Published Quarterly
Mangalore, South India
ISSN 0972-5997
Volume 6, Issue 1; Jan -Mar 2007

Original Article

Validation of the polysemen admixture on viability and acrosomal morphology of boar spermatozoa

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Citation
Ogbuewu IP, Umesiobi DO, Okoli IC, Okoro VM. Validation of the polysemen admixture on viability and acrosomal morphology of boar spermatozoa. *Online J Health Allied Scs.* 2007;1:3

URL
http://www.ojhas.org/issue21/2007-1-3.htm

Open Access Archives
http://cogprints.ecs.soton.ac.uk/view/subjects/OJHAS.html
http://openmed.nic.in

Submitted: Nov 22, 2006; Accepted: July 13, 2007; Published: July 17, 2007

Abstract:
Semen were collected using artificial vagina (AV), from 5 large white boars aged 2-2.5 years twice a week for 16 weeks in each of the two seasons, early rainy (ER) and late rainy (LR) seasons, to determine the effects of multiple semen pool admixture on the viability and acrosomal morphology. The semen qualities studied were sperm motility, live sperm and sperm concentration, while the acrosomal parameters includes normal apical ridge (NAR), damaged apical ridge (DAR), missing apical ridge (MAR) and loose apical ridge (LAC). There were no significant (P>0.05) seasonal effects. Three-boar semen admixture gave the highest percentage NAR, motility, live sperm concentration and least DAR and LAC, although these were not significantly (P>0.05) different from the 2-boar semen admixture. The result of this study suggests that 3-boar semen admixture is most suitable for use in artificial insemination program.
Key Words: Semen viability, Acrosomal

Introduction:

Advancement in biotechnology is central to improving the efficiency of livestock reproduction and overall production for optimum profitability. One of such examples that illustrate the importance of biotechnological development in animal reproduction is sperm pool admixture. The technique is based on mixing ejaculated semen form different boars for fertility evaluations and artificial insemination of estrus females.(1) Although the benefits of polysperm admixture has been reported, much remains to be understood especially the correlation between polysperm admixture and fertility of boar semen.

General, the four basic parameters that are measured to evaluate boar semen quality are motility, concentration, livesperm and acrosome integrity.(2,1) Of these sperm motility, sperm concentration and acrosomal morphology are most routinely used for evaluating semen prior to processing and insemination.(3-5)

The inherent disadvantages in the use of semen from one boar for the insemination of a sow has been identified.(6) Males with unproven sperm motility, concentration and acrosome morphology were found to have serious clinical problems as azoospermia.(1) Severe oligozoospermia, tetrazoospermia and asthenozoospermia are also more difficult to be diagnosed than total or near total infertility.(7) It is important therefore, not to base the verdict about a boar's fertility on a single boar semen sample. It is reasonable to expect that a higher semen viability and fertility could be achieved from semen pooled together form different boars. This study validates the effectiveness of polysperm admixture on the viability and acrosomal morphology of large white boar semen.

Materials and Methods:

Location: The study was conducted at the Federal University of Technology, Owerri, Research Farm, Nigeria. The geographical and agro-climatic characteristics of the area has been described.(8)

Experimental animals: Five matured large white boars aged 2 to 2.5 years and having body weight ranges of 90 to 100kg were used for the study. The choice of boars were based on the recommendation of Ensor.(9)

The experimental animals were housed in individual pens, in a confinement facility bedded with straw and fed ad libitum. They were also identified by means of ear tags and treated against ectoparasites using sebacil (50% EC).

Preparation of coconut water extender

200ml of coconut water was harvested and boiled at 100^{oc} for 15 minutes. The solution was then slowly cooled down to room temperature ($25\text{-}29^{oc}$). It was filtered to remove all solid particles. 1000 iu of penicillin and streptomycin were added to the filtrate and stored for use in accordance with the procedures of Umesiobi DO.(1)

Semen collection, processing and evaluation

Semen was collected from each boar twice per week by the artificial vagina method. The gel mass was immediately separated by filtration through a cheesecloth. The sperm rich fractions were transferred into an insulated conical flask.

