

1   **Title page**

2   **Title: Prevalence, Clinico-Pathological and Hematological Features Of Peste des Petits**  
3   **Ruminants in Different Breeds Of Goats and Their Response To Antimicrobial**  
4   **Treatment**

5   **Running Title:** *Prevalence, Clinico-Pathological and Hematological Features Of Peste des*  
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7   *Treatment*

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**Title: Prevalence, Clinico-Pathological and Hematological Features Of Peste des Petits Ruminants in Different Breeds Of Goats and Their Response To Antimicrobial Treatment**

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**Prevalence, Clinico-Pathological and Hematological Features Of Peste des Petits Ruminants in Different Breeds Of Goats and Their Response To Antimicrobial Treatment**

**ABSTRACT**

The Study was carried out on one hundred and eighty two goats registered at Upazila Veterinary Hospital, Cox's Bazaar, Bangladesh during July, to December, 2012. Clinical examination revealed significantly ( $P<0.05$ ) increased heart, temperature and respiratory rates in Peste des Petits Ruminants affected goats ( $n=87$ ). Significantly ( $P<0.05$ ) higher prevalence of PPR (65%) was recorded in non vaccinated group ( $n=102$ ) whereas non significant

( $P>0.05$ ) difference in PPR was recorded with respect to breed, sex and month of disease occurrence. Blood samples of PPR affected goats ( $n=10$ ) exhibited significantly ( $P<0.05$ ) decreased total leukocyte count ( $9.31\pm0.53$  thousand/ $\text{mm}^3$ ) and lymphocytes ( $4.12\pm2.26\%$ ) whereas significantly ( $P<0.05$ ) increased neutrophils ( $41.30\pm2.32\%$ ) as compared to healthy goats ( $n=10$ ). Non significant difference ( $P>0.05$ ) was recorded with respect to hemoglobin, packed cell volume, total erythrocyte count, monocytes, eosinophils and basophils. Postmortem examination of PPR affected goats revealed congested lungs, enlarged heart, splenomegaly, soft and swollen intestinal lymph nodes, necrosed and hemorrhagic intestinal tract and zebra stripe lesions at ileo-caecal junction. Highest recovery rate (55%) was recorded in the clinical cases ( $n=20$ ) administered with antimicrobial, oxytetracyclin @of 10mg/kg, pheneramine melete @of 1mg/kg and an oral rehydration saline (ORS) @1.25 mg/kg. It was concluded that PPR can affect goat population irrespective of age, breed and sex. Supportive therapy with oxytetracycline-100 can enhance recovery of the PPR affected goats and vaccination can reduce the disease prevalence leading to effective control and prevention.

**Key words:** PPR, Clinico-pathological features, Prevalence, Hematological parameters, Post-mortem, Breeds of goat

## INTRODUCTION

Peste des Petits Ruminants (PPR) is an acute and highly contagious viral disease of small ruminants caused by a non-segmented negative strand RNA virus, peste des petits ruminants virus (PPRV). International organizations for animal health (OIE) has identified PPR as a notifiable and economically important transboundary viral disease of small ruminants associated with high morbidity and mortality. PPR was first reported in the Ivory Coast of West Africa and was later found in other parts of the world including sub-Saharan Africa, the

Arabian Peninsula, the Middle East, and the parts of Asia (Balamurugan et al., 2012). Although Food and Agricultural Organization (FAO) and OIE use the French name PPR but the disease has other synonym like stomatitis-pneumonia-enteritis complex disease, pseudo-rinderpest of small ruminants, Kata (Banik et al., 2008). PPR is one of the most widespread, infectious and contagious disease which drastically affect different breeds of goats of Bangladesh. It has been reported that the Black Bengal goat is more susceptible (67.24%) to PPR than Jamunapari breed (32.76%) and the rate of incidences is highest during the rainy season and in the dry agro-climatic zones (Hegde et al., 2009). Animal affected by PPR shed the virus in exhaled air, in secretions and excretions from the mouth, eye and nose, and in feces, semen, and urine (Maganga et al., 2013). Clinically, it is depicted by sudden dullness in infected animals, with high fever and inappetence. One or two days later, congestion of oral, ocular and nasal mucosae leads to serous discharges that later on become more abundant and mucopurulent (Roeder and Obi, 1999). It was reported that the carcass of an affected animal is usually emaciated, the hindquarters soiled with soft/watery feces and the eyeballs sunken. The eyes and nose contain dried-up discharges (Chauhan et al., 2009). Control of PPR outbreaks depends on movement control combined with the use of vaccine. In Bangladesh a live attenuated conventional PPR vaccine was developed by Bangladesh Livestock Research Institute (BLRI) and currently being used in the country (Rahman et al., 2011). This vaccine is highly effective in control against PPR in goats. Although there are some reports on vaccine failure and it might be due to breach in cold supply chain. This study was designed to investigate how the vaccine and supportive treatment can reduce the mortality in goat due to PPR. This study will help for the planners in formulating a control strategy against in PPR in goat.

