Conference Paper

Effects of Energy-Protein Balance in the Diet on Semen Characteristic of West Java Local Ducks

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Abstract

Cihateup (West Java highland) and *Rambon* (West Java lowland) ducks are two local ducks which are commonly raised by farmers in West Java under extensive systems. The decline of land availability as a result of increasing human population has meant that the ducks should be raised under intensive system. An experimental research was conducted to evaluate the effect of energy-protein balance in the diet on semen characteristic of *Cihateup* and *Rambon* drakes under restricted water system (intensive system). The research was designed in Completely Randomized Design; there were six energy-protein balance in the diets as treatment, which were G_1 (3000 kcal/kg ME, 20% CP); G_2 (3000 kcal/kg ME, 16% CP); G_3 (3000 kcal/kg ME, 13.5% CP); G_4 (2700 kcal/kg ME, 20% CP); G_5 (2700 kcal/kg ME, 16% CP); and G_6 (2700 kcal/kg ME, 13.5% CP); each treatment was replicated three times. Semen was collected when the drakes reached the age of nine months and semen evaluation for volume semen, sperm motility and sperm abnormality was conducted. The results show that semen characteristics show that the highest motility was produced by G_5 (2700 kcal/kg ME, 16% CP) for *Cihateup* drakes and G_6 (2700 kcal/kg ME, 13.5% CP) for Rambon drakes. There was no significant different effect among treatments on abnormality of Cihateup drakes semen; anyhow G_5 (2700 kcal/kg ME, 16% CP) can be considered as the best diet for Rambon drakes based on its semen abnormality. It can be concluded that at feeding diet containing similar Metabolizable Energy level, Cihateup drakes required higher protein level than Rambon drakes to produce a good quality of semen.

Keywords: energy-protein balance, west java local drakes, semen.

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1. Introduction

Cihateup duck is a common duck which is raised by most duck farmers in West Java highland in the elevation above 378 meters; it is also known as a mountain duck (*itik gunung).* Meanwhile Rambon duck is mostly raised in West Java lowland or costal region, and well known as coastal duck (*itik pesisir*); both of those ducks are raised under extensive system. The decline of land availability especially paddy field as a

result of land conversion and increasing in human population has meant that the ducks should be raised under intensive system.

Under extensive raising system productivity of the fowl including reproductive efficiency is low. This study was aimed to evaluate the productivity of Cihateup and Rambon drakes, which are raised under intensive system. The semen quality in poultry is an indicator of their reproductive potential. [1] reported that semen quality is positively correlated with fertile eggs and hatchability. The major components of semen quality assessment are concentration, motility, and abnormality. These components are under control of many factors including feeding.

Energy-Protein balance of a diet play an important role in the reproduction process of male animal; [2] reported that drakes fed the high level of Metabolizable Energy (ME) or Crude Protein (CP) had higher ejaculate volume; sperm's motility was improved by high ME, whereas CP levels had no effect. Total abnormal sperms were decreased by high level of ME and CP in the diet.

2. Materials and Method

2.1. Experimental Animals

Thirty six Cihateup and thirty six Rambon day old ducklings were each randomly divided into six groups and kept in separate cages. At the age of nine month, three drakes from each group were selected based on positive reaction to dorso-abdominal massage for artificial semen collection.

2.2. Experimental Diets and Design

Ducks received diets which were formulated to contain studied Metabolizable Energy (ME) and Crude Protein (CP) content in the diet. There were six treatment diets (Table 1) at different energy-protein ratios which were: T1 (ME 3000 kcal/kg, protein 20%); T2 (ME 3000 kcal/kg, protein 16%); T3 (ME 3000 kcal/kg, protein 13/5%); T4 (ME 2700 kcal/kg, protein 20%); T5 (ME 2700 kcal/kg, protein 16%); T6 (ME 2700 kcal/kg, protein 13.5%). The experiment was arranged in Completely Randomized Design, obtained data were variance analyzed.

