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Potential of Market Vegetable Waste as Animal Feed in Greater Malang

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ABSTRACT

This study aims to determine the potential of vegetable waste as animal feed from various traditional markets in the city of Malang. This research is descriptive and experimental. The descriptive method is used to overview the diversity, the amount of availability of various vegetable waste for each season, the type of vegetable waste that dominates the market that is suitable for livestock consumption, and the nutritional value of vegetable waste. The experimental research method used a randomized block design ANOVA with an accuracy of 1% to determine the chemical quality of vegetable waste that dominates several markets and the chemical quality of vegetable waste based on shelf life with observations of 0, 2, 4, and 6 days of storage. The results showed that the accumulation of vegetable waste per day in the selected market was 3774.76 kg in dry matter, equivalent to meeting the consumption needs of 308.14 ruminant units. The conclusion is that the nutritional value of vegetable waste from the market is the same as the nutritional value of elephant grass from DM, OM, CP, DMD, and OMD. Vegetable waste from the market easily loses its nutritional value as a result of the decay process.

1. Introduction

Traditional market organic waste is a type of waste or waste generated and collected in the traditional market area that can decompose by itself. So far, the traditional market's organic waste has become a source of problems to achieve public hygiene and health. In addition to polluting the environment, vegetable waste which has the characteristics of rapidly decaying causes environmental pollution in the form of an unpleasant odor. Solid organic waste is a problem almost all over the world so it requires proper management to avoid negative effects such as harming human health, wasteful use of natural resources, reducing the environmental burdens and preserving ecosystems [1]. Disposal of foodstuffs such as fruit and vegetables are a major threat to the world [2]. There is a loss of about 1.3 billion tons of vegetables and fruits every year [3]. Loss of food in the form of waste can be avoided by processed them into animal feed. Sources of fodder consist of two types, namely forage and concentrate. Traditional market waste in the form of vegetable residue has the potential as a source of forage or forage fiber for ruminants. Nonetheless, provision of vegetable waste to ruminants needs to be considered in terms of quality and quantity.

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Ruminants have a characteristic because they have microbes in the rumen so that they are able to utilize forages including non-conventional forages such as market waste as main feed which is easily available and cheap. Therefore, as the amount of forage from the market increases simultaneously with the number of livestock increases and as conventional forage shrinks due to reduced rainfall or dry season, forage from the market can be a substitute for ruminant forage. The continuity of forage utilization sources need to be considered [4]. The problem of using forage in the form of grass and legumes generally fluctuates depending on the season.

The rainy season produces abundant forage while in the dry season there is often a shortage of feed so that alternatives are needed to support livestock production. The low availability of feed in an area is one of the triggering factors for failure in the development of productivity and livestock population in the area. This is due to the low supply of feed that is not in accordance with the number of livestock populations while the type of feed that is needed by livestock is forage. Provision and feeding are the important success factors for livestock productivity. In smallholder farms, especially for farmers who keep livestock in cages, the majority of feed is given in the form of natural grass that grows in pastures, public fields, paddy fields, gardens, and along riverbanks, without the fertilization process that can grow quality grass.

Currently, the development of animal protein supply from broilers needs attention because the success and progress of livestock farming is highly dependent on forage productivity. Forage is the main feed for livestock, especially ruminants. However, it is known that forage productivity is seasonal, during the rainy season forage is abundant, but in the dry season it is very little or no so that livestock can experience a decrease in productivity. To overcome this problem, it is necessary to find alternative feed alternatives for forage in the dry season and when feed is lacking. Scarcity of feed needs on the island of Java because most of the land is used for community settlements. There is a change in function from agricultural land to non-agricultural land. Therefore, there is limited land for planting vegetable feed sources. The solution that can be done is to take advantage of unproductive land that should be used as a vegetable feed crop field. One alternative to overcome the shortage of feed ingredients is the use of market vegetable waste. Market waste contains various organic wastes commonly used as feed in the form of agricultural waste such as vegetables, fruits and leaves as well as fishery and livestock products. The proper way to manage the collection of market vegetable waste as feed is to take it directly from every trader who has collected vegetable waste. The vegetable waste has potential as animal feed in terms of safety, feasibility and nutritional safety as well as environmental evaluation [5].

The technology used for making vegetable waste into animal feed is drying using an oven, microwave and burning. The same result was also found [6] in the vegetable waste in the special area of Yogyakarta that contains protein (>20%), fiber (<30%) and heavy metal concentrations that can still be tolerated for ruminants because they were below the maximum limit. Vegetable waste such as peas, tomato pomace, cabbage leaves have high protein and energy content of more than 20% [7]. Meanwhile, carrot pulp and jackfruit waste have crude protein content below 10%. Vegetable waste has high palatability. However, it should be noted that the use of vegetable waste comprises of pesticide contaminants and pesticide residues as well as high water content, heavy metals, antinutrients and mycotoxins. Some of these problems can be overcome by several commercial technologies including drying and ensiling. This study aims to determine the potential of vegetable waste in the Central Market of Gadang, the Central Market of Kedung Kandang and the Central Market of the Karangploso Region, Malang. The results obtained as a consideration for the use of traditional market vegetable waste as feed ingredients.

2. Method

The research used descriptive and experimental methods. The descriptive method is used to overview of the diversity, the amount of availability of various vegetable wastes each season, the type of vegetable waste that dominates the market that is suitable for livestock consumption, the nutritional value of vegetable waste. The experimental method used a randomized block design ANOVA with an accuracy of 1% to determine the chemical quality of vegetable waste that dominates

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several markets and the chemical quality of vegetable waste based on shelf life with observations of 0.2,4, and 6 days of storage. The study was conducted from April to November 2019. Observations were made 3 times per week. The observations were conducted at several locations including the Gadang Central Market, the Kedung Kandang Central Market and the Karangploso Central Market. The selected waste sample was market waste which was available in all markets and the next step was to determine the type of waste that dominates market vegetable waste up to 95% of the total vegetable waste in the research location. The nutritional value of market waste was compared with the quality of elephant grass (Pennisetum purpureum) then analyzed by unpaired test.

3. Results and Discussion

3.1. Amount of vegetable waste

The use of market vegetable waste as an alternative to forage for animals to provide more forage in the dry season. Limited forage supply in the dry season can have an impact on livestock productivity. The results showed that all types of vegetable waste in all markets contained 14 types of waste (Table 1), the average accumulation of market waste per day at the research site reached 7,316.85 kg or equivalent to 3774.76 kg of dry matter. The daily need for cattle feed is 10% of body weight with details of 60% grass and 40% legumes [8]. Calculation of feed requirements is usually based on dry matter. The dry matter of feed contains all the nutrients. Feed dry matter is defined as weight loss in samples that have been dried in an oven for 12 hours at 100^{o}C [9]

The low availability of feed in an area is one of the triggering factors for failure in the development of productivity and livestock populations in an area, this is due to the low supply of feed that is not in accordance with the number of livestock populations while the type of feed what livestock really need is forage [10]. Ruminants have a characteristic because they have microbes in the rumen so that they are able to utilize forages including non-conventional forages such as market waste as main feed which is easily available and cheap. So along with the increasing number of forages from the market and the increasing number of livestock, when conventional forage shrinks due to reduced rainfall intensity or the dry season, forage from the market can be a substitute for ruminant forage, one of which is market vegetable waste, namely corn husks.

Corn waste management needs to be done because it becomes the dominant waste in some areas [11]. Corn waste, especially the skin, has a large amount but is rarely used, especially the skin part which has been left to rot or be burned [12]. Leaving corn husks becomes a problem because it is difficult to degrade, while burning corn husks causes environmental pollution and health hazards.

Table 1. Types of vegetable waste and amount of availability in the three locations.

No	Types of vegetable waste	Availability per day (kg)			Total
		Gadang Central Market	Kedung Kandang Central Market	Karangploso Central Market	
1	Spinach weevil	4.50	2.56	1.59	8.55
2	kale spinac	6.50	2.08	1.56	10.04
3	Leaves onion	984.0	168.01	30.0	1182.07
4	Leaves onion pre	87.01	4.02	3.54	94.06
5	Leaves broccoli	212.09	2.52	1.53	216.58
6	Leaves celery	16.01	1.53	1.06	18.58
7	peel sprouts	19.53	9.55	3.5	32.57
8	Peel of garlic	7.52	0.25	0.18	7.86
9	Peel of cassava	3.00	0.56	1.09	4.57
10	Peel of pale jackfruit	11.53	6.58	4.55	22.59
11	Peel of lamtoro	1.54	0.59	0.53	2.50

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12	Peel of corn	3392.05	120.01	825.04	4337.09
13	Coconut husk	3.02	1.54	0.57	5.06
14	Shredded cabbage	480.01	365.02	171.05	1376.06
	Amount	5537.03	386.25	1393.62	7316.85

