Jurnal Sain Peternakan Indonesia
Available at https://ejournal.unib.ac.id/index.php/jspi/index
DOI: https://doi.org/10.31186/jspi.id.19.3.124-131
P-ISSN 1978-3000
E-ISSN 2528-7109
Volume 19 Issue 3 July-September 2024

Effect of Giving Moringa Leaf Infusion (Moringa oleifera) in Triggering Puberty in Peranakan Etawa (PE) Goats

Salmin[1], H. Sukoco[2], N. S. Said[2], Rahmawati[2], Awaluddin[1], A. Malewa[1], and R. Y. Tantu[1]

[1]Department of Animal Husbandry, Faculty of Animal Husbandry and Fisheries, Tadulako University
[2]Department of Animal Husbandry, Faculty of Animal Husbandry and Fisheries, Universitas Sulawesi Barat, Jl. Prof. Dr. Baharuddin Lopa, S.H., Baurung, East Banggae, Majene Regency, West Sulawesi
Corresponding Author: salmin.bouato@gmail.com
Revised: 2024-10-08, Accepted: 2024-10-10, Publish: 2024-11-10

ABSTRACT

This study aims to determine the potential benefits of moringa leaf infusion on PE goats' puberty. The research method used a Randomised Group Design, with five treatments and four groups. The observed parameters were puberty or time of first estrus, estrus behaviour, estrus quality, onset, and duration. Analysis in this study used the One-Way ANOVA test followed by Duncan's test to determine the fundamental differences between treatments. The results of the analysis of variance showed that there is a significant effect between treatments ($P < 0.05$) on puberty. Treatment P4 (20%) found the fastest puberty time fastest puberty time was found in treatment P4 (20%), which is at the age of PE goats at about 10.25 months, followed by treatment P3 (15%), which is at the age of PE goats at about 10.50 months. The most extended estrus duration was found in P3 and P4 treatments, 36.50 hours and 36.25 hours, respectively. This study concludes that moringa leaf infusion can significantly affect puberty or the onset of sexually mature symptoms. Giving 20% moringa leaf infusion is the maximum dose that can trigger the onset of puberty. These findings offer hope and optimism for the potential benefits of moringa leaf infusion in managing and developing PE goat farms.

Keywords: Moringa leaf infusion, puberty, PE goats, estrus, reproductive performance

INTRODUCTION

The reproductive performance of livestock is an urgent matter that needs to be considered when developing Peranakan Etawa (PE) goat farms. PE goats belong to a group of small ruminants resulting from a cross between Etawa goats from India and local goats. PE goats have great potential to be developed because they can utilize their meat and milk parts (dual-purpose type). Currently, PE goats have been categorized as part of the pet livestock group because of their large number in several regions in Indonesia (Nuraliah et al., 2023). In addition, PE goats can adapt to the environment quickly and give birth to more than two heads in a pregnancy (Solihati et al., 2021). Goats have several advantages, including a relatively small body, fast-reaching sexual maturity, and easy maintenance. From the management aspect, goat farming is easy and practical, does not require a large area of land, is a relatively small capital investment, is easy to market, and has fast-turning business capital (Measya, 2018). Physiologically, reproductive performance indicates the ability of livestock to produce offspring (Nur Hazizah et al., 2022). According to Hafez, 1993, goat reproduction's low performance and efficiency in the tropics are closely related to several things, such as low fertility, unobserved estrus symptoms, or uncontrolled estrus time, so mating time cannot be determined.

One of the reproductive performance of goats is puberty. Puberty is a physiological criterion of reproduction that must be met by livestock before they can reproduce (Faidiban, 2010). According to Iskandar et al. (2015), puberty in Peranakan Etawa (PE) goats is around 10-12 months, with an average body weight of 18.5 kg. Puberty is the starting point for the active reproductive functions of an animal. The beginning of the functioning of reproductive organs is used as a sign of the start of puberty (Luthfi et al., 2015). Physiologically, puberty is indicated by the first symptoms of estrus being manifested. Symptoms of estrus can be detected through direct observation in the pen by paying attention to the sexual behavior of female goats in approaching and paying attention to males, wagging their tails, rubbing their bodies against the body of the male, walking around the male and kissing the male's genitalia, and finally being silent when ridden by the male (Siregar, 2009). Estrus detection can generally be done by looking at the behaviour of the animal and the state of the vulva or physiological condition of the animal. Other techniques in estrus detection can be done

by using a teaser or looking at records of previous estrus (Widiarso, 2012). Many factors influence the reproductive performance of livestock, including incorrect mating patterns, low knowledge of farmers about detecting estrus, low quality or lack of selectivity in the use of males in natural mating, lack of skill of inseminators, inaccurate implementation of AI, low knowledge of farmers about reproductive management, reproductive disorders, and the environment including feed management (Dwatmadji et al., 2017). Without quality feed, superior livestock cannot reproduce optimally because, in certain feed ingredients, nutrients significantly influence everything from fetal formation and reproductive performance to quality and production levels in livestock.

Moringa (*Moringa oleifera*) is one of the plants in the tropics and subtropics (Cao et al., 2023), which is widely used to feed PE goats. Moringa leaves have complete nutrition: high protein (13-14%) and minerals (11-13%). Moringa leaves also contain calcium (2.9-3%), potassium (1%), and iron (50-80 mg/100 g dried leaves) (Juliani et al., 2008). In addition, moringa leaves are also claimed to be a natural source of several antioxidant compounds, vitamins C and E, beta-carotene, and phytochemical antioxidants from the phenolic group, so that they can protect against free radical attacks (Jusnita et al., 2019). Many studies have reported that Moringa leaves have high antioxidant and anti-microbial properties (Dass et al., 2012). Substances with the highest concentration in Moringa leaves include ascorbic acid, flavonoids, β- sitosterol, iron, calcium, phosphorus, vitamins A, B, and C, and amino acids (Islam et al., 2021).

Flavonoids are a vital and functional element in the physiological activity of reproductive performance. Research conducted by Liu et al. (2019) found that Shicuan bamboo, which contains high levels of flavonoids, can increase estrogen levels in female pandas. Flavonoids are a group of isoflavone compounds that can bind directly to estrogen receptors because they have a chemical structure similar to 17-α estradiol in the body (Primiani et al., 2018). The flavonoid content in moringa leaf extract is part of phytoestrogens that have almost the same activity as the hormone estrogen to recognize and bind to estrogen receptors in organs located in the nucleus and plasma membranes (Balumbi et al., 2021). The intake of phytoestrogen compounds from Moringa leaf extract causes estrogen levels in the blood to increase. It stimulates the hypothalamus to secrete GnRH (Gonadotropin Releasing Factor) so that the anterior pituitary secretes more FSH (Follicle - Stimulating Hormone) to stimulate primary follicles into de Graff follicles, where in the end, the estrogen hormone produced by the de Graff follicles will spur the onset of symptoms of lambing (Russel et al., 2000).

The Infusa method is one extraction method that uses distilled water solvents. This distilled water solvent is a polar active substance obtained from filtering. Filtering in this method can produce maximum extracts. The resulting extract consists of active flavonoids, antioxidants, and polyphenols (Yuliani & Desmira, 2015). The infusion method has a working principle similar to the basic principle of making using the decoction method. Still, the advantage of the infuse method compared to the usual decoction method is that the manufacturing process is more controlled so that the protein does not denature (Brata & Wasih, 2021). The infusion method is an extraction method that is cheap, easy to obtain, non-volatile, and non-flammable (Risfianty & Indrawati, 2020).

