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The Impact of Processing Methods and Levels of *Jatropha gossypifolia* L. Leaves on Productivity of Goats, Considering Distance

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ABSTRACT

Jatropha gossypifolia L. is a critical source of feed ingredients for livestock, providing 60% protein with a proper balance of essential amino acids when appropriately processed. This study aimed to evaluate the production performance, physiological status, and haematological value of Nuts goats fed with jatropha leaves processed using different methods and levels. Thirty local female goats of 10 months old with a weight range of 10.89kg to 18.98kg were used. The research employed a 2×5 factorial randomized block design and was repeated three times. The analysis revealed an interaction between the processing method and the level of red jatropha leaves given to obtain body weight gain, consumption of dry matter, and crude protein ration. The processing method of red jatropha leaves had a significant impact on the consumption of dry matter and crude protein ration, body temperature, pulsus frequency, and hematological value (white blood cell count, red blood cell count, hemoglobin level, hematocrit value) of the goats. However, it did not affect the efficiency of using dry ingredients, protein rations, and the frequency of respiration of nuts goats.

1. INTRODUCTION

The exploration of animal feed originating from agricultural/plantation land is crucial to overcome the limited availability of feed sources [1]. Utilizing green energy sources that are healthy and environmentally friendly, such as red castor leaf (*Jatropha gossypifolia* L.), as animal feed ingredients can provide essential nutrients, including crude protein, crude fiber, crude fat, and ash, needed for livestock growth. However, the presence of antinutrient substances and poisons, including antitrypsin, tannins, phytate, and high crude fiber from the main toxins of phorbolester, hinders their use [3]. To overcome this challenge, treatment is necessary to reduce or eliminate these substances.

Feed processing can be performed by chemical methods in the form of immersion in an alkaline solution or biological processing in the form of fermentation using microorganisms, resulting in an effective method for reducing or eliminating all poisons or antinutrient substances contained in jatropha leaves [4]. Alkali treatment can effectively stretch and/or break lignocellulosic bonds in plant fiber components, making them enzymatically digestible by rumen microbes [5, 6]. The use of the husk ash filtrate is considered safe and has been demonstrated to be effective in reducing the content of fiber components [7, 8]. In this study, hydrolysis treatment was performed using secant ash filtrate, given its wide availability and simplicity, making it suitable for application in the countryside [9, 10].

Fermentation is another method that can be employed to improve the nutritional value of jatropha leaves and requires the use of microorganisms. Neurophore sitophila is a known mold that can effectively increase the nutritional value of feed ingredients, and it can grow well in high humidity at a temperature between 20-30℃ in aerobic conditions [11]. Ascomycetes, such as "soft rot fungi," can degrade lignin and lignocellulosic material [12]. Improving the nutritional value of red jatropha leaf is crucial in providing cheap and easy feed ingredients [13, 14].

The chemical or biological processing of red castor leaf is thought to be able to improve the quality of nutrition so that when consumed by livestock it has an impact on digestibility and physiological state of livestock [15]. This process is very interesting and valuable, so the authors feel the need of conducting research to obtain useful information in an effort to use red jatropha leaves as potential ruminant food [16].

Based on the description above, the writer is interested in conducting research on the chemical processing of red jatropha leaves using husk ash filtrate and biological processing using N. Sitophila to understand their influences on body weight gain, physiological conditions namely physiological status (body temperature, respiration frequency, and pulsus frequency) and haematological values (red blood cell count (erythrocytes), white blood cell count (leukocytes), hemoglobin and hematocrit of goat nuts.

2. MATERIALS AND METHODS

This research was conducted in the Experiment Cage owned by CV. Prima BREED Tondo Village, Mantikulore District, Palu City, Central Sulawesi Province, from June 2019 to May 2020.

2.1 Caprine experiment

Caprine used in this study were 30 female goats ± 10 months with a body weight range from 10.89kg to 18.98kg. Selection of goats because there is quite a lot of availability, female goats are prepared to replace old mothers. the use of male goats does not have the same effect due to different hormonal effects and nitrogen retention.