2.3. Semen Collection and Determination of Semen Quality Traits

Dorso-abdominal massage, as described by [3] was used for semen collection of Rambon and Cihateup's drake. Semen was collected early in the morning, once a week for

Table 1: Composition and Calculated Analysis of the Experimental Diets.

Ingredients	T1	T2	T3	T4	T5	T6
..... %						
Yellow corn	59.00	65.00	70.00	49.00	55.00	59.00
Rice bran	7.00	12.00	15.00	19.25	22.25	29.00
Soybean meal	14.00	8.00	4.00	14.00	7.00	3.00
Coconut meal	5.75	3.00	0.00	5.75	6.00	0.00
Fish meal	11.00	8.00	6.50	10.00	7.00	6.00
Bone meal	1.25	2.00	2.50	1.50	2.25	2.50
Coconut oil	1.50	1.50	1.50	0.00	0.00	0.00
Premix	0.50	0.50	0.50	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00	100.00	100.00
Calculated analysis ..... %						
Crude protein	20.02	16.06	13.52	20.03	16.01	13.50
Crude fat	5.93	6.44	6.80	5.54	5.84	6.64
Crude fiber	3.83	3.75	3.51	5.09	5.16	4.90
Calcium	1.03	1.03	1.05	1.05	1.05	1.04
Phosphor	0.61	0.61	0.62	0.62	0.62	0.62
Lysine	1.17	0.88	0.70	1.19	0.87	0.73
Met+ Cys	0.78	0.66	0.59	0.80	0.67	0.62
ME (kcal/kg)	3006	3004	3022	2709	2716	2713

five weeks. As soon as semen was collected, ejaculate volume, motility, and abnormality were determined for each drake. Sperm motility was evaluated by placing a drop of the semen diluted in saline solution between a glass slide and coverslip under 400X magnification of optical microscope observation. Sperm motility (% progressive movement of sperm) was counted by reducing the total concentration of sperm by the sperm dead (sperm with circular, backward, and no movement). Sperm concentration was determined by counting in a Neubauer haemocytometer under 400X magnification of optical microscope. The obtained number of sperm was used in the sperm concentration formula according to WHO [4]. Sperm abnormality was evaluated using eosin-negrosin staining on semen smears [5]. Sperm abnormality defined in this study was the secondary abnormal sperm that is a loosened head or tail sperm.

3. Result and Discussion

Accurate evaluation of freshly drawn drake semen is important in artificial insemination to ensure in achieving reproductive efficiency. Therefore, physical and chemical properties, such as volume, pH, sperm motility, and abnormality have been investigated in this study, particularly in relation to the dietary contents. According to the

Table 2: Cihateup and Rambon drake's ejaculate volume.

	Group of treatment					
	G1	G2	G3	G4	G5	G6
Cihateup						
Vol (ml)	0.07 ± 0.03	0.07 ± 0.03	0.1 ± 0.00	0.08 ± 0.03	0.08 ± 0.03	0.1 ± 0.00
pH	7	7	7	7	7	7
Rambon						
Vol (ml)	0.1 ± 0.00	0.08 ± 0.03	0.05 ± 0.00	0.08 ± 0.03	0.08 ± 0.03	0.12 ± 0.06
pH	7	7	7	7	7	7

result, as shown in Table 2, there was no significant difference between two types of drake fed on different dietary ME and CP on semen volume, as well as on pH. Nevertheless, semen volume varies from breed to breed and is influenced by age, breed, body weight, and season.

Table 3 summarizes that varying energy levels in combination with varying crude protein (CP) levels in Cihateup duck's diet had significantly affected sperm motility rate. The highest motility rate was obtained from high energy-high protein level (G1) and medium energy-medium protein level (G5), even though the later group was not significantly different with other groups, except low energy-low protein level. It appears that high energy level effect obviously on motility rate. This result is similar with those reported by [2] who stated that the diet contained 2950 kcal ME/kg and 19% of crude protein resulted 95 to 96% of sperm motility rate. This result revealed that the dietary contains might effect on the testicular size of the birds. This is in agreement with previous findings that dietary energy level leads to an increase of testes weight, while high CP level gives a high testosterone level [1–5]. According to [7] sperm was produced by sertoli cells in tubules seminiferous and the number of sertoli cells is associated with testicular size and sperm production. On the other hand, testosterone produced by Leydig cells is responsible for the maturation of sperm during spermatogenesis which is further correlated with motility rate. In this study, G5 which contained energy and protein level lower than that contained in G1 had similar result on motility rate. Reference [8] reported that in birds, high dietary energy level intake leads to intratesticular hyperthermia which may lead to reduction of sperm quality. This could be concluded that the optimum level of energy level in combination with protein level in the diet contains 2700 kcal ME/kg and 16% of CP for Cihateup drake's sperm motility rate. On the other hand, the combination of low energy level and low protein level in the diet resulted the lowest motility rate, as showed in G6. Even though this group gave 88.6% of motility rate which is still classified as good quality of sperm, this result showed that the nutritional deficiencies could depress the quality of semen.

Table 3: Sperm motility of Cihateup drakes at different dietary energy and protein levels.

n	Group					
	G1	G2	G3	G4	G5	G6
	..... %					
1	96.81	95.47	96.03	95.10	96.59	88.33
2	97.44	96.27	93.53	93.51	97.98	90.71
3	97.78	95.64	94.77	96.38	97.02	8676
Total	292.02	287.39	284.33	284.99	291.59	265.81
Mean	97.34 ^{d}	95.80 ^{bcd}	94.78 ^{b}	95.00 ^{bc}	97.20 ^{cd}	88.60 ^{a}

Note: means in the same column bearing different superscript are significantly different ($p \leq 0.05$)

Table 4: Sperm motility of Rambon drakes at different dietary energy and protein levels.

Replication	Group of treatment					
	G1	G2	G3	G4	G5	G6
	..... %					
1	57.50	89.32	94.70	90.20	85.44	96.87
2	64.86	93.33	92.86	96.67	93.25	94.79
3	56.25	92.97	93.82	93.41	91.73	97.21
Total	178.61	275.62	281.38	280.27	270.41	288.87
Mean	59.54 ^{b}	91.87 ^{a}	93.79 ^{a}	93.42 ^{a}	90.14 ^{ab}	96.29 ^{a}

Note: means in the same column bearing different superscript are significantly different ($p \leq 0.05$)

Several reports elucidated that nutrition plays a key role in the production and quality of semen because nutrition affects the endocrine and the spermatogenic function of the testis [9, 10].

In this study, Table 4 presents the combination of dietary energy levels and protein levels of Rambon drake. The summary of the analysis variance indicated that the combination of dietary contains had significant effect on sperm motility of Rambon drake ($P < 0.05$).The sperm motility of Rambon drake fed on G6 gave the best result compared to drake fed on other groups. Whilst, G1 containing a high energy and protein level had the lowest motility rate. This finding is inversely proportional with our findings in Cihateup drake which had a highest motility rate as a result of a combination of high energy and protein level administration. The explanation could be addressed to this findings might be due to both Cihateup and Rambon drake have a different body weight which leads to different physiological responses on their environmental condition. In this study, Rambon drake has body weight lighter than the other drake. It has been demonstrated that small body weight of birds have better heat tolerance to stressful environments [11].

Table 5: Sperm abnormality of Cihateup drakes at different dietary energy and protein levels.