The conical flask were labeled A,B,C,D and E where A_1, B_2, C_3, D_4 and E_5 stands for semen from boar 1,2,3,4, and 5 respectively. 3ml of each boar semen were collected and mixed as follows: A: A_1; B: $A_1 + B_2$; C: $A_1 + B_2 + C_3$; D: $A_1 + B_2 + C_3 + D_4$; E: $A_1 + B_2 + C_3 + D_4 + D_5$.

The semen admixtures were extended with coconut water in 1:2 dilutions for average of 2 hours before taken to the laboratory for analysis. Part of the extended semen was immediately evaluated for sperm motility on a warm stage at x 400 phase contract microscope sperm acrosomal morphology was determined and classified as normal apical ridge (NAR), damage apical ridge (DAR), missing apical ridge (MAR), and loose apical cap (LAC) as described by Pursel C et al.(10) The semen quality parameter recorded were sperm concentration sperm motility and live sperm during the early rainy and late rainy season.

Data analysis: The data were analyzed using analysis of variance (ANOVA) procedure.(11) Means were separated by Duncan multiple Range test method.

Results and Discussion

Table I shows that 3-boar semen admixture returned the highest sperm motility, sperm concentration and livesperm; though not significantly ($p>0.05$) different from monosperm except in sperm concentration which was statistically significantly ($p<0.05$) different from monosperm. The progressive motility, sperm concentration and livesperm values were not affected by seasons (Early rainy and late rainy seasons); this is in support of results reported earlier(12) on WAD goats. The highest mean value for livesperm, sperm concentration and motility were recorded during the late rainy season but not statistically significant ($p>0.05$) form early rainy season. The result obtained on viability parameters partially support earlier results reported (13,14) on monosperm. The difference in the two results may be as a result of breed difference and semen collection method.

TABLE 1 Effects of multiple sperm pool on viability parameters of large white boars.

BSA	Motility		Live sperm		Sperm concentration/ ml x10^6	
	(ER)	(LR)	(ER)	(LR)	(ER)	(LR)
BS1	70±1.8^a	72±1.8^a	86±0.5^a	88±0.5^a	240±1.3^b	245±1.8^b
BS2	75±1.6^a	76±0.7^a	88±0.8^a	90±1.8^a	252±1.1^b	250±1.4^b
BS3	76±0.7^a	76±0.6^a	90±1.8^a	92±0.8^a	256±0.8^a	259±0.4^a
BS4	71±0.4^a	72±0.9^a	85±1.3^a	86±1.2^{ab}	246±1.1^b	246±1.0^b
BS5	60±1.8^b	59±0.4^b	77±1.4^b	80±1.1^b	218±0.9^c	217±0.6^c

^{abc} Means with different superscript are significantly ($p<0.05$) different.

TABLE 2: Effects of multiple sperm pool on acrosome parameter of large white boar.

BSA	NAR		DAR		MAR		LAC	
	(ER)	(LR)	(ER)	(LR)	(ER)	(LR)	(ER)	(LR)
BS1	70±1.8^a	76±1.4^{ab}	12±1.1^{ab}	14±1.4^{ab}	7±0.4^b	5±0.5^b	8±0.4^b	6±0.4^b
BS2	76±1,1^a	79±1.4^{ab}	7±0.8^{bc}	6±0.7^{ab}	8±0.9^b	7±0.8^b	7±0.6^b	5±0.4^b
BS3	79±0.4^a	82±0.7^a	5±0.6^a	5±1.0^{ab}	5±1,0^b	4±0.4^b	4±0.5^c	4±0.6^c
BS4	67±1.1^a	70±1.6^a	6±0.4^b	4±1.0^b	7±0.4^b	5±0.7^b	9±0.9^b	9±0.6^b
BS5	60±0.7^b	58±0.7^b	12±0.7^a	10±0.9^a	14±1.0^a	12±0.9^a	18±0.9^a	16±0.6^a

^{abc} Means with different superscript are significantly ($p<0.05$) different.