3.2. Availability of vegetable waste suitable for livestock consumption from two seasons

The results of observations on the types and availability of vegetable waste from three central markets in Greater Malang, it is known that the dry season and rainy season in April and November 2019 after being described from the availability are shown in Table 2. The results of the observations stated that corn waste had the largest percentage of the observed markets. From some of the data listed in the table, it is found that corn waste dominates in several markets in the Greater Malang. Meanwhile, if it is seen from the season that the rainy season produces more waste than the dry season in some markets. The large amount of several types of waste in the rainy season is because the rainy season produces more vegetables. The number of vegetables harvested in the dry season is less, therefore it is recommended to grow their own vegetables at home, practice irrigation and increase soil fertility [13]. Dry season is a problem in some farms, especially on sloping agricultural land, this is due to the availability of adequate water and therefore additional costs are needed to purchase fuel for water irrigation [14]. Table 2 shows the types of vegetable waste which are permanent waste at the Gadang central market, Kedung Kandang central market and Karangploso central market, which are suitable for livestock consumption. Other types of vegetable waste just happen by chance.

Table 2. Types and accumulation of average availability from two seasons

No	Types of Vegetable Waste	Average Availability Per Day (kg)			
		Rainy	Dry	Average	%
1	Corn *husk* (*Zea mays*)	4490.25	4183.75	4337.00	58.62
2	Seabed cabbage (*Brassica oleracea*)	1398.50	1353.50	1376.00	18.60
3	Shallots (*Allium ascalonicum*)	1176.50	1187.50	1182.00	15.98
4	Broccoli Leaves (*Brassica chinensis*)	203.25	228.75	216.00	2.92
5	Seek onion (*Allium cepa*)	96.25	91.75	94.00	1.27
6	Mung bean sprouts (*Vigna radiata*)	88.25	88.25	88.25	1.19
7	Seeped celery (*Apium gravedens*)	34.00	31.00	32.50	0.44
8	Garlic Skin (*Allium sativum*)	13.00	21.50	17.25	0.23
9	Spinach weevil *(Amaranthus Sp)*	21.50	11.50	16.50	0.22
10	Spinach (*Ipomea reptans*)	18.75	13.75	16,25	0.22
11	Peanut Skin (*Pisum sativum*)	14.75	16.75	15.75	0.21
12	Lamtoro skin (*Leucaena glauca*)	6.75	6.75	6.75	0.09
	Amount	7561.75	7234.75	7398.25	100.00

3.3. Domination of vegetable waste for animal consumption

The results of the survey are on the type and amount of vegetable waste available for livestock consumption in the market, followed by verification of the mode of emergence of vegetable waste and the level of availability. The results of the verification show that the type of vegetable waste that is always present and its availability dominates until its accumulation is equal to or more than 95% of the average total vegetable waste on the market, presented in Picture 1.

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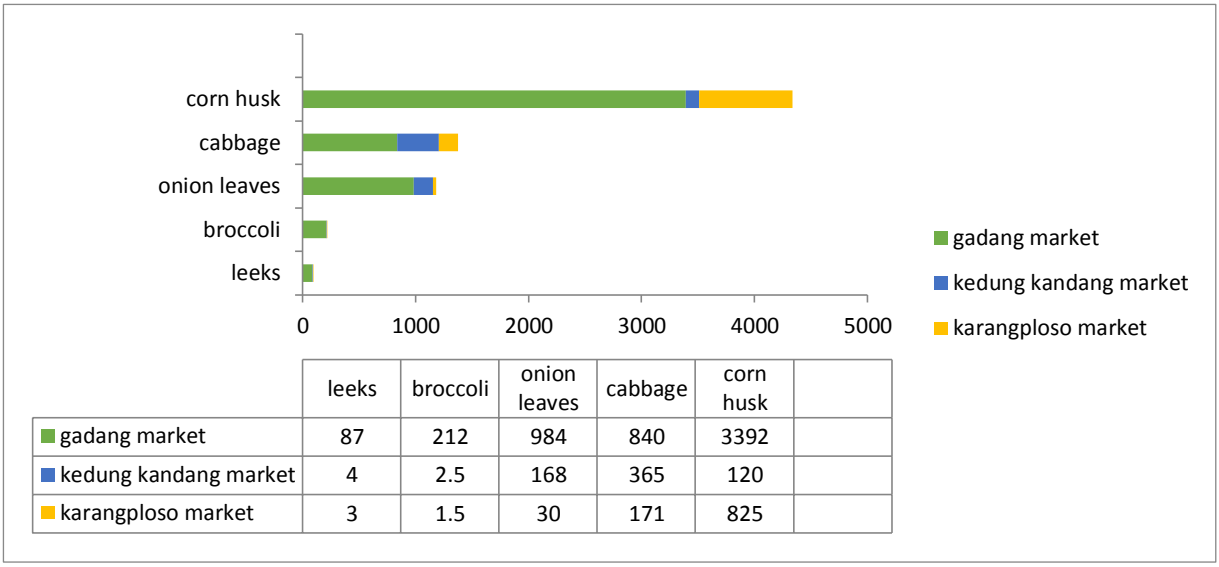

	leeks	broccoli	onion leaves	cabbage	corn husk	
gadang market	87	212	984	840	3392	
kedung kandang market	4	2.5	168	365	120	
karangploso market	3	1.5	30	171	825	

