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Hematological Profile and Growth of Local Goats After Administration of Probiotics Yeast and Lactic Acid Bacteria (RABAL)

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Abstract | Yeast and lactic acid bacteria (RABAL) are probiotic fermentation product derived from *Saccharomyces* fungi and *Lactobacillus* bacteria, utilizing fruit waste as a substrate. This study aimed to determine the effects of RABAL oral administration on hematological parameters (blood profiles), and growth performance in local goats. This study used nine male local goats aged between 8-12 months with a weight range of 7.9-20.9 kg. The study design used a Completely Randomized Design (CRD) with three distinct treatment groups, each containing three goats. Over the 28-day study period, the animals received a daily oral dose of RABAL in the afternoon prior to herding. Blood samples were collected from the jugular vein using vacuum tubes containing EDTA anticoagulant (1-1.5 mg/ml) which were then analyzed for hematological parameters. Growth performance was assessed by measuring Average Daily Gain (ADG) and Body Condition Score (BCS). Data were subjected to analysis of variance (ANOVA) and descriptive analysis. The statistical analysis indicated that RABAL supplementation did not exert a significant influence ($P>0.05$) on hematological parameters, but had a significant effect ($P<0.05$) on ADG. The administration of 6 ml of RABAL resulted in a higher ADG (0.16 kg/head/day) compared to the control group (0.05 kg/head/day). Furthermore, the group receiving the 6 ml dosage achieved a Body Condition Score of four. In conclusion, the findings suggest that a daily oral administration of six ml RABAL can enhance growth performance and productivity in local goats without altering their hematological profile.

Keywords | Body condition score (BCS), Body weight, Hematological profile, Local goats, Yeast and lactic acid bacteria (RABAL)

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INTRODUCTION

Goats are a type of ruminant livestock that adapt easily to agro-ecosystems, easy to trade, easy to raise, and do not require a large area of land. Currently, there are seven local goat breeds, characterized by the marica, muara, samosir, gembrong, PE, and kacang goats (Batubara *et al.*, 2006). Male goats are primarily raised for meat production, with demand peaking during religious celebrations such as Eid al-Adha and Aqiqah (Bukhori *et al*., 2017). Currently, the goat population is declining due to increasing slaughter rates and increasing morbidity (Zulkarnain *et al*., 2015). A primary challenge exacerbating this issue in Indonesian goat farming is the consistent provision of high-quality feed in adequate quantities. Inefficient feeding strategies and poor feed quality are significant factors behind low productivity in ruminants, as essential nutrients often remain inaccessible to digestive enzymes (Partama, 2013). Consequently, strategic feed management is critical to enhance feed quality, farming efficiency, and overall livestock health. One promising strategy to increase productivity, particularly growth rates in goats, is through probiotic supplementation (Adriani, 2009; Aisyah and Luqman, 2017).

Probiotics are a type of nutritional supplement that can be given as an alternative to increase productivity and growth in livestock (Hamid *et al*., 2021). Microbes that have the potential to act as probiotics include lactic acid bacteria (LAB) and yeast (Amin *et al*., 2020). Previous research has shown that administering LAB probiotics can increase the weight gain of tiger shrimp. The final body weight of tiger shrimp was higher than the initial weight across all treatment groups (Nurliana *et al*., 2020). Probiotics derived from lactic acid bacteria (LAB), such as *Lactobacillus plantarum* and *Lactobacillus casei*, function by stabilizing the natural equilibrium of the gut microbiota and inhibiting the growth of pathogenic bacteria (Syam *et al*., 2019; Azizah *et al*., 2018; Jannah *et al*., 2023). A key beneficial effect of this microbial balance is the reduction in the ability of pathogenic microorganisms to produce toxins (Sumarsih *et al*., 2012). Beyond bacteria, yeast is another potent probiotic ingredient that serves as a nutrient source, enhancing the overall nutritional value of animal feed (Arissirajudin *et al*., 2019; Pangandaheng *et al*., 2020).

