Conference Paper

Evaluation of Semen Quality in Bali Bull Based on Different Body Weight and Age at the National Artificial Insemination Center, Singosari -- Indonesia

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Abstract.

The aim of this research was to assess the effect of age and body weight on semen quality. The material used was secondary data of 50 Bali Bull from 2012 to 2018 which were grouped as follows. Age 2–4 years: body weight (BW) was low (260-408 kg), medium (409-557 kg) and high (558-706 kg). Age 5–7 years: BW was low (314-470 kg), medium (471-627 kg) and high (628-784 kg). Age 8-10 years: BW was low (481-580 kg), medium (581-680 kg) and high (681-780 kg). The method used in this research is a case study. The obtained data was analyzed by using Nested Completely Randomized Design. The results showed that the older the Bali bull, the volume and individual motility increased ($p<0.05$) but sperm concentration decreased ($p<0.05$). Age 2-4 years: BW significantly affected ($p<0.05$) the volume, sperm concentration and individual motility. Age 5-7 years: BW significantly affected ($p<0.05$) the volume and individual motility, but not significantly ($p>0.05$) sperm concentration. Age 8-10 years: BW significantly affected ($p<0.05$) the volume, sperm concentration and individual motility. The research concluded that the selection of Bali cattle to obtain good quality of semen production should consider the body weight.

Keywords: Age, body weight, semen quality, semen production, Bali bull

1. Introduction

Bali cattle contributes more that 27 percent of the total population of cattle production in Indoneisa. The most of the Bali cattle are kept under small farmer indicating the smallholder farmer in Indonesia plays an important role [1]. The most population of Bali cattle can be found in South Sulawesi Province, East Nusa Tenggara Province (NTT), West Nusa Tenggara (NTB) and Bali Province. The development of Bali cattle population is one important program by Indonesian Government form year to year. This program is supported by using the artificial insemination (AI) technique that already implemented in the overall area in the country. To accelerate the improving population, however, needs

high genetic quality of bull that capable to produce semen with the superior grade compare to the other bull. The simple visible variable to select the bull is by measuring the scrotal circumference and body weight of the bull. This variable showed positive correlation to the semen productivity and sperm motility in Indonesia local cattle [2]. The similar report is found in other Ongle Grade cattle at Research Center in Grati Pasuruan [3].

The potential production of bull to produce semen is considered the capability of bull to produce semen with high production, quality and fertility to result pregnancy of the serviced cows [4]. The quality of bull is important to ensure the success of artificial program, since the continuous availability of qualified semen is one of the key of the success of artificial program [5].

Evaluation of bull with approaching measurement of age and body weight in relation to predict the potential of semen production is the simple method in the practice work especially for technical practician work daily work in the field, since they need quick result to make work decision in practice. This study was aimed to evaluate and analyze the relation between age and body weight of bull to the semen production including volume, sperm motility and sperm concentration in the ejaculate.

2. Materials and Methods

This study was conducted at National Artificial Insemination Center-Singosari (NAICS), Malang. The method of study was collecting data form the records of semen collection of all Bali bull. This study included 50 Bali bull covering the data from 2012 to 2018. The bulls are kept under individual pen house, fed daily with 10 kg forage, 2.5 kg mixed concentrate, 2.5 kg corn silage, 3 kg hay, and 0.05 kg mineral. The body weight was measured monthly.

The study was conducted under the survey method with case study by collecting secondary data available at the data center. The data was at the form of digital data saved in the office computer. The considered data used in this study were age of bull, body weight, semen volume/ejaculate, sperm individual motility and sperm concentration. The age of the bull was grouped into 2 – 4 year old, 5 – 7 year, and 8 – 10 year. In each age class, the body weight is categorized into 3 groups. While for age class 2 – 4 year, the body weight consisted low body weight (260 – 408 kg), medium body weight (405-557 kg), and high body weight (558-705 kg) groups. In the age class 5-7 year consisted of low (314-470 kg), medium (471-627 kg) and high (628-784 kg) body weight

groups. And the age class 8-10 year divided into low (481-580 kg), medium (581-680 kg), and high 681-780 kg) body weight groups.

Data was analyzed by Microsoft SPSS open access Version 24.00 for comparing between groups (One Way Method) with the design of Nested approach of body weight groups to the age classes. Identification of significant differences between age class and body weight groups were analyzed by Duncan's Multiple Range Test.

3. Results and Discussion

3.1. Semen production under the different age class

The semen volume per ejaculate in Bali bull increased significantly (P<0.05) according to the age. Table 1 showed the means of semen volume per ejaculate ranged between 4.88±1.55 ml/ejaculate to 6.25±1.43 ml/ejaculate. The lowest volume was found in the young bull of the 2 − 4 year age class, while the highest one was in the older year of 8 − 10 age class. Other result showed the means semen volume of the bull at 12 year old (5.73 ml) was higher compared to other young one 2 year old (4.87 ml) [6]. This might be as the effect of the growing the testis, as the other result showed the testis volume correlate to the semen volume per ejaculate, while the testes volume increased according the age of bull until the body growth reached plateau [2]. Semen volume increased with age due to increased scrotal size after puberty [7].

TABLE 1: Means of semen volume, progressive motility and sperm concentration per ejaculate

Age (year)	n	Volume (ml)	Progressive Motility (%)	Sperm concentration (Mill/ml)
2 − 4	333	4.88 ± 1.55^a	60.28 ± 12.03^a	1088.12 ± 297.14^{bc}
5 − 7	661	5.61 ± 1.37^b	63.26 ± 09.41^b	1035.24 ± 279.79^a
8 − 10	210	6.25 ± 1.43^c	63.10 ± 11.06^b	1057.84 ± 264.92^{ab}

Note: different superscripts a, b, d in columns indicate significant differences (P<0.05)

The average sperm motility of Bali cattle showed that the increasing age will increase the sperm motility of Bali cattle (p <0.05). Table 1 showed the mean of sperm motility in Bali cattle ranging from 60.282 ± 12.026% to 63.259 ± 9.409%. The lowest motility is in the 2-4 years age group and the highest is in the 5-7 years age group.

[6] stated that the motility of bulls continued to increase until the age of 12 years, but it was not significant. This is probably due to an increase in volume followed by an increased of seminal plasma. Seminal plasma can protect spermatozoa and maintain motility [8]. [7] stated that seminal plasma contains different biochemical compounds

between livestock ages. The sperm motility in this study was included in the good semen quality category, which was between 60% - 75% for the sperm motility [9].

Sperm concentration of Bali bulls decreased with increasing age (p<0.05). Table 1 showed the average sperm concentration between 1035.24 $\pm$ 279.79 to 1088.12 $\pm$ 297.14 x106 / ml. The average sperm concentration of Bali bulls was highest in the 2 to 4 year age group.

In the previous studies, older males produced the lowest sperm concentration compared to younger males [7, 10, 6]. The sperm concentration in this study was included in the category of good semen quality, between 1000 x106 / ml - 1500 x106 / ml for sperm concentration [9]. This can be caused by degenerative changes in the seminiferous tubules, fat deposition that may occur in the scrotum and damage to body muscles, especially testicular tissue due to aging [11].

3.2. Semen Poduction and Qualities of Bali Bulls on Different Ages and Body Weight

The results of this research on the average volume, sperm motility and concentration in each body weight groups can be seen in Table 2. The results of statistical analysis showed that volume increased with body weight gain (p <0.05), both in the age group 2 - 4 years, 5 - 7 years old, 8 - 10 years old. Table 2 showed that in each groups of age, high body weight produced the highest average semen volume and sperm motility.

TABLE 2: Average volume, sperm motility and sperm concentration based on body weight in each age classes.

Age (years)	Body Weight (kg)	n	Volume (ml)	Progressive Motility (%)	Sperm Concentration(10^6)
			Mean $\pm$ sd	Mean $\pm$ sd	Mean $\pm$ sd
2 – 4	260-408	42	3.90 ± 1.09^a	58.66 ± 15.39^b	1082.37 ± 277.08^{ab}
	409-557	190	4.79 ± 1.33^b	58.10 ± 12.35^a	1052.38 ± 304.00^a
	558-706	101	5.46 ± 1.83^c	65.05 ± 7.86^c	1157.75 ± 282.22^{bc}
5 – 7	314-470	26	5.69 ± 1.86^{ab}	60.12 ± 10.04^a	999.22 ± 452.19
	471-627	436	5.35 ± 1.33^a	62.46 ± 10.15^a	1024.94 ± 290.61
	628-784	199	6.17 ± 1.22^{bc}	65.43 ± 6.98^b	1062.50 ± 220.08
8 – 10	481-580	37	6.46 ± 1.78^b	52.65 ± 13.99^a	792.51 ± 258.09^a
	581-680	134	5.93 ± 1.27^a	64.82 ± 9.61^b	1140.42 ± 222.33^c
	681-780	39	7.18 ± 1.13^c	67.07 ± 5.58^b	1025.80 ± 237.13^b

Different superscripts within columns indicate significant differences (p<0.05)

3.3. Correlation Between Body Weight and Semen Quality

Bali cattle in the age group 2-4 years, 5-7 years old, 8-10 years old found the highest individual volume and motility results at high body weight. The results of the study are consistent with [10, 12, 4] stated that the highest volume and sperm motility were found in males with high body weight. At 2 - 4 years old and 5 - 7 years old the highest sperm concentration was found in high body weight. However, at the age of 8-10 years, the highest sperm concentration was found at moderate body weight. This is probably caused by decreased function of the reproductive organs due to increasing age. Many factors caused the differences of sperm concentration in each ejaculation, even within the same breed [13]. The sperm concentration depends on sexual development and maturity, male health, testicular size, age, body weight and feed quality [14].

TABLE 3: Correlation between body weight and semen quality of Bali Bull.

Correlati	R	r^2	Y	P Value
BW-SV	0.317	0.101	y = 3.593 + 0.832x	0.000
BW-PM	0.229	0.053	y = 52.614 + 4.224x	0.000
BW-SC	0.046	0.002	y = 1000.995 + 22.782x	0.109

Note: BW: Body Weight; SV: Sperm Volume; PM: Progressive Motility; SC: Sperm Concentration

Table 3 showed positive correlation between body weight and semen quality. Coefficient of determination of body weight with volume, individual motility and concentration were 0.101; 0.053 and 0.002, this mean 10.1% of sperm volume; 5.3% of progressive motility; 0.2% of sperm concentration is explained by the body weight factor. The different result from research [15] showed the coefficient of determination of body weight on motility and sperm concentration of Murrah cattle from India were (r^2 = 81%) and (r^2 = 41%), respectively. While PO cattle, the coefficient of determination of body weight on sperm volume (r^2 = 22.6%), motility (r^2 = 42.3%), sperm concentration (r^2 = 11) [2]. In Holstein cattle, the correlation values of body weight to sperm volume (r = 0.282), motility (r = 0.324), sperm concentration (r = 0.116) [16]. The difference of this correlation is influenced by differences of breed, each breed of cattle has different semen quality criteria depending on the productivity of the bull, the ability of ejaculate and libido.

4. Conclusions

It was concluded that in order to produce high quality semen (volume, sperm motility and sperm concentration), at least choose bulls with a high body weight. This can be applied to Bali bulls up to 10 years old because the quality of the semen is still good.

5. Acknowledgement

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