Replication	Group of treatment					
	G1	G2	G3	G4	G5	G6
	..... %					
1	10.00	11.50	7.00	7.00	11.00	9.00
2	7.00	10.00	9.00	8.50	4.50	4.50
3	7.50	7.50	7.50	9.50	6.50	7.50
Total	24.50	29.00	23.50	25.00	22.00	21.00
Mean	8.17	9.67	7.38	8.33	7.33	7.00

Note: means in the same column bearing different superscript are significantly different ($p \leq 0.05$)

Under high temperature condition, birds alter their behavior and physiological homeostasis seeking thermoregulation, thereby decreasing body temperature and reducing feed intake [12]. Moreover, [2] reported that birds reduce both 3,5,3'-triiodothyronine (T_3) and testosterone level due to the effect of dietary manipulations or to the summer environmental condition. It is well recognized that thyroid hormones decreased during summer season as an adaptive behavior to alleviate heat stress. A similar report also showed that testosterone indicative of a lower sex libido resulting from thyroid hormones decrease. However, our results show that dietary modulations by the combination of different energy and protein levels may overcome these conditions on sperm quality, hence the combination of low dietary 2700 kcal/kg energy and 13.5% protein level gave the best sperm motility of Rambon drake. This result are in agreement with those obtained by [2] who showed that the best motility rate of Domyati drakes was obtained from the combination of 2858 kcal/kg dietary energy and 15% of protein level.

Results presented on Table 5 showed significant differences in the sperm abnormality of Rambon drake as affected by the combination of different levels of dietary energy and protein. The drakes fed diet contained high energy level combined with high protein level gave low sperm abnormality percentages, as obtained in G1 and G2 by 7.5% and 5.5%, respectively. The percentage was significantly decreased when the dietary energy and protein contain were increased, as shown in G1, G4, G5, and G2 by 7.5%, 6.5%, 6.7%, and 5.5%, respectively. The lowest sperm abnormality was obtained from the diet contained 3000 kcal/kg of energy in combination with 16% of crude protein. This result is in accordance with a previous result in [13] who reported that a diet containing 2950 kcal/kg of energy and 17% of protein could be used to decrease sperm abnormality of drake. It is likely that both energy and protein contained in the diet could be the main sources to maintain all physiological mechanism thus reflected on the sperm quality.

Table 6: Sperm abnormality of Rambon drakes at different dietary energy and protein levels.

Replication	Group of treatment					
	G1	G2	G3	G4	G5	G6
	..... %					
1	7.00	6.00	9.50	6.50	7.00	10.00
2	10.50	4.00	9.00	6.00	6.00	12.00
3	5.00	6.50	6.50	7.00	7.00	12.00
Total	22.50	16.50	2.,00	19.50	20.00	34.00
Mean	7.50 ^{bc}	5.50 ^{c}	8.33 ^{ab}	6.50 ^{bc}	6.67 ^{bc}	11.00 ^{a}

Note: means in the same column bearing different superscript are significantly different ($p \leq 0.05$)

On the other hand, sperm abnormality of Cihateup drake was not significantly affected due to varying levels of dietary energy and protein. The different results between Cihateup and Rambon drake might be due to physiological and endocrinological condition of these two types of drake. Since there is no information regarding physiological condition of these local Javanese drakes, it is difficult to reveal how the mechanism underlying abnormal sperm obtained from different dietary contains. However, the result of this study was still included in the normal range of sperm abnormality whereas the range was about 7% to 9.67%. [14] stated that the abnormality of sperm ranged 5-20%. Moreover, [3] stated that abnormality of sperm more than 25% will reduce fertility.

Though dietary content is the main factor effecting semen quality, but in evaluating male fertility, there are many factors must be considered. It is necessary to consider stress condition and seasonal change when evaluating studies of semen quality related male fertility. Even though the drakes in this study was placed in a limited-water condition, but this study do not reveal physiological condition especially hormonal status in regulating the factors affecting semen quality. Definitely, this approach will give new insights on the biology orchestra of semen quality.

4. Conclusion

The highest motility was obtained from low ME- medium CP level for *Cihateup* drakes and low ME-low CP, level for Rambon drakes. Abnormality of Cihateup drakes semen was not affected by ME nor CP levels; anyhow low ME- medium CP level can be considered as the best diet for Rambon drakes. It can be concluded that at feeding diet containing similar Metabolizable Energy level, Cihateup drakes required higher protein level than Rambon drakes to produce a good quality of semen.

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