The efficacy of these nutritional strategies is reflected in the animal's physiological status, which can be evaluated through hematological and blood chemical profiles (Ali *et al*., 2013; Kamil, 2020). These parameters are influenced by various factors, including feed quality, environmental conditions, and management practices (Rahayu *et al*., 2017). Crucially, low-quality feed can lead to inadequate nutrient absorption, which in turn results in suboptimal blood nutrient levels and compromises animal health and productivity (Astuti *et al*., 2008). This study was therefore conducted to investigate the efficacy of RABAL supplementation as a feed additive to increase the productivity and health of local goats based on hematological profiles, average daily gain (ADG) and Body Condition Score (BCS).

MATERIALS AND METHODS

Research materials

The production of RABAL was conducted at the Veterinary Public Health Laboratory, Faculty of Veterinary Medicine, Syiah Kuala University, Banda Aceh. RABAL administration was carried out at a smallholder farm in Gampong Lamtimpeung, Tungkop sub-district, Aceh Besar. The 9 local goats used as samples were male, aged between 8-12 months and body weight range between 7.9-20.9 kg. The goats were kept in cages equipped with feed and water containers. The yeast used was tape yeast and lactic acid bacteria used were *Lactobacillus plantarum* and *Lactobacillus casei*.

Research design

This study used a Randomized Group Design (RAK) design consisting of three treatment groups: P0 (control group), P1 (goats given 3 ml RABAL) and P2 (goats given 6 ml RABAL). The experimental goats were administered RABAL orally once daily, immediately before their release from the pen. Each treatment was replicated with three animals.

Preparation and administration of RABAL

The RABAL probiotic was prepared according to the methodology established by Nurliana *et al*. (2020). RABAL was prepared using pineapple and papaya peels that were cleaned, weighed, mashed, and filtered. The resulting filtrate was placed into a container, and molasses, *Lactobacillus casei*, and *Lactobacillus plantarum* were added at dosages predetermined by previous research. The storage container was tightly closed and placed in a place not exposed to sunlight for 5-7 days. RABAL was administered orally once a day at noon before the goats were released to forage for 28 days. In order to identify the goats easily, the goats were marked in the form of necklaces on the neck with different colors in each treatment.

Determination of ADG and BCS in goats using the weighing/measurement method at the beginning (day 0) and end of the study period (day 28). The ADG was calculated using the following formula:

ADG= (Final weight - Initial weight)/Length of weighing Day

Determination of BCS in this study involves visual inspection and palpation of several areas of the livestock's body, especially on the fatty part of the hip meat muscle, the curve of the upper spine of the abdomen, the thickness of the fatty meat muscle of the chest and the ribs. Score in the BCS method has a scale of 1-5. Scale 1 indicates that the goat is very thin, scale 2 thin goat, scale 3 medium goat, scale 4 fat goat, and scale 5 very fat goat (Priska *et al*., 2023).

Table 1: Local Goat blood profile values (erythrocytes 106/µl), hemoglobin (g/dL), hematocrit (%) and leukocytes (103/µl).

Parameter	Goat blood profile value each treatments			Reference: (Muayad *et al*., 2018)
	P0	P1	P2	
Erythrocytes (10^6/µl)	2.94±0.42	3.06±1.32	2.64±0.83	3.3 x 10^6/µl
Leukocytes (10^3/µl)	18.90±1.04	17.17±2.81	17.73±4.09	16.7x 10^3/µl
Hemoglobin (g/dL)	9.77±0.23	8.77±1.36	9.13±1.21	10,4 g/dL
Hematocrit (%)	31.23±3.19	33.53±16.06	27.80±5.91	27 %

Description: P0 (Without giving RABAL), P1 (Giving RABAL at a dose of 3 ml), and P2 (Giving RABAL at a dose of 6 ml).

Blood profile was measured using a haematology analyzer to measure the value of erythrocytes, hemoglobin, hematocrit and leukocytes of local goat blood.

