ± 0.05 kg live weight), were randomly divided into three experimental groups with each strain being represented by two cocks.

Management of experimental animals : The cocks were kept singly in battery cages measuring 0.15 m x 0.12 m x 0.15 m. They were fed on commercial breeder's ration of 18 % crude protein at a rate of 130 g per cock per day and water was given free choice throughout the experimental period. The study was carried out in the University of Ibadan Farm with an equatorial humid and semi-hot climate (8).

Experimental design : Three experimental groups were each subjected to three ejaculation frequencies in a change over design. The ejaculation frequencies used were once a day, twice a day and thrice a day for a seven-day period each. There were thirty minutes between successive ejaculations and two weeks of rest between frequencies.

Semen collection : Semen was collected by the double hand massage method of Burrows and Quinn (15). The cocks were subjected to a pre-experimental daily training period of three weeks to get them used to the collection method.

Semen evaluation : The semen colour was visually appraised directly from the collection tube and the volume of the ejaculate read off to the nearest 0.01 ml from the graduated collection tube. Sperm concentration was determined haemocytometrically while the proportion of live-dead spermatozoa was differentiated and counted in a smear stained with eosin-nigrosin according to Blom (16) and the abnormal sperm were microscopically evaluated by random observation of 200 spermatozoa at a magnification of 1000. Sperm cells were classified as normal and abnormal as per Egbunike (17).

Data analysis : The data were analysed using percentages and two-way analysis of variance (18) while means were compared using Duncan's multiple range test (19).

RESULTS

A total of 751 successful ejaculations was recorded and the colour of the ejaculates was watery, milky white or creamy (Table 1). As frequency of ejaculation increased, significant ($P < 0.05$) decreases were recorded in volume of ejaculate, progressive motility and sperm concentration. A significant ($P < 0.05$) increase in percentage abnormal spermatozoa was observed as the frequency of ejaculation increased. No significant difference was observed in percentage dead spermatozoa (Table 2).

Table 1. Mean occurrence of colour of ejaculate of chickens (%).

Colour	Frequency of ejaculation		
	Once/day	Twice/day	Thrice/day
Creamy	75.0	58.0	28.5
Milky	20.7	31.5	20.4
Watery	4.3	10.5	51.1

Table 2 Breed and seasonal influences on the qualitative and quantitative physical characteristics of cock semen

Parameters	Seasons							Means ± sem
	Breed	Late dry	Early rain	Late rain	Early dry			
Body weight (kg)	Exotic	2.17 ± 0.03	2.23 ± 0.02	2.01 ± 0.03	2.04 ± 0.05			2.11 ± 0.05*
	Local	1.58 ± 0.02	1.64 ± 0.03	1.59 ± 0.03	1.50 ± 0.03			1.58 ± 0.03
Semen volume (ml)	Exotic	0.42 ± 0.06 ^a	0.25 ± 0.02 ^b	0.28 ± 0.02 ^b	0.41 ± 0.05 ^a			0.34 ± 0.04*
	Local	0.28 ± 0.04 ^a	0.22 ± 0.02 ^a	0.25 ± 0.03 ^a	0.23 ± 0.04 ^a			0.25 ± 0.01
Sperm motility (%)	Exotic	79.26 ± 1.54	81.46 ± 1.43	78.83 ± 1.40	83.80 ± 1.45			80.80 ± 0.77**
	Local	72.68 ± 1.78	73.26 ± 2.01	74.75 ± 1.56	76.75 ± 2.10			74.51 ± 0.92
Semen pH	Exotic	7.22 ± 0.07	7.23 ± 0.08	7.17 ± 0.09	7.23 ± 0.06			7.21 ± 0.10
	Local	7.39 ± 0.10	7.48 ± 0.12	7.33 ± 0.07	7.50 ± 0.09			7.43 ± 0.03
Sperm concentration (x 10 ⁹ /ml)	Exotic	4.21 ± 0.46 ^a	3.28 ± 0.46 ^a	3.08 ± 0.27 ^b	3.88 ± 0.43 ^a			3.64 ± 0.21*
	Local	3.40 ± 0.31 ^a	2.16 ± 0.21 ^b	2.64 ± 0.30 ^a	3.79 ± 0.32 ^a			3.04 ± 0.32
Sperm output (x 10 ⁹)	Exotic	2.04 ± 0.43 ^a	0.95 ± 0.19 ^b	0.95 ± 0.15 ^b	1.53 ± 0.22 ^a			1.36 ± 0.15**
	Local	1.00 ± 0.18	0.48 ± 0.09	0.78 ± 0.15	0.93 ± 0.22			0.81 ± 0.08
Total abnormality (%)	Exotic	10.99 ± 1.98	10.20 ± 0.98	10.17 ± 0.73	10.25 ± 0.82			10.66 ± 0.24
	Local	13.11 ± 2.01	12.33 ± 1.04	12.13 ± 1.52	13.63 ± 1.85			12.80 ± 0.30
Total dead (%)	Exotic	3.40 ± 0.52	2.65 ± 0.41	2.43 ± 0.46	3.62 ± 0.83			3.03 ± 0.28*
	Local	8.15 ± 0.63	6.63 ± 0.50	6.59 ± 0.51	7.85 ± 0.65			7.31 ± 0.45

* Breed differences are significant (P < 0.05)

** Breed differences are significant (P < 0.01)

ab: Seasonal values in the same row differently superscripted differ significantly (P < 0.05)

Significant ($P < 0.05$) differences were observed among the local, Anak and Harco breeds in volume of ejaculate with 0.16 ± 0.02 ml, 0.21 ± 0.01 ml and 0.25 ± 0.01 ml, respectively, sperm concentration (1.83 ± 0.22 , 2.44 ± 0.24 and $3.72 \pm 0.40 \times 10^9$ /ml, respectively) and percentage dead spermatozoa (6.26 ± 1.01 %, 5.83 ± 0.08 % and 5.56 ± 1.00 %, respectively). Percentage abnormal spermatozoa was highest in the local breed (17.02 ± 0.53 %) while no significant difference was observed between the exotic breeds (15.93 ± 6.17 % and 15.95 ± 6.19 % for Anak and Harco breeds, respectively).

DISCUSSION

The creamy, milky and watery colours of the ejaculate recorded in the study fall within the normal range reported by Sturkie (20). However, the lower incidence of the high density cream colour as the frequency of ejaculation increased is in agreement with the findings of Moss et al. (21) and Jainudeen et al. (22) attributing the change in colour to decreasing sperm concentration.

The significant breed difference in volume of ejaculate is as reported by Egbunike and Oluyemi (23) and Egbunike and Nkanga (4). This breed variation in ejaculate volume might be due to differences in the liveweight in favour of the heavier exotic breeds which possibly have larger reproductive organs with capacity for high seminal fluid secretion. The significant decrease in volume as the frequency of ejaculation increased was similar to that reported already (24, 25) although Oyeyemi et al. (1) observed no such effect while using electro-ejaculator for semen collection in goats. The method of ejaculation and the larger epididymides of the buck compared to the cock may therefore be responsible for this divergence.

The significant low motility observed as the frequency of ejaculation increased may be attributed to the observation of a greater incidence of abnormalities and dead spermatozoa with increasing ejaculation frequency. This agrees with the findings of earlier workers (9, 23). The increase in percentage sperm abnormality may be due to the depletion of the epididymal sperm reserves which in turn will lead to the release of immature sperm cells into the ejaculate and hence decrease in fertilization. The percentage dead spermatozoa observed in this study while agreeing with some findings (23) was higher than others (4).

It is possible to infer that the breed differences in sperm concentration could have resulted from the relatively higher spermatogenic efficiency of the exotic breeds over the local as has been advanced (9, 26) and is said to be due to a cumulative expression of several interactive factors such as large body weight and testes weight, volume percent of seminiferous tubules and the volumetric proportions of germinal cells. The sperm concentration reported in the study, though higher than 0.259×10^9 sperm/ml reported by Ledec et al. (27), is similar to those found by Egbunike and Nkanga (4). The difference in values obtained by different

workers is expected since sperm concentration varies with breed, nutrition and method and season of ejaculation.

The decreasing sperm concentration and output as the frequency of ejaculation increased is in good agreement with earlier findings (14) that in natural matings semen volume and sperm cell numbers decrease with each successive ejaculation and that very few sperm cells were observed after three of four ejaculations within a thirty-minute period. This decrease was not however substantial enough as to fall below the 62 million sperm cells per insemination estimated by Van Duijn (28) to be desirable for optimum fertility.

CONCLUSION AND APPLICATION

We can conclude from these results that

1. Breed differences in semen quality in poultry may be related to the liveweight of cocks.
2. That increased frequency of ejaculation could have adverse effects on semen quality and hence the fertilizing capacity of the cocks.
3. Although the deterioration of semen with increasing ejaculation frequency was not to the minimum point prescribed for optimum fertility (Van Duijn, 1964), it is prescribed from these findings that properly fed and managed cocks should not be ejaculated more than once a day.

REFERENCES

1. Oyeyemi, M. O., M. O. Akusu, M. O. Olaoye and O. T. Omobowale, 1996. Effect of frequent ejaculation on the semen characteristics of West African Dwarf bucks. *Trop. Vet.* 14: 71 - 75.
2. Egbunike, G. N. and A. O. Elemo, 1978. Testicular and epididymal sperm reserves of crossbred European boars raised and maintained in the humid tropics. *J. Reprod. Fert.* 54: 245 - 248.
3. Egbunike, G. N. and E. E. Nkanga, 1999. Effects of breed and season on semen characteristics of the cock in the humid tropics. *Trop. J. Anim. Sci.* 1(1): (In press).
4. Egbunike, G. N. and J. A. Oluyemi, 1979. Comparative studies on the reproductive capacity of Nigerian and exotic poultry breeds. I. Testis and semen characteristics. *Niger. J. Anim. Prod.* 6: 47 - 51.
5. Nkanga, E. E., 1989. Breed and seasonal influences on the reproductive potential of the cock in a humid tropical environment. Ph. D., University of Ibadan, Ibadan, Nigeria.
6. White, I. G., 1958. Chemical composition of White Leghorn semen. *Anim. Breed. Abstr.* 26: 109.
7. Perry, E. J., 1973. Factors influencing the quality and quantity of semen. In: *Artificial Insemination of Farm Animals* (4th ed), pp 76 - 89.

8. Egbunike, G. N., W. Holtz, W. Endell and D. Smidt, 1975. Reproductive capacity of German improved Landrace boars. I. Gonadal and extragonadal sperm reserves. *Zuchthygiene* 10: 184 - 187.
9. Kamar, G. A. R. and A. L. Badreldin, 1959. Seasonal variation in semen characteristics of adult Fayomi cocks. *Poult. Sci.* 38: 301 - 315.
10. Nkanga, E. E. and Egbunike, 1992. Seasonal influence on fertility and hatchability in the domestic fowl in the humid tropics. In: 12th Int. Congr. Anim. Reprod., The Hague, 3pp.
11. Perek, M. and N. Snapair, 1963. Seasonal variations in semen production of different breeds of cocks and the effect of vitamin C feed supplementation upon the semen of White Rocks. *Brit. Poult. Sci.* 4: 19 - 26.
12. Foote, R. H., 1975. Artificial insemination. In: *Reproduction in Farm Animals*. (3rd ed., Hafez, E. S. E., ed), Lea & Febiger, Philadelphia, pp 409 - 421.
13. Almquist, J. O. and E. B. Hale, 1956. An approach to the measurement of sexual behaviour and semen production of dairy bulls. 3rd. Int. Congr. Anim. Reprod., Cambridge, U.K., pp 50 - 59.
14. Parker, J. E., 1942. Fertility in fowls under Egyptian conditions. *Indian J. Vet. Sci.* 29: 19 - 25.
15. Burrows, W. H. and J. P. Quinn, 1937. The collection of spermatozoa from the domestic fowl and turkey. *Brit. Poult. Sci.* 16: 19 - 24.
16. Blom, E., 1959. A rare sperm abnormality "Cocksore Sperm" associated with sterility in bulls. *Nature (London)* 183: 1280 - 1281.
17. Egbunike, G. N., 1980. Changes in the acetylcholinesterase activity of mammalian spermatozoa during maturation. *Int. J. Andrology* 3: 459 - 468.
18. Steel, R. G. D. and J. H. Torrie, 1960. *Principles and Procedures of Statistics*. McGraw-Hill Book Co., Inc, New York.
19. Duncan, P. B., 1955. New multiple range and multiple F-tests. *Biometrics* 11: 1 - 42.
20. Sturkie, P. D., 1970. Respiration in Birds. In: *Dukes Physiology of Domestic Animals* (Swenson, M. J., ed), Comstock Publishing Assoc., New York, pp 109 - 113.
21. Moss, J. A., D. R. Melrose, H. C. D. Reed and Vandep lasche, 1979. In: *Fertility and infertility of domestic animals* (Laing, J. A., ed) pp 59 - 91.
22. Jainudeen, M. R., Bongso, T. A. and S. Dass, 1982. Semen characteristics of Swamp Buffalo (*Bubalus bubalis*). *Anim. Reprod. Sci.* 4: 213 - 217.
23. Egbunike, G. N. and J. Steinbach, 1979. Seasonal variations in the sperm production rates of boars in a humid tropical environment. *Niger. J. Agric. Sci.* 1: 21 - 26.
24. Nwakalor, L. N., G. C. Okere and D. C. Njoku, 1986. Semen characteristics of the Guinea Fowl (*Numida meleagris*). *J. Anim. Prod. Proc.*, Ahmadu Bello University, Zaria, March 23 - 27, 1986.

25. Pfaff, W. K., A. J. Pescatore, F. Rutz, A. H. Cantor and T. H. Johnson, 1990. Effect of frequency of semen collection on semen production and fertility during post-rest period. *Poult. Sci.* 69: 183 (abstr).
26. Nkanga, E. E. and G. N. Egbunike. 1990. Daily sperm production of the domestic fowl (*Gallus domesticus*) determined by quantitative testicular histology and homogenate methods. *Trop. Anim. Prod. Invest.* 1 (1): 1 - 8.
27. Ledec, M. C., J. Suka and P. Skrobanek, 1981. A comparison of semen characteristics of the domestic chicken with guinea fowl. *Anim. Breed. Abstr.* 49 (7): 4284.
28. Van Duijn, C. J. R., 1964. *Int. J. Fert. Abstr.* 9: 609 - 612.