Although moringa leaf infusion has relatively high nutrition, its use for animal feed has yet to be widely done to trigger reproductive performance significantly. The specific problem in this case is the unknown time of puberty in PE goats, which is indicated by the manifestation of estrus symptoms. In addition, the pattern of estrus behavior, quality of estrus, the onset of estrus, and duration of estrus are not yet known. This research is vital because moringa leaf infusion has a very high nutritional quality in triggering puberty. In addition, moringa raw materials are easy to obtain and grow widely anywhere, especially in tropical countries such as Indonesia. This research explores the effect of moringa leaf infusion on puberty in PE goats.

MATERIALS AND METHODS

This research was conducted in a community pen in Tandassura Village, Limboro District, Polewali Mandar Regency, West Sulawesi Province. The tools used in this study were a magnetic stirrer hotplate, pot, blender, basin, stirrer, sieve, mercury thermometer, and sonic livestock scales (250 kg x 20 g). The materials used in this study were 7-8 months heifer female PE goats with a healthy body weight of 20-25 kg, moringa leaves, distilled

water, and stage cages. The experimental design was a randomized group Design with five treatments and four groups. Grouping was done based on the initial body weight of the study with the treatment of moringa leaf infusion substitution and concentrate as follows:

P0 = 0% Moringa Leaf Infusion + 100% Concentrate + Forage ad libitum (control)
P1 = 5% Moringa Leaf Infusion + 95% Concentrate + Forage ad libitum
P2 = 10% Moringa Leaf Infusion + 90% Concentrate + Forage ad libitum
P3 = 15% Moringa Leaf Infusion + 85% Concentrate + Forage ad libitum
P4 = 20% Moringa Leaf Infusion + 80% Concentrate + Forage ad libitum

Table 1. Ingredients of the Concentrate

Concentrate Materials	Composition of Concentrate %
Coconut cake	54.00
Fine Powder	33.64
Ground Corn	12.35

Moringa Leaf Infusa Manufacturing Process

Moringa leaves (*Moringa oleifera*) used in this study are old green to yellowish moringa leaves that were washed using clean water. Moringa leaves were weighed in a ratio of 1:1, as much as 1 kg, and 1 litre of clean water was added. The next step is to blend the moringa leaves and then boil them at 50°C for 30 minutes according to the instructions of Parwata (2016). The results of the decoction were filtered and stored for treatment purposes.

Treatment

During the study, PE goats were given moringa leaf infusion feed (IDK), concentrate, and gamal leaf forage feed. Concentrate feed was shown at 07.00 AM, moringa leaf infusion feed at 11.00 AM, and Gamal leaf forage feed at 16.00 PM. Forage feeding of Gamal leaves was served ad libitum.

Observed Parameters

The parameters observed in this study were the time of first estrus, estrus behavior, estrus quality, the onset of estrus, and duration of estrus.

Table 2. Goat Estrus Assessment Criteria

Criteria	Scoring	Description
Mucosal color	1	The standard mucosal color is pink
	2	The color of the mucosa is redder than normal mucosa/dark pink
	3	The color of the mucosa tends to be reddish
Presence of mucus	1	Normal mucus in the mucosa
	2	Excess mucus, still in the vulva area
	3	Lots of mucus is coming out of the vulva area, and there are traces of dripping around the vulva.
Swelling	1	No swelling
	2	There are more significant changes in shape, and the wrinkles of the vulva begin to become unclear.
	3	The vulva appears enlarged; it looks like a buildup of fluid, and the wrinkles of the vulva are not clear.

Source : (Siregar, 2009)

Data analysis

The puberty and estrus quality data of PE goats obtained were analyzed for diversity using the One-Way ANOVA test, which was continued with the Duncan test, and several parameters were analyzed descriptively.

RESULTS AND DISCUSSION

Puberty or Time of First Estrus

The average observation of the effect of moringa leaf infusion (Idk) on PE goats on pubertal or the first time of estrus is shown in Table 4. The analysis of variance obtained shows a significant effect between treatments ($P < 0.05$). The fastest time of puberty is found in treatment P4 (20%), which is at the age of PE goats around 10,25 months, followed by treatment P3 (15%), which is at the age of PE goats around 10,50 months.

