



Semen Quality of Garut Rams feed by Different Protein Sources and Their Implementation Potential in Small Farms of West Java

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ABSTRACT. Maggot *Hermetia illucens* (Maggot Black Soldier Fly, MBSF) is an alternative protein source besides soybean meal (SBM) which may be used as a feed for improving the quality of semen particularly in Garut rams to support prolific nature. The aims of this study were to analyze and compare the impact of different protein sources in feed on semen quality of Garut rams, and to assess the prediction ability of Garut rams to serve ewe in small-scale breeders in West Java, Indonesia. This study was conducted using a completely randomized design with 3 treatments and 4 replications, consisted of *Brachiaria humidicola* (BH) grass and T1 (concentrate contains 20% of SBM), T2 (concentrate contains 10% of SBM and 10% of MBSF), and T3 (concentrate contains 20% of MBSF). The parameters measured were feed consumption, semen quality (macroscopic and microscopic characteristics), also a potential ability of rams to serve ewe. The results showed there were no significant effect on protein consumption, semen volume, semen pH, semen color and consistency, sperm mass movement, sperm motility, sperm concentration, sperm morphology, and prediction potential ability to serve ewe. However, the result showed a significant effect ($P<0.05$) on sperm viability and sperm plasma membrane integrity. Sperm plasma membrane integrity of ram feed with T3 was better than T1 and T2 ($P<0.05$). The prediction potential ability rams to serve ewes on MBSF treatment was 38 heads, while in T1 and T2 were 43 and 57 heads, respectively. In conclusion, MBSF can be an alternative source of protein besides SBM to improve the semen quality of Garut rams.

Keywords: Garut rams; semen quality; maggot BSF and protein

ABSTRAK. Maggot *Hermetia illucens* (Maggot Black Soldier Fly; MBSF) adalah sumber protein alternatif selain bungkil kedelai (SBM) yang dapat dipergunakan sebagai pakan untuk memperbaiki kualitas semen terutama pada domba Garut untuk mendukung sifat prolif. Tujuan penelitian ini adalah menganalisis dan membandingkan dampak pemberian sumber protein berbeda terhadap kualitas semen domba Garut dan untuk menilai kemampuan domba Garut pejantan dalam melayani betina pada peternakan rakyat di Jawa Barat, Indonesia. Penelitian ini menggunakan Rancangan Acak Lengkap (RAL) dengan 3 perlakuan dan 4 ulangan yang terdiri dari rumput *Brachiaria humidicola* (BH) dan T1 (konsentrat mengandung 20% SBM), T2 (konsentrat mengandung 10% SBM dan 10% MBSF), dan T3 (konsentrat mengandung 20% MBSF). Parameter yang diukur adalah konsumsi pakan, karakteristik semen (makroskopis dan mikroskopis) serta potensi domba jantan melayani betina. Hasil Penelitian menunjukkan tidak ada perbedaan signifikan pada konsumsi protein pakan, volume semen, pH semen, warna dan konsistensi semen, gerakan massa sperma, motilitas sperma, konsentrasi sperma, morfologi sperma, dan prediksi potensi pejantan dalam melayani betina. Namun, hasil penelitian menunjukkan terdapat perbedaan ($P<0.05$) pada viabilitas sperma dan membran plasma utuh sperma. Membran plasma utuh pada perlakuan T3 lebih baik dibandingkan perlakuan T1 dan T2 ($P<0.05$). Prediksi potensi betina terlayani dari pejantan yang diberi pakan MBSF adalah 38 ekor, sedangkan yang diberi SBM dan kombinasinya adalah 43 dan 57 ekor. Kesimpulan penelitian ini adalah MBSF dapat menjadi alternatif sumber protein selain bungkil kedelai dalam memperbaiki kualitas sperma domba Garut.

Kata kunci: Domba Garut, kualitas semen, maggot BSF dan protein

INTRODUCTION

Indonesia Garut sheep (*Ovis aries*) have the potential to become significant contributors to the national animal protein needs. The main advantages of this breed are its adaptability to tropical climate and non-seasonal breeding, also able to produce more than one lamb per lambing. The potential of this prolific nature became an interesting study because it was able to increase

the population of sheep in short period. Indonesia Directorate General of livestock (2018) declared that the total population of sheep in West Java are 11 608 559 tails, particularly for Garut breed are 11 425 574 tails (Department of Food and Animal Husbandry, 2018). However, the amount is disproportionate when compared to the population of Indonesian (257 million people).

A gap problem can be mitigated by optimizing prolific nature of the Garut sheep with supporting good nutrition to enhance reproduction factors, including semen quality of Garut ram. Nutrition plays significant role to maximize the potential of fertility, it has a significant impact on

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gonadotropins releasing hormone which ultimate determine the fertility (Singh et al., 2018). Protein is one of important nutrition component to regulate many reproduction functions of Garut rams. The distribution of protein can increase volume, motility, concentration, and live percentage of sperm (Dethan et al., 2010). On the other hand, low dietary protein causing delayed puberty and reduced fertility (Soliman et al., 2014), poor testicular development (Tegegne et al., 1994), decreased thickness and diameter of seminiferous tubules (Barth et al., 2008), and impaired sperm production (VanDemark & Mauger, 1964).

The source of protein can be derived either animal protein and/or plant protein. Soybean meal (SBM) is one of protein source which often utilized as feed. High amino acid content, palatable, and easily obtained are reason why SBM used in the feed mixture. However, SBM commonly used on other livestock feed thus availability for SBM is limited. Diversification of protein sources in feed of rams need to be conducted. Maggot from Black Soldier Fly (*Hermetia illucens*) is an insect that can be used as alternative feed due to their high protein content. Maggot Black Soldier Fly (MBSF) contains approximately 47% or 476 g kg⁻¹ protein (Kroeckel et al., 2012), so it can be the main protein source in feed to trigger maturation of

reproductive organs, thus is expected to increase the quality of sperm. The aims of this research were to analyze the effect of MBSF supplementation on sperm quality in Garut rams and to investigate the potential ability to serve ewes in small-scale breeders.

MATERIALS AND METHODS

Animals and diets

Twelve sexually matured, and healthy Garut rams with average age 1.5 years, average of live body weight is 27.23 ± 2.49 kg were used in this study. The rams were kept at laboratory of Small Ruminant Livestock Production Science block B, Faculty of Animal Science, IPB University (Bogor, Indonesia) under optimum nutrition and housing condition. The diets consisted of *Brachiaria humidicola* (BH) and concentrate made from starch, cassava, copra, premix, DCP, salt, SBM, and MBSF mash. Diet treatment consisted of 3 types; T1 was BH + diet contained 20% SBM, T2 was BH + diet contained 10% SBM and 10% MBSF, and T3 was BH + diet contained 20% MBSF. Water was provided *ad libitum*. The animals were supplemented with diet treatment for six week. The feed formulation and nutrition composition of concentrate for this study was shown in Table 1 and Table 2.

Table 1. Experimental concentrate formulation (% as fed)

Feed ingredients	Formulation		
	T1	T2	T3
Cassava Meal	28.15	28.15	28.15
Pollard	18	18	18
Copra Meal	17.5	17.5	17.5
Yellow Corn	10	10	10
Molases	5	5	5
Soybean Meal (SBM)	20	10	0
Maggot BSF (MBSF)	0	10	20
NaCl	0.5	0.5	0.5
Premix	0.5	0.5	0.5
DCP	0.35	0.35	0.35
Total	100	100	100

DCP = Dicalcium phosphat; NaCl = Natrium Chloride; T1= concentrate contains 20% of SBM; T2= concentrate contains 10% of SBM and 10% of MBSF; T3= concentrate contains 20% of MBSF.

Table 2. Nutrient composition of concentrate

Treatment	DM	CP	EE	CF	TDN	Ca	P
T1	85.61	17.89	1.80	8.05	67.92	0.40	0.51
T2	86.36	17.50	4.24	8.15	66.68	0.75	0.54
T3	87.11	17.11	6.68	8.25	65.44	1.09	0.56

DM: dry matter, CP: crude protein, EE: ether extract, CF: crude fiber, Ca: calcium, P: phosphorous, TDN: total digestible nutrient. T1= concentrate contains 20% of SBM, T2= concentrate contains 10% of SBM and 10% of MBSF, T3= concentrate contains 20% of MBSF.



Semen Collection and Evaluation

The semen samples were collected once a week for six consecutive weeks started at 6.00 a.m. to 8.00 a.m. before rams were fed. The semen was collected by using artificial vagina (AV). Immediately after collection, the semen samples were evaluated macro-and microscopically as described by Arifiantini (2012) at Rehabilitation Unit of Reproduction (URR) Faculty of Veterinary Medicine, IPB University (Bogor, Indonesia). Macroscopic evaluation included volume, color, pH, and consistency. Semen volume was determined from the graded collection tube soon after collection. Color and consistency were determined visually, and pH was measured with indicator paper (Merck Germany, scale 6.4–8). Microscopic evaluation included mass activity, sperm progressive motility, sperm concentration, sperm viability, sperm morphology, and sperm plasma membrane integrity. Mass movement was evaluated by transferring a drop of undiluted sperm to a warm slide (37 °C), and observing under a microscope at 100x. The forward progressive motility (FPM) was assessed by transferring a drop of sperm diluted with 8-10 NaCl on a warm slide (37 °C) then covered by cover glass, and estimating the progressive sperm motility observed at 400x. Sperm concentration was prepared by mixing 2 μ L semen with 998 μ L (1:500) of formolsaline solution then homogenous 2-3 minutes. Mixing solution fill into a counting chamber (Neubauer chamber) and observing under microscope at 400x of 5 boxes of views. Sperm concentration calculated by multiply average sperm number on chamber, diluting factor, and corrections factor.

The sperm viability and morphology were evaluated at the same slide using eosin-nigrosin staining. One drop of semen and 4 drops of eosin-nigrosin were put on a clean object glass, homogenized, smeared, and dried above heating plate. Sperm viability was assessed using Eosin-Nigrosin staining technique. Semen was mixed with eosin nigrosin in a ratio of 1:4. After homogenization slide smears were prepared and dried using heating table (37 °C). At least 200 sperms were counted in total 10 fields of the slide. Sperm were classified as life (colorless) and dead (red sperm head). The morphology of sperm in the ejaculate was observed by diluting a drop of sperm with 8-10 drops of eosin nigrosin solution then determined visually under microscope at 400x with 10 field of view. Hypo-osmotic

swelling (HOS) test was used for functional sperm membrane integrity assessment. Semen (10 μ L) was added to 1 ml of an hypoosmotic solution (100 mOsm/kg H₂O) prepared by mixing 0.9 g fructose and 0.49 g sodium-citrate in 100 mL distilled water. After incubation for 45 min at 37 °C, sperm tail swelling was assessed by placing 15 μ L of well-mixed sample on a warm slide (37 °C) which was covered with a cover glass before being observed under microscope at 400x magnification (300 sperm per slide were observed). The sperm were classified as reacted or nonreacted based on the presence or absence of coiled tail.

The Prediction of Potential Ability Garut Rams to Serve Ewe

The ability of rams to serve ewes was measured within one mating cycle. The predictions were conducted by multiplying value of semen volume, sperm concentration, and sperm motility and then divide by the artificial insemination dosage; 50x10⁶ cell sperms.

Statistical Analysis

Statistical analyses ($P \leq 0.05$) were run with the program Statistical Software Package SPSS. The model used for the analysis was completely randomized design (CRD) with 3 treatments and 4 replications. The following is formula applied for statistical analysis: $Y_{ij} = \mu + T_i + e_{ij}$, where, Y_{ij} was an observation of the dependent variable ij ; μ was the population mean for the variable; T_i was the effect of the treatment on reproductive performances, as a fixed effect, and e_{ij} was the random error associated with the observation ij . Differences between variables were compared by a one-way analysis of variance (ANOVA). Observations with ($P < 0.05$) were considered to be statistical significant.

