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Application of Total Mixed Ration (TMR) FEED Based on Local Feed Material in Lactation Phase Cross Awassi Sheep

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Abstract
This study aimed to analyze the physical and nutritional quality of Total Mixed Ration (TMR) feed formulated from local feed ingredients and to evaluate the performance of Cross Awassi sheep during the lactation phase. The research employed a field-based observational method, assessing both the physical and chemical characteristics of the TMR, as well as the performance parameters of the sheep, including DMI, average daily gain (ADG), milk production, feed conversion ratio (FCR), and income over feed cost (IOFC). The results indicated that the locally sourced TMR exhibited good physical and nutritional quality, although the crude protein content was still slightly below the National Research Council (NRC) 2007 standard. The ADG was 111.2 g/head/day, with a dry matter intake of 1.83 kg/head/day. The FCR for body weight was 15.6, and the FCR for milk was 1.43. Average milk production reached 1.28 kg/head/day, with a composition of 3.97% protein, 6.59% fat, 5.96% lactose, and 10.84% SNF.

INTRODUCTION

Awassi sheep are a breed of sheep from the Middle East. Based on the Decree of the Minister of Agriculture of the Republic of Indonesia No. 282 of 2024, Awassi sheep have become a breed developed in Indonesia. The development of Awassi sheep is not limited to full-blooded breeds but also includes crossbred Awassi sheep, one of which is the cross Awassi (F1), resulting from the crossbreeding of full-blooded Awassi rams and cross Texel ewes. This crossbred sheep has commercial value in terms of meat, milk, and wool production. Cross Awassi sheep are one of the sheep breeds being developed due to their promising commercial potential. As explained by Wahyudi et al. (2023), the advantages of cross Awassi sheep include their ability to adapt easily to the environment, resistance to stress or disease, prolificacy (capable of producing more than two offspring), and high productivity.

Wahyudi et al. (2023) explained that cross awassi sheep are livestock originating from subtropical countries, so if they are to be raised in Indonesia, feed that is suitable for tropical climatic conditions must be developed. The National Research Council (2007) explained that formulating feed that is suitable for the reproductive phase of livestock greatly affects future feed efficiency. Lactating sheep weighing 50 kg require feed amounting to 4.6% of their body weight conversion in the form of dry matter with a crude protein content of 14.6% and total digestible nutrients (TDN) of 65.2%. These requirements are obtained from a 50:50 ratio of forage and concentrate feed. Therefore, a strategy is needed to maintain the nutritional quality

of feed that has been formulated according to the reproductive phase. This requires proper processing and feeding management by implementing Total Mixed Ration (TMR) feed management based on local feed ingredients.

Total Mixed Ration (TMR) is a feeding technique for ruminants. This technique involves mixing all feed ingredients, such as forage, grains, concentrates, vitamins, and minerals, evenly to form a homogeneous mixture. Budiono, et al. (2003 in Kusuma, et al. 2021) Total Mixed Ration is a type of feed that can meet the nutritional needs of livestock, which includes forage and concentrates in proportions that are appropriate for the nutritional needs of livestock. The use of Total Mixed Ration feed can minimize selective feeding by livestock because the forage and concentrates have been mixed into a homogeneous mixture. In addition, according to Ginting (2009), the process of processing feed raw materials into complete TMR feed usually results in an increase in the nutrient density of the feed. This increase in nutrient density is mainly due to the processing (chopping/grinding) process.

RESEARCH METHODOLOGY

Time and Place

This study was conducted from October to December 2025. TMR feed was applied at the UD. Kambing Burja Lawang Farm in Malang. Proximate analysis was conducted at the BSIP Grati Laboratory in Pasuruan.

Research Materials

The research materials included Cross Awassi sheep in the lactation phase and TMR formulations based on pakchong grass silage, indigofera, corn, and cassava peel. Data were collected through observation of TMR physical quality (color, texture, aroma) and analysis of nutritional content (CP, CR, Ca, TDN), as well as sheep performance including dry matter intake (DMI), daily weight gain (DWG), milk production, milk quality, IOFC, and feed conversion ratio (FCR).

Data Analysis

The data obtained from the study were analyzed based on scientific references using quantitative descriptive statistics.

RESULTS AND DISCUSSION

Physical and Nutritional Quality of Feed

Based on the results of laboratory tests conducted, the feed quality results are presented in Table 1 and Table 2.

Table 1. Results of physical quality tests of Local TMR

Criteria	Results	Standard Result
Color	Brownish green	Brownish green
Texture	Soft and easily separated	Like the beginning, not clumpy, not slimy
Smell	Sour	Fresh sour
pH	4.3	3.5–4.2

The physical quality of TMR color results in natural green or brownish green to dark green or brownish yellow. This color indicates that the ensilage process is proceeding normally and is a good color criterion for silage. Good silage color is light brown (yellowish) (Hermanto, 2011). Then, the texture quality shows soft and easily separated results. This is in accordance with Hidayat, et al. (2012) stating that TMR is considered successful if the ensilage process produces a texture that is easily separated. Siregar in (Zuliansyah, 2022) states that TMR silage is generally categorized as good if it has a texture that is still clear like its natural state.