Data analysis

Data obtained from measurements of ADG, BCS and blood profile profiles were analysed statistically using ANOVA and descriptive analysis.

RESULTS AND DISCUSSION

Blood profile of local goats after RABAL application

Based on the results of statistical analysis, RABAL application did not significantly affect (P>0.05) the blood profile value of local goats (Table 1). The average erythrocyte values of local goats after administration of RABAL at doses of 3 ml and 6 ml were 3.06 ± 1.32 x106/µl and 2.64 ± 0.83 x106/µl, respectively. According to Muayad *et al*. (2018), the erythrocyte value of local goats that appear healthy under tropical climates is 3.3 x 10^6/µl. However, according to Sunder *et al*. (2016), the average erythrocyte value of male and female teressa goats that are extensively reared and are in a healthy condition is 1.48 ± 2.86 x 10^6/µl and 0.96 ± 2.09 x 10^6/µl. The results of this study are also lower than the results of research by Widyono *et al*. (2014), in intensively reared lokal goats obtained an average number of erythrocytes of 13.23-14.17/µl x 10^6/µl.

Erythrocyte values are influenced by goat species and the physiological condition of the animals. In general, the physiological state of each goat affects the variation in the number of erythrocytes. Some factors that affect the physiological state of goats include feed quality, environmental temperature, maintenance management and body fluid balance (Rahayu *et al*., 2017). Based on field observations, local male goat farmers in Lamtimpeung Village, Darussalam Subdistrict, Aceh Besar use a semi-intensive rearing system. The goats were housed in pens overnight and released for grazing at 16:00 WIB. During this time, they foraged for food in open areas such as fields, soccer pitches, rice fields, and roadsides around the rearing facility before being returned to their pens at 18:00 WIB. Consequently, their diet consisted almost exclusively of naturally available grasses and forage leaves during grazing, with no provision of concentrate feed and only poor access to water. Goat farmers prefer not to give concentrates for additional feed because it costs more money. Farmers prefer to utilize forage feed because it is considered more economical, although farmers lack knowledge of its content.

Semi-intensive rearing systems also contribute to creating anemic conditions in goats. The low number of mature erythrocytes in the blood will cause anemia (Rahayu *et al*., 2017). Lack of protein and some minerals needed in the process of erythrocyte formation results in a decrease in the number of erythrocytes (Rumlaklak and Lapenangga, 2022). The mineral deficiency is caused by nutrient intake from feed consumption that is insufficient for goats raised semi-intensively (Rahayu *et al*., 2017).

The average leukocytes of local goats obtained after administration of RABAL with a dose of 3 ml and 6 ml were 17.17±2.81x10^3/µl and 17.73±4.09 x 10^3/µl, respectively. According to Muayad *et al*. (2018) stated that the leukocyte value of pea goats is 16.7 x 10^3/µl. The leukocyte value in the treatment group was above the reported value. Probiotics containing *Lactobacillus* sp. can result in increased leukocyte values in the circulatory system and provide greater resistance to intestinal pathogens (Alayande *et al*., 2020). Furthermore, an increase or decrease in leukocytes in the blood is the body's reaction to invading pathogens (Purnomo and Isroli, 2015).

An increase in the number of leukocytes indicates a humoral and cellular resistance response to disease-causing pathogenic agents and an increase in the body's defense capabilities (Soeharsono *et al*., 2010). According to Florensia *et al*. (2021) infectious disease, anaphylactic shock, feed poisoning, and central nervous disorders make leukocyte values increase, while inflammation, viral infections, decreased leukocyte production and bone marrow disorders make total leukocytes decrease.

The state of the number of leukocytes that are above the average normal value is called leukocytosis, this situation, neutrophils have an influence on the increase or decrease in the number of leukocytes (Widhyari *et al*., 2020). At the time of blood collection, animals will experience stress that causes leukocytosis or an increase in the number of peripheral blood leukocytes. This is caused by an increase in the flow of leukocytes from the bone marrow into the bloodstream (Isnarni and Sulistyani, 2015). Goats experiencing stress or uncomfortable conditions will show an increased number of neutrophils. Stress will trigger an increase in cortisol levels in the blood resulting in the release of neutrophils from the bone marrow into the bloodstream which makes the number of leukocytes increase (Ali *et al*., 2020).

The average hemoglobin values of local goats obtained after administration of RABAL at a dose of 3 ml and 6 ml were 8.77±1.36 mg/dL and 9.13±1.21 mg/dL, respectively (Table 1). According to Muayad *et al*. (2018), the hemoglobin value of pea goats is 10.4 g/dL. The hemoglobin value in the treatment group was below the value reported by Muayad *et al*. (2018). Feed and environment greatly affect hemoglobin so that nutritional deficiencies in feed can cause hemoglobin production to decrease (Nabawi *et al*., 2023). Probiotics given to livestock will produce amylase, protease and lipase enzymes that support absorption in the intestine. Proteolytic bacteria in probiotics are able to synthesize keratinase-producing protease enzymes, then simple compounds in the form of amino acids are broken down by keratinase. Amino acids act as precursors for the formation of erythrocytes (Harnentis and Robi, 2022). Hemoglobin levels indicate nutritional adequacy, namely the fulfillment of protein needs in livestock, low hemoglobin levels in addition to indicating anemia also indicate protein deficiency and liver damage due to parasitic infections (Olugbemi, 2010). Feed and environment will affect hemoglobin in the blood. The presence of parasitic infections, mineral deficiencies, and stress caused by heat are likely to trigger low hemoglobin levels (Kasthama and Marhaeniyanto, 2006). The highlands where goats live will trigger the goat's need for a lot of acid or oxygen, allowing hemoglobin levels in goats to increase (Ihtifazhuddini *et al*., 2021).

The average hematocrit of local goats obtained after giving RABAL probiotics at a dose of 3 ml and 6 ml was 33.53 ± 16.06% and 27.80 ± 5.91%, respectively. The hematocrit value in the treatment group was above the value reported by Muayad *et al*. (2018) that the hematocrit value of peanut goats is 27%. Hematocrit value has a close relationship with erythocyte value. Likewise, the pattern of the rise and fall of hematocrit values is strongly influenced by the number of erythrocytes (Rahayu *et al*., 2017). Goats that have hematocrit values around the normal average range indicate that the goat is in good health, if the hematocrit value in the livestock is low, it can indicate that the livestock is in a sick condition (Rohmah *et al*., 2020). Age, water consumption, livestock activity, environmental temperature and the content of nutrients in feed, especially protein, minerals and vitamins that are needed to control hematocrit values, can influence differences in hematocrit values (Weiss and Wardrop, 2010). An increase in hematocrit value occurs due to an increase in blood cell levels or a decrease in blood plasma levels. Conversely, a decrease in hematocrit value occurs due to a decrease in blood cells or an increase in blood plasma levels such as in anemia (Hidayat *et al*., 2017). According to Mayulu *et al*. (2012) that a decrease in hematocrit levels is caused by a lack of nutrients in the feed, while an increase in hematocrit levels occurs due to dehydration of the body. Hafsan (2018) mentioned that improving digestive conditions by probiotics is able to achieve basic living needs that are met so that the substances needed in the process of forming blood cells can run better. Although the provision of RABAL does not affect the blood profile of local goats. However, the provision of RABAL does not provide a negative change in the blood profile of local goats, so the provision of RABAl can be tested again with a higher dose.

Average daily weight (ADG) and body condition score (BCS) of local goats after RABAL Administration

Goat productivity can be seen based on ADG and BCS. The ADG data obtained has been thoroughly analyzed. The analysis results showed that the data was normally distributed. The data obtained has gone through normality testing using the Shapiro-Wilk test. The ADG data were also homogeneously distributed, indicating that the variability within the data groups was similar. The results of the study on the effect of RABAL on ADG in goats are shown in Table 2. Based on statistical analysis, it shows that the provision of RABAL has a significant effect (P<0.05) on ADG of local goats. P2 treatment is better than the control. The highest ADG value in the research goats in the P2 treatment with ADG 0.16 kg/head/day and the lowest in the P0 treatment with ADG 0.05 kg/head/day.