## **MATERIALS AND METHODS**

### ***Case Definition and Diagnosis***

All the registered goats (n=182) were clinically examined for temperature, heart rate, respiratory rate and dehydration. Close inspection was carried out to find out any oral erosion, nasal and ocular discharge. Breed, age, sex and history of vaccination were also recorded at the time of clinical examination. Disease was diagnosed on the basis of thorough clinical examination.

### ***Study Population***

A total of 182 goats registered at the Upazila Veterinary Hospital, Cox's Bazaar, Bangladesh during July, to December, 2012 were selected as study population.

### ***Collection of Samples***

Blood samples were randomly collected from jugular veins of clinically affected (n=10) and healthy goats (n=10) with sterile syringe into the tubes containing EDTA @2mg/ml for hematological studies.

### ***Laboratory Analysis***

Blood samples were analyzed for determination of hemoglobin, packed cell volume, total erythrocyte count, total leukocyte count and differential leukocyte count using light compound microscope blood examination technique (Tibbo et al., 2004).

### ***Postmortem Examinations***

Postmortem examination was carried out in two suspected affected PPR dead animals. A PPR case was tentatively diagnosed if postmortem examinations reveal the presence of changes like erosions on the gums, soft and hard palates, tongue and cheeks and into the esophagus were observed in most of the kids, consolidated and pneumonic lungs, Erosive and hemorrhagic ulcerative lesions were located in all organs of the digestive system from the

mouth to the colon, characteristics Zebra stripe in the mucosa of colon, enlarged lymphnodes, congested liver, necrosis and hemorrhagic plugs in the cecum (Sahinduran et al., 2012).

### ***Administration of Treatment Packages***

Three different regimens of treatment were conducted in PPR infected goat for evaluating the treatment. **Group I:** Animals were administered with Sulphadimidine @of 165mg/kg on first day and 82.5 mg/kg for the next four days, Pheneramine meleate @of 1mg/kg and an oral rehydration saline (ORS) @1.25gm/liter of water/goat for five days; **Group II:** were administered with Oxytetracycline-100mg @of 10mg/kg body weight for five days, Pheneramine meleate @of 1mg/kg and an oral rehydration saline (ORS) @1.25gm/liter of water/goat for five days; and **Group III:** were treated with oral Sulphadimidine @of 200mg/kg on first day and 100mg/kg for the next four days and an oral rehydration saline (ORS) @1.25gm/liter of water/goat for five days; A diluted solution of Potassium permanganate (0.5%) and glycerin was smeared on the gums, tongue and palate (oral cavity) in all three PPR affected groups for soothing effect (Narayanan et al., 2008). Affected animals survived after the treatments were considered as success and death of the animals were recorded as the failure of the treatment given.

### ***Statistical analysis***

All the data including categorical variables - sex, breeds, vaccination status, season and continuous variables- age, temperature, heart rate, respiratory rate etc from the goats clinically examined were entered into MS excel (Microsoft office excel-2007, USA). Data management and data analysis were done by STATA version-12.1 (STATA Corporation, College Station, Texas). Prevalence was calculated according to different categories of the explanatory variables. Descriptive analysis was done by means of creating histogram and boxplot. To identify the association between a categorical explanatory variable with the outcome (occurrence of PPR), chi- square ( $\chi^2$  test) test was performed and for continuous

variables t-test was conducted to evaluate if the mean values between positive and negative group of animals differed significantly or not. An association was regarded as significant if the  $p \leq 0.05$ .

## RESULTS

### *Prevalence of PPR*

The proportions of PPR cases according to different explanatory variables are shown in Figure 3. The overall prevalence of PPR during the study period was estimated to be 47% (95% CI 34.6-59.4%). Of the black bengal goats clinically examined during the study period 51% (95% CI 39.9-62.0%) were daignosed with PPR. On the other hand, 43% (95% CI 28.0-57.9%) and 47% (95% CI 34.6-59.4%) cross and jamunapari goats, respectively, was affected with PPR. Between male and female goats, the proportion of positive goats were nearly similar 47% (95% CI 38.2-55.8%) and 50% (95% CI 37.1-62.9%), respectively. Proportion of PPR positive goats were varied remarkably according to vaccination status. Twenty six percent (95% CI 16.4-35.6%) goats which were vaccinated and 65% (95% CI 55.7-74.3) among nonvaccinated goats were positive to PPR. Seasonal variation was not very notable in this present study.

### *Descriptive statistics of continuous variables*

In Figure 4. boxplot is presented with the median, minimum, maximum, 25<sup>th</sup> and 75<sup>th</sup> percentile values of age between the 2 groups of goats (PPR negative and positive) investigated the median age of PPR- positive goats was comparatively higher than PPR- negative goats. Figure 5. is showed with the median, minimum, maximum, 25<sup>th</sup> and 75<sup>th</sup> percentile values of temperature between PPR negative and positive goats. The median temperature was higher in PPR positive goats than the PPR- negative ones. Figure 6. is portrayed with a boxplot showing the median, minimum, maximum, 25<sup>th</sup> and 75<sup>th</sup> percentile

values of heart rate between PPR negative and positive goats, respectively. The median heart rate was observed in PPR-positive goats was higher compared with the negative goats. Figure 7. is presented with the median, minimum, maximum, 25<sup>th</sup> and 75<sup>th</sup> percentile values of respiratory rate between PPR negative and positive goats respectively. The median respiratory rate was higher in PPR positive goats compared with negative goats.

### ***Association of categorical variables with outcomes***

Table 1. presented with the statistics of 182 goats according to different categorical variables. Most goats registered to the hospital belonged to two breeds and a cross-bred. Of the 87 PPR-goats 40 belonged to the Black Bengal breed, 29 to Jamuna pari and 18 to the cross-bred. The prevalence of PPR was evenly distributed in both Black Bengal and Jamuna Pari goats ( $p=0.66$ ). Its occurrence was proportionately but not significantly higher in female goats ( $p=0.68$ ). The rate of PPR in the non-vaccinated goats was 65% (95% CI 55.7-74.3) significantly higher compared with the vaccinated goats, 26% (95% CI 16.4-35.6%) ( $P<0.001$ ). According to season, the prevalence was recorded higher in the winter month (December) than in the rainy ones (July and August). During July, August and December the prevalence of PPR were 47%, 42% and 54%, respectively, and there were no significant difference ( $P>0.50$ ) in its occurrence in the said three months of investigation. Comparative mean values of different continuous variables such as age (in month), temperature, heart rate, respiratory rate etc were shown in Table 2. In the PPR positive goats the mean age was  $10.20 \pm 0.41$ ,  $9.39 \pm 0.40$  months in the negative goats ( $p=0.16$ ). In the PPR affected goats the mean temperature, heart rate and respiratory rate - all were significantly higher ( $p<0.001$ ) compared with PPR-negative goats.

### ***Comparison of Hematological pictures***

Hematological pictures of 10 PPR affected goats compared with 10 normal goats shown in Table 3. In the diseased goats the Mean  $\pm$  SE values of Hb ( $8.84 \pm 0.50$  gm %), PCV ( $19.70 \pm 1.35$ ), TEC ( $8.97 \pm 0.71$  million/mm<sup>3</sup>), TLC ( $9.31 \pm 0.53$  thousand/mm<sup>3</sup>), Lymphocyte ( $41.20 \pm 2.26$  %), Monocyte ( $3.50 \pm 0.50$  %), Neutrophil ( $41.30 \pm 2.32$  %), Eosinophil ( $3.60 \pm 0.40$  %), Basophil ( $0.70 \pm 0.21$  %) all were lower compared with the healthy goats.