This study only uses goats, for testing other types of livestock can of course be used with different concentrations and treatments.

The goats used have the same age, namely 10 months old and do not have much influence on research, these goats are a development belonging to the company CV Prima BREED Tondo Village, Mantikulore District, Palu City, Central Sulawesi Province.

2.2 Animal feed

The feed given during the study consisted of Roxburg concentrate and *Panicum sarmentosum* (Roxb). The concentrate used consisted of a mixture of several ingredients in the form of soybean 22%, rice bran 60%, milled corn 18%, fermented jatropha leaves as a treatment. Concentrate was given at 07:30 am as much as 1.5% of body weight based on dry matter, while *Panicum sarmentosum* Roxb was given after the concentrate was consumed ad-libitum.

The concentrate used consisted of 22% oybean, 60% rice bran, 18% milled corn, is a concentrate composition of 100% which is given as a comparison to meet the standard needs of goat livestock.

The nutrient content of the constituent ingredients is listed in Table 1.

Table 1. Nutrient content and composition of concentrate used [17]

Feed ingredients	Material Dry*	Protein Rough*	Fiber Rough*	Fat Rough*	TDN **
Soybean Flour	85.85	40.61	14.38	1.47	70.04
Milled Corn	85.20	11.93	2.91	4.89	7.86
Rice Bran	88.68	8.61	20.09	7.88	48.88
Fermented Jatropha Leaves	88.76	17.17	14.42	1.19	74.04
Leaves Distance Soaking	90.00	14.23	16.65	2.07	69.97
Panicum sharmentosum	22.77	9.11	19.53	1.60	61.00

2.3 Making castor leaves

Propagation of Culture Neurospores of Sitophila

The Neurospora sitophila fungus is bred on boiled corncobs. Young corn seeds were boiled, cooled down and stored in a container, then incubated at 37°C for 3 days. After the fungus grow with orange characteristics, it is ready to be used as an inoculum.

Neurispora sitophila as one of the microbes that can reduce the very high levels of tannin (crude fiber) in jatropha, as well as increase crude protein. Neurospora sitophila is used as a fermentation material so that chemical changes occur in organic substrates caused by the action of enzymes released by microbes. Changes in microorganisms include changing complex molecules consisting of proteins, carbohydrates and fats into simple molecules that are easy to digest and provide a better aroma, increase endurance and can reduce toxic compounds from the basic ingredients so that they have better economic value.

2.4 Fermented jatropha leaves

Leaves are rarely dry and corn bran is mixed until homogeneity is reached at a ratio of 3:1, steamed for 20 minutes, removed and then placed in a plastic tray measuring 60cm long, 30cm wide and 3cm high. The substrate is allowed to cool down until it reaches room temperature.

The cooled culture was given a pre-made inoculum evenly on the surface of the substrate tray. The molds were arranged in an incubator rack, then incubated at 26-29°C for three days (72 hours) with 68-72% RH. After incubating for 72 hours, the fermented castor leaf (FCL) was dried. After being dried, it was grounded until becoming smooth, being ready to be used as feed ingredients for the concentrate.

2.5 Making jatropha leaves (MJL)

The procedure for making jatropha leaves (hydrolysis) used in this study refers to the procedure of the study [18] as follows:

1) The rice husk is dried burned to the point of becoming ashes and then cooled down.
2) 200g of rice husk ash was put into a bucket and mixed with 1 liter of water to get the filtrate concentration determined by the unit of measurement % weight/volume (% w/v). The solution was then stirred until all the ash dissolved and evenly mixed with water. After that, it was deposited for 24 hours until the water became clear.
3) After clearing, the water of the rice husk ash solution called the rice husk ash filtrate was filtered with a cloth and measured for pH. 600ml of the husk ash filtrate solution was sprinkled on 600g of dried castor leaf (ratio 1:1) which was put in a plastic basin while stirring it evenly. Efforts were made to absorb water into castor leaf tissue.
4) Furthermore, the substrate is put into a plastic bag while being pressed to reduce air and voluminous cavities in the bag. The bag is then tied with a rubber band.
5) It is stored in room temperature for 12 hours.
6) After the curing process is over, the plastic bag is opened, dried in the sun for 5-6 days and then ground into flour. The ground MJL is ready to be used as a material for making concentrates.

2.6 Analysis method

The design used in this study was a Randomized Block Design Factorial Pattern 2×5 which was repeated three times. The first factor is the distance of fermented jatropha (DFJ) and jatropha leaves. The second factor consists of five levels of utilization of jatropha leaves, namely 0%; 5%; 10%; 15% and 20% in concentrate.

3. RESULTS AND DISCUSSION

3.1 Goat livestock production performance

The results of observations of the Nuts goat's production

performance which were given jatropha flour with different levels and processing methods are listed in Table 2.

In Table 2, the average consumption of dry matter and consumption of goat crude protein shows a tendency to increase along with the increase of jatropha leaves' level. However, there is a decrease in body weight gain, efficient use of dry matter and crude protein ration. Likewise, it was seen that body weight gain, consumption of dry matter and consumption of crude protein in goat ration was higher in the provision of fermented jatropha leaves than in the immersion jatropha leaves, while the efficiency of using dry matter and efficiency of using crude protein ration was lower in goats fed with fermented jatropha castor leaf leaves.

The results of statistical analysis of jatropha leaves with different levels and processing methods showed an interaction ($P<0.05$) on body weight gain, dry matter consumption, and crude protein consumption of goat ration, but no significant effect ($P>0.05$) on efficient use of dry ingredients and efficient use of goat crude protein. Provision of jatropha leaves with different levels had a significant effect ($P<0.05$) on body weight gain, consumption of dry matter, consumption of crude protein ration and the efficient use of dry ingredients ration, but no significant effect ($P>0.05$) on the efficiency of use of crude protein in goat ration. The processing method of red jatropha leaves gives a real effect ($P<0.05$) on body weight gain, consumption of dry matter, and consumption of crude protein ration.

Giving red jatropha leaves up to 20% as feed ingredients is still possible for the growth of goats. This is possible because Milled jatropha leaves can inhibit the growth of Ascaris lumbricoides and Necator americanus worms [19], to increase the amount of consumption of goat paga ration.

Fermentation results in higher nutritional value than alkaline processing [20]. This is due to catabolic microbes or breaking down complex components into simpler substances that are easier to digest, and can synthesize some vitamins [21], while soaking was only able to stretch the bonds of complex compounds in feed ingredients. Thus, an improved weight gain and consumption of rations is noticed if it is processed biologically as the quality of feed can be improved with the presence of biological treatments such as fermentation. Considering this process involves microorganisms in degrading crude fiber, the levels of lignin and anti-nutrient compounds are reduced, so that the digestibility of feed from waste can increase [22]. The fermentation process can minimize the antinutrients effect and improve digestibility of feed ingredients [23].

Higher yield of immersed jatropha leaves improve the efficiency of dry matter and goat crude protein, due to the presence of saponins that are still needed by livestock for their physiological activities. Saponins have toxic effects on protozoa by forming an irreversible complex with steroids in the protozoan cell wall [24]. The complex formed results in damages to the protozoan cell membrane [25]. The decrease in protozoan population in this rumen is likely to have several positive effects such as increased efficiency of nitrogen metabolism, reduction of methane gas emissions, shifts in bacterial and fungal populations in the rumen as well as potential increase in bacterial protein flow to the lower digestive tract [25].