Table 2: Average of Increase in weight (IIW) during 28 days and daily weight gain (DWG) of local goats given RABAL.

Treatment	IIW (kg/28 days)	DWG (kg/head/day)
P0	1.5^{a}	0.05^{a}
P1	2.1^{a}	0.08^{a}
P2	4.4^{b}	0.16^{b}

Description: a and b different superscripts on the same line indicate a significant difference (P < 0.05), P0 (Without the administration of RABAL), P1 (Administration of RABAL dose 3 ml), P2 (Administration of RABAL dose 6 ml), Daily Weight Gain (DWG).

The difference in body weight in treatment groups P0, P1, and P2 showed significant variation among treatments during the observation period. The P0 group, which served as the control group without treatment, showed changes in body weight that could be used as a basis for comparison. Group P1, which was given 3 ml RABAL, and group P2, which was given 6 ml RABAL, each showed different changes in body weight (Table 2). Probiotics have a role in creating a balance of microflora in the digestive tract. Probiotic bacteria will colonize and attach to the digestive tract mucosa which causes pathogenic bacteria to not be able to attach to the digestive tract mucosa. This situation will cause optimal conditions in the process of feed digestion. Feed digestion that occurs in good condition will result in feed efficiency that can be converted into meat (Putra and Humaidah, 2022).

Based on the research, the average ADG value of local goats measured in each treatment is above the ideal threshold when compared to the research of Nurmiati (2014) on the effect of gender on the growth of intensively reared goats that, obtained the average ADG of male goats as much as 33.28 g/head/day or 0.03 kg/head/day. The increase in ADG in goats resulted in an increase in body weight in goats (Final weight).

Yeast and lactic acid bacteria (RABAL) are the result of fermentation of yeast and lactic acid bacteria. Yeast is known to be able to produce energy substrates in digestive cells so that the intestines become healthier and the work of the digestive system becomes more optimal. The cooperation between yeast and lactic acid bacteria in the digestive tract will spur the growth of lactic acid bacteria (Sahara *et al*., 2023). The addition of yeast containing yeast can trigger the growth of lactic acid bacteria because the activity of yeast in fermentation is able to break down lactose into lactic acid so that there is an increase in lactic acid production (Rahma, 2011). Lactobacillus plantarum produces an antimicrobial compound called plantaricin, while casei can produce homofermentative lactic acid that forms almost 85% pure lactate obtained from glucose fermentation and lactate formation (Azizah *et al*., 2018). The mechanism of action of probiotics is by attaching and colonizing the digestive tract. If probiotic microbes develop well, then pathogenic microbes will be eliminated from the host animal's intestinal cells. Furthermore, probiotics will inhibit pathogenic organisms by competing for food substrates to be fermented, namely prebiotics in the form of fiber.

Lactic acid-producing *Lactobacillus* species will produce cellulase enzymes that can break down hard-to-digest crude fiber components in the digestive tract. The development of pathogenic microbes in the digestive tract will be inhibited by toxins released by probiotics. The toxin can increase the host animal's immunity (Sumarsih *et al*., 2012).

Increasing the population of cellulotic bacteria such as lactic acid bacteria in the rumen of goats will increase cellulotic activity and shorten the time needed to digest fiber. If the level of fiber digestibility in the rumen is increased, it will also increase feed consumption and nutrient supply to the intestine (Wina, 2000). Probiotics do no harm even if the number of bacteria from probiotics increases in the digestive tract. This is because probiotic bacteria do not damage digestive wall cells or take nutrients needed by livestock. Probiotic bacteria only eat food substances such as inulin that cannot be digested (Ikasari, 2017).

