Volume: 8 Issues: 55 Special Issue [August, 2023] pp. 119 - 127
Journal of Islamic, Social, Economics and Development (JISED)
eISSN: 0128-1755
Journal website: www.jised.com
DOI: 10.55573/JISED.085511

CHEMICAL COMPOSITION AND FEEDING VALUE OF VEGETABLE WASTES COLLECTED FROM PALU TRADITIONAL MARKETS AS FEED COMPONENT OF RUMINANTS

Marsetyo [1*]
I Wayan Sulendre [2]

[1] Departement of Animal Science, Tadulako University, Palu, Central Sulawesi, Indonesia
Email:marsetyomarsetyo@yahoo.co.uk
[*]Corresponding author
[2] Departement of Animal Science, Tadulako University, Palu, Central Sulawesi, Indonesia
Email: wayanptkutd@gmail.com

Article history

Received date	:	11-6-2023
Revised date	:	12-6-2023
Accepted date	:	25-7-2023
Published date	:	15-8-2023

To cite this document:
Marsetyo, & I Wayan Sulendre. (2023). Chemical composition and feeding value of vegetable wastes collected from palu traditional markets as feed component of ruminants. *Journal of Islamic, Social, Economics and Development (JISED)*, 8 (55), 119 – 127.

Abstract: *Two studies were done to identify chemical content of vegetable waste (VW) from Palu markets (study 1) and to examine the effect of VW level inclusion in the diet on total dry matter intake (DMI), dry matter digestibility (DMD), average daily gain (ADG) and income over feed cost (IOFC) of Kacang goat received with rice bran (RB) (study 2). In study2, there were 4 treatments and 6 replications in a completely randomized block design. The treatment include RB plus corn stover, RB plus CS:VW (80:20), RB plus CS:VW (60:40), RB plus CS:VW (40:60, all are ad libitum.Total VW collected from Palu markets was 46.931 kg/months.Dry matter (DM), organic matter (OM), crude protein (CP), and crude fibre (CF) of VW were variable with the range of 10.32-25.36; 85.33-91.87;2.80-25.85; and 4.23-46.29%, respectively.Goat received RB plus CS:VW (40:60) ad libitum had the highest total DMI,DMD, LWG and IOFC value.It was concluded that VW can be included in goat diet up to 60% with high profitability.*

Keywords: *Vegetable waste, ruminants, intake, digestibility, Palu*

Volume: 8 Issues: 55 Special Issue [August, 2023] pp. 119 - 127
Journal of Islamic, Social, Economics and Development (JISED)
eISSN: 0128-1755
Journal website: www.jised.com
DOI: 10.55573/JISED.085511

Introduction

In raising ruminants in Central Sulawesi, the main problem often faced by farmers is the difficulty of providing forage in a sustainable manner. This is often deteriorated during the long dry season. Finding new feed sources that available locally with low cost such as the use of agricultural byproducts is one way to solve the problem. One of the potential agricultural byproducts that have not been utilized optimally as ruminant feed is vegetable waste (VW) (Vegetables are commonly traded in the traditional market daily, which is often resulted by-products in the form of vegetable scraps that have been rejected and are not suitable for marketing. Every day there are huge amount of VW from the traditional market being dumped in the city of Palu and other cities in Indonesia. Moreover, utilizing VW in animal diets is also a critical strategy to manage waste and environmental problem particularly in the traditional markets. Recycling VW for ruminants is one strategies to minimise food loss and to reduce waste disposal cost (Saenab, 2014; E.C Soto, H.Khelil, M.D. Carro, 2015; Bakshi et al., 2016; Dou et al., 2018) Besides, the utilization of VW can also help the smallholder farmers in finding alternative ruminants feed supply in a sustainable manner.

Despite the abundance of VW availability, there are some challenges to use VW for ruminant feed. The challenges include the cost associated with collection, transport, and handling of VW that may be some smallholder farmers cannot afford. In many situations in which ruminant farm located in close to the source, some of VW, may be provided at little to no cost to livestock farms. In this case, the use of VW for ruminants can reduce feed costs significantly (Wadhwa & Bakshi, 2013).

Chemically, VW contains nutrients (protein, carbohydrates, vitamins and minerals) that can meet the nutritional requirement of ruminants. (Muktiani A.J., Achmadi BIM, Tampoebolon, 2013) reported that VW from traditional market have a CP content of 12.64-23.50% and a CF content of 20.76-29.18%. The ranges of CP content of these VW were higher than some common forages such as elephant grass (*Pennisetum purpureum*) with a CP content of 8.2% (Marsetyo et al., 2012) and corn stover (*Zea mays*) with a CP of 7.4% (Marsetyo et al., 2021).

To be used as animal feed, VW have several limitations, namely high water content (91.56%) which causes vegetables to quickly rot. This condition causes the quality of VW to rapidly decline (Das et al., 2019). Vegetable waste will be useful if it is used as feed through processing. Processing of VW through drying and chopping processes into small pieces is one of the efforts to extend the shelf life and value of feed. Until now, the use of mixed VW in Palu as a component of ruminant feed has not been practiced. A research is needed to identify the type, nutritional value and feeding value of VW in traditional markets of Palu, to be applied to the wider community of farmers.

Materials And Methods

Site, Animal and Experimental design

The study 1 was done in Masomba and Inpres traditional markets in Palu city. Study 2 was conducted at Tadulako University experimental farm, located in Sibalaya village, Sigi District, Central Sulawesi province. Feed composition was analysed at Nutrition Laboratory, Department of Animal Science, Tadulako University.

In study 1, identification of market VW was carried out using a survey method, namely by a) collecting, separating, and weighing market VW based on the type of waste every day for two months, and b) conducting chemical composition analysis in the laboratory.

In study 2, a completely randomized block design was used for the feeding trial with 4 treatments and 6 block/replications. Twenty four 1 year old Kacang goats averaging 18.41 ± 0.46 kg of live weight (W) were used. The goats were belongs to Mr. Ahmad Rivaldi, a goat farmer in Palu. Six goats were allocated to each of the four dietary treatments. They were housed individually in pens with wood floor. At day 1 of adaptation period, the goats were injected with *ivomec* (1 mL/10 kg live weight) to control internal and external parasites. The four dietary treatments include (1) RB plus CS ad libitum (RBCS100) (2) RB plus CS:VW (80:20) ad libitum (3) RB plus CS:VW (60:40) ad libitum (4) RB plus CS:VW (40:60) ad libitum. The experimental period consist of 2 weeks adaptation period followed by 10 weeks for collection period. Water was available to goat at all time.

Experimental diets, feeding and measurement

In study 2, the experimental feeds were consisted of RB, fresh CS and mixed VWs. Rice bran was purchased from rice mill in Sigi district. Corn stover was bought from small-scale farmers in Sigi district after harvested. Mixed VWs were collected from two biggest traditional market in Palu city (Masomba and Inpres) then dried with sun. Both SC and mixed VWs were cut using chopper into length of 5-10 cm before offering to goats. The nutritive value of experimental feed are shown in Table 3.

Rice bran was offered daily at 0700 h. The combination of CS and mixed VW were offered in two similar portions at 0830 and 1600 h. The combination of CS and mixed VW were given ad libitum

The collection period was run for 10 weeks. Feed intake was measured by weighing feed offer and feed refusal every day for 10 weeks. Daily body weight changes each goat were monitored each week during 10 weeks collection period. The digestibility run was conducted for 7 consecutive days on week 10 of collection period. During the digestibility run, total feces production from each goat was weighed. About 10% of the daily feces production was taken, bulked for 7 consecutive days and stored in a freezer (–20°C). At the last day of digestibility measurement, samples of feces taken daily from each goat were mixed thoroughly then sub-sampled and dried in oven at 60°C to reach a constant weight. The determination of DMD was based on the difference in DM content of feed offer and fecal production divided by DM contained in feed offer. ADG was determined the the difference between final weight and initial weight of each animal divided by the number of feeding days. The calculation of income over feed cost (IOFC) was based on the method developed by (Bailey K, Beck T, Cowan E, 2009) by subtracting the income with feed cost with purchased and sale price/kg liveweight of the goat daily.

Chemical analysis

Samples of individual, ground, mixed VWs, feed offer, refusals and feces were analysed in the laboratory to determine their DM, OM, nitrogen, CF content (AOAC, 1990), while the CP content was calculated as nitrogen × 6.25.

