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Effect of foot and mouth disease vaccination on seminal traits in pure Holstein Friesian bulls

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ABSTRACT

The present investigation was carried out to study the effect of foot and mouth disease vaccination on seminal traits of 30 Holstein Friesian (HF) bulls, 3-5 years old, maintained at BAIF Central Research Station, Uruli Kanchan, Pune, India. The study period was from August to September 2013 and semen quality traits were evaluated on each bull maintained under identical feeding and management regimes. A total of 180 semen ejaculates were collected with one ejaculate from each bull at 3 days interval in a week at 15 days before, 15 and 30 days after FMD vaccination. Raksha Ovac vaccine of Indian Immunologicals Ltd. was used for vaccination purpose. Seminal traits like fresh and post thaw sperm motility, sperm concentration, semen volume, live and dead count, plasma membrane integrity were evaluated for all the ejaculates. Data on seminal traits were analysed by using one way ANOVA. Results revealed that vaccination had significant ($P<0.05$) effect on post thaw motility and highly significant ($P<0.01$) deleterious effect on HOS test, head and mid piece abnormalities; however no effect was noted on ejaculate volume, sperm concentration, initial motility, viability and tail abnormalities. The observations showed that vaccination alters the seminal traits of pure HF bulls.

Key words: Foot and Mouth Disease, Holstein Friesian, Motility, Morphology, Plasma membrane integrity.

INTRODUCTION

Foot and mouth disease has adversely affected the Indian economic condition. Hence vaccination against FMD + HS + BQ is a regular prophylactic measure especially among the breeding bulls which are housed for semen collection in private and government semen stations (Bhakat *et al*., 2010; Bhakat *et al*., 2011). BAIF is one of such a premier private organisation rearing more than 300 breeding bulls with a majority of productive HF. Vaccination against various bacterial and viral infection in BAIF is being practised on a regular basis in bull stud and bull mother farm. Vaccination produces anaphylactic stress factor, which affect various seminal traits. Various authors reported that body as well as testes temperature increases following vaccination which results in aberration of spermatogenesis and epididymal dysfunction (Bhakat *et al*., 2015; Perumal *et al*., 2013; Bhakat *et al*., 2010; Anderson, 2001). Febrile condition during post vaccination increases the incidence of morphological abnormalities especially defective heads (Perumal *et al*., 2013; Bath and Oko, 1989) besides that percentage of progressive motility, live spermatozoa and fertility also decrease (Kumar and Gangadhar, 1998; Waites and Setchell, 1990). The extent of damage depends upon the duration and degree of rise in temperature. All the stages of spermatogenesis, spermatogonial stem cell and fully formed spermatozoa are temperature sensitive. These deleterious effects due to stress factor are reversible and returns to normal quality and morphology. Although scanty reports effect of vaccination on semen as well as bull physical conditions are available but the findings are conflicting. Besides, few observations have been noted on morphology of sperm and duration of amelioration. The objective of the study was to know the extent of vaccine stress on the bulls through evaluation of different seminal traits. Therefore, the present *in vivo* study was designed to see the effect of FMD vaccination on seminal parameters, morphological aberration and duration of time required to return to normal seminal traits in HF bulls.

MATERIALS AND METHODS

Thirty Holstein Friesian bulls aged between 3 and 5 years-maintained at BAIF Central Research Station, Uruli Kanchan, Pune India were used in present investigation during August to September 2013. All the bulls were maintained under identical feeding and management regimes. Sterilized artificial vagina and standard procedure of semen collection with proper sexual preparation with two false mount on teaser bull was followed. Reaction time was recorded in minutes. Immediately after collection the semen was kept at 34°C in water bath inside the evaluation room. In all, 180 semen ejaculates were collected with one ejaculate from each bull