Table 2. Average of body weight gain, ration consumption and efficiency of ration used in bean goats fed with jatropha leaves with different levels and processing methods

Parameter	Processing	Level					Average
		0.0%	5.0%	10.0%	15.0%	20.0%	
Increased Body Weight (g/head/day)	Soak it	42.78b	41.19b	32.78a	39.19b	38.92	38.97 a
	Fermentation	42.86b	42.22b	42,14b	41.67b	41.03	41.98b
	Average	42.82a	41.71a	37.46b	40.43a	39.98 a	
Consumption of Dry Ration Material (g/head/day)	Soak it	336.82b	337.57b	276.54a	340.93b	345.81b	327.53a
	Fermentation	336.81b	353.31b	353.70b	354.68b	357.11b	351.12b
	Average	336.81ab	345.44b	315.12a	347.80b	351.46b	
Consumption of Crude Ration Protein (g/head/day)	Soak it	89.36b	92.78bc	75.37°	95.38c	94.72c	89.52a
	Fermentation	94.63c	96.61s	102.77s	99.98s	99.42s	98.68b
	Average	91.99 tab	94.70b	89.07°	97.68b	97.07b	
Efficient Use of Dry Ration Material	Soak it	0.127a	0.122a	0.094a	0.112a	0.110a	0.120a
	Fermentation	.128a	0.121a	0.120a	0.118a	.115a	0.113a
	Average	0.127a	0.121ab	.107ab	0.115b	0.113b	
Efficient Use of Rational Protein	Soak it	2.12°	1.89°	1.69°	1.78a	1.90a	1.88a
	Fermentation	1.76°	1.94°	1.59°	1.78a	1.87a	1.79a
	Average	1.94°	1.92°	1.64°	1.78a	1.89a	

Information: Numbers followed by different letters towards the line shows the real difference

Table 3. Physiological status average of goats fed with jatropha flour with different processing levels and methods

Parameter	Processing	Level					Average
		0.0%	5.0%	10.0%	15.0%	20.0%	
Rectal Temperature (°C)	Soak it	39.08	38.47	38.05	37.52	37.45	38.12a
	Fermentation	39.20	39.19	38.60	38.58	38.42	38.80b
	Average	39.14c	38.83c	38.32bc	38.05ab	37.94a	
Respiration frequency (times/min)	Soak it	41.96	41.89	33.63	40.61	40.28	39.67
	Fermentation	40.88	40.92	41.07	42.64	42.89	41.68
	Average	41.42	41.40	37.35	41.62	41.58	
Pulsus Frequency (times/minute)	Soak it	67.32	66.17	60.63	63.34	62.69	64.03a
	Fermentation	67.01	67.53	69.08	69.31	69.74	68.53b
	Average	67.17	66.85	64.85	66.32	66.21	

Information: Numbers followed by different letters towards the line shows the real difference

Table 4. Haematological value average of goat nuts blood fed with jatropha leaves with different levels and processing methods

Parameter	Processing	Level					Average
		0.0%	5.0%	10.0%	15.0%	20.0%	
White Blood Cells (thousand/mm^3)	Soak it	11.33	12.67	10.05	13.07	13.91	12.21°
	Fermentation	8.33	10.00	11.33	12.00	12.33	10.80b
	Average	9.83a	11.33ab	10.69a	12.53bc	13.12c	
Red Blood Cells (million/mm^3)	Soak it	9.00	11.33	9.60	12.13	13.25	11.06°
	Fermentation	11.00	12.00	12.33	12.67	13.67	12.33b
	Average	10.00a	11.67b	10.97ab	12.40b	13.46b	
Hemoglobin (g/dl)	Soak it	9.33	10.33	9.41	12.21	13.32	10.92°
	Fermentation	11.67	12.00	13.00	13.33	13.67	12.73b
	Average	10.50 a	11.17°	11.21b	12.77bc	13.49c	
Hematocrit (%)	Soak it	24.00	25.00	21.63	27.44	28.11	25.24°
	Fermentation	26.00	28.67	29.33	31.00	31.33	29.27b
	Average	25.00a	26.83ab	25.48a	29.22bc	29.72c	

Information: Numbers followed by different letters towards the line shows the real difference

3.2 Goat livestock status

The results of measurements of body temperature, respiration frequency and pulsus frequency of Nuts goats fed with jatropha leaf flour with different levels and processing methods are listed in Table 3.