The mean values for sperm acrosomal morphology in the five boars studies during the two seasons are presented in Table 2. There were no significant seasonal effect on acrosomal parameters studied. 3-boar semen admixture gave the highest mean NAR value during the late rainy season and the least missing apical ridge during the late rainy season, but not statistically ($p>0.05$) different from others except 5-boar semen admixture which was significantly ($p<0.05$) different from 3-boar semen admixture. The assessment of sperm viability and acrosomal status gives reliable estimate of fertility of the male.(15) It is apparent from the present result that the fertilizing ability of the semen from boar may be higher in late rainy season. Blom E(16) indicates that the head anomalies of the sperm may result from aberration in the later stage of sperm development in the epididymis. The highest DAR (12%), MAR (!4%) and LAC (18%) may be due to faulty or incomplete ejaculation and genital diseases.(17) The high acrosomal values recorded in 5-boar semen admixture also may be attributed to improper handling method. The present study has shown that 3-boar semen admixture is most suitable for artificial insemination. The mean seasonal value for the semen quality parameters recorded are presented in Table 3 and Table 4. There were however, no significant variation in acrosomal and semen quality values for early rainy season and late rainy season.

TABLE 3: Effects of season on semen quality parameters of large white boars.

BSA	Motility (%)		Live sperm (%)		Sperm conc/mlx10^6	
	ER	LR	ER	LR	ER	LR
BS1	70±1.8^a	72±1.0^a	86±0.5^a	88±0.5^a	245±1.8^a	240±1.3^a
BS2	75±0.7^a	76±0.7^a	88±0.8^a	92 ±1.8^a	250±1.4^a	252±1.1^a
BS3	76±0.7^a	76±0.6^a	90±1.8^a	92±0.8^a	259±0.4^a	256±0.8^a
BS4	71±0.4^a	72±0.9^a	85±1.3^a	86±1.2^a	246±1.2^a	246±1.0^a
BS5	60±1.8^a	59±0.4^a	75±1.4^b	80±1.1^a	218±0.9^a	217±0.6^a

^{ab} Means with different superscripts in row are significantly different (P<.0.05).

TABLE 4: Effects of seasons on acrosome parameters of large white boar.

BSA	NAR		DAR		MAR		LAC	
	(ER)	(LR)	(ER)	(LR)	(ER)	(LR)	(ER)	(LR)
BS1	70±1.8^b	76±1.4^a	10±1.1^a	14±1.4^b	7±0.4^a	5±0.5^b	8±0.4^a	3±0.4^b
BS2	76±1.1^a	79±1.4^a	7±0.8^a	6±0.7^a	8±0.9^a	4±0.8^b	7±0.6^a	5±0.4^b
BS3	79±0.4^a	82±0.7^a	5±0.6^a	5±1.0^a	5±1.0^a	3±0.4^b	4±0.5^a	4±0.6^a
BS4	67±1.1^b	75±1.6^a	6±0.4^a	4±1.0^b	7±0.4^a	5±0.7^a	9±0.9^a	9±0.6^a
BS5	60±0.7^a	58±0.7^a	12±0.7^a	10±0.9^a	14±1.4^a	10±1.0^b	18±0.9^a	16±0.6^a

^{ab} Means with different superscript are significantly different. ($p<0.05$)

Key: BSA; Boar Sperm Admixture, BS: Boar Sperm: NAR: Normal apical ridges: DAR: Damage apical ridge: MAR: Missing apical ridge: LAC: Loose apical Cap: ER: Early rainy season; LR Late Rainy Season.

Conclusion

The 3-boar semen admixture (BS3) with the highest sperm motility,(76%) live sperm(92%), sperm concentration of 259/ml x 10^6, normal apical ridge (82%) and least values for Damaged apical ridge (5%), Missing apical ridge (3%) and loose apical cap (4%) should be used in artificial insemination program.

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