### ***Response of treatments***

The recovery rates in the three treatment groups are presented in Table 4. Treatment with Oxytetracycline had higher 55% (95% CI), recovery in comparison to two other groups.

### ***Post-mortem findings***

At necropsy, severe dehydration, obstructions of the nostrils with purulent exudates were the common findings. Dirty white, pseudo membranes, erosions on the gums, soft and hard palates, tongue and cheeks and into the esophagus were also observed and consolidated lungs, dark red/ purple and firm to touch, necrosed and congested liver, enlarged heart, splenomegaly, soft and swollen intestinal lymphnodes, necrosed and haemorrhagic ulcerative intestinal tract, zebra stripe lesion in ileo-caecal junction etc were recorded in Figure 8.

## **DISCUSSION**

Among different diseases in goats, PPR is one of the most commonly occurred diseases in Bangladesh. In the present study higher prevalence of PPR was found in Black Bengal than Jamuna Pari and cross-bred goats. (Sarker and Islam, 2011) reported similar findings in goats. The prevalence of PPR was slightly higher in male goats compared with females which in contrast with findings of (Abdalla et al., 2012). They observed higher prevalence in female goats which may be explained that farmers keep more female goats production purposes to get economic benefit. It is not clear whether PPR has any sex predilection which needs further investigation to confirm.

In the vaccinated goats the prevalence of PPR was lower compared with non-vaccinated ones is in the line with (Islam et al., 2012). The higher prevalence of PPR in non vaccinated animals is due to absence of antibodies to PPRV (Banik et al., 2008). The occurrence of PPR in non-vaccinated goats may be associated with failure of continuation of booster dose. Also it is not proven whether PPR vaccine itself produce disease as the PPR vaccine is a live virus vaccine.

The disease occurrence in Cox's Bazar was highest during the months of December, and lowest in the month of August. Based on season, apparently the disease does not differ significantly ( $P>0.05$ ) but during winter (December) the percentage of occurrence was comparatively higher than in Rainy season. This finding is supported by (Gupta et al., 2007). Apparently the disease does not differ significantly ( $P>0.05$ ) between different age groups, but median age was comparatively higher in PPR-positive goats than negative. It was previously reported that the goats of age of between 4 to 12 months were more prone to PPR than older ( $>1$  year) (Gupta et al., 2007). The median temperature was significantly higher in PPR positive goats ( $P<0.05$ ) than negative goats. Similar higher temperature described by (Khan et al., 2005). The present study also recorded a higher heart rate and respiratory rate in PPR-positive goats than negative. A higher heart rate may be the results of severity of dehydration and nutritional status of the PPR- positive animals, supported by (Radostits et al., 2000). On the other hand respiratory rate might have increased in the PPR-goats because of pneumonic condition. A similar high respiratory rate in PPR-goats was reported by (Radostits et al., 2000).

The values of all hematological parameters were lower in the PPR-goats compared to healthy goats, except neutrophil counts. Total erythrocyte counts (million/mm<sup>3</sup>) and level of Hb (gm %) were similar in both the PPRV-infected and healthy goats and PCV (%) was lower ( $P>0.05$ ). The Hb (gm %) and PCV (%) reflect the downturn of the TEC counts. Total

leukocyte counts were higher in healthy goat as compared to affected goats though this value does not cross the normal limit. The counts for neutrophils were significantly higher in the PPRV-infected goats ( $P<0.05$ ). In contrast, lymphocyte counts in the PPRV-infected goats were lower than healthy goats ( $P<0.05$ ). Monocyte, Eosinophil and Basophil counts were lower in the PPRV-infected goats than in healthy goats.