Table 4. Average observation results of the effect of moringa leaf infusion on PE Goats on puberty, estrus quality, estrus onset, and estrus duration

Treatment	Puberty (month)	Estrus Quality Parameters (criteria score)			Estrus Onset (days)	Duration of Estrus (hours)
		Vulvar Mucosa Colour	Presence of Mucus	Vulvar Swelling		
P0	12.50	2.00	1.25	1.00	117.50	31.50
P1	11.75	2.00	1.25	1.25	110.75	32.25
P2	11.25	2.25	1.75	1.25	109.75	34.25
P3	10.50	2.25	2.00	1.75	100.00	36.50
P4	10.25	2.50	2.25	1.75	94.00	36.25
Total	56.25	11.00	8.50	7.00	532.00	170.75
Average	11.25	2.20	1.70	1.40	106.40	34.15

P0 = 0% Moringa Leaf Infusion + 100% Concentrate + Forage ad libitum (control)
P1 = 5% Moringa Leaf Infusion + 95% Concentrate + Forage ad libitum
P2 = 10% Moringa Leaf Infusion + 90% Concentrate + Forage ad libitum
P3 = 15% Moringa Leaf Infusion + 85% Concentrate + Forage ad libitum
P4 = 20% Moringa Leaf Infusion + 80% Concentrate + Forage ad libitum

Moringa leaf infusion impacted puberty or the onset of sexually mature symptoms significantly. Giving 20% moringa leaf infusion (P4) is the maximum dose that can trigger the onset of puberty. Moringa leaf infusion has been widely proven to have complex nutrients, such as protein in moringa leaves, reaching 27% (Dewi et al., 2011). The content of chemical compounds contained in moringa leaves are ascorbic acid, flavonoids, phenolics, and rubberonoids (Farabi et al., 2023), where the substance with the highest concentration in moringa leaves includes ascorbic acid, flavonoids, β- sitosterol, iron, calcium, phosphorus, vitamins A, B and C, amino acids and others. Flavonoids are a group of isoflavone compounds that can bind directly to estrogen receptors because they have a chemical structure similar to 17-α estradiol in the body. Estrogen hormones play an essential role in puberty, characterized by the start of the estrus cycle and ovulation (Zade & Dinesh, 2014). As raw materials for moringa leaf infusion, Moringa plants contain many nutrients, properties, and benefits, so moringa is nicknamed the Miracle Tree. Moringa leaves contain secondary metabolite compounds, including saponins, phenolics, alkaloids, and tannins. In addition, Moringa leaves also contain natural antioxidant compounds, namely ascorbic acid, phenolics, and carotenoids (Farabi et al., 2023).

Estrus Behavior

The results of the study of estrus behavior based on the criteria of decreased appetite, intense tail movement, and distinctive sounds shown by PE goats are listed in Table 5. The analysis of variance showed that the effect of moringa leaf infusion did not show significant differences between treatments (P>0.05).

Table 5. Estrus behavior based on the criteria of decreased appetite, intense tail movement, and characteristic sounds (%)

Treatment	Decreased Appetite		Intense Tail Wagging		Make a Distinctive Sound	
	Yes	No	Yes	No	Yes	No
P0	50	50	25	75	25	75
P1	50	50	50	50	50	50
P2	25	75	50	50	75	25
P3	25	75	50	50	50	50
P4	25	75	75	25	75	25
Total	175	250	250	250	275	225
Average	35	50	50	50	55	45

P0 = 0% Moringa Leaf Infusion + 100% Concentrate + Forage ad libitum (control)
P1 = 5% Moringa Leaf Infusion + 95% Concentrate + Forage ad libitum
P2 = 10% Moringa Leaf Infusion + 90% Concentrate + Forage ad libitum
P3 = 15% Moringa Leaf Infusion + 85% Concentrate + Forage ad libitum
P4 = 20% Moringa Leaf Infusion + 80% Concentrate + Forage ad libitum

observed in the female reproductive organs are the vulva being red, swollen, warm, and wet or Estrus behavior on the criteria of decreased appetite, the lowest percentage was shown in the P2, P3, and P4 treatments, 25%, while the highest percentage was shown in the P0 and P1 treatments, 50%. In the criteria of moving the tail intensely, the lowest percentage was found in the P0 treatment, which was 20%, while the highest percentage was found in the P4 treatment, which was 75%. Furthermore, in the criteria for making a distinctive sound, the lowest percentage was found in the P0 treatment, 25%, while the highest percentage was found in the P2 and P4 treatments, 75%.