Furthermore, observations of the TMR aroma yielded a characteristic sour smell from the fermentation process. The observation results showed that the silage had an acidic smell, in accordance with Utomo in (Kojo, 2015), who explained that the smell of silage is generally acidic. This is due to the production of lactic acid during the fermentation process. The pH value of the local TMR feed in Table 1 was 4.3 with a fermentation period of 21 days. The pH value obtained was 4.3, which is still within the ideal range and criteria for TMR silage. Hermanto (in Nahak, 2019) states that the ideal TMR pH ranges from 4.3 to 4.5 and is most ideal at 3.8 to 4.2.

Table 2. Proximate Analysis Results of Local TMR Feed

Sample type	Proximate Analysis Results (in %)					
	Moisture Content	Dry Matter	Crude Protein	Crude Fiber	Ca	P
Local feed TMR	58	42	10.25	67.11	0.96	0.37
NRC Standard 2007	-	-	14.6	65.2	0.43	0.28

Nutritional content analysis is a test conducted to determine the chemical composition contained in feed, which includes crude protein, TDN, calcium, and phosphorus. The results of the proximate analysis of the nutritional content of TMR based on local feed ingredients in Table 2 show that the crude protein content of 10.25% does not meet the 2007 NRC standard, but the TDN, calcium, and phosphorus content meet the minimum nutritional requirements for livestock.

The digestibility of nutrients or TDN in TMR feed is sufficient, so the lack of protein can be overcome, and dairy cattle need more energy for milk production. This is supported by the results of research by Russel (in Mathius, 2003) in temperate climates, which showed that feeding sheep sufficient energy to meet their needs can increase milk production and reduce mortality rates.

Performance of Cross Awassi Sheep

The average performance of Cross Awassi sheep fed with local TMR feed can be seen in Table 3.

Table 3. Average performance parameters of Cross Awassi sheep

Parameter	Results	Standard result
Dry matter intake (kg/d)	1.83 ± 0.5	1.2 – 1.7 (Hilali, 2011)
ADG (g/d)	111.2 ± 0.99	-27.2 g/hr (NRC 2007)
FCR body weight	15.6	
FCR milk	1.43	1.37 (Ince, 2013)
Milk production (kg/d)	1.28 ± 0.21	
Income Over Feed Cost (Rp/head)	1,880,746	

Dry matter intake

The results of the analysis of dry matter intake in the TMR treatment showed a total average dry matter intake of 1.83 kg/head/day. The ability of sheep to consume feed in this study was low because the basal feed given was voluminous pakchong silage. Dry matter intake in this study ranged from 2.9% to 3.7% of body weight, which is in line with the standard stated by Scholz in (Soepranianondo, 2007) that dry matter intake for sheep ranges from 3.2% to 5.0% of body weight.

Daily Weight Gain

Based on the analysis, the average daily weight gain reached 111.2 g/head/day. McDonald et al. (Soepranianondo, 2007) stated that livestock growth is controlled by specific nutrient consumption, particularly energy consumption. Weight gain is due to the fact that the dry matter requirements of livestock in feed are met, and also due to the high fermentation products of protein and carbohydrates, resulting in better growth.

Feed Conversion Ratio

The data in Table 3 for the feed conversion and milk conversion parameters of this study showed average conversion values of 15.6 and 1.43, respectively. This can be said to be efficient in terms of feed use in lactating sheep, so the feed given according to the calculation is economical. The feed conversion ratio depends on the quality of the feed provided; the better the digestibility, the better the feed conversion ratio produced (Soepranianondo, 2004).

Milk Production

The study on the effect of local TMR feed on milk production in crossbred Awassi sheep reported an average milk production of 1.28 kg/head/day. This result is consistent with the studies by Hilali (2011) and Ince (2013), which found that lactating Awassi sheep can produce 0.90 to 1.37 kg/head/day of milk. The level of milk production is influenced by several factors, including feed quality, livestock production itself, health, and location of husbandry. However, feed is the factor that has the greatest influence on production compared to other factors. This is in line with the statement by Sodiq and Abidin in (Septia, 2022), who stated that efficient feeding and nutrition have the greatest influence compared to other factors and are very important for increasing productivity.

Income Over Feed Cost

Income Over Feed Cost (IOFC) is an economic parameter used to assess cost efficiency in livestock production. IOFC is calculated by subtracting the total feed cost from the income obtained from total livestock production. A higher IOFC value indicates better feed efficiency and higher economic returns. The results of the analysis obtained an IOFC value of IDR 1,880,746, which indicates a large profit and a better economic level for the business. Astuti et al. (2015) stated that the important factors influencing the calculation of IOFC are livestock productivity, feed consumption, and feed prices during maintenance. High productivity accompanied by good feed conversion will show maximum profits.