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at 3 days interval in a week at 15 days before and 15 and 30 days after FMD vaccination. Raksha Ovac vaccine of Indian Immunologicals Ltd. was used for vaccination purpose. The ejaculate volume was recorded in the graduated semen collection tube in millilitres. Semen samples were evaluated for seminal traits like sperm concentration, motility, viability and plasma membrane integrity. The concentration of spermatozoa was determined by using calibrated photometer (Salisbury *et al*., 1978), sperm viability and morphology by using eosin and nigrosin stain and plasma membrane integrity by HOS test as per Jeyendran *et al*. (1984).The semen samples immediately after collection-and evaluation were diluted with egg yolk tris citrate extender (1:10 ratio) containing 20% egg yolk, 7% glycerol as cryoprotectant, and antibiotics 1000 IU penicillin and 500mg streptomycin per ml were used as per Salisbury *et al*. (1978). The extended semen was filled in French mini straws and frozen using routine conventional freezing protocol or biofreezer as per MSP protocols by government of India. Post thaw motility was recorded after 24 hrs of cryopreservation and instant thawing in water bath at-37°C for 30 sec.

Data on seminal quality traits before and after vaccination were statistically analysed by one way analysis of variance using SPSS software package (Version 16.0). The pair wise difference of means was compared by post doc Tukey test and P-value less than 0.05 was considered to be statistically significant.

RESULTS AND DISCUSSION

The findings on various seminal traits studied 15 days before, and 15 and 30 days after vaccination are presented in (Table 1).Vaccination had non-significant effect on ejaculate volume, sperm concentration, initial motility and viability. Although sperm concentration, volume, initial motility and viability after 15 days of vaccination were gradually reduced, with slight rise and approaching toward the normal values after 30 days of vaccination. Present findings were in accordance with the earlier reports of various authors, who reported non-significant effect of vaccination with decreasing trend in semen quality parameters following vaccination (Bhakat *et al*.,2015; Perumal *et al*., 2013; Dhia and Ali, 2012; Bhakat *et al*., 2011; Bhakat *et al*., 2010). On the contrary, Bhakat *et al*. (2008) reported a significant increase in semen volume but decrease in concentration, initial motility and live % after vaccination. They also reported that the activities of accessory sex glands remained unaffected following vaccination. Interestingly, transient decline in sperm concentration and viability % might be attributed to the adverse effects of therapeutic agents on germinal cells resulting into teratozoospermia. Moreover increased dead sperm get phagocytosed by leucocytes, which ultimately lead to reduction in epididymal sperm reserves and hence concentration (Cooper *et al*., 2002) and eventually live-sperm % get reduced. The motility of sperm cell develops during their passage through epididymis (Olson *et al*., 2002). However, following vaccination transitory rise in body as well as testes temperature causes derangement in spermatogenesis and epididymal function and leads to vaccination mediated declined sperm motility (Arthur 1989).

In the present study, post-thaw sperm motility was significantly decline ($P<0.05$) after 15 days of vaccination and non-significantly after 30 days of vaccination as compared to pre-vaccination. But overall, the post thaw motility after 30 days was found to resilient with normal values before vaccination. Our results are in agreement to the findings of Bhakat *et al.* (2010) who reported a significant decline in post thaw motility during post vaccination. Contrary to this Mangurkar *et al.* (2000) observed no significant effect on post freezing motility. Both physiological and structural status of sperm gets severely affected during cryopreservation (Bailey *et al*., 2003). The chemical, osmotic, thermal and mechanical stresses during extension, cooling, freezing and thawing result in cryoinjuries of varying degree to the spermatozoa (Farooq *et al.*, 2013). Therefore the significant variation in post thaw motility can be attributed to the effect of thermal stress developed following vaccination.

Plasma membrane integrity (HOS test) declined highly significantly ($P<0.01$) after 15 days of vaccination and significantly ($P<0.05$) after 30 days of vaccination as compared to pre-vaccination in HF bulls. The present findings

Table 1: Mean ± S.E 0f volume, concentration, initial motility, post thaw motility, live and dead, Hos test and morphological defects before and after vaccination.