Along with the onset of puberty, there are behavioral changes in PE cattle, such as decreased appetite, intense tail movement, and distinctive sounds. The actual expression of sexual behavior (estrus) only appears when the animal reaches puberty (Sutama & Budiarsana, 2009). Changes in animal behavior during estrus include a slightly swollen vulva, vaginal discharge, reddened vulva, tail movement, and willingness to be ridden by males (Wijayanti & Ardigurnita, 2020). The hormone estrogen physiologically influences these signs and is closely related to fertility. Estrogen levels increase during the estrous phase and decrease 3-4 days after estrus. Animals in estrus become agitated, which is closely related to cortisol levels (Dwi Wijayanti, 2020).

Quality of Estrus

The results of scoring observations of the quality of estrus of PE goats given moringa leaf infusion with the criteria of changes in the color of the vulval mucosa, the presence of mucus on the vulva, and swelling of the vulva are shown in Table 4 columns 3, 4 and 5. The results showed no significant difference (P>0.05) between treatments on the criteria of changes in the color of the vulval mucosa. Still, on the requirements for mucus and swelling of the vulva, there was a significant difference (P<0.05) between treatments.

Regarding the quality of estrus in PE goats on the criteria for changes in the color of the vulval mucosa, the lowest score was found in the P0 and P1 treatments, with a score value of 2, while the highest score was found in the P4 treatment, with a score value of 2.5. A score of 2 to <3 Indicates that the color of the vulval mucosa is redder than normal/dark pink vulval mucosa. In the criteria for the presence of mucus on the vulva, P0 (0%) was not significantly different (P>0.05) from treatment P1 (5%) and P2 (10%), but there was a significant difference with treatment P3 (15%) and P4 (20%). The lowest score was found in treatments P0 and P1, with an average score of 1.25. A score value of 1 to <2 indicates that mucus is standard on the mucosa, while the highest average score is in treatment P4 (2.25) followed by treatment P3 (2.00), a score value of 2 to <3 This indicates that mucus is excessive and still in the vulva area.

In the vulval swelling criterion, P0 (0% Idk) was not significantly different (P>0.05) with treatment P1 (5%) and P2 (10%), but there was a significant difference (P>0.05) with treatment P3 (15%) and P4 (20%). The lowest score was found in the P0 treatment, with an average score of 1.00, and the highest average score was found in the P3 and P4 treatments, with an average score of 1.75. A 1 to <2 score indicates no swelling or slight swelling in the vulva area.

Visual signs of estrus in all treatment groups at the beginning of estrus showed a change in vaginal color to be more red, swollen, warm and slimy, and silent when ridden by males. At the end of estrus, the vagina appeared dry (not slimy), tended to be pink and pale. Experimental female goats in the late estrus phase also refused when approached by males. These symptoms, by the opinion of Anggriawan et al. (2017), changes in animal behavior during estrus show a slightly swollen vulva, vaginal discharge, reddened vulva, tail movement, and willingness to be ridden by males. Symptoms of lust that are usually whether there is mucus coming out, as well as the behavior of female goats that mount other goats or remain silent when mounted on a bully male (Pangestuningrum et al., 2021).

Onset of Estrus

The results of the research onset of estrus of PE goats after the administration of moringa leaf infusion was fastest shown in treatment P4 (20%), followed by the slowest P3 (15%), P2 (10%), P1 (5%) and P0 (0%). Based on the results of the analysis of variance, there was a significant difference (P <0.05) between treatments, namely P0 (100%) was significantly different from the treatments P3 (15%) and P4 (20%) but not significantly different (P>0.05) from the treatments P1 (5%) and P2 (10%). The results of this study indicate that two treatments occur in estrus symptoms simultaneously with good estrus quality. Physiologically, this

phenomenon is very understandable due to an increase in the concentration of estrogen and progesterone in the blood. According to Zade and Dinesh (2014), along with the increase in blood estrogen concentration and ovulation time, estrogen concentration reaches a maximum level so that livestock will experience faster estrus.

Duration of Estrus

The most extended estrus duration was found in P3 and P4 treatments, 36.50 hours and 36.25 hours, respectively. Furthermore, the lowest duration was found in treatments P0, P1, and P2. The data analysis results show no significant difference ($P>0.05$) between treatments. The duration of estrus that occurred in the P3 and P4 treatments may be due to the effectiveness of moringa leaf infusion in influencing the occurrence of estrus due to its complex nutritional content. Usually, the length of estrus in goats is 24-48 hours (Anita et al., 2023). This is according to Mulyono (2011), who states that the estrus cycle of female goats occurs between 20-24 days, with estrus lasting 24-48 hours. In contrast to the opinion of Siregar (2009), which states that in a non-pregnant state, adult female goats always experience periodic estrous cycles with one cycle of 18-21 days and a length of estrous of 24-36 hours.

Duration of estrus is influenced by the presence of estrogen produced by follicles in the ovaries (Handayani et al., 2014). Adult cattle are thought to have a larger ovary size than virgin cattle, so their activity is more optimal for follicle growth. The estrogen produced will be more, so cattle with more than one parity are assumed to it is believed that cattle with more than one parity will have a longer estrus length than virgin cattle and first parity (Puspita et al., 2023).

CONCLUSION

Based on the study's results, it was concluded that Moringa leaf infusion significantly affected puberty or the onset of symptoms of sexual maturity. Giving 20% moringa leaf infusion is the maximum dose that can trigger the onset of puberty. Along with the onset of puberty, there were behavioral changes in PE goats, better estrus quality such as the presence of mucus, vulvar swelling, vaginal discoloration, onset of estrus 94.0 days and duration of estrus 36.25 hours.

REFERENCES

Anggriawan, RP., Utama, S., and Eliyani, H. 2017. The relation of body temperature and vaginal cytology examination in time artificial insemination rate fat-tailed sheep (Ovis aries) in the district Sidoarjo East Java. *In The Veterinary Medicine International Conference. KnE Life Science.* 2017: 642-649.

Astuti, T., Harissatria., Afrini, D. 2020. Penggunaan Pakan Komplit Untuk Sapi Betina Bibit Di Kelurahan Aro Iv Korong, Kota Solok, Sumatera Barat. *9Communnity Development Journal.* 1(3): 459-468.

Cao, J., Shi, T., Wang, M., Zhu, F., Wang, J., Wang, Y., Cao, F., Su, E. 2023. *Moringa oleifera* leaf protein: Extraction, characteristics, and applications. Journal of Food Composition and Analysis. 119: 105234

Balumbi, M., Fachruddin., Risman, M. 2021. Morfometri Ovarium setelah Pemberian Ekstrak Daun Kelor (Moringa oleifera LAM). *Acta Veterinaria Indonesiana*. 9(1): 44-52

Brata, A. and Wasih EA. 2021. Uji efek antipiretik infusa daun sungkai (Peronema canescens) pada mencit putih jantan (Mus musculus). *Riset Informasi Kesehatan*: 10(2): 1-10

Dass, A. K., V. Rajkumar, A. K. Verma, and D. Swarup. (2012). Moringa oleifera Leaves Extract: A Natural Antioxidation in Cooked Goat Meat Patties. *International Journal of Food Science and Technology*. 47: 585-591.