Postmortem examination of two dead animals reveal dirty white, false membranes, erosions on the gums, soft and hard palates, tongue and cheeks and into the esophagus. Erosive and hemorrhagic ulcerative lesions were located in all organs of the digestive system from the mouth to the colon consolidated lungs, dark red/ purple and firm to touch consolidated and pneumonic lungs, enlarged lymphnodes, congested and enlarged liver, characteristic Zebra striping in the mucosa of colon, necrosis and hemorrhagic plugs in the cecum etc. Similar findings were observed by (Sahinduran et al., 2012). The success rate of treatment with parenteral (I/M) administration of oxytetracycline was higher (55%) than parenteral (I/M) use of sulphadimidine (40%) and oral/gut acting sulphadimidine (25%), supported by the findings of (Gupta et al., 2007).

It was concluded that PPR can infect goat population irrespective of age, breed and sex. Vaccination and supportive therapy of Oxytetracycline-100 can significantly decrease its rate of occurrences leading to effective control and prevention. Hematology was carried out in small number of affected population and the study was carried out for a brief period and in a one hospital. In case of higher sample the scenario might be changed.

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## COMPETING INTERESTS

Authors declare that they have no competing interests.

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**Table 1. Association of different categorical variables with PPR incidence in goats under the investigation**

| Variables         | Category    | Number of observation (n) | PPR positive n (%) | Chi square value | P value |
|-------------------|-------------|---------------------------|--------------------|------------------|---------|
| Breed             | Black       | 78                        | 40 (51)            | 0.81             | 0.66    |
|                   | Bengal      |                           |                    |                  |         |
|                   | Cross       | 42                        | 18 (43)            |                  |         |
|                   | Jamuna Pari | 62                        | 29 (47)            |                  |         |
| Sex               | Female      | 58                        | 29 (50)            | 0.16             | 0.68    |
|                   | Male        | 124                       | 58 (47)            |                  |         |
| Vaccination       | No          | 102                       | 66 (65)            | 26.57            | <0.001  |
|                   | Yes         | 80                        | 21 (26)            |                  |         |
| Month of the year | July        | 74                        | 35 (47)            | 1.38             | 0.50    |
|                   | August      | 52                        | 22 (42)            |                  |         |
|                   | December    | 56                        | 30 (54)            |                  |         |

Values at  $P < 0.05$  are statistically significant

**Table 2. Comparison of mean values of different continuous variables between PPR positive and negative goats analyzed with t-test**

| Variables        | Disease status of the goat | Mean   | SE   | 95% CI        | p-value |
|------------------|----------------------------|--------|------|---------------|---------|
| Age (month)      | PPR negative               | 9.39   | 0.40 | 8.59-10.19    | 0.16    |
|                  | PPR positive               | 10.20  | 0.41 | 9.38-11.02    |         |
| Temperature      | PPR negative               | 102.88 | 0.09 | 102.69-103.08 | <0.001  |
|                  | PPR positive               | 103.80 | 0.08 | 103.63-103.96 |         |
| Heart rate       | PPR negative               | 71.33  | 0.52 | 70.29-72.37   | <0.001  |
|                  | PPR positive               | 80.73  | 0.73 | 79.27-82.19   |         |
| Respiratory rate | PPR negative               | 31.71  | 0.45 | 30.81-32.61   | <0.001  |
|                  | PPR positive               | 36.33  | 0.56 | 35.20-37.46   |         |

Values at P<0.05 are statistically significant

**Table 3. Comparison of Haematological parameters (Mean± SE) of healthy and PPRV affected goats**

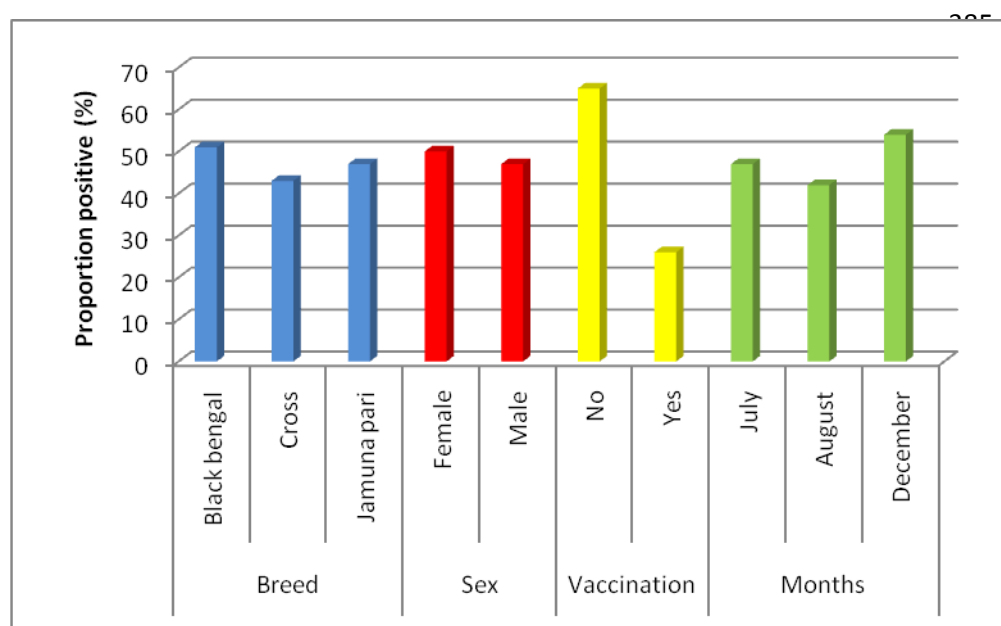
| SL NO | Parameters         | Healthy goat |            | PPR affected goat |             | p-value |
|-------|--------------------|--------------|------------|-------------------|-------------|---------|
|       |                    | Mean± SE     | Min-Max    | Mean± SE          | Min-Max     |         |
| 1     | Hb (gm %)          | 8.93±0.47    | 6.70-12.00 | 8.84±0.50         | 6.80-12.00  | 0.8     |
| 2     | PCV (%)            | 23.40±1.26   | 17-30      | 19.70±1.35        | 14.00-28.00 | 0.06    |
| 3     | TEC (million/mm3)  | 9.18±0.66    | 7.22-13.07 | 8.97±0.71         | 6.72-13.07  | 0.8     |
| 4     | TLC (thousand/mm3) | 11.58±0.71   | 8.90-16.20 | 9.31±0.53         | 7.00-12.30  | 0.02    |
| 6     | DLC (%)            | -            | -          | -                 | -           | -       |
|       | Lymphocyte (%)     | 51.90±2.72   | 39-69      | 41.20±2.26        | 31-53       | 0.01    |
|       | Monocyte (%)       | 4.20±0.57    | 1-7        | 3.50±0.50         | 1-6         | 0.37    |
|       | Neutrophil (%)     | 33.9±1.72    | 25-42      | 41.30±2.32        | 33-56       | 0.02    |
|       | Eosinophil (%)     | 4.70±0.42    | 3-7        | 3.60±0.40         | 2-6         | 0.08    |
|       | Basophil (%)       | 1.20±0.33    | 0-3        | 0.70±0.21         | 0-2         | 0.22    |

Values at P<0.05 are statistically significant

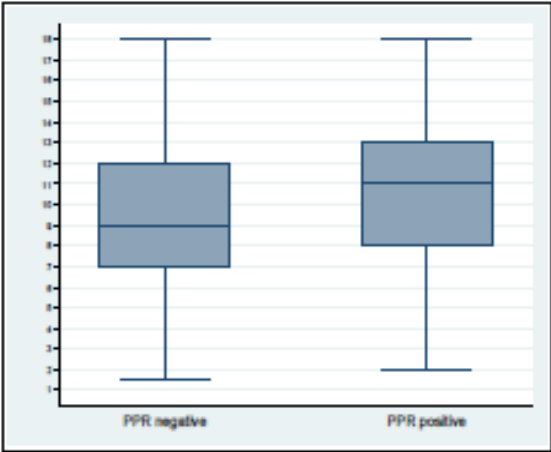
**Table 4. Response to treatments in the three different groups**

| Groups of Drugs | Drug name                                                                              | Response to treatment |          | Total | % of response to treatment |
|-----------------|----------------------------------------------------------------------------------------|-----------------------|----------|-------|----------------------------|
|                 |                                                                                        | Positive              | Negative |       |                            |
| I               | Diadin ( Sulphadimidine-Na) + Antihista vet (Pheneramine meleate) + Renalyte(ORS)      | 8                     | 12       | 20    | 40                         |
| II              | Renamycin-100 (Oxytetracycline) + Antihista vet (Pheneramine meleate) + Renalyte (ORS) | 11                    | 9        | 20    | 55                         |
| II              | Orally Sulphadimidine + Renalyte (ORS)                                                 | 3                     | 9        | 12    | 25                         |