Picture 1 The dominating type of waste and its proportion (kg)

Picture 1 describes the average amount of vegetable waste in a day, equal to or more than 95% of the total waste. The types of waste are 60.20% corn husks, 19.10% grated cabbage, 16.40% red onions, 3.00% broccoli leaves and 1.30% pre-grated onions. If the market waste is to be used as feed, it needs to be processed so that it is free from contamination from other waste, soil, and anti-nutrients. The other market waste process is to be another form such as wafer feed. Market waste can be used as wafers by choosing waste that is not contaminated with soil and other waste. The Gadang market produces more waste than other markets with the largest amount of waste being corn husks. Gadang market is located in a trading center that contributes to local government revenues [15]. Historically, this market was built in 1970 and is one of the largest markets in the Malang area.

3.4. Nutrition Value of Vegetable Waste from the Traditional Markets

The results of measurements are chemical composition and digestibility value of vegetable waste originating from Gadang central market, the Kedung Kandang central market and Karangploso central market are presented in Table 3.

Table 3. The chemical quality of vegetable waste in Gadang Market, Kedung Kandang Market and Karangploso Market .

No	Nutrition Quality	Percentage
1	Dry Matter (DM)	36.26 (%)
2	Organic matter (OM)	84.83 (% DM)
3	Crude Protein (CP)	9.45 (% DM)
4	Crude Fiber (CF)	25.58 (% DM)
5	Crude fat	3.70 (% DM)
6	Nitrogen Free Extract (NFE)	51.01 (% DM)
7	Neutral Detergent Fiber (NDF)	53.90 (% DM)
8	Acid Detergent Fiber (ADF)	34.35 (% DM)
9	Dry Matter Digestibility (DMD)	53.07 (% DM)
10	Organic Matter Digestibility (OMD)	54.33 (% DM)

Source: Laboratory analysis results

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The nutritional value of the five dominant types of vegetable waste in several markets were taken as is. The average value obtained is listed in Table 3. The average value is then compared to the nutritional value of elephant grass (Table 4). From Table, 4 it can be seen that the content of OM, CP, Crude Fat, DMD and OMD in the vegetable waste market are no different from elephant grass. This is due to the characteristics of market vegetable waste which are similar to the characteristics of elephant grass, but the vegetable waste from the traditional market is dominated by young vegetables and smooth leaves. This is the reason why the CF, NDF and ADF are lower than elephant grass. As aged plants have a lot of stress, plants try to balance through the formation of lignin, cellulose and hemicellulose metabolites. Elephant grass contains (DM, % of FM) 14.56, OM (% of DM) 93.86, CP (% of DM) 10.19, EE (% of DM)1.76, NDF (% of DM) 73.74, ADF (% of DM)43.28, NFC (% of DM)13.04, INND (% of DM)1.56, INAD (% of DM)0.34 and LIGNIN (% of DM) 6 34 [16].

The amount of CP in vegetable waste from the market is higher than in elephant grass. The high CP content is determined by the type of vegetables observed. Vegetables dominated by leaf elements have a higher CP content than those dominated by stems, while vegetables dominated by stems have higher CF content than those dominated by leaves. Vegetable market waste consists of broccoli stems and leeks. The waste also consists of leeks, cabbage, broccoli and corn husks. Nonetheless, the stem elements in vegetable market waste come from plants that are cut at a young age. Fiber for ruminants is very important because the concentration of VFA is affected by carbohydrate fermentation in the rumen. Feed plays a role in the presence of the rumen. In the rumen, these microbes can digest forage by producing xylanase and glucans so that they can convert it into VFA [17]. Ruminants use VFA to be used as an energy source for more than 70% [18]. The concentration of VFA is formed from the breakdown process of crude fiber by microbes, Accordingly, the content of CF in feed affects the value of VFA. The characteristics of NDF fiber between forage feed ingredients are different. Therfore, each part of the forage has different fiber content and nutrient value. The quality of the feed is based on the results of the nutritional value analysis carried out in the laboratory.