Dwatmadji, Suteky, T., Sutrisno, E. 2017. Reproductive And Feeding Management To Improve The Performance Of Livestock In Tugu Rejo, Kabawetan District Kepahiang Bengkulu. *Jurnal Dharma Raflesia*. 16(1): 29-36

Dewi, RR., Wayuningsih., and Diah, T. 2011. The Estrus Response of Ettawa Crossbreed with Body Condition Score (BCS) 2 and 3 using Controlled Internal Drug Release in Short Period Combined With PGF2á Injection. *Jurnal Kedokteran Hewan*. 5(1): 11-16

Faidiban, OR. 2010. Puberty In Beef Heifers: A Review. Jurnal Ilmu Peternakan. 5(1): 20-27

Farabi, K., Windah AS., and Nisa IH. (2023). Optimasi Pelarut Pada Ekstraksi Senyawa Fenolik Dari Daun Kelor (Moringa oleifera L.) Menggunakan Simplex Lattice Design.*Jurnal Kedokteran Unram*. 12(1):1258-1264

Hafez, ESE. (1993). Artificial Insemination.Reproduction in Fram Animals.6th Ed. Lea dan Febiger, Philadelphia. Pp. 424-439.

Handayani, UF., Hartono, M and Siswanto. 2014. Respon kecepetan timbbulnya estrus dan lama estrus pada Sapi Bali setelah dua kali pemberian prostaglandin F2α (pgf2α). *Jurnal Ilmiah Peternakan Terpadu*. 2 (1): 33-39

Hazizah, N., Rahmatulalh, SN., and Ibrahim. 2022. Reproductive Evaluation Performance of Twin Births Jawarandu Goats in Lempake Village North Samarinda. *Jurnal Ilmiah Peternakan*. 5(2): 85-89.

Iskandar. F., Setiatin, ET., and Sutiyono. 2015. Changes vulva and cervical mucus secretion improvement as indicators in estrus female goats kejobong using the enhanced fertility pituitary extract) pendahuluan kambing kejobong merupakan kambing lokal yang kejobong merupakan kambing lokal yang banyak terdapat di kabupaten purbalingga. *Agromedia*. 33(2):28-34.

Islam Z, Islam SMR, Hossen F, Mahtab-Ul-Islam K, Hasan MR, Karim R. 2021. *Moringa oleifera* is a Prominent Source of Nutrients with Potential Health Benefits. *International Journal of Food Science*. 2021:1-11

Jusnita, N. and Syurya, W. 2019. Characterization of Nanoemulsion from Moringa oleifera' Extract. *Jurnal Sains Farmasi & Klinis*. 6(1): 16–24

Luthfi, M., Trinil, S., and Isnaini, N. 2015. Difference Puberty Velocity Ongole crossbred Bull Candidates on Reared in Different Groups Sex. *J. Ternak Tropika*. 16(2): 07-15

Liu, H., Zhang, C., Liu, Y., Duan, H. 2019. Total flavonoid contents in bamboo diets and reproductive hormones in captive pandas: exploring the potential effects on the female giant panda (Ailuropoda melanoleuca). *Conservation Physiology*. 7: 1-10

Maesya, A. and Rusdiana, S. 2018. Prospek pengembangan usaha ternak kambing dan memacu peningkatan ekonomi peternak. *Jurnal Sosial Ekonomi dan Kebijakan Pertanian*. 07(2).: 136-138.

Mulyono, S. 2011. Teknik Pembibitan : Kambing dan Domba. Penebar Swadaya. Jakarta.

