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# Effects of *Peste des petits ruminants* (PPR) vaccination on the semen characteristics of West African Dwarf goat bucks

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## Abstract

*Peste des petits ruminants* (PPR) is a very important disease of ruminants. Vaccination with the PPR vaccine is the major strategy adopted for its prevention and control. The effects of PPR vaccination on semen characteristics of goats have not been reported. This study investigated the effects of PPR vaccination on the semen characteristic of West African Dwarf (WAD) goat bucks. Eight (8) apparently healthy, sexually matured WAD bucks were used for the study. The bucks were randomly assigned into two groups (Vaccinated group and Unvaccinated control group) of four bucks each. Bucks in the Vaccinated group were given PPR vaccine while those in the Control group were not vaccinated. Semen samples were collected through the use of electro-ejaculator, pre-vaccination, and at four and eight weeks post-vaccination. The semen characteristics evaluated included volume, color, sperm mass activity, percentage progressive motility, percentage live-dead ratio and concentration, and the evaluations were done following standard laboratory procedures. Results showed that the colour of the semen remained milky to creamy white in both the Vaccinated group and the Unvaccinated control group. The mean semen volume, sperm concentration, sperm motility, mass activity and live-dead ratio of the Vaccinated bucks on week 4 and 8 post-vaccination did not significantly ($p > 0.05$) differ from the pre-vaccination values and the values obtained for the Control group. These findings suggest that PRR vaccination as used in this study did not significantly alter the semen characteristics of the WAD goat bucks. PPR vaccine can thus be safely administered to goat bucks during the breeding period.

***Keywords***: *Peste des petits ruminants* (PPR); PPR Vaccine; Semen Characteristics; West African Dwarf goats.

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## Introduction

West African Dwarf (WAD) goats are found in the humid regions of West and Central Africa, and they constitute an important livestock resource in these areas (Saidu *et al.*, 2017). Numerous studies had been done and reported on WAD goats due to their unique genetic characteristics (Aikhuomobhogbe and Orheruata, 2006). The WAD goat attains sexual maturity from three to six months of age, with a mature weight of about 30 kg for males and 20 kg for females (National Research Council, 1991). When compared to cattle in West Africa, the WAD goat is much more valuable as it can flourish in harsh environments and has a high reproduction rate with a short generative interval (Oyeyemi *et al.*, 2011).

*Peste des petit ruminants* (PPR) is an important disease caused by *Peste des petit ruminants* virus (PPRV). The *Office International des Epizooties* (OIE) has identified the causative virus of PPR as extremely contagious and the disease as one of the economically significant viral diseases that affect small ruminants, both domestic and wild (Ezeasor *et al.*, 2014). Due to its associated high morbidity and mortality rates and quick spread, PPR is considered a notifiable illness (FAO, 2013). The disease is characterised by pyrexia, oculo-nasal discharge, pneumonia, gastroenteritis, and ulcerative/necrotizing stomatitis and death (Emikpe and Ajusegiri, 2011; Emikpe *et al*., 2013).

The PPR virus is widely distributed over southern Asia, the Middle East, Arabia, and West and Central Africa (Ezeasor *et al.*, 2014). These regions include a large portion of the developing world that is primarily dependent on subsistence farming to offer commodities for trade or food, with small ruminants being an excellent source of both (Banyard *et al.*, 2010). In low-income nations of Sub-Saharan Africa and south-east Asia, where the stamping-out programme cannot be followed, vaccination is the most effective way to prevent this disease (Diallo, 2007). Vaccines and vaccination have been used as major aspects of the global eradication campaigns against PPR (Kayser and Ramzan, 2021).

Previous studies have reported the effect of vaccines such as Foot and mouth disease vaccine, haemarrhagic septicaemia and black quarter vaccine on semen parameters in cattle and bufallo (Bhakat *et al.*, 2015, Perumal *et al.*, 2013, Saha *et al.*, 2011, Sirohi *et al.*, 2016). Other studies have reported the effect of PPR vaccine on haematological parameters of WAD bucks (Aikhuomobhogbe and Orheruata, 2006, Ezeasor *et al.*, 2014). There is however dearth of information on the effect of PPR vaccine on the semen characteristics of WAD bucks. This study evaluated the effects of PPR vaccination on the semen characteristics of West African Dwarf (WAD) goat bucks.

## Materials and Methods

**Approval for the Use of the Animals for Research:** Approval for the use of the goat bucks for the study was obtained from University of Ilorin Research Ethics Review Committee before commencement of the study, with Approval Number UREC/FVM/PG20/68VO002. All ethical considerations on the use of animals in research were followed.

**Experimental Animals and Treatments:** Eight apparently healthy, sexually matured WAD goat bucks were used for the study. The animals were housed at the Small Ruminant Unit of University of Ilorin Veterinary Teaching Hospital, Ilorin, Kwara State. Laboratory analyses were conducted at the Theriogenology Laboratory, Department of Theriogenology and Production, Faculty of Veterinary Medicine, University of Ilorin, Nigeria. The animals were housed in a well-ventilated pen and provided feed and water *ad libitum*. The bucks were procured and quarantined for two weeks to allow them acclimatize to the environment. During the acclimatization period, they were treated against internal and external parasites.

**Experimental Design:** The eight bucks used for the study were randomly assigned into two groups (Vaccinated group and Unvaccinated Control group) of four bucks each. After the acclimatization, semen was collected from all the bucks (pre-vaccination) and the PPR vaccine was administered to all the bucks in the Vaccinated group. The PPR vaccine used for the study (Nigerian strain 75/1) was obtained from the National Veterinary Research Institute, Vom, Nigeria. It was administered subcutaneously at the manufacturer's recommended dose rate of 1 ml per goat buck. After the vaccination, semen samples were further collected from the bucks in the Vaccinated group at weeks 4 and 8 post-vaccination.

**Semen Collection and Analysis:** The semen samples were collected using an electroejaculator as described by Bitto *et al.* (2000) and Raji and Ajala (2015). The semen characteristics evaluated included volume, color, sperm mass activity, percentage progressive motility, percentage live-dead ratio and concentration. The ejaculates were subjected to evaluation for volume by reading the measurements on the collection tube (Ramukhithi *et al.,* 2017). The colour of the semen was recorded. The sperm motility was evaluated by placing 10 µl of semen on a pre-warmed glass slide (37°C), which was mounted with a cover slip on a microscope and examined at × 10 objective for individual progressive unidirectional/linearly motile sperms (Ramukhithi *et al.*, 2017). The mass activity was assessed at × 100 magnification using a light microscope after placing a drop of semen on a glass slide that had been warmed beforehand in order to observe the level of wave motion, while the sperm concentration was evaluated by the haemocytometer method (Tomar, 1997). The Live-Dead ratio was determined by staining with eosin-nigrosin stain (Robeck and O'Brien, 2004), while the sperm morphology was evaluated by counting 200 sperm cells per slide in a smear stained with eosin-nigrosin (Loskutoff and Crichton, 2001).

**Statistical Analysis:** Data obtained were analysed using GraphPad Prism Version 5.03. One-way analysis of variance (ANOVA) followed by *Turkey's post hoc* test was used to analyze the data. Values of $P<0.05$ were considered significant. The results were presented as means ± standard error of mean (SEM).

## Results

The results of the laboratory evaluation of the semen characteristics are presented in Table 1. There were no significant ($p > 0.05$) differences between the week 4 (0.39 ± 0.02) and week 8 (0.40 ± 0.03) semen volume (ml) when compared to the pre-vaccination (0.42 ± 0.03) and control group (0.41 ± 0.05) values (Table 1). The colour of the semen was milky to creamy white all through from pre-vaccination to week 4 and 8 post-vaccination (Table 1). The mean sperm mass activity of the unvaccinated control was 3.8 ± 0.32, and this value did not significantly ($p > 0.05$) differ from the pre-vaccination value of 4.2 ± 0.50 and the week 4 (4.1 ± 0.17) and week 8 (4.3 ± 0.58) post-vaccination values recorded for the vaccinated bucks (Table 1). The percentage sperm motility and Live-Dead ratio did not significantly ($p > 0.05$) vary between the Unvaccinated control and the Vaccinated group both at pre-vaccination and at week 4 and week 8 post-vaccination (Table 1). Also, the mean sperm concentration (× $10^9$/ml) of the Unvaccinated control group (408.7 ± 8.74) did not significantly ($p > 0.05$) differ from the pre-vaccination value of 412.7 ± 6.36 and the week 4 (402.0 ± 15.04) and week 8 (410.3 ± 7.62) post-vaccination values recorded for the Vaccinated group (Table 1).

**Table 1**. Semen characteristics of WAD goat bucks vaccinated with *peste des petits* ruminant PPR) vaccine, compare with unvaccinated control [Results are presented as mean ± standard error].

| Parameters | Unvaccinated Control | Vaccinated Group | | |
|---|---|---|---|---|
| | | Pre-vaccination | Week 4 post-vaccination | Week 8 post-vaccination |
| **Volume (ml)** | 0.41 ± 0.05 | 0.42 ± 0.03 | 0.39 ± 0.02 | 0.40 ± 0.03 |
| **Colour** | Milky to creamy white | Milky to creamy white | Milky to creamy white | Milky to creamy white |
| **Mass Activity** | 3.8 ± 0.32 | 4.2 ± 0.50 | 4.1 ± 0.17 | 4.3 ± 0.58 |
| **Sperm Motility (%)** | 97.3 ± 1.20 | 93.7 ± 2.91 | 88.33 ± 3.76 | 92.67 ± 0.67 |
| **Live-Dead Ratio (%)** | 90 ± 2.08 | 89.7 ± 1.20 | 79.7 ± 2.40 | 87 ± 3.61 |
| **Sperm Concentration ($x10^9$/mL)** | 408.7 ± 8.74 | 412.7 ± 6.36 | 402 ± 15.04 | 410.3 ± 7.62 |

No significant differences ($p > 0.05$)

**Discussion and Conclusion**

The lack of significant change in the semen volume in the Vaccinated group in this study following vaccination of the WAD bucks with PPR vaccine implies that the vaccination did not affect the accessory sex glands which secrete seminal fluid. This finding does not agree with the report of Sirohi *et al.*, (2016) who found a progressive decrease in the volume of semen following foot and mouth disease (FMD) vaccination in Frieswal crossbred bulls. Perumal *et al*. (2013) also found a decrease in semen volume post-FMD vaccination. Volume of semen was reported to have increased slightly during post-FMD vaccination in Karan Fries and Murrah buffalo bulls (Bhakat *et al.*, 2010). However, the present finding agrees with the reports of Bhakat *et al*. (2015) who found no significant change in volume of semen following hemorrhagic septicaemia and black quarter (HS and BQ) vaccination in buffalo. Also, the fact that semen colour did not significantly vary from pre-vaccination to weeks 4 and 8 post-vaccination in the vaccinated group indicates that the vaccination did not affect semen colour, which is commonly a reflection of the sperm concentration. The findings in this present study that the mean mass activity did not significantly vary pre- and post-vaccination contrasts with the reports of Perumal *et al.*, (2013) who recorded a significant decrease in mass activity following FMD vaccination.

There was no significant change in the sperm motility pre- and post-vaccination. The values obtained at weeks 4 and 8 post-vaccination was slightly lower than the pre-vaccination value. The slightly lower but not significantly different percentage sperm motility recorded in this study for the vaccinated bucks partly concurs but does not agree with the reports of decrease in sperm motility following FMD vaccination by Venkatareddy *et al.*, (1991) who attributed it to the vaccination's anaphylactic stress response, which manifested as a significant increase in body temperature. Similarly, Sirohi *et al.* (2016)

reported significant decrease in sperm motility in Frieswal crossbred bulls following FMD vaccination. Bhakat *et al.* (2008) also reported non-significant decrease in initial motility following FMD vaccination in Sahiwal bulls. In the same vein, Mathur *et al.* (2003) reported a significant decline in percentage motility after IBR and HS and BQ vaccinations in Frieswal bulls.

The percentage Live-Dead ratio did not differ significantly in the values obtained pre-vaccination and post-vaccination. This finding does not agree with the reports of Saha *et al.* (2011) that showed significant decrease in the live sperm cells percentage following FMD vaccination in Holstein Friesian bulls and that of Sirohi *et al.* (2016) who reported an increase in the percentage live sperm cells following FMD vaccination in Frieswal crossbred bulls.

The finding in this present study of no significant differences between pre-vaccination and post-vaccination values in sperm concentration following vaccination with PPR vaccine does not agree with the reports of Perumal *et al.* (2013) who recorded a decreased sperm concentration following FMD vaccination in mithun and the findings of Sirohi *et al.* (2016) who reported a slight increase in the concentration of spermatozoa in Frieswal crossbred bulls post FMD vaccination.

We speculate that the reasons why the PPR vaccine used in this study did not cause any semen abnormalities may be as a result of the nature of the virus used in making the vaccine (Barda *et al.,* 2022). It could also probably be because PPR virus infection and the disease does not routinely lead to semen abnormalities in male reproductive organs, in contrast to the FMD virus/disease (Perumal *et al.*, 2013).

In conclusion, the present study showed that administration of PPR vaccine to the WAD goat bucks did not cause significant changes in the semen characteristics (semen volume, colour, mass activity, percentage progressive motility and sperm concentration) evaluated. These findings imply that PPR vaccination does not affect semen characteristics in WAD bucks, thus the vaccination can be safely administered to goat bucks during the breeding period, without expecting any adverse effects on semen quality.

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