RESULTS AND DISCUSSION

The Nutrient Consumption

Feed consumption is a basic indicator in the assessment of performances and feed quality. The result shows there were no significant differences between treatments on the level of protein consumption ($P > 0.05$). The results indicate that level of palatability between MBSF and SBM are equivalent. Since the literature shows that MBSF has a protein content of 43.6% (Kroeckel et al., 2012) which does not differ from the protein

content of SBM by 48.8% (NRC 2006) this means that, in quantity perspective, MBSF can be one of the alternative protein sources for substituting SBM. Moreover, there is no significant value of

DM consumption, CF consumption, Ca consumption, and TDN consumption between three treatments.

Table 3. Nutrient consumptions

Nutrient	Nutrient consumption (g day ⁻¹)		
	T1	T2	T3
DM Consumption (g/day)	753.98 ± 89.94	789.42 ± 42.13	816.63 ± 61.86
CP Consumption (g/day)	107.10 ± 12.78	110.46 ± 5.79	110.02 ± 8.71
EE Consumption (g/day)	13.26 ± 1.58a	23.51 ± 1.23b	24.10 ± 1.90b
CF Consumption (g/day)	140.87 ± 16.80	142.33 ± 7.96	145.07 ± 9.54
Ca Consumption (g/day)	12.41 ± 1.48	11.60 ± 0.64	12.78 ± 0.90
P Consumption (g/day)	8.94 ± 1.07a	9.19 ± 0.51a	12.14 ± 0.86b
TDN Consumption (g/day)	477.48 ± 56.96	500.57 ± 26.51	519.36 ± 40.20

T1= concentrate contains 20% of SBM; T2= concentrate contains 10% of SBM and 10% of MBSF; T3= concentrate contains 20% of MBSF. DM = dry matter, CP = crude protein, EE= ether extract, CF = crude fiber, Ca = calcium, P = phosphor, TDN = total digestible nutrient.

The quality perspective, the protein between MBSF and SBM is relatively equal. Rambet et al. (2016) revealed that the utilization of maggot BSF at 11.25% in diet could increase protein digestibility by 75.32% in chicken livestock, on the other hand this value of digestibility does not related to a high animal performance or productivity in small ruminant particularly rams due to the difference in protein digestion and utilization in the digestive tract of animal (Das et al., 2015). In fact, protein is degraded by the rumen microbes and transformed into microbial protein. Other part of protein is not degraded by the microbes and directly by-pass to lower intestine which later can be degraded by protolithic enzymes.

Furthermore, the rate of protein degradation in rumen may vary and can be divided into rapidly, intermediately and slow degradable fractions (Edmunds et al., 2012). The value of protein consumption in this research is need to consider digestion and utilization characteristic of a feed protein in order to achieve a more precise formulation, so that it is closely related to animal performances. McDonald et al. (2011) explained that the protein content of the feed is digested in the small intestine to produce amino acids which will be absorbed by the blood and transported to the male reproductive organs.

The proteins will be transformed into peptides, then transported to the hypothalamus to support the formation of gonadotropin-releasing hormone (GnRH) and producing follicle stimulating hormone (FSH) and luteinizing hormone (LH) (Garner and Hafez, 2000). These

hormones are distributed to testes cell receptors, which will help the spermatogenesis process and release the hormone testosterone into the bloodstream to support mating activities. These factors may explain why the MBSF is feasible as a new source of protein and is expected to be an alternative protein source besides SBM in the future.