Nuraliah, S., Susanti, IS., Agustina., Dahniar., Suhartina., and Ibrahim, S. 2023. The Effectiveness Of Supplementation Of Moringa Leaf (Moringa Oleifera) Infusion On The Performance Of Etawa Peranakan Goats. *Jurnal Pertanian Agros*. 25(4): 3437-3443

Pangestuningrum, J., Madyawati, SP., Eliyani, H., Damayanti, R., Rochmi, SE. 2021. Etawa Goat Estrus Quality with Estrus Synchronization. *Journal of Applied Veterinary Science and Technology*. 2: 15-21

Parwata, AOMI. 2016. Antioksidan. *Bahan Ajar*. Universitas Udayana. Bali

Priamini, CN., Widianto, J., Rahmawati, W., Chandrakirana, G. 2018. Isoflavones Profile as Phytoestrogens in Various Local Leguminoceae. *Proceeding Biology Education Conference*. 15(1): 704-708

Puspita, AC., Chomsiatun. NH, Mas Yedi. S., Dadang. MS., and Aras, PN. 2023. Respon Onset dan Lama Estrus Kambing Sapera Pada Berbagai Paritas Setelah Sinkronisasi Estrus Dengan Hormon Prostaglandin. Prosiding Seminar Nasional Teknologi dan Agribisnis Peternakan X: "Peningkatan Kapasitas Sumberdaya Peternakan dan Kearifan Lokal untuk Menghadapi Era Society 5.0" Fakultas Peternakan Universitas Jenderal Soedirman, 20.

Risfianty, DK., Indrawati. 2020. Perbedaan Kadar Tanin Pada Infusa Daun Asam Jawa (Tamarindus Indica L.) Dengan Metoda Spektrofotometer Uv-Vis. *Lombok Journal of Science (LJS)*. 2(3): 1-7

Russell KS, Haynes MP, Sinha D, Clerisme E, and Bender JR. 2000. Human vascular endothelial cells contain membrane binding sites for estradiol, which mediate rapid intracellular signaling. *Proceedings of the National Academy of Sciences.* 97(11): 5930-5935.

Siregar, T.N. (2009). Estrogen and Progesterone Profile in Aceh Local Goat Estrous Cycle. *Jurnal Kedokteran Hewan.* 3(2): 240-247

Soetanto, H, E., Marhaeniyanto., and Chuzaemi, S. 2011. Penerapan Teknologi Suplementasi Berbasis Daun Kelor dan Molases pada Peternakan Kambing Rakyat. Buana Sains. 11(1): 25-34

Solihati, N., Rasad, SD., and Prayoga, MAF. 2021. The Effect Of Implant Duration Of Cidr (Controlled Internal Drug Released) On The Size Of Vulvas Changes Of Etawah Crossbreed Goats. Jurnal Produksi Ternak Terapan. 2(2): 70-75

Sutama. I K, and Budiarsana, IGM. 2009. Panduan Lengkap Kambing Dan Domba. Jakarta, Penebar Swadaya.

Widiarso, BP. 2012. Identifikasi Faktor-Faktor Penyebab Kegagalan Inseminasi Buatan Pada Sapi Limosin Dalam Mendukung Swasembada Daging Di Kecamatan Tegalrejo, Kabupaten Magelang. *Jurnal Program Studi Kedokteran Hewan Universitas Wijaya Kusuma Surabaya (UWKS).* 3(3): 8-14

Wijayanti, D., and Ardigurnita, F. (2020). Effects Of Parijoto (Medinilla speciosa) Fruit Extract In Body Temperature, Respiratory Frequency and Profile Of White Blood Cells On Etawa Crossbred Goat. *Jurnal Agripet*. 20(1), 96–105.

Wijayanti, D., and Ardigurnita, F. 2020. Kualitas Tampilan Vulva dan Tanda-Tanda Berahi pada Kambing Peranakan. *Sains Peternakan*. 18(1): 31-37

Yuliani, NN. and Desmira PD.2015. Uji Aktivitas Antioksidan Infusa Daun Kelor (Moringa oleifera, Lamk) dengan metode 1,1-diphenyl-2-picrylhydrazyl (DPPH). *Jurnal Info Kesehatan*. 14(2): 1060: 1082

Zade, V. and Dinesh, D. 2014. Antifertility Effect of Alcoholic Extract of Moringa oleifera Stem Bark on Estrous Cycle and Estrogenic Activity of Female Albino Rat. American Journal of Advanced Drug Delivery. 3(3): 223-235