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Compacted Feed Potency to Minimize Cattle Feed Adaptation Period on The New Introduced Feed

(Kemampuan Pakan Kompak untuk Meminimumkan Masa Adaptasi Sapi dengan Pakan yang Baru Diintroduksi)

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ABSTRACT

Compacted feed such as wafers and pellets is still rarely given to cattle shipping in Indonesia because it requires an adaptation period to the newly introduced feed. This study aimed to observe forage compacted feed potency to minimize the adaptation period of kupang cattle to a new feed with high nutrient content. Two experiments were carried out to observe six feed formulations and four different feed forms. The first experiment was an experiment to determine three of six formulations with the same nutritional content to be tested in the second experiment. The second experiment was to observe four feed forms (wafers, pellets, dry pellets, and cubes) combined with the three best formulations from the first experiment. Six treatments and five replications using 30 cattle and 30 kg of feed were carried out in the first study, while the second one used a randomized factorial design of 4×3 treatments and 5 replications consisting of 60 cattle and 420 kg of feed. The results showed that there was no significant difference between the formulations at the same nutritional level. The highest consumption results were found in the form of wafer followed by cubes, pellets, and dry pellets (P <5%). The conclusion of this study is that the compacted feed in the form of wafers, pellets, and cubes can be used to eliminate the feed adaptation period.

Keywords: feed logistics, compacted feed, kupang cattle, adapting period, feed adaptability

ABSTRAK

Pakan kompak seperti wafer dan pelet jarang diberikan selama pengiriman sapi menggunakan kapal di Indonesia karena membutuhkan masa adaptasi dengan pakan yang baru diintroduksi. Penelitian ini bertujuan mengamati seberapa cepat kemampuan adaptasi sapi kupang dengan pakan kompak hijauan untuk meniadakan masa adaptasi sapi dengan pakan baru yang kandungan nutriennya lebih baik. Dua perlakuan telah dicobakan untuk mengamati enam formulasi pakan dan empat bentuk pakan yang berbeda. Percobaan diawali untuk menentukan tiga dari enam formulasi dengan kandungan nutrisi yang sama untuk diuji pada percobaan kedua. Pada eksperimen kedua dimati empat bentuk pakan (wafer, pelet, pelet kering, dan kubus) yang dikombinasikan dengan tiga formulasi terbaik dari eksperimen pertama. Enam perlakuan dan lima ulangan menggunakan 30 ekor sapi dan 30 kg pakan, sedangkan penelitian kedua menggunakan rancangan faktorial acak lengkap 4×3 perlakuan dan 5 ulangan, yang terdiri atas 60 ekor sapi dan 420 kg pakan. Hasilnya menunjukkan bahwa tidak terdapat perbedaan yang nyata antara formulasi pada tingkat nutrisi yang sama. Hasil konsumsi tertinggi terdapat pada bentuk pakan wafer diikuti dengan kubus, pelet, dan pelet kering (P<0,05). Dapat disimpulkan bahwa pakan kompak dengan bentuk wafer, pelet, dan kubus mampu meniadakan masa adaptasi pakan pada sapi.

Kata kunci: pakan logistik, pakan kompak, sapi kupang, masa adaptasi, daya terima pakan

INTRODUCTION

Cattle shipping from Kupang, NTT (East Nusa Tenggara), to Jakarta needs about five days (Talithania *et al.* 2020). During the shipping, feed management problems were found for the cattle on the ship. Kupang local cattle are commonly shepherded on a vast expanse of pasture (Wirdahayati & Bamualim 1994), so they are not accustomed to eating concentrate. Ruminants do not desire to eat a novel feed that has never been fed (Heazlewood *et al.* 1992). Wet forages such as napier grass are easily fermented inside the ship because the high humidity and temperature environment greatly influence the ship's microbial growth (Malik & Singh 2004). Straw feeding on shipping cattle in Indonesia has been established because it is not easy to be fermented inside the ship and has good feed acceptability on cattle. The problem with straw feeding on cattle is the bulkiness (Herrero *et al.* 2005) because straw has a low density and low nutrient content (Van Soest 2006), so it requires a large feed storage area and nutrients lacking on the voyage. Feed and water deprivation causes a considerable weight loss in shipping cattle (Warris 1990), so cattle are prone

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to stress. Therefore, it is necessary to provide appropriate feed management.