Volume: 8 Issues: 55 Special Issue [August, 2023] pp. 119 - 127
Journal of Islamic, Social, Economics and Development (JISED)
eISSN: 0128-1755
Journal website: www.jised.com
DOI: 10.55573/JISED.085511

Statistical analysis

In study 1, data collected were calculated on average and followed by descriptive explanation. In study 2, data collected were analysed by analysis of variance using Minitab statistical sotfware. The treatment differences was tested by using Least Significant Difference Test (Stell R.G.D. and Torrie, 1991).

Results And Discussions

Type, quantity and nutritive value of vegetables waste

The type and quantity VW collected from Masomba and Inpres traditional market is presented in Table 1. In both markets there were similar type of VWs collected. However, the total quantity of VWs collected in Inpres market was 2.24 times higher than VWs collected at Masomba market. This is because the Inpres market is the largest vegetable sales center in Palu city which serves all vegetable sales in Palu and its surroundings. It is therefore anticipated that the VWs collected from Inpres market is higher than other markets. There are 10 types of VWs identified in the two largest markets in Palu. *Sechium edule* and *Cucurbita moschata* were the highest and the lowest quantity of VWs collected in Palu markets, respectively. Most of the vegetables sold in the Palu market come from the Napu (Poso district) and Sigi districts. The type of VW collected in Palu relatively similar with VGs found in Samarinda city (Sains et al., 2013), Kupang city (Wea, 2010) and Magelang (Rahayu & Surya Perdana, 2018).

The Chemical composition of each VW type collected in Palu market is presented in Table 2. The composition varied among VWs, with ranged 16.40-25.36% for DM, 85.33-91.87% for OM, 2.80-25.85 for CP and 4.23-46.29%, for CF. This chemical composition indicates that most VWs collected in Palu markets contain medium to high nutritive content that are potential for ruminants feed component. This chemical composition of VWs of Palu market were in the range of chemical composition of VWs in other previous experiments (Wadhwa et al., 2006; Muktiani A.J., Achmadi BIM, Tampoebolon, 2013; Bakshi et al., 2016; Dou et al., 2018).

Table 1: Type and quantity of vegetable wastes collected from Masomba and Inpres traditional markets in Palu city, Central Sulawesi

No	Vegetable waste	Masomba market		Inpres market		Total
		kg/day	kg/month	kg/day	kg/month	kg/month
1	Chayote (*Sechium edule*)	120.30	3609.00	189.40	5682.00	9291.0
2	Cabbage (*Brassica oleracea var. Capitata*)	84.80	2544.00	224.40	6733.20	9277.20
3	Corn husk (*Zea Mays*)	51.80	1554.00	130.70	3920.10	5474.10
4	Purple egg plant (*Solanum melongena*)	46.40	1392.00	78.90	2367.00	3759.00
5	Tomatoes (*Solanum lycopersicum syn*)	36.10	1083.00	88.30	2650.20	3733.20
6	Water spinach (*Ipomoea aquatic*)	29.70	891.00	68.60	2058.00	2949.00
7	Green spinach (*Amaranthus viridis*)	22.00	660.00	49.30	1479.60	2139.60
8	Sweet potato leaves (*Manihot esculenta*)	21.50	645.00	49.50	1486.20	2131.20
9	Chinese cabbage (*Brassica rapa subsp. Pekinensis*)	17.50	525.00	44.50	1335.00	1860.00
10	Red spinach (*Amaranthus tricolor*)	16.10	483.00	32.90	986.70	1469.70
11	Mustard greens (*Brassica chinensis var. Parachinensis*)	14.50	435.00	27.90	836.40	1271.40
12	Green egg plant (*Solanum torvum Sw*)	5.50	165.00	25.40	762.90	927.90
13	Papaya leaf (*Carica papaya*)	4.10	123.00	23.10	692.70	815.70

Volume: 8 Issues: 55 Special Issue [August, 2023] pp. 119 - 127
Journal of Islamic, Social, Economics and Development (JISED)
eISSN: 0128-1755
Journal website: www.jised.com
DOI: 10.55573/JISED.085511

14	Long beans (*Vigna unguiculata*)	2.80	84.00	12.90	386.70	470.70
15	Corn cob (*zea mays*)	3.40	102.00	10.80	323.40	425.40
16	Bean leaf (*Vigna unguiculata*)	1.40	42.00	7.30	219.90	261.90
17	Papaya flower (*Carica papaya*)	1.00	30.00	5.40	163.20	193.20
18	Papaya fruit (*Carica papaya*)	1.20	36.00	4.90	146.70	18.70
19	*Diplazium esculentum*	1.30	39.00	3.90	116.70	155.70
20	Summer squash (*Cucurbita moschata*)	1.20	36.00	3.60	106.80	142.80
Total vegetable wastes collected		**482.60**	**14478.00**	**1081.80**	**32453.40**	**46931.40**

Table 2: Chemical composition of vegetable wastes collected in Masomba and Inpres market Palu city, Central Sulawesi

No	Vegetable waste	Nutrien Content			
		DM* (%)	OM* (%DM)	CP* (%DM)	CF* (%DM)
1	Chayote (*Sechium edule*)	22.30	86.29	3.89	8.27
2	Cabbage (*Brassica oleracea var. Capitata*)	22.24	90.33	19.30	15.59
3	Corn husk (*Zea Mays*)	25.36	89.27	9.22	8.27
4	Purple egg plant (*Solanum melongena*)	19.32	88.11	7.26	6.81
5	Tomatoes (*Solanum lycopersicum syn*)	10.32	85.13	18.56	6.29
6	Water spinach (*Ipomoea aquatic*)	24.55	90.92	14.46	10.00
7	Green spinach (*Amaranthus viridis*)	21.76	89.35	17.39	7.37
8	Sweet potato leaves (*Manihot esculenta*)	20.11	90.43	20.52	5.18
9	Chinese cabbage (*Brassica rapa subsp. Pekinensis*)	20.59	89.48	19.79	6.58
10	Red spinach (*Amaranthus tricolor*)	22.36	88.90	3.45	4.78
11	Mustard greens (*Brassica chinensis var. Parachinensis*)	16.40	91.87	18.44	4.23
12	Green egg plant(*Solanum torvum Sw*)	26.12	91.28	4.76	9.36
13	Papaya leaf (*Carica papaya*)	20.40	88.32	11.83	21.56
14	Long beans (*Vigna unguiculata*)	16.69	87.90	3.78	13.39
15	Corn cob (*zea mays*)	19.11	90.00	2.80	32.70
16	Bean leaf (*Vigna unguiculata sp.*)	18.45	86.39	8.93	4.31
17	Papaya flower (*Carica papaya*)	19.22	88.78	16.28	15.42
18	Papaya fruit (*Carica papaya*)	20.31	85.33	25.85	18.52
19	*Diplazium esculentum*	18.20	87.04	18.73	14.25
20	Summer squash (*Cucurbita moschata*)	17.86	86.21	22.14	16.77

*DM = dry matter, * OM = organic matter, * CP = crude protein, CF =crude fibre

Nutrition content of feeds in study 2

The nutrition content of the feedstuffs used in study 2 is shown in Table 3. The DM and CP content of CS was the lowest as this feed was given in the fresh form, while the DM content of RB and mixed VG are relatively similar and higher than that of CS. Mixed VW had the highest CP content. In addition, CS contained the highest CF, while RB had the lowest one.

Table 3: Chemic of feed offered to experimental goat in study 2

Feedstuffs	DM (%)*	OM (% DM)*	CP (% DM)*	CF (% DM)*
Rice bran	90.43	91.08	12.80	10.42
Corn stover	25.68	88.63	7.46	20.18
Mixed vegetable waste	88.75	90.16	14.52	13.46

*DM = dry matter, * OM = organic matter, * CP = crude protein, * CF = crude fibre

Volume: 8 Issues: 55 Special Issue [August, 2023] pp. 119 - 127
Journal of Islamic, Social, Economics and Development (JISED)
eISSN: 0128-1755
Journal website: www.jised.com
DOI: 10.55573/JISED.085511

The effect of increasing substitution of vegetable waste to corn stover on intake, digestibility, growth and income over feed cost of Kacang goat given rice bran

Data of RB, mixed VW DMI, total DMI, DMD, ADG and IOFC of Kacang goat received increasing level of VW inclusion as basal diet are presented in Table 4. All of RB were almost completely eaten by the treated animals. Increasing proportion of mixed VW in the diet lifted up significantly (P<0.05) total DMI, DMD, ADG and IOFC. Goats received RBCS100 and RB plus CS:VW (40:60) ad libitum had the lowest and highest total DMI, DMD, ADG and IOFC, respectively. Increasing total DMI in associated with increasing the proportion of VW as basal diet was due to physical properties and CP content of mixed VW. Physically mixed VW is easily degraded by rumen microbes because of its low crude fiber content. This causes the duration period of VW in the rumen to be relatively short so that it can stimulate the goat to eat more. Many authors noted that the consumption of feed by ruminants is related to many factors, such as texture, other physical properties of the feed (Poppi, D.P., France, J. and McLennan, 2000; Park, J.H., S.J. Kim., N.Y. Kim., S.Y. Jang., J.W. Leo., Y.S. Yun., 2018).

The DMD of Kacang goat given RB plus CS substituted with increasing mixed VW are shown in Table 4. Increasing substitution of VW to CS lifted up significantly ($P < 0.05$) DMD of goat fed RB. Goat treated with RBCS100 and RB plus CS:VW (40:60) ad libitum had the highest (P<0.05) DMD. The increase in DMD was due to increased CP intake (Table 4) as a result of increased VW intake. Increased CP intake has been reported to enhanced microbial activity in the rumen. This argument is in agreement with previous studies (Poppi, D.P., France, J. and McLennan, 2000; Park, J.H., S.J. Kim., N.Y. Kim., S.Y. Jang., J.W. Leo., Y.S. Yun., 2018). These authors documented that addition of rich nitrogen feed increased feed digestibility. In addition, goats received higher proportion of VW had relatively higher digestibility of the feed, which had less CF, and thus replaced the less digestible CS.

Kacang goat consuming the basal diet CS as single basal feed demonstrated the lowest ADG (32.56 g/day). Corn stover is common diets offered by goat farmers across Central Sulawesi. In Palu and Sigi districts, corn famers commonly harvested their corn at younger age to meet corn demand for human consumption. Therefore quality of the stover is still medium. The ADG response of goats to increasing substitution of mixed VW up to 60% for Kacang goat is shown in Table 4. It appears that there was trend in increase of ADG in association with increasing level of mixed VW intake.

The low ADG of Kacang goat given RB plus CS:VW (100:0) in the current study (32.56 g/day) is in the range of previous studies. Adiwinarti et al., (2016) for example, reported that ADG of Kacang goat given native grass was only 27.22 g/day. These authors noted that by addition of fish meal supplement to Kacang goat, their ADG increased to 59.03 g/day. This suggested that addition protein source to the diet can increase the ADG of Kacang goat Protein in feed can stimulate rumen microbes to synthesize microbial proteins which can be absorbed in the small intestine. This phenomenon is then followed by an increase in the growth of goats

The IOFC in the current study increased significantly (P<0.05) in association with increasing consumption of mixed VW of Kacang goat (Table 4). The highest IOFC was found in Kacang goat received RB plus CS:VW (40:60) ad libitum with value of IDR 1227/day. This finding suggested that the use of a combination of high ME feed from RB and high protein from mixed VW would be very profitable for goat farmers in Central Sulawesi. This finding suggest that farmers need to plan for a fattening using this feed combination containing mixed VW as the basal diet.

Table 4: Effect of increasing substitution of vegetable waste (VW) to corn stover on total dry matter intake (DMI), dry matter digestibility (DMD), average daily gain and income over feed cost of Kacang goat given rice bran

