ENHANCING SEXUAL BEHAVIOUR IN GILTS THROUGH THE ADMINISTRATION OF TESTOSTERONE ENANTHATE

[1]Ladokun, A.O.*, [2]Otite J.R.,[2]Sokunbi O.A., [1]Oke O. E. and [2]Adejumo, D O
[1]Dept of Animal Physiology, University of Agriculture, Abeokuta
[2]Dept of Animal Science, University of Ibadan
*author for correspondence bimboladox@gmail.com

ABSTRACT

The objective of this study was to evaluate the effects of testosterone enanthate on sows as a means of improving sexual behaviour in breeding pigs. A total of 24 Large White sows were used for the study. Testosterone enanthate was administered to half of the number of pigs from postnatal to puberty. The other half were administered blank injections. The pigs were observed for courtship, estrus grunts, receptability, copulation, strutting, restlessness and violence. The results revealed that, 100% of the pigs administered testosterone showed signs of courtship as compared to 66.67% of pigs in the control. Pigs placed on testosterone were more receptive than those without (66.67% and 16.67%, respectively). All pigs on testosterone showed estrus grunts as compared to 50% without testosterone. Restlessness was observed in all pigs on testosterone while only 50% were observed in the control. Only pigs on testosterone showed evident signs of violence (biting). In conclusion, although testosterone increased aggression in female pigs, it could be used to enhance their sexual behavior and breeding.

Key Words: Gilts, puberty, courtship, Immobility, copulation.

INTRODUCTION

The need for alternative sources of income in developing countries has resulted in an increase in the number of farmers directly involved in animal production (Dafwang, 2010). This has been a boost to man's quest for an increase in food production owing to an ever growing human population. The majority of drugs used in pig reproduction are involved in getting gilts and sows into heat or the induction of farrowing, so that the timing of service and sow through put in batches can be optimized and farrowing supervised. As such, they are very valuable management tools (Cameron, Kieran and Martin, 2000). Very simply, the brain controls reproductive function and the anterior pituitary, at its base, releases hormones, which control the activity of the ovary.

Due to the high cost of equipment, the practice of breeding of animals has been arduous, as majority of the farmers do not have the financial capacity to acquire the required sophisticated equipment. Since farmers work with limited resources, certain practices, which apply in the developed countries, are impractical in the third world. For instance, farmers would try to cope with aggression in their herd rather than cull aggressive pigs. Acquiring devices such as hormonal assay kits to determine the optimum time for breeding is beyond the reach of the common farmer in the developing countries. As a result, farmers have to rely on elementary methods such as day count, male check and standing heat to determine the optimum time for breeding. Although majority of the signs produced by sows occur under the influence of estrogens, their accuracy remains in question. For instance, not all sows on estrus will stand even when meant to be in standing heat. In some instances, immobilizing the female is necessary to guarantee successful mating. Artificial insemination, which is a major way of avoiding the inconvenience of breeding non productive gilts, sows and also size incompatible pigs, is being practised on a small scale due to the lack of qualified specialists in the AI field. Androstenone within boar saliva aids in eliciting the standing response in the sow (Gonyou, 2001). Some sows are more attractive to boars than others and occasionally a sow may avoid and refuse to stand for a specific boar. Rearing females in isolation from males delays the standing response of the

females once they are introduced to boars (Soede and Schouten, 1991).

Therefore, there is need to investigate alternative methods of improving breeding of sows and ensuring their soundness. An example of such is the use of easily affordable synthetic hormones. One of such hormones is testosterone. This study was undertaken to determine the effect of administering testosterone to sows from post natal through to puberty and to evaluate how this can be used to improve swine production especially in the tropics.

MATERIALS AND METHODS

The experiment was carried out at the Piggery Unit, Teaching and Research Farm, University of Ibadan, Ibadan.

Experimental Animals and hormonal administration: A total of 24 female Large White pigs were used for this experiment. At birth, (day-old) the piglets were weighed (on the average the pigs weighed 1.62kg) and randomly divided into control and treatment groups. The pigs were identified by inscription of numbers and codes on their back using a permanent color marker. Half the number (12) was used as experimental control animals with blank injections (1.0 ml corn oil with no testosterone) administered. The other 12 were administered testosterone enanthate (Shanghai Pharmaceutical Company, China) injections. The hormone was obtained from a local veterinary pharmacy shop in Ibadan. The injections were given by deep intra-muscular injections in the thigh muscles of hind-legs at a dosage of 1.2mg testosterone enanthate per kilogram body weight and it was carried out between the hours of 7 and 8am weekly from birth to 24 weeks of age. Each treatment group consisted of 3 replicates of 4 animals each.