The results of statistical analysis of jatropha leaf with different levels and processing methods showed no interaction (P>0.05) on body temperature, pulsus frequency and respiration frequency. Provision of jatropha leaves with different levels gives no significant effect (P>0.05) on goat body temperature, respiration pulsus frequency. The method of processing red jatropha leaves has a significant effect (P<0.05) on body temperature and pulsus frequency, but it has no significant effect (P>0.05) on the goat's respiration frequency.

Goat body temperature decreases with increasing level of jatropha leaves in the ration, but still in the normal range. According to the stufy [26] normal body temperature in goats ranges from 38.5 to 40.5°C. The decrease in body temperature is closely related to the physiological activity of livestock, primarily metabolic activities. Likewise, the body temperature of goats that were given jatropha leaves was significantly lower than the body temperature of goats fed with jatropha leaves. The animal's body temperature is closely related to physiological activity as described by Habeeb et al. [27] who says that rectal temperature in livestock is influenced by several factors, namely environmental temperature, activity, feed, drink, and digestion, heat production by the body indirectly dependent on the food it obtains and the amount of food supply in the digestive tract. The most important respiration activities are oxygen, carbon dioxide and their transportation to and from the respiratory tissue [28].

Respiration frequency of goats fed with jatropha leaves with different levels and processing methods are still in the normal range. According to the study [29], normal range of respiration in goats is 26-54 times/minute. This indicates that the use of jatropha leaves as food does not interfere with metabolic activities in the body and consequently with animal health. Respiration is a process of oxygeninhalation and carbon dioxide release through respiratory organs [30]. The main function of the respiratory system is to provide oxygen for livestock, and take carbon dioxide from the blood.

Pulsus or pulse can change according to the physiological conditions of the livestock body. From the results of this study indicated that the pulsus frequency was not influenced by the level of castor leaf, but the frequency of goat pulsus which were given immersed jatropha leaves were significantly lower than the frequency of pulsus from goats fed with fermented castor leaf. The different pulsus frequency is probably caused by differences in the metabolic activity of livestock, where caprine fed with fermented jatropha leaves present a higher activity. The pulsus value is increased followed by an increase in respiration which supplies many nutrients through increased blood flow by increasing the pulse rate [31].

3.3 Haematological value of goat blood

The results of observing the number of white blood cells (white blood cells), red blood cells (red blood cells), hemoglobin levels and blood hematocrit values of Peanut goats fed with jatropha leaves with different levels and processing methods are listed in Table 4.

The results of statistical analysis of jatropha leaves with different levels and processing methods showed no interaction (P>0.05) on the number of white blood cells, red blood cell counts, hemoglobin levels and hematocrit values of goat blood. Provision of jatropha leaves with different levels had a significant effect (P<0.05) on the number of white blood cells, red blood cell count, hemoglobin level and hematocrit value of goat blood. The method of processing red jatropha leaves gives a real influence (P<0.05) on the number of white blood cells, the number of red blood cells, hemoglobin levels and the blood hematocrit value of goats.

The number of white blood cells from the results of this study was 8.33-13.91 thousand/mm^3, lower than the measurement of white goat's blood cells by the study [32] in the amount of 19.81±5.75 thousand/mm^3. Still, it is in the range of research results from the study [33] which ranged between 6-16 thousand/mm^3. The number of white blood cells in livestock is influenced by several factors including the response of animals to foreign bodies or conditions of animals that are sick. The results of this study indicate that white blood cells increase along with increasing levels of castor leaf administration, likewise goats that are given jatropha leaves have higher white blood cell counts compared to the number of goats' white blood cells that were given fermented jatropha leaves. This is possible due to the response of goats to the antinutrient content in jatropha leaves such as tannins and saponins. An increase or decrease in the level of white blood cells in the blood circulation can be indicated as the presence of inflammatory disease agents and allergic reactions. Therefore, it is necessary to know the normal picture of white blood cells in each individual [34].