Parameters	Dietary treatments			
	RB+CS:VW (100:0)*	RB+CS:VW (80:20)*	RB+CS:VW (60:40)*	RB+CS:VW (40:60)*
Rice bran DMI (kg/d)	0.09 ± 0.03	0.09 ± 0.04	0.09 ± 0.03	0.09 ± 0.04
Rice bran DMI (%W/day)	0.48 ± 0.04	0.50 ± 0.05	0.49 ± 0.05	0.49 ± 0.05
Corn stover DMI (kg/d)	0.42 ± 0.14	0.35 ± 0.09	0.32 ± 0.13	0.22 ± 0.08
Corn stover DMI (%W/day)	2.24 ± 0.29	1.95 ± 0.03	1.73 ± 0.27	1.19 ± 0.23
Vegetable waste DMI (kg/d)	0.00 ± 0.00	0.09 ± 0.08	0.19 ± 0.09	0.33 ± 0.09
Vegetable waste DMI (%W/day)	0.00 ± 0.00	0.50 ± 0.08	1.03 ± 0.56	1.79 ± 0.28
Total DMI (kg/d)	0.50 ± 0.15	0.52 ± 0.12	0.59 ± 0.17	0.64 ± 0.1
Total DMI (%W/day	2.72 ± 0.53[a]	2.95 ± 0.42[b]	3.24 ± 0.22[c]	3.47 ± 0.26[d]
DMD (%)	56.23 ± 0.53[a]	59,82 ± 0.73[b]	62.47 ± 0.84[c]	65.21 ± 0.42[d]
Average daily gain (g/day)	32.56 ± 0.35[a]	37.75 ± 0.40[b]	44.81 ± 0.58[c]	53.52 ± 0.51[d]
Income over feed cost (Indonesian rupiah (IDR/day))	495.14 ± 59.43[a]	711.66 ± 25.25[b]	930.30 ± 52.93[c]	1266.71 ± 57.53[d]

*RB+CS:VW (100:0) = rice bran plus corn stover ad libitum, RB+CS:VW (80:20) = rice bran plus corn stover:mixed vegetable waste (80:20) ad libitum, RB+CS:VW (60:20) = rice bran plus corn stover:mixed vegetable waste (60:40) ad libitum, RB+CS:VW (40:60) = rice bran plus corn stover:mixed vegetable waste 40:60) ad libitum

In general, this study suggests the significancy of utilizing VW as ruminant feed. There are at least two advantages to using VW as animal feed. The first is to reduce the level of environmental pollution. The second is to find the solution of feed shortage for goats especially during dry season. This study has proven that VW can nutritionally meet the needs of goats for production and can economically increase farmer income.

Conclusions

It was concluded there were 20 VW type collected from Palu traditional markets. The vegetables wastes contained high nutrient content which is potentially as sources of ruminant feed. The substitution of VW up to 60% as basal feed resulted in a significant increase in total DMI, DMD, ADG and IOFC of goat received corn stover and rice bran.

Acknowledgments

An appreciation was directed to the Ministry of Education, Culture, Research and Technology of the Republic of Indonesia through Applied Research Scheme, for financial support of this study. The authors also appreciate to Mr. Ahmad Rivaldy for providing the goats for the experiment.

References

Adiwinarti, R., Kustantinah, Budisatria, I. G. S., Rusman, & Indarto, E. (2016). Improving the performance of local kacang goats using ruminally undegradable protein feeds. *Asian Journal of Animal Sciences*, *10*(4–5), 262–267. https://doi.org/10.3923/ajas.2016.262.267

AOAC. (1990). *Official methods of analysis*.

Bailey K, Beck T, Cowan E, I. V. (2009). *Dairy risk-management education: managing income over feed costs. In 'Agricultural communications and marketing*. https://doi.org/10.3390/ani9100769

Bakshi, M. P. S., Wadhwa, M., & Makkar, H. P. S. (2016). Waste to worth: Vegetable wastes as animal feed. In *CAB Reviews: Perspectives in Agriculture, Veterinary Science, Nutrition* *and Natural Resources* (Vol. 11). CABI International. https://doi.org/10.1079/PAVSNNR201611012

Das, N. G., Huque, K. S., Amanullah, S. M., & Makkar, H. P. S. (2019). Feeding of processed vegetable wastes to bulls and its potential environmental benefit. *Animal Nutrition*, *5*(1), 87–94. https://doi.org/10.1016/j.aninu.2018.04.002

Dou, Z., Toth, J. D., & Westendorf, M. L. (2018). Food waste for livestock feeding: Feasibility, safety, and sustainability implications. In *Global Food Security* (Vol. 17, pp. 154–161). Elsevier B.V. https://doi.org/10.1016/j.gfs.2017.12.003

E.C Soto, H.Khelil, M.D. Carro, D. R. Y.-R. and E. N.-A. (2015). Use of tomato and cucumber waste fruits in goat diets: effects on rumen fermentation and microbial communities in 20 CAB Reviews. *Journal of Agricultural Science*, *153*(3), 43–52.