The Characteristic of Ram Fresh Semen

The characteristic of weekly ejaculates varied. There was no different in volume, pH, color, consistency, sperm mass movement, sperm progressive motility, sperm abnormality, sperm concentration and sperm concentration per ejaculate. The volume for T1, T2, and T3 respectively were 1.05, 1.18, 0.88 mL, pH were 6.70, 6.48, and 6.63, with a white milky color and medium consistency for T1 and a cream color and thick consistency for T2 and T3. The sperm mass movement for T1 was ++, T2 and T3 were +++, sperm progressive motility for T1, T2, T3 respectively were 77.5%, 80%, 81.25%, Sperm abnormality 11.20%, 10.14%, 12.60%, Sperm concentration were 2653x10⁶ for T1, 3061x10⁶ for T2, 2717x10⁶ for T3 and sperm concentration per ejaculate were 3333x10⁶ for T1, 3582x10⁶ for T2, and 2370x10⁶ for T3. However, the sperm viability in T1 (77.68%) and T3 (76.74%) were significantly higher (P<0.05) than T2 (69.76%). The sperm plasma membrane integrity in T3 (94.77%) and T1 (93.42%) were significantly higher (P<0.05) than T2 (90.06%). The semen characteristics of Garut rams are presented in Table 4.

Table 4. Semen characteristic of garut rams

Variables	Treatment			Normal Range	Reference
	T1	T2	T3		
Volume (mL)	1.05 ± 0.31	1.18 ± 0.21	0.88 ± 0.13	0.8-1.2	Arifiantini (2012)
pH	6.70 ± 0.12	6.48 ± 0.08	6.63 ± 0.14	6.5-6.8	Garner and Hafez (2000)
Color	White milky	Cream	Cream	Cream	Ax et al. (2000)
Consistency	Medium	Thick	Thick	Thick	Ax et al. (2000)
Sperm mass movement	++	+++	+++	++/ +++	Bearden et al. (2004)
Sperm motility (%)	77.50 ± 5.95	80.00 ± 4.08	81.25 ± 2.39	70-87%	Sarastina et al. (2012)
Sperm concentration (x10 ⁶ cell mL ⁻¹)	2 653 ± 758	3 061 ± 355	2 717 ± 35	2000-3000	Toelihere (1993b)
Sperm concentration per ejaculate	3 333 ± 121	3 582 ± 63	2 370 ± 32	-	-
Sperm abnormality (%)	11.20 ± 3.46	10.14 ± 3.81	12.60 ± 1.09	3.1-4.05%	Riyadhi et al. (2012)
Sperm Viability (%)	77.68 ± 2.93a	69.76 ± 2.34b	76.74 ± 1.57ab	75-85%	Nurcholis et al. (2016)
Sperm plasma membrane integrity (%)	93.42 ± 1.82ab	90.06 ± 1.12b	94.77 ± 0.54a	85-95%	Fonseca et al. (2005)

T1= concentrate contains 20% of SBM; T2= concentrate contains 10% of SBM and 10% of MBSF; T3= concentrate contains 20% of MBSF.

The ejaculates of Garut rams which were collected in this experiment had normal characteristic and appropriate for evaluation. Kroeckel et al. (2012) explaining the protein content inside MBSF are 476 g kg⁻¹ DM or ± 47.6% DM are not much different with protein content inside SBM approximately 489 g kg⁻¹ DM or ± 49% DM (Banaszkiewicz, 2011). It shows the protein content between two different types of protein source are similar and able to use as feed ingredients in concentrate for small ruminant particularly in Garut rams. Overall, all the treatment with SBM (T1), MBSF (T3) and combination of SBM and MBSF (T2) had improve semen and sperm quality of Garut rams.

The study present protein inside SBM has sufficient amount for regulate the process of spermatogenesis and function of producing seminal plasma in accessory glands (Astadi et al., 2009), while MBSF has positive effect in regulating the spermatogenesis process in terms of total semen volume, color, and consistency during the study. The protein had a positive impact on the stabilization of pH in this research due to accessory glands i.e. vesicularis prostate that secrete seminal plasma function properly to produce an efficient buffer for sperm cells (Bearden et al., 2004).