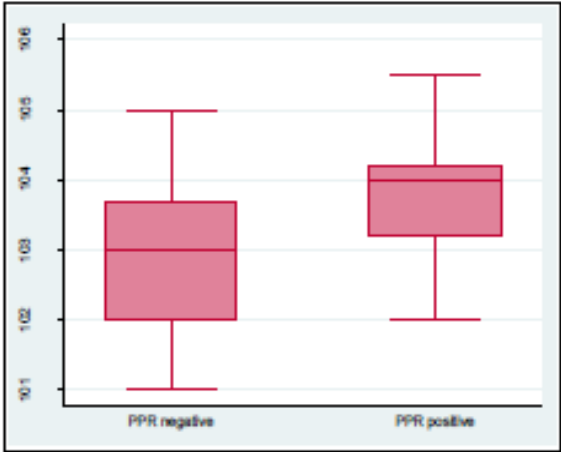
**Figure 3. Proportion of PPR positive goats according to different categorical variables**



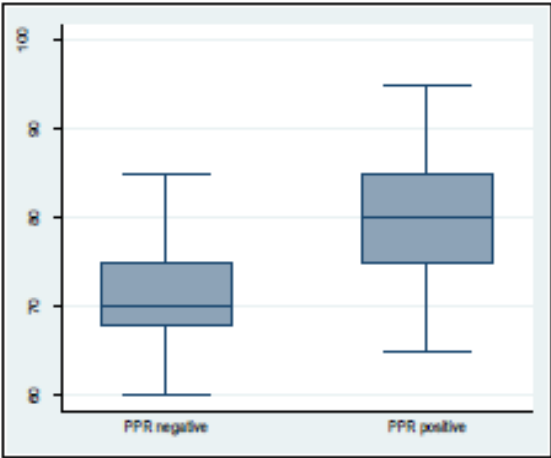
Descriptive statistics of continuous variables



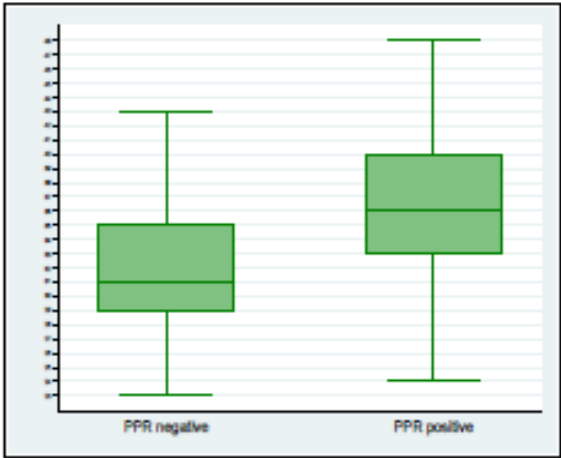
**Figure 4:** Boxplot showing the median, minimum, maximum, 25<sup>th</sup> and 75<sup>th</sup> percentile values of age (month) among PPR positive and negative goats



**Figure 5:** Boxplot showing the median, minimum, maximum, 25<sup>th</sup> and 75<sup>th</sup> percentile values of temperature (°F) among PPR positive and negative goats



**Figure 6:** Boxplot showing the median, minimum, maximum, 25<sup>th</sup> and 75<sup>th</sup> percentile values of heart rate (per minute) among PPR positive and negative goats