In this study, BCS assessment was also carried out by assessing the condition of the livestock's body visually and palpating the fat deposits under the skin around the base of the tail, backbone and hips. Fat and thin goats are determined by muscle growth and fat in the body of the animal. The results of the research on BCS in goats can be seen in Table 3.

Table 3: Average body condition score (BCS) in goats given RABAL during 28 days.

Treatment	Initial BCS	Final BCS
P0	3.33	3.33
P1	3.33	3.33
P2	3.33	4.0

Description: P0 (Without RABAL administration), P1 (Given RABAL 3 ml), P2 (Given RABAL 6 ml), BCS 1 (Very thin), BCS 2 (Thin), BCS 3 (Ideal), BCS 4 (Fat), BCS 5 (Very fat).

The average BCS value in the P0, P1 and P2 treatments is at a score of 3 which indicates that the goats are in ideal condition. Ideal livestock have body conditions that are not too fat or too thin. According to Winaya and Sujono (2016), at BCS 3 goats are seen in a condition where the backbone does not protrude and the ribs cannot be seen clearly with a layer of fat covering it. In addition, the space between the ribs can only be felt by applying pressure. Goats with BCS 3 have an ideal body condition because the goats get feed with good quality and quantity (Dewi *et al*., 2011). In this study, the P0 treatment group which was not given RABAL and P1 which was given RABAL at a dose of 3 ml had less impact on increasing the BCS of goats. In the P0 and P1 treatments, there was no change in the average value of BCS from the initial BCS examination to the final BCS, while the P2 treatment showed an increase in the average value of BCS from score 3 to 4.

The nutrients contained in the feed are very influential in achieving a good BCS. An increase in animal body size is followed by an increase in chest circumference, body length, and body weight (Anggraini, 2023). Other factors that affect BCS value are genetics and treatment. Livestock that have a higher BCS value indicate that the fatty body is in good condition. The greater the BCS value, the better it is for livestock raised as broilers (Priska *et al.*, 2023). BCS assessment is commonly used as a material to assess feeding management, see the nutritional status of livestock, check livestock health conditions and evaluate livestock conditions. Body condition score (BCS) is a good and simple indicator in estimating fat reserves and assessing the body condition of livestock that can be used in any period (Netika *et al.*, 2020). Livestock with very thin body condition have fewer fat reserves. Fat comes from nutrients in feed that become energy reserves stored in the body of livestock. There are two things that can be done in improving the BCS value, namely improving the quality of feed by providing food supplements and providing nutritional needs according to the condition or condition of the livestock (Masir *et al.*, 2020).

CONCLUSION

The administration of both 3 ml and 6 ml of RABAL resulted in normal blood profiles in local goats. Furthermore, the 6 ml dosage significantly enhanced growth performance, yielding an Average Daily Gain (ADG) of 0.16 kg/head/day and achieving a maximum Body Condition Score (BCS) of 4.

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NOVELTY STATEMENT

This study is the first to investigate the impact of probiotic yeast and lactic acid bacteria on the hematological profile and growth performance of local goats. Its findings can serve as a basis for developing probiotics as a safe and effective feed supplement for livestock.

AUTHOR'S CONTRIBUTION

Nurliana was responsible for the research conceptualization, design, and initial draft preparation. Kanaya and Syahzidane were involved in the investigation and data collection. Wahyu Eka Sari and Henni Vanda contributed to data curation and formal analysis. Amalia Sutriana, Juli Melia, and Nuzul Asmilia performed data analysis, as well as the writing, review, and editing of the manuscript.

Ethical approval

This research has been approved by the Veterinary Ethics Committee Faculty of Veterinary Medicine Syiah Kuala University with protocol number Ref: 433/KEPH/VIII/2024 Banda Aceh, August 5th, 2024.

Generative AI and AI-assisted technology statement

Generative AI tools are used solely for language editing and grammar improvement. No AI tools are used for data analysis, interpretation, or scientific content creation.

Conflicts of interest

The authors have declared no conflict of interest.

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