The number of red blood cells obtained from this study was 9.00-13.67 million/mm^3 which is still in the normal range of

goat red blood cells. The number of red blood cells obtained in the results of this study showed an increase along with the increasing level of jatropha leaf that was given. Likewise, the provision of fermented jatropha leaves had a higher number of red blood cells compared to the number of goat red blood cells fed with jatropha leaves. This is closely related to the nutritional content in castor leaf which is related to the formation of red blood cells. Variations in the number of erythrocytes in female goat nuts are generally influenced by the physiological conditions of each goat. Physiological conditions in animals can be influenced by several factors such as environmental temperature, maintenance management, feed quality and body fluid balance [35]. Also states that differences in the number of erythrocytes can be influenced by the production of the hormone erythropoietin. Erythropoietin is a humoral regulator of erythropoiesis produced by the kidneys. Erythropoietin production in the body depends on tissue oxygen pressure [36].

The levels of goat hemoglobin from the results of this study ranged from 9.33 to 13.67g/dL. These results were higher compared to the research results of Mhlomi et al. [37] who obtained an average level of hemoglobin in female pea goats of 8.4g/dL. [38] results amounted 9.09g/dL and 8.7g/dL. The research results show increased hemoglobin levels with increasing levels of the provision of red jatropha leaves. Likewise, the goats that were given fermented jatropha leaves showed higher hemoglobin levels compared to the hemoglobin levels of goats fed with immersed red jatropha leaves. High hemoglobin levels are caused by the influence of the quality and quantity of feed given to the formation of hemoglobin. The results of the proximate analysis of the soaked red jatropha leaves showed they have lower quality compared to those that were fermented (Table 1). Thus, the higher level of fermented jatropha leaf that is given, the higher the quality of the ration will be. Bata et al. [39] stated in the results of his research that buffalo fed with high concentrates will show higher hemoglobin levels.

The hematocrit value of goats from the results of this study ranged from 21.63 to 31.33%, almost the same as the results by Garba et al. [40] who obtained an average hematocrit score of 22.3%. Obtained a hematocrit value of 28.58%, higher than [41], a hematocrit value of 15.32% [42]. The research results indicate that hematocrit value increases with increasing levels of red jatropha leaf that is given. Likewise, goats that are given fermented jatropha leaves show a higher hematocrit value than the hematocrit value of goats that are given red jatropha leaf. The difference in hematocrit value is influenced by several factors including the nutrient content in feed, especially protein, minerals and vitamins that are necessary to maintain normality and hematocrit values [43]. Hematocrit value has a very close relationship with the number of erythrocytes. A decrease in the number of erythrocytes is generally followed by a decrease in hematocrit value.

4. CONCLUSIONS

There is an interaction between the level of administration with the method of processing red jatropha leaves on body weight gain, consumption of dry matter and consumption of crude protein ration. However, there is no interaction with the efficiency of using dry ingredients ration, efficient use of protein ration, physiological status (body temperature, respiration and pulsus frequency) and haematological values (white blood cell count, red blood cell count, hemoglobin level, hematocrit value) of goats.

The method of processing red jatropha leaves influences the administration of the method of processing red jatropha leaves on body weight gain, consumption of dry matter and consumption of crude protein ration, body temperature, pulsus frequency and haematological value (white blood cell count, red blood cell count, hemoglobin level, hematocrit value) of goats. Nevertheless, it did not have an effect on the efficiency of the use of dry matter, the efficient use of protein ration and the frequency of the Nuts goat's respiration.

The level of jatropha leaf influences the body weight gain, consumption of dry matter and consumption of crude protein ration, efficient use of dry ingredients, body temperature, and hematological value (white blood cell count, red blood cell count, hemoglobin level, hematocrit value) of goats. However, it does not have an effect on the efficient use of dietary protein, respiration frequency, and pulsus frequency of nuts goats.

Further research is needed with production performance parameters, physiological status and hematological values of nut goats with different age classes so that accurate information can be obtained for the development of nut goats livestock.

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