Marsetyo, Damry, Quigley, S. P., McLennan, S. R., & Poppi, D. P. (2012). Liveweight gain and feed intake of weaned Bali cattle fed a range of diets in Central Sulawesi, Indonesia. *Animal Production Science*, *52*(7), 630–635. https://doi.org/10.1071/AN11285

Marsetyo, Sulendre, I. W., Takdir, M., Harper, K. J., & Poppi, D. P. (2021). Formulating diets based on whole cassava tuber (Manihot esculenta) and gliricidia (Gliricidia sepium) increased feed intake, liveweight gain and income over feed cost of Ongole and Bali bulls fed low quality forage in Central Sulawesi, Indonesia. *Animal Production Science*, *61*(8), 761–769. https://doi.org/10.1071/AN20297

Muktiani A.J., Achmadi BIM, Tampoebolon, S. R. (2013). Pemberian silase limbah sayuran yang disuplementasi dengan mineral dan alginat sebagai pakan domba. *Jurnal Pengembangan Peternakan Tropis.*, *2*, 144–150.

Park, J.H., S.J. Kim., N.Y. Kim., S.Y. Jang., J.W. Leo., Y.S. Yun., S. H. M. (2018). Effects of dietary crude protein levels on intake, digestibility, and crude protein balance of growing Korean native goats (Capra Hircus Coreanae). *J Anim Plant Sci.*, *28*, 981–988. https://doi.org/10.24843/soca.2019.v13.i03.p08

Poppi, D.P., France, J. and McLennan, S. R. (2000). Intake, passage and digestibility. In : Feeding Systems and Feed Evaluation Models. Theodorou, M.K. and France, J. (eds.). CAB International, Wallingford, UK. *Cab International*. https://journal.ipb.ac.id/index.php/pim/article/download/30391/19577%0Ahttps://scholar.google.com/scholar?qrelated:cts6_whpXDwJ:scholar.google.com/ scioqsource:%22jurnal+pusat+inovasi+masyarakat%22+source:pim -hlen -as_sdt2007 -as_ylo2016 -as_yhi202

Rahayu, A., & Surya Perdana, A. (2018). Analisis Jenis-Jenis Limbah Pasar Sebagai Pakan Ternak Di Kota Magelang. *Prosiding Seminar Teknologi Dan Agribisnis Peternakan VI*, *2010*, 297–301.

Saenab, I. A. (2014). Menuju Swasembada Daging Sapi 2014 Sebagai Pakan Ternak Ruminasia di Dki Jakarta. *Publikasi Budidaya Ternak Ruminansia*, 1–6.

Sains, J., Lingkungan, T., Rahayu, D. E., & Sukmono, Y. (2013). *Kajian Potensi Pemanfaatan Sampah Organik Pasar berdasarkan Karakteristiknya (Studi Kasus Pasar Segiri Kota Samarinda)*. *5*(2), 77–90.

Stell R.G.D. and Torrie, J. H. (1991). *Principles and Procedure of Statistics, a Biometrical Approach*.

Wadhwa, M., & Bakshi, S. P. M. (2013). Utilization of fruit and vegetable wastes as livestock feed and as substrates for generation of other value-added products. *RAP Publication 2013-04 (FAO)*, *April*, 67. http://www.fao.org.webtranslate widget.systransoft.com/docrep/018/i3273e/i3273e.pdf

Wadhwa, M., Kaushal, S., & Bakshi, M. P. S. (2006). Nutritive evaluation of vegetable wastes as complete feed for goat bucks. *Small Ruminant Research*, *64*(3), 279–284. https://doi.org/10.1016/j.smallrumres.2005.05.017

Wea, R. (2010). Identifikasi Limbah Organik Pasar Sebagai Pakan Ternak Babi. *Partner*, *17*(1), 23–32.