Data Collection/Observation: The pigs were observed for agonistic and sexual behaviours with the use of Video camera recorders done weekly after 15 minutes of administration of injections. The sexual behaviour was compared with results of blood sampling for hormones (Serum FSH, LH, Oestradiol, Progesterone and Testosterone) assay for those showing signs of oestrus. Blood was sampled from all animals. 5ml of blood was collected into non-heparinized bottles then centrifuged at 3000g for 10 minutes to obtain serum. The serum was sucked out/decanted into well labeled bottles. Gonadal hormones (FSH and LH) with Steroid hormones (E2, Testosterone, P4) was assayed using Enzyme linked immunoassays (ELISA) according to procedure of Voller, Barlett and Bidwell (1978). Statistical Package for Social Sciences (SPSS) was used for analyses of behaviours, while One-Way ANOVA of Statistical Analysis Systems (SAS, 2001) was used to analyze data from serum hormones.

RESULTS

Table 1 shows the summary of parameters of sexual behaviour and aggression by female pigs injected with testosterone and their untreated control counterparts. In the control, 66.67% exhibited courtship compared to 100% for those injected with testosterone. The oestrus grunts, immobility (receptivity), were 50% and 16.67%, respectively for the control pigs and 100% and 66.67% for the injected subjects, respectively.

The observations on the aggressive behaviour in the control pigs; investigative, strutting, restless/slashing, were 66.67, 66.67 and 50%, respectively whereas all the treated pigs indicated investigative behaviour while 83.33, 100 and 83.33% displayed strutting, restless (slashing) and violent (biting), respectively.

Figure 1-5 shows the serum hormone profile of gilts in the experiment. The high oestrogen levels exhibited in pigs from 10 weeks suggest that the pigs may have ovulated earlier than controls. This trend is also supported by results of the luteinizing hormone (LH) and follicle stimulating hormone (FSH) levels.

Table 1: Summary of parameters of sexual behaviour and aggression by female pigs injected with testosterone compared to their untreated counterparts

Parameter	Control(Blank)	Testosterone
Total number of subjects tested	12	12
Sexual behavior		
Courtship, %	66.67	100
Estrus grunts, %	50	100
Immobility (receptivity), %	16.67	66.67
Copulating (mating), %	0	0
Standard error	0.84	1.18
Sexual Behaviour index	1.63 ± 0.14	1.88 ± 0.10
Main parameter exhibited	courtship	courtship/grunts
Aggressive behaviour		
Investigative, %	66.67	100
Strutting, %	66.67	83.33
Restless/slashing, %	50	100
Violent/biting, %	0	83.33
Standard error	0.92	1.44
Aggression index	1.91 ± 0.10^{b}	2.45 ± 0.20^{a}
Main parameter exhibited	Investigative	Restless/investigative

ab:means in the same row differently superscripted differ significantly ($P<0.05$).
The average weight of pigs in the control group is $38.59^{b} \pm 0.09$ (kilogram) and for the testosterone administered group the average live weight is 46.62 ± 0.13^{a}

Figure 1: Effect of Testosterone injection on Serum FSH concentrations in female pigs

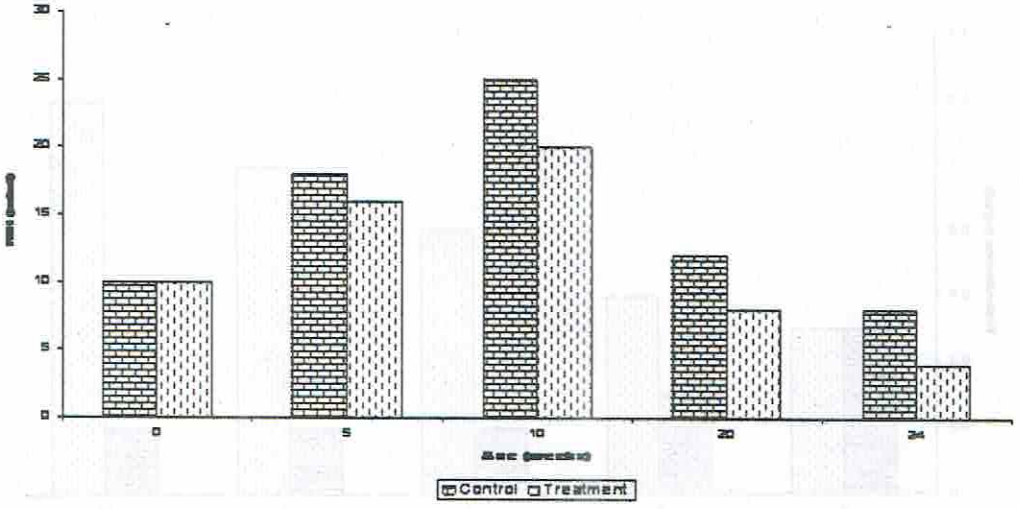

Figure 2: Effect of Testosterone injection on Serum LH concentrations in female pigs

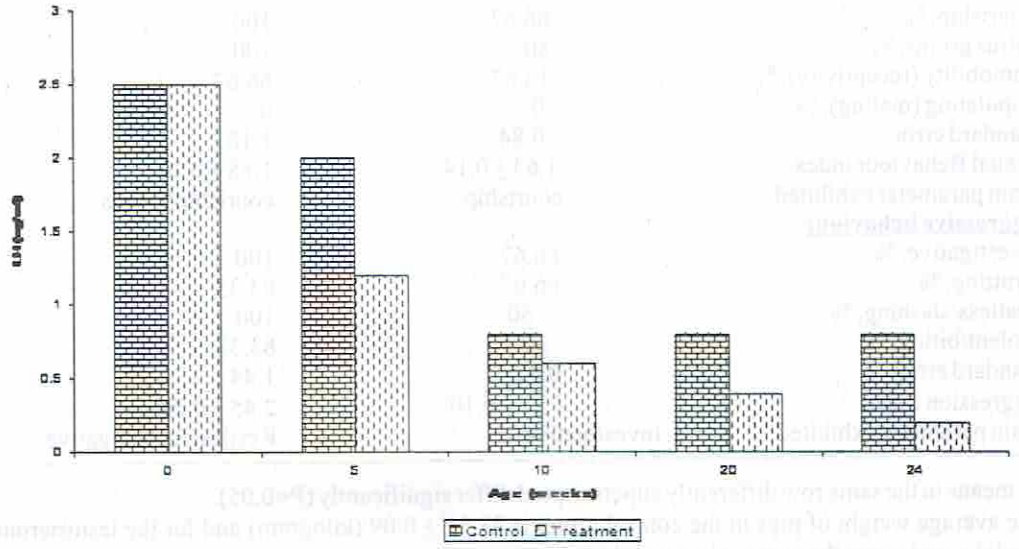

Figure 3: Effect of Testosterone injection on Serum Testosterone concentrations in female pigs.

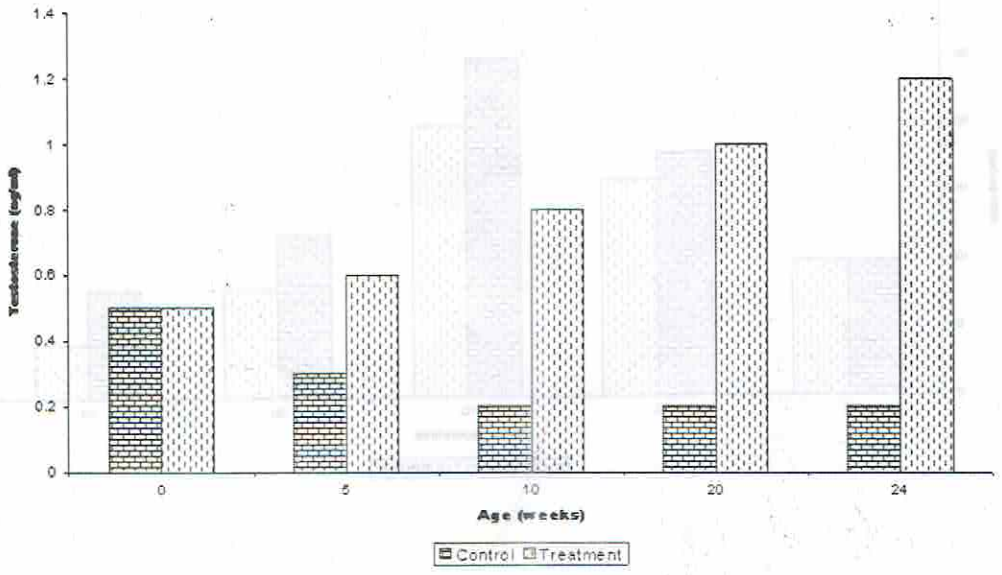

Figure 4: Effect of Testosterone injection on Serum Estradiol concentrations in female pigs

Figure 5: Effect of Testosterone injection on Serum Progesterone concentrations in female pigs

DISCUSSION

The results from this study (Table 1) show that exogenous testosterone led to early exhibition of sexual behaviour in female pigs. Sows must attain a minimum percentage of their body weight before coming on fertile oestrus (Lofstedt, 2004), though weekly weight gain data are not presented in this result, the average body weight at 24 weeks of age as stated beneath table 1 suggests a significant weight increment induced by testosterne. Testosterone induces masculinity of the hypothalamus (Blackshaw and Blackshaw, 1982). A female animal treated neonatal with androgen may not show the cyclic patterns of gonadotrophin secretion that are characteristic of the female. Lee *et al.* (2002) observed that application of exogenous androgen could induce masculinization in castrated pigs. Van Weerden *et al.* (1976) and Grandadam *et al.* (1975) reported 'masculine' behaviour in finishing barrows following implantation of Revalor® (which has androgenic effects just as testosterone). These results however were not in line with the works of de Wilde and Lauwers (1984) who observed declining 'sexuality' as a result of testosterone administration to castrates. In spite of this inconsistency of results by different authors, the results of the present study show that administration of testosterone enanthate has an effect on aggression and onset of sexual behaviour.

Exposure to a male at the pre-pubertal stage has also been observed to be positively related to attaining early puberty in gilts (Pearce and Hughes, 1987) most likely resulting from an increase in the pulsative release of LH (Squires, 2010). It thus follows that female pigs are sensitive to male hormones and/or pheromones. Hormones secreted during foetal and neonatal life cause sexual differentiation of the nervous system (Anuka, 2002). The increased observation of signs of oestrus associated with the pigs placed on testosterone may have been due to the effects of testosterone on females as testosterone in females is aromatized to oestradiol in the ovaries (Fortune and Armstrong, 1977; Ca´rdenas and Pope, 2002). Sexual behaviour and vulva swelling occur under the influence of estrogens (Cassar, 2009). This thus explains why sows administered testosterone were more receptive than those without testosterone.

With regards to aggression, sows administered testosterone tended to be more aggressive and violent than their untreated counterparts. This is in agreement with the report of Ford (1990), and Adejumo and Egbunike (1989) who reported similar findings.

In addition to the above observed effects, results of the study showed that sows also exhibit male patterns of sexual behaviour, although with reduced frequency, which suggests the absence of sexualization of the nervous structures involved in the realization of such patterns. This behaviour is similar to those observed and reported by Ford, (1990) who noted that, female pigs receiving male-like hormonal treatment (daily injections of androgen) exhibit the complete repertoire of male sexual behaviour including the copulatory patterns and the subsequent refractory period. Sleeth *et al.* (1953) reported that semi-weekly injections of testosterone propionate caused frequent riding and ranting in both barrows and gilts. There is positive association of the above behaviour with ovulation in sows. Ca´rdenas and Pope, (1994, 1997) had observed that testosterone administration on days 17 and 18 of the estrous cycle increased ovulation rate in gilts possibly due to the influence oestradiol has in promoting the LH surge through its positive correlation with the hypothalamic secretion of GnRH or GnRH-R in luteotropes (Kirkpatrick et al., 1998). With regards to body conformation and palatability, testosterone-treated animals have trimmer sides and jowls (Beeson *et al.*, 1995). This is good for breeding animals. Bratzler *et al.* (1954) observed no effect of testosterone on palatability in pork.

Ford (1990) also noted that this frequency of the patterns, their sequential organization, and the dose-reaction relations are similar. Such male behavioural patterns associated with testosterone were also expressed in form of aggression as demonstrated by violence characterized by biting. Although this might be a hazard in breeding, since sows placed on testosterone are more likely to engage in copulation and are more likely to exhibit standing heat, this form of

aggression can be managed by introducing female sows to the boar and not vice versa as this has shown to reduce aggressive resistance to the mating process by over aggressive females.

CONCLUSION

In the absence of highly specialized breeding equipment, testosterone can be administered in sows or gilts peri-pubertal to hasten, as well as enhance sexual behaviour in sows. Aggressive behaviour associated with testosterone can be curtailed by introducing the sows to boars during the mating process.

REFERENCES

Adejumo. D.O. and Egbunike, G.N. (1989): Effect of pre-versus pubertal and post-pubertal castration on aggression and sexual behaviour in Boars. *International Journal of Animal Science* 4: 148 - 151.

Anuka, J.A. (2002). The role of sex hormones in sexual differentiation of the brain.: A review. *West Afr. J. Pharmacol. Drug Res.* Vol 18 (Nos 1&2) January-December 2002; 1-5

Blackshaw, J.K. and Blackshaw, A.W. (1982). Animal Production in Australia. The effects of prostaglandin (PGF2alpha) on the behaviour of the domestic non-pregnant sow and boar. Proc. Aust. Soc. Anim. Prod. (1982) 14: 550-552

Bratzler, D.J., Soule, R.P., Reineke, e.P. and Paul, P. (1954). The Effect of Testosterone and Castration on the Growth and Carcass Characteristics of Swine. *J. Animal Sci.*, 13;171-176

Beeson, W.M., Andrews, F. N., Perry, T.W. and Stob, M. (1955). The effect of orally administered stilbestrol and testosterone on growth and carcass composition of swine. *J. Animal Sci.* 14:475.