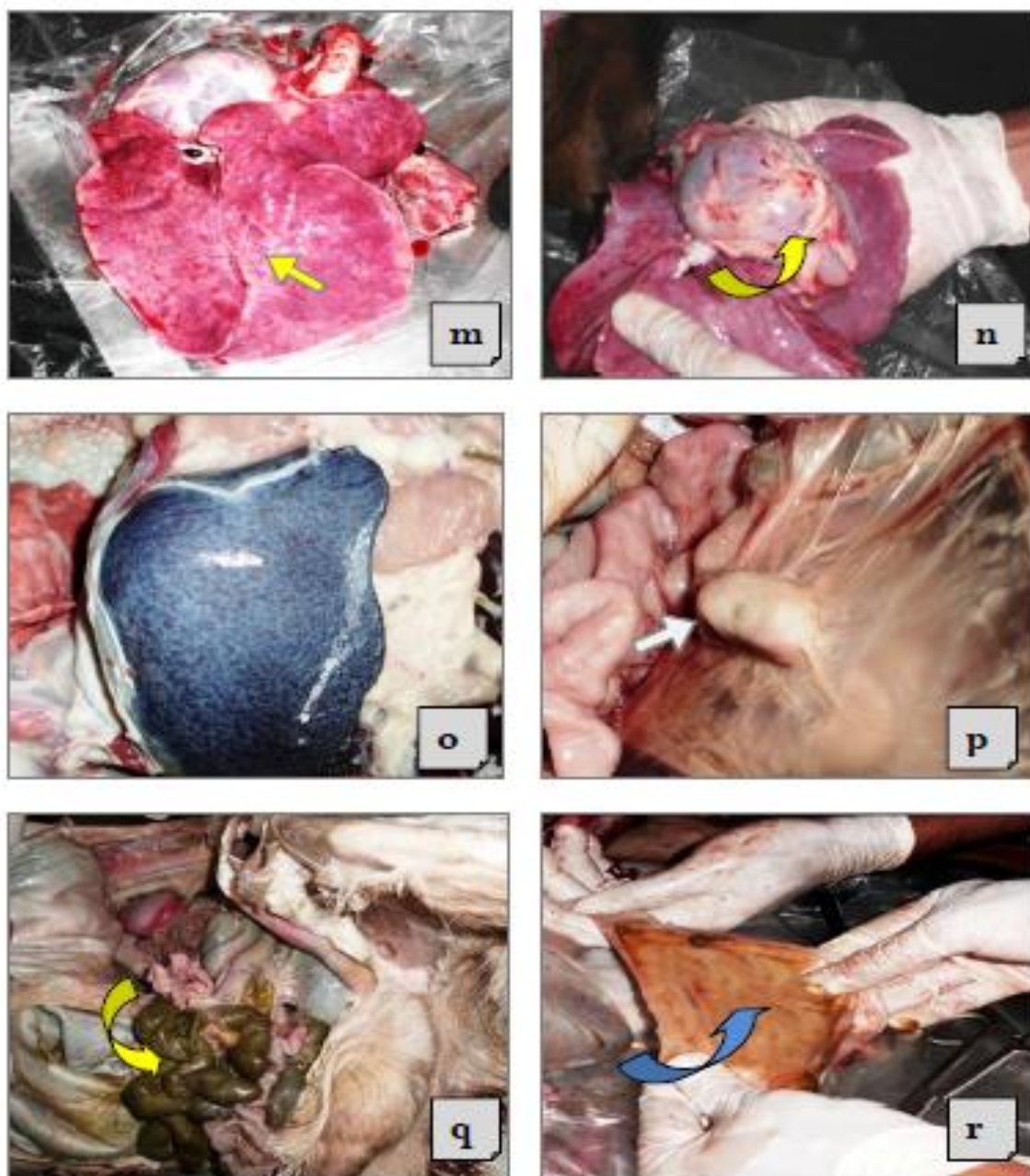


**Figure 7:** Boxplot is presented with the median, minimum, maximum, 25<sup>th</sup> and 75<sup>th</sup> percentile values of respiratory rate (per minute) among PPR positive and negative goats

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Postmortem examination of PPR affected goats. (m) Congested lung, dark red/purple areas & firm to touch ( n ) enlarged heart ( o ) Splenomegaly ( p) Soft and swollen intestinal lymphnode ( q ) Necrosed & haemorrhagic intestinal tract ( r ) Zebra stripe lesion in ileo-caecal junction in PPR affected goat.