Mostly, cattle need to adapt to the newly introduced feed before being transported by ship because they usually raise their cattle in pastures (extensive forage-based breeding system) and are not familiar with concentrates (MLA 2011). An adaptation period is needed for cattle due to feeding adaptation, fecal and digest composition, ruminal fermentation, and rumen bacterial composition (Machado *et al.* 2016). While in Indonesia, an adaptation period from forage to concentrate feed is rarely applied for individual farmers who want to send their cattle over long distances. Small-holder farmers do not want to spend their money to maintain the feed at the quarantine before being shipped, so they tend to put their cattle directly inside the ship and give hay straw as the only available feed. One solution that can be applied to eliminate the adaptation period in cattle is providing a compacted feed consisting of 100% forage composition. Compacted feed is physically engineered, so it becomes solid and does not utilize an ample space on vehicles (Widjaya *et al.* 2018). The hypothesis is that cattle will consume the compacted feed without any detention because the cattle are already familiar with forage feedstuff.

Compacted forage feeding such as wafer, pellet, dried pellet, and cube are some feed forms that have been observed in this study. Wafer and cube forms are usually used to process forages, while pellet is used for concentrates (Lewis 2013). Before applying the feed directly to the cattle on board, testing the adaptability, palatability, and effectiveness of the compacted forage feed to kupang cattle at the quarantine is necessary. This study aimed to examine the feed adaptability of compacted forage feed on kupang cattle.

MATERIAL AND METHODS

Experiment 1. Cattle consumption on six different feed formulations

The first experiment was conducted for two months, including feed formulation and production, and cattle feeding. The feed was formulated using Excel solver software to find the ideal composition of each feedstuff. The feedstuffs that had been used were hay straw and napier grass as the main energy source and legumes such as leucaena and indigofera as the main protein source. The nutrient requirement of the formulation was settled according to MLA (2011) in Table 1. The formulation and the nutrient content that had been used are given in Table 2 and Table 3.

Feed productions consist of five processes: collecting, chopping, drying, grinding, and mixing. In this experiment, 30 kg of total feed was needed in dried condition. Before the drying, the feedstuffs were chopped to expediting the process. The drying was conducted for one week so that the feedstuffs could be ground. After being ground, the mash form was weighed and mixed according to the six formulations (Table 2).

This experiment was conducted at kupang cattle quarantine in Cibitung, Indonesia, for one day. A Completely Randomized Design of six treatments and five replications was used in this experiment using 30 cattle. Each replication consisted of one cattle given one kg of the treated feed. The parameters observed were feed consumption and duration. The duration was measured by counting the time since the feed was given to the cattle until they finished consuming it. The three best results of the formulation were used in the second experiment. If the results between treatments are not significantly different, the best results are chosen depending on availability, production cost, and handling of feed processing.

Experiment 2. Cattle consumption on three different feed formulations and four feed forms

The feed production processes are similar to the feed production in the first experiment, but there was an addition of the feed forming at the end. Pellet was made by hammer mill pellet machine that used 1 cm (width) and 3 cm (length) die. Dried pellets were made by a roller mill pellet machine with 1 cm die and 3 cm in length. Water was added to the dried pellets manufacturing. After that, the dried pellets were dried in an oven for 24 hours. Wafers were made by a wafer machine that consists of 25 slots, with a size of 7 cm × 7 cm × 10 cm (length × width × height) when inserted. The wafer shrank to a size of 7 cm × 7 cm x 7 cm after being processed. Compaction was carried out using a hydraulic machine to press them until it becomes solid. Each wafer production cycle takes approximately 20 minutes. Cