

## SEASONAL VARIATIONS ON SEMEN CHARACTERISTICS OF FAT-TAILED AND GARUT RAMS UNDER TROPICAL CONDITIONS

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### ABSTRACT

This study investigated the influences of rainy and dry seasons on semen characteristics of fat-tailed and Garut rams under tropical conditions. A total of 4 healthy rams (2 fat-tailed rams and 2 Garut rams) aged 3 to 4 years old were used in this study. The semen was collected from each ram during November 2016 to February 2017 (rainy season) and May to August 2017 (dry season). The measurement of semen characteristics including semen volume (SV), sperm concentration (SpC), total sperm (TSp), individual sperm motility (ISM), post-thawing sperm motility (PTSM), and frozen semen production (FSP). The rainy season resulted higher SV ( $P= 0.021$ ), TSp ( $P= 0.005$ ), ISM ( $P= 0.028$ ), and FSP ( $P= 0.005$ ) than the dry season. On the other hand, fat-tailed rams had higher ( $P<0.001$ ) SV, TSp, and FSP compared to Garut rams. There was no interaction ( $P>0.05$ ) between season and breed on all semen characteristic parameters found in the present study. It can be concluded that the semen collection during the rainy season had a beneficial impact to produce high-quality semen for artificial insemination program than in the dry season. Fat-tailed rams have better semen characteristics compared to Garut rams.

Key words: artificial insemination, dry season, frozen semen, Indonesian native sheep, rainy season

### ABSTRAK

Penelitian ini dilakukan untuk mengetahui pengaruh musim penghujan dan kemarau terhadap karakteristik semen domba ekor gemuk dan domba garut yang dipelihara pada kondisi tropis. Sebanyak 4 ekor domba pejantan (2 ekor domba ekor gemuk dan 2 ekor domba garut) berumur 3 sampai 4 tahun digunakan pada penelitian ini. Semen ditampung dari masing-masing domba pejantan pada bulan Nopember 2016 sampai Februari 2017 (musim penghujan) dan pada bulan Mei sampai Agustus 2017 (musim kemarau). Evaluasi karakteristik semen meliputi volume semen, konsentrasi sperma, total sperma, motilitas individu sperma, motilitas sperma post-thawing, dan produksi semen beku. Hasil penelitian menunjukkan bahwa musim penghujan memberikan hasil yang lebih tinggi pada volume semen ( $P= 0,021$ ), total sperma ( $P= 0,005$ ), motilitas individu sperma ( $P= 0,028$ ), dan produksi semen beku ( $P= 0,005$ ) dibandingkan dengan musim kemarau. Di sisi lain, domba ekor gemuk menghasilkan volume semen, total sperma, dan produksi semen yang lebih tinggi ( $P<0,001$ ) jika dibandingkan dengan domba garut. Tidak ditemukan adanya interaksi ( $P>0,05$ ) antara musim dan bangsa domba pada seluruh parameter karakteristik semen. Kesimpulan dari penelitian ini adalah bahwa penampungan semen pada musim penghujan memberikan keuntungan dalam menghasilkan semen domba dengan kualitas tinggi. Semen yang dihasilkan oleh domba ekor gemuk memiliki karakteristik yang lebih baik jika dibandingkan dengan domba garut.

Kata kunci: inseminasi buatan, musim kemarau, semen beku, domba lokal Indonesia, musim penghujan

### INTRODUCTION

Currently, meat consumption in Indonesia is relatively lower than the other ASEAN countries. Total meat consumption in Indonesia is only 11.3 kg/capita/year, whereas total meat consumption in Thailand, Philippines, Viet Nam, and Malaysia are 22.9, 29.6, 52.9, and 54.7 kg/capita/year, respectively (OECD, 2018). Moreover, meat production in Indonesia is dominated by poultry, while the sheep is very few. Based on the data published by Indonesian Directorate General of Livestock and Animal Health Service (2017), total meat production is 3,344 thousand tons with 55.26% comes from poultry meat, while the sheep only contribute to about 1.64%. These data show that the sheep are not well developed, so the efforts are needed to increase the sheep population in Indonesia.

Fat-tailed sheep is one of sheep which commonly found in East Java Province, Indonesia (Bintara *et al.*, 2017). This sheep has a potency to produce meat due to the several advantages including well-adapted to the harsh environment and able to use low-quality feed (Jakaria *et al.*, 2012). Another breed of sheep which also has a great potency as meat producer is Garut sheep. This Indonesian native sheep is a prolific animal

(Khotijah *et al.*, 2015) and has good feed conversion ratio compared to several crossbred sheep in Indonesia (Yulistiani *et al.*, 2015). An effort which can be done to improve the productivity of fat-tailed and Garut sheep is by using artificial insemination program. However, the semen quality of the rams become a critical point in this program so that it should be evaluated regularly.

In tropical countries such as Indonesia, environmental factors may fluctuate the reproductive performance of animals. The changes in temperature and humidity could generate thermal discomfort in the livestock, which then may reduce sperm quality (Salles *et al.*, 2012). The increased in the temperature-humidity index (THI) due to the seasonal change also depress the reproductive hormone secretion such as FSH, LH, and testosterone, resulting in a reduction of bovine semen quality (Perumal *et al.*, 2017). It also well known that the increase in environmental temperatures, such as in the dry season, could promote heat stress, which then may alter the sperm production and quality (Hansen 2009; van Tilburg *et al.*, 2014; Isnaini *et al.*, 2019a). Therefore, this current study was performed to investigate the influences of rainy and dry seasons on semen characteristics of fat-tailed and Garut rams raised under tropical conditions.

## MATERIALS AND METHODS

This research was carried out at Lembang Artificial Insemination Center, Bandung District, West Java Province, Indonesia. This site is situated between 06° 49' 35.6" South latitude and 107° 37' 03.6" East longitude. The altitude of this site is 1,241 m above sea level. The climatological data including temperature, relative humidity, and precipitation were received from Lembang Geophysics Station (Table 1). The calculation of temperature-humidity index (THI) was done by a formula =  $(0.8 \times T) + (RH \times (T-14.4)) + 46.4$ . T was the temperature in Celsius degree, while RH was relative humidity expressed as a proportion.

A total of 4 healthy rams, 2 of each breed (Fat-tailed and Garut), aged 3 to 4 years old were used in this study. All of the rams were raised under similar feeding, housing, and other management conditions as per the standard protocol in Lembang Artificial Insemination Center. The semen was collected using an artificial vaginal method once a week. The semen collection was done during November 2016 to February 2017 (rainy season) and May to August 2017 (dry season) resulting in a total of 112 ejaculate semen; 28 ejaculate semen of each breed in the rainy season and another 28 ejaculate semen in the dry season.

### Measurement of Semen Characteristics

The fresh semen was immediately transferred to the laboratory and then kept in a constant temperature of 37° C by using a water bath. The semen volume (SV) was measured using a scaled tube used in the semen collection. The semen was then measured for its pH by immersing the probe of pH meter into the semen sample. Sperm concentration (SpC) was measured by using spectrophotometer. The SpC was multiplied by SV to obtain total sperm (TSp) (Al-Anazi *et al.*, 2017). Individual sperm motility (ISM) and post-thawing sperm motility (PTSM) were observed under a light microscope with 400 times of magnification (Isnaini *et al.*, 2019b). The recovery rate (RR) was calculated by formula =  $(PTSM/ISM) \times 100\%$  (Kaabi *et al.*, 2003). The frozen semen production (FSP) was calculated by dividing TSp by  $50 \times 10^6$  (Indonesian National Standard, 2014).

### Data Analysis

Data of semen characteristics were analyzed using the Univariate General Linear Model (SPSS 13.0 for Windows, SPSS Inc., Chicago, IL, USA, 2004). A 2 x 2 factorial arrangement was used to evaluate the effects of breed (Fat-tailed and Garut) and season (rainy and dry) as well as their interaction. Data were presented as mean followed by standard error of mean (SEM). Data were considered to be statistically significant at  $P < 0.05$ .

## RESULTS AND DISCUSSION

Table 2 shows the effects of season on SV, pH, SpC, and TSp of fat-tailed and Garut rams. The significant differences of SV and TSp were found

between the seasons and the rainy season; whereas the rainy season had more favorable effects than the dry season. Meanwhile, no significant seasonal effects were recorded on pH and SpC. The results showed that SV and TSp were differed significantly between the two breeds with higher value in fat-tailed rams as compared to Garut rams. However, there were no significant differences of pH and SpC between fat-tailed and Garut rams. No season and breed interaction effects were observed on SV, pH, SpC, and TSp.

This study reveals that in the rainy season, the rams, regardless of breed, had more preferable semen characteristics as indicated by higher SV, TSp, ISM, and FSP compared to those in the dry season. These results may be related with the THI value, which was lower during rainy season compared to dry season (Table 1). In agreement with this current finding, Perumal *et al.* (2017) also observed that the lower THI value in the spring and winter seasons resulting in a higher SV of Mithun bulls as compared to the summer season with high THI. Al-Anazi *et al.* (2017) also reported a higher SV and TSp in Najdi rams during semen collection in the spring and winter seasons compared to those in the summer season. Chella *et al.* (2017) also found that SV of Zulu rams was higher in the spring and winter seasons compared to those in the summer season. In another study, Ramachandran *et al.* (2016) also noted that Jamunapari bucks had higher ISM during the rainy season than in the summer season.

The lower semen characteristics in the dry season may be because of the increased in AT which may induce heat stress in the rams. Bhakat *et al.* (2009) stated that the high AT during summer season may induce heat stress as indicated by the increase of plasma corticosteroids, which then may inhibit luteinizing hormone secretion and ultimately could deteriorate spermatogenesis. As a consequence, the sperm quality will be reduced. Moreover, van Tilburg *et al.* (2014) reported that the high AT during the dry season could increase the testis temperature of Saanen bucks, resulting in the 14% reduction of sperm motility as compared to the rainy season.

In this current study, fat-tailed rams had higher SV, TSp, and FSP compared to Garut rams. The SV of fat-tailed rams was comparable to those reported by Bintara *et al.* (2017). On the other hand, although SV of Garut rams was lower than fat-tailed rams, this current data shows a higher value than in the previous reports (Herdis *et al.*, 2002; Herdis *et al.*, 2011). Moreover, SV of both breeds used in this study was higher than the other breeds raised under tropical conditions. Aké-López *et al.* (2016) reported that Pelibuey rams had SV ranged from 0.53 to 0.58 mL. In another study, Carvajal-Serna *et al.* (2018) reported that Creole rams had the average SV of 1.85 mL.

Both fat-tailed and Garut rams had statistically similar pH and SpC. The results of pH and SpC in this current study was comparable with Solihati *et al.* (2016) who reported that semen pH and SpC of Indonesian native rams were ranged from 6.5 to 6.8 and

**Table 1.** Mean ambient temperature (AT), relative humidity (RH), temperature-humidity index (THI), and precipitation (Pr) at the research site

| Season  | AT (° C) | RH (%) | THI  | Pr (mm) |
|---------|----------|--------|------|---------|
| Rainy   | 20.3     | 86.5   | 67.7 | 256     |
| Dry     | 21.7     | 76.5   | 69.3 | 72.2    |
| Overall | 21       | 81.5   | 68.5 | 164     |

**Table 2.** Effects of season on semen volume (SV), pH, sperm concentration (SpC), and total sperm (TSp) of fat-tailed and Garut rams

| Items               |            | SV (mL) | pH    | SpC (million/mL) | TSp (million) |
|---------------------|------------|---------|-------|------------------|---------------|
| Season              | Rainy      | 2.29    | 6.76  | 3,041            | 7,007         |
|                     | Dry        | 2.07    | 6.76  | 2,874            | 5,926         |
| Breed               | Fat-tailed | 2.42    | 6.75  | 3,043            | 7,314         |
|                     | Garut      | 1.94    | 6.77  | 2,872            | 5,619         |
| Fat-tailed          | Rainy      | 2.53    | 6.73  | 3,153            | 7,912         |
|                     | Dry        | 2.31    | 6.77  | 2,933            | 6,715         |
| Garut               | Rainy      | 2.05    | 6.79  | 2,929            | 6,101         |
|                     | Dry        | 1.82    | 6.75  | 2,815            | 5,138         |
| SEM                 |            | 0.096   | 0.022 | 109              | 376           |
| Source of variation |            |         |       | P value          |               |
| Season              |            | 0.021   | 0.948 | 0.128            | 0.005         |
| Breed               |            | <0.001  | 0.325 | 0.119            | <0.001        |
| Season*breed        |            | 0.926   | 0.072 | 0.626            | 0.756         |

**Table 3.** Effects of season on individual sperm motility (ISM), post-thawing sperm motility (PTSM), recovery rate (RR), and frozen semen production (FSP) of fat-tailed and Garut rams

| Items               |            | ISM (%) | PTSM (%) | RR (%)  | FSP (straw) |
|---------------------|------------|---------|----------|---------|-------------|
| Season              | Rainy      | 79.1    | 40.2     | 51      | 140         |
|                     | Dry        | 76.9    | 40.1     | 52.5    | 119         |
| Breed               | Fat-tailed | 78      | 40       | 51.7    | 146         |
|                     | Garut      | 78      | 40.3     | 51.8    | 112         |
| Fat-tailed          | Rainy      | 78.9    | 40       | 50.8    | 158         |
|                     | Dry        | 77      | 40       | 52.6    | 134         |
| Garut               | Rainy      | 79.3    | 40.4     | 51.2    | 122         |
|                     | Dry        | 76.8    | 40.2     | 52.5    | 103         |
| SEM                 |            | 1       | 0.15     | 0.87    | 15          |
| Source of variation |            |         |          | P value |             |
| Season              |            | 0.028   | 0.560    | 0.081   | 0.005       |
| Breed               |            | 0.929   | 0.082    | 0.910   | <0.001      |
| Breed*season        |            | 0.790   | 0.560    | 0.798   | 0.756       |

from 2,780 to 3,439 million/mL, respectively. Interestingly, although the SpC was similar between the breeds, TSp value was higher in fat-tailed rams than in Garut rams. This result may be as a reflection of the higher SV in fat-tailed rams than Garut rams.

The effects of season on ISM, PTSM, RR, and FSP of fat-tailed and Garut rams are presented in Table 3. The results showed that ISM and FSP were higher in the rainy season than in the dry season. On the other hand, PTSM and RR remain unchanged between the two seasons. The breeds did not influence ISM, PTSM, and RR. However, fat-tailed rams had higher FSP compared to Garut rams. No interaction between season and breed was observed on ISM, PTSM, RR, and FSP.

In this study, ISM, PTSM, and RR did not differ between the two breeds. The value of these semen characteristics in both breeds had fulfilled the requirement for artificial insemination. A good quality of fresh semen which was qualified to be processed into frozen or liquid semen should at least have sperm motility of 70% (Rizal *et al.*, 2018). Moreover, according to the Indonesian National Standard (2014), the post-thawed semen of rams should have at least 40% of sperm motility to be used in artificial

insemination program. The recovery rate value of both breeds in this study also comparable to those reported by Herdis *et al.* (2002) who noted that the rams had recovery rate value ranged from 51.09 to 58.49%. The FSP was measured based on the standard dose of frozen semen of  $50 \times 10^6$  sperm (Indonesian National Standard, 2014). In this study, the higher FSP was observed in the fat-tailed rams than Garut rams. Since FSP was calculated using TSp data, the higher TSp will also followed by FSP.

## CONCLUSION

It can be concluded that the semen collection during rainy season has a beneficial impact to produce high-quality semen for artificial insemination program than in the dry season. Fat-tailed rams have more favorable semen characteristics compared to Garut rams.

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