Cameron, R.D.A., Kieran, P.J. and Martin, I. (2000). The efficacy in inducing batch Farrowing and the impact on sow behaviour of the prostaglandins cloprostenol and dinoprost. Proceedings of the 16th International Pig Veterinary Society Congress, Melbourne, Australia, p 386

Ca´rdenas, H., and Pope. W. F. (1994). Administration of testosterone during the follicular phase increased the number of corpora lutea in gilts. *J. Anim. Sci.* 72:2930–2935.

Ca´rdenas H., and Pope, W. F. (1997). Administration of testosterone from day 13 of the estrous cycle to estrus increased the number of corpora lutea and conceptus survival in gilts. *J. Anim. Sci.*75:202–207.

Ca´rdenas, H. and Pope, W. F. (2002). Control of ovulation rate in swine *J. Anim. Sci.* 80(E. Suppl. 1):E36–E46

Cassar, G. (*2009*). Hormonal control of pig reproduction. *London Swine Conference – Tools of the Trade 1-2 April pp: 137-139*

De Wilde R. O. and Lauwers.H. (1984). The effect of parenteral use of estradiol, progesterone, testosterone and trenbolone on growth and carcass composition in pigs. *J. Anim. Sci.* 59:1501-1509.

Gonyou, H.W. (2001). The social behaviour of pigs, in Social Behaviour in Farm Animals, ed. Keeling, L.J. and Gonyou, H.W. CABI, Oxon

Grandadam, J. A., Scheid, J. P., Jobard, A., Breux, H. and Boisson, J. M. (1975). Results obtained with trenbolone acetate in conjunction with estradiol 17β in veal calves, feedlot bulls, lambs and pigs. *J. Anim. Sci.* 41:969-977.

Ford,J.J. (1990), Differentiation of sexual behaviour in pigs. *J Reprod Fertil Suppl.* 40:311-21.

Fortune, J. E. and Armstrong, D. T. (1977). Androgen production by theca and granulosa isolated from proestrous rat follicles. *Endocrinology* 100:1341-1347.

Kirkpatrick, B. L., E. Esquivel, G. E. Moss, D. L. Hamernik, and M. E. Wise. 1998. Estradiol and gonadotropin-releasing hormone (GnRH) interact to increase GnRH receptor expression in ovariectomized ewes after hypothalamic-pituitary disconnection. *Endocrine* 8:225-229.

Lee, C. Y., Lee, H. P., Jeong, J. H., Baik, K. H., Jin, S. K., Lee, J. H. and S. H. Sohn. 2002. Effects of restricted feeding, low-energy diet, and implantation of trenbolone acetate plus estradiol on growth, carcass traits, and circulating concentrations of insulin-like growth factor (IGF)-I and IGF-binding protein-3 in finishing pigs. *J. Anim. Sci.* 80:84-93.

Lofstedt, R. (2004). Reproductive physiology of the domestic animals for veterinary practitioners. Theriogenology notes. Atlantic Veterinary College. Prince Edward Island.

Pearce,G. P. and Hughes, P.E. (1987). The influence of boar-component stimuli on puberty attainment in the gilt. British Society of Animal Science. *Animal Production,* 44 : pp 293-302

Sleeth, R.B., Person, A.M., Wallace, H.D, Kropf, D. and Koger, M. (1953). Effects of Injection of Testosterone, Estradiol and a Combination of the Two upon Growing-Fattening Swine. *J Anim Sci*1953, 12:322-330.

Soede, N.N. and Schouten, W.G.P. (1991) Effect of social conditions during rearing on mating behaviour of gilts. *Appl. Anim. Behav. Sci.* 30, 373-379

Squires, J.E. (2010).Applied Animal Endocrinology. 2nd edition. CAB International. Pp 220

Van Weerden, E. J. and Grandadam, J. A. (1976). The effect of an anabolic agent on N deposition, growth, and slaughter quality in growing castrated male pigs. In: Anabolic Agents in Animal Production (Ed. F. C. Lu and J. Rendel). *Environmental Quality and Safety (Suppl.* V):115-122.

Voller, A., Barlett, A., and Bidwell, D. E. 1978. Enzyme Immunoassays with special reference to ELISA techniques. *J. Clin. Path.* 31:507