Table 4. Differences in the average nutritional value of vegetable market waste comparison with elephant grass (*Pennisetum purpureum).*

Nutrition Value	Vegetable waste	Elephant Grass	Notation
DM (%)	36.26 ± 0.03	21.43 ± 0.01	**
OM (% DM)	84.83 ± 0.01	86.00 ± 0.02	Nf
CP(% DM)	9.45 ± 0.01	9.23 ± 0.01	Nf
CF(% DM)	25.58 ± 0.02	33.30 ± 0.04	**
Crude Fat(% DM)	3.70 ± 0.07	3.77 ± 0.02	Nf
NFE (% DM)	51.01 ± 0.04	42.3 ± 0.01	**
NDF (% DM)	53.90 ± 0.01	62.85 ± 0.07	**
ADF (% DM)	34.35 ± 0.02	49.81 ± 0.01	**
DMD (% DM)	53.07 ± 0.07	52.29 ± 0.04	Nf
OMD (% DM)	54.33 ± 0.02	52.73 ± 0.02	Nf

Source: Laboratory analysis results
Note : ** : very significant different
Nf : no significant different

3.5. The chemical quality of vegetable waste based on shelf life

The results of the measurement of the nutritional value of vegetable waste from the market showed that the difference in shelf life treatment could have a significant different on the nutritional value ($P < 0.01$). The nutritional value of vegetable waste from the market has lower content as shelf life increases (Table 5). This is due to the decomposition process by the role of cellulolytic, amylolytic, proteolytic bacteria in synergies either directly or indirectly, converting lactic acid from carbohydrates

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into butyric acid, CO_2 and H_2 disappear and evaporate [18]. Besides, the acid degrades amino acids, protein acids into acetic acid, propionic acid, NH_3 and CO_2 are evaporated [20].

The results of the BNT test showed that the content of OM and CF, NDF and ADF of storage treatment duration of 0 days was not different from the shelf life of 2 days. This can be explained by the calculation of OM measurements including fiber elements. The fiber elements in the material are not directly degraded by cellulolytic bacteria due to the role of lignin on cellulose and hemicellulose. Meanwhile, at the shelf life of 4 days, cellulose and hemicellulose may have started to degrade, because the digestion of cellulose and hemicellulose in the bacterial fermentation process takes time to stretch the lignocellulose bonds. So that, the bacteria can penetrate completely [21]. The length of shelf life has a significant impact on the lignin and hemicellulose content [22].

Table 5. Average nutrition value of vegetable waste from market in different shelf life

Nutrition Value	Notation	0 days	2 days	4 days	6 days
DM (%)	**	53.26 ± 0.05 ^{d}	52.43 ± 0.01 ^{c}	41.69 ± 0.04^{b}	35.61 ± 0.01 ^{a}
OM (%)	**	84.93 ± 0.04^{c}	81.38 ± 0.05 ^{c}	70.03 ± 0.05 ^{b}	63.78 ± 0.05 ^{a}
CP (%)	**	9.45 ± 0.05 ^{c}	8.26 ± 0.04^{bc}	7,78 ± 0.04^{b}	5.53 ± 0.04 ^{a}
CF (%)	**	25.58 ± 0.05 ^{c}	25.33 ± 0.05 ^{c}	24.43 ±0.05 ^{b}	23.11 ± 0.05 ^{a}
Crude Fat (%)	**	3.70 ± 0.04 ^{c}	3.19 ± 0.04^{bc}	3,10 ± 0.01^{b}	1.59 ± 0.01 ^{a}
NDF (%)	**	53,90 ± 0.05 ^{b}	53.55 ±0.01^{b}	52.03 ± 0.04^{a}	50.81 ± 0.05 ^{a}
ADF (%)	**	34,35 ± 0.05 ^{c}	30.04 ± 0.01^{c}	27.78 0.05 ^{b}	23.84 ± 0.05 ^{a}
DMD (%)	Ns	53.07 ± 0.01	53.90 ± 0.05	53.89 ± 0.01	54.03 ± 0.04
OMD (%)	Ns	54.66 ± 0.01	54.17 ± 0.01	54.33 ± 0.01	54.26 ± 0.01

Note: ** : very significant different
ns : no significant different
$^{a-d}$: different on the same row, meaning very different

4. Conclusions

The amount of vegetable waste from Gadang central market, Kedung cage market and Karangploso market is sufficient to meet the consumption needs of 308.14 livestock units. The nutritional value of vegetable waste from the market is the same as the nutritional value of elephant grass from of DM, OM, CP, DMD, and OMD. Vegetable waste from the market is easily decreasing in nutritional value due to the decay process.

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