Milk Quality

Table 4. Milk Quality

Milk Production (kg/head)	Parameter	Yield (%)		Production (kg/liter)	Haile et al. (2019)	Hilali et al. (2011)
67.7	Protein	3.97	± 0.45	2.69	4.60	5.82
	Fat	6.59	± 1.94	4.47	4.89	6.59
	Lactose	5.96	± 0.68	4.04	4.17	4.54
	Solid Non Fat	10.84	± 1.24	7.35	14.20	8.73-17.66

The average protein content of Awassi crossbred sheep milk after feeding local TMR was 3.97% (Table 4). This value is still below the results of studies by Haile (2018) and Hilali et al. (2011), which found average protein contents of 4.60% and 5.82% in Awassi sheep. The lack of effect of local TMR feed on milk protein content is likely due to the quality of feed protein and protein digestibility being below the NRC 2007 standard (Table 2). This resulted in a relatively constant supply of amino acids to the ewes' udders, preventing an increase in milk protein content. The process of milk protein biosynthesis is influenced by the protein content in the feed (Daning, 2023).

The results of the milk fat parameter analysis showed an average value of 6.59% (Table 4). These results are in line with the research by HaiIe et al. (2018), which states that the fat content of Awassi sheep milk has an average value of 4.89%, and is in line with the results of research by Hilali et al. (2011), which obtained an average fat value of 6.59%. The high fat content is due to the optimal amount of crude fiber consumed by sheep, which is then fermented by rumen microbes to produce optimal acetic acid as the basic ingredient of milk fat. Tanuwiria et al. (2008) in Suhendra et al. (2015) stated that milk fat content is influenced by feed fiber and its metabolic product, acetate. Rations containing high crude fiber will produce a lot of acetic acid, which is a precursor to de novo synthesis of milk fat in the udder.

Lactose is the main carbohydrate found in milk and its processed products. Lactose is a disaccharide consisting of two simple sugar molecules, namely glucose and galactose. The slightly sweet taste of milk is determined by lactose, which also acts as a source of energy for the body (Saleh 2004). The results of the lactose parameter analysis in Table 4 obtained an

average value of 5.96%. This result is in accordance with HaiIe et al. (2018), which found that the lactose content of Awassi sheep milk reached an average of 4.17%, and Hilali et al. (2011), which found that the lactose content of Awassi sheep milk was 4.54%. This lactose production is due to the sufficient crude fiber content consumed by sheep, so that the fermentation process by rumen microbes produces more VFA. One part of VFA is propionic acid, which is the basic ingredient of milk lactose (Suhendra, et al. 2015).

The average result of the Solid Non-Fat (SNF) analysis in Cross Awassi sheep milk was 10.84%, which is in line with the research by Hilali et al. (2011) that the SNF value of Awassi sheep ranges from 8.73-17.66%. However, the SNF value in Table 4 is lower than that found in the study by Haile et al. (2018), which obtained a value of 14.20%. SNF or non-fat dry matter is the total amount of milk components minus water and fat content, consisting of protein, lactose, minerals, and vitamins (Sarwiyono, et al. 1990 in Suhendra, et al. 2015). Mutmainah, et al. (2013) stated that the higher the lactose protein, the higher the non-fat dry matter in milk. The increase in SNF is due to the fact that fat content is not included in this component, so that the total remaining protein and lactose can affect the percentage produced.

Business Feasibility Analysis

Business feasibility is an activity to observe and assess the benefits that can be obtained from carrying out a business. Business feasibility analysis is conducted to determine the feasibility of a business from a financial aspect. The business analyzed is the Awassi cross sheep business, which focuses on milk production. The financial aspect is observed from the amount of return on investment generated. A business feasibility analysis usually includes calculations of costs such as production costs, receipts, and income. The Awassi crossbred sheep business requires production costs of IDR 7,330,907, consisting of fixed and variable costs, with receipts of IDR 10,016,400 obtained from the sale of milk and sheep products, and business profit income of IDR 2,685,493.

Based on the financial data, the business obtained a Break Even Point (BEP) analysis result of Rp 120,972, a Return on Investment (ROI) of 17.9%, or over 6 maintenance periods. With an R/C ratio of 1.36, this Awassi cross-breed lactating sheep business is feasible to operate.

CONCLUSIONS AND SUGGESTIONS

Total Mixed Ration feed based on local feed ingredients is able to provide good nutrition for Awassi crossbred sheep in the lactation phase. Although the crude protein content is slightly below standard, livestock performance such as feed consumption, weight gain, and milk production shows positive results. The use of TMR based on local feed is feasible for application in ruminant farming systems in tropical regions.

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