Parameter N= 36		15 days before vaccination	15 days after vaccination	30 days after vaccination	F value
Volume(ml)		6.6 ±0.3	6.2±0.2	6.3±0.3	0.5989
Concentration (millions/ml)		1705.7±86.1	1657.2±68.9	1701.6±71.6	0.8821
Initial motility(%)		76.5±0.3	76.0±0.3	76.1±0.3	05251
Live and dead (%)		78.9±2.1	79.6±1.5	79.8±2.0	0.9361
Post thaw motility(%)		58.2±0.4^{a}	56.7±0.3^{b}	57.4±0.4^{ab}	0.0338*
Hos test(%)		61.5±0.4^{a}	59.4±0.2^{b}	60.5±0.3^{c}	0.0003*
	Head (%)	2.8±0.2^{a}	3.9±0.2^{b}	3.4±0.2^{ab}	0.01*
Morphology	**Mid (%)**	2.3±0.1^{a}	3.1±0.1^{b}	1.8±0.1^{c}	0.0001**
	Tail (%)	2.1±0.1	2.3±0.1	2.1±0.1	0.6107

*($P<0.05$) **($P<o.01$) Different superscripts in different rows differ significantly

indicate that towards 30 days of vaccination plasma membrane integrity returned almost to normal levels. Since the plasma membrane involved in the process of capacitation, acrosome reaction and ultimately binding of spermatozoa to the oocyte is a well documented fact (Argov *et al*., 2007). So the HOS test is able to assess the fertilizing ability of spermatozoa. Our results were a kin to the findings of other researchers where significant reduction in HOS reactive spermatozoa have been reported following scrotal insulation in cattle and buffalo (Bhakat *et al*., 2008; Bhakat *et al*., 2010), Mithun (Perumal *et al*., 2013) which may be due to raise in testicular temperature.

The morphological abnormalities in the present findings showed significant difference ($p<0.05$) in head and mid peice defect however overall tail defect showed non-significant difference between pre and post vaccination. Surprisingly, head defect was found to be highest as compared to mid peice and tail defects. We observed a significant ($p<0.05$) escalation in head and mid peice defects after 15days of vaccination, but a non-significant difference in head defect was recorded after 30 days of vaccination as compared to pre-vaccination. However more interestingly highly significant ($p<0.01$) decline in mid peice defect was observed particularly after 30 days of vaccination, where the mean values were found to be in close proximity with the pre-vaccination values. Our observations were in consonance to the results of Perumal *et al*. (2013).The earlier report of Barth and Oko (1989) also mentioned that FMD vaccine stress has an adverse effect on sperm head followed by mid peice defect and that an increase in abnormality is associated with raise in testicular temperature. Besides that the interval for recovery depends on severity and longevity of raised temperature. However in our study there was slight raise in temperature (103°F -104°F) for the 1st and 2nd days of vaccination thereafter reduced to its normal temperature on 3rd day, which might be attributed to the earlier recovery of sperm morphology within 4 weeks of vaccination. Moreover bull reaction time (2-3minutes) showed no significant difference. In contrast to our findings about duration of revitalization, previous studies of Perumal *et al*. (2013) and Kastelick *et al*. (1996) showed that sperm morphology usually returns to pre-vaccination values within 8thweek of thermal insult. However in their report the rectal temperature, bull reaction time remain significantly elevated for 1st five weeks of vaccination then it gradually reduced to normal.

CONCLUSION

From the study, it is clear that application of FMD vaccine results in febrile reaction causing alteration in the seminal attributes which depends on the extent and duration of rise of body temperature. There was general decline in performance of seminal traits of bulls for first 4 weeks after vaccination only. It was thus concluded that FMD vaccination causes alteration in spermiogram but functions of accessory sex glands remain unaltered.

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Conflict of interest: The authors declare that they have no competing interests.

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