Both types of protein source were suspected to play an important role in regulating and improving the function of sperm cells, including the quality of sperm mass movement which positively correlated with the concentration and the motility of sperm (Bearden et al., 2004). Both of fresh semen with mass movement (++) and (+++) has a high density of sperm, moving waves,

and estimated to have 90% active sperm. The arginine amino acid contained in both types of protein is expected to be sufficient as basic needs for tissue formation in the reproductive organs and metabolized to produce Adenosine triphosphate (ATP) to supporting sperm active movement (Rodrigues et al., 2013).

Related with sperm mass movement, arginine amino acid has a function on sperm motility to maintain structural stability, protects sperm cell membranes, also their integrity from damage. It strengthens the structure of sperm membrane to be strong and stable also increasing ATP availability for sperm cells to have a better motility and velocity of sperm (Mayasari et al., 2005). The solid sperm membrane and huge energy availability was direct provision to improve sperm movement either in mass movement or in individual movement (motility). The result in this research (Table 3) show that the role of protein from MBSF and SBM causing similar result.

Protein serves in feed was good and able to increase the sperm concentration by encouraging gonadotropin-releasing hormone (GnRH) circulation which stimulates the production of follicle stimulating hormone (FSH) to regulates sperm cell production and luteinizing hormone (LH) to regulates and increases Leydig cells to produce testosterone (Pinilla et al., 2012). Testosterone helps the seminiferous tubules to producing androgen to supporting sperm maturation during the spermatogenesis process, this process can cause sperm concentration increases (Nurcholis et al., 2016). Furthermore, arginine amino acid serves to assist

spermatogenesis process as precursor for putrescine synthesis to produce spermidine. Spermidine serves to regulate and stabilize the plasma membrane in the process of spermatogenesis (Wu *et al.*, 2009).

Sperm morphology i.e. abnormalities are classified into two, primary and secondary abnormalities. The results in this study highlight secondary abnormalities which occur generally in the shape of a circular or bent tail (Afati *et al.*, 2014). It suspected occur due to epididymis damage that can interfere with testosterone functions for maturation and transport of sperm cells. Damages in the epididymis probably occurs because of androgen hormones disruption that impact the function of maturation (Hasbi & Gustina, 2018). The disruption of androgen function was considered related to the protein ingredients in feed. The protein functions to increasing testosterone and LH level in spermatogenesis process (Cheah & Yang, 2011). Protein contained in SBM and MBSF are insufficient to increase testosterone and LH levels, thus disrupting the maturing sperm cells process. On the other hand, proteins are sufficient to improving sperm concentration.

Feed contained excellent protein are consider to being able increase or maintain viability because protein can affect the quality of plasma membranes (Dethan *et al.*, 2010). The research result (Table 3) show the good protein content derived from SBM and MBSF can affect the Garut rams sperm viability. Jimenez *et al.* (2012) explain that excellent protein contained arginine amino acid are essentials to synthesize several components, i.e. sodium (Na^+), potassium (K^+), and ATP. It regulates the balance of ion transport and distribution of ATP to maintain plasma membrane, particularly preventing sperm head to damage (Kardive *et al.*, 2014). It also considered involved to enhance the permeability of plasma membrane integrity and sperm capacity to fertilize eggs (McDermott *et al.*, 2015). However, the combination of SBM and MBSF treatment (T2) forms antagonistic nature, where the nutrient content has not been able to prevent damage to the permeability of sperm cell membranes during the sperm production. Hence, the sperm metabolism would be disrupted which will eventually lead to the death of sperm (Yulnawati & Setiadi, 2005).

Related with viability's membrane that covers sperm and regulating biochemical process, plasma membrane integrity is an indicator of the correct structure that helps in preventing damage

to sperm membrane in order to improve the regulation processes that take place within sperm. The result (Table 3) indicates protein contained SBM and MBSF had an important role in increasing value of plasma membrane integrity in sperm. Dethan *et al.* (2010) stated excellent protein content in diet able to form sperm cells substance also maintaining and protecting lipoprotein sheaths in sperm cell, this role causing plasma membrane integrity increased.

Proteins through peptide chains are essentials in stabilizing sperm plasma membrane and maintaining motility. Protein also functions through antioxidants in reducing lipid peroxidation by producing oxidative nitrite (NO) (Husen *et al.*, 2011). Moreover, a combination of aspartate amino acid and alanine amino acid also maintains metabolic activity and membrane stability that impacts ion and ATP transfer. Proteins are also capable to increase sperm transportation capabilities through hormones (Juyena & Stelletta, 2012). The crucial amino acid that plays a major role in plasma membrane integrity is lysine. Lysine is a forming precursor of L-carnitine which plays an important role in the generation of metabolic energy by stimulating oxygen consumption in the mitochondria level (Sariozkan *et al.*, 2013), it can improving plasma membrane integrity into better form which means it's not easy to damage. MBSF and SBM respectively contained 10.65% and 6.10% amino acid lysine (Wardhana, 2016; Astuti *et al.*, 2009).

The indicator for the structure and consistency sperm plasma membrane integrity is influenced by seminal plasma. In general, protein also has an impact on sperm and seminal plasma. Rodriguez-Martinez *et al.* (2011) explain that seminal plasma is a cauda epididymis fluid derived from physiological hormonal and enzymatic secretions from male sexual organs. Seminal plasma has a function to stabilize the sperm environment in order to protect the structure of the sperm plasma membrane integrity (Barrios *et al.*, 2005). It is responsible for transporting sperm cell across the female reproductive tract (Rodriguez-Martinez *et al.*, 2011), the interaction of sperm and egg cells in order to fertilization processes (Juyena & Stelletta, 2012).

Seminal plasma contained protein which can play a role to maintains the wholeness of sperm structure (Caballero *et al.*, 2012), also protects sperm membranes from reactive oxygen species (ROS) which can cause sperm cell death when passing through the female reproductive

tract (Aitken, 2006). The proteins contained in SBM and MBSF is sufficient to increase or maintains viability which can improve the ability of sperm survival in any environment (Dethan et al., 2010). The interaction between proteins and polysaccharides in the seminal plasma provides sufficient energy for sperm to move and causing sperm become more active and motile (Rodriguez-Martinez *et al.*, 2011).

The Prediction Potential Ability of Garut Rams to Serve Ewes at Farmers Level

There was no difference in the prediction potential ability of Garut rams to serve ewes at farmer level in SBM, MBSF, or in their combination treatment. The value of prediction T1 was 43 heads, T2 was 57 heads, and T3 was 38 heads. The result from this study is shown in the Table 5.

Table 5. The prediction ability of Garut rams to serve ewes

Variables	Treatment		
	T1	T2	T3
Ewes Served (heads)	43	57	38

T1 = concentrate contains 20% of SBM;

T2 = concentrate contains 10% of SBM and 10% of MBSF;

T3 = concentrate contains 20% of MBSF.

These results shows that there are no significant differences between treatments ($P>0.05$) on this parameter. However, descriptively it was seen that rams fed the dietary treatments T2 had the ability to serve more ewes than T1 and T3. The number of females predicted to be served by rams fed T1: 43, T2: 57, and T3: 38 ewes. T2 treatments had a value that tends to be stable on semen volume, sperm motility, and sperm concentration, which causes the value of motile sperm per ejaculate and prediction in serving females were higher.

The T2 treatment (the combination of feed factors between SBM and MBSF) produces a combination of good protein nature to regulate many functions in the process of spermatogenesis. In addition, arginine and lysine amino acids in soybean meal and maggot BSF play a role in regulating and stabilizing plasma membranes, and inhibit the reaction of nitrite oxidase (NO) in the process of spermatogenesis (Cheah and Yang 2011). Also, in increasing maturation of sperm cells, so that capability of serving ewes in ram feed with T2 is better.

CONCLUSIONS

In this research MBSF can be an alternative source of protein as a replacement for SBM in order to improve the quality of Garut sheep in reproductive assessment to help small-scale farmers enhance the numbers of livestock. The semen quality of Garut rams fed with different protein sources, i.e. soybean meal, maggot BSF, and their combination showed no difference in the macroscopic and microscopic variables except on the viability and integrity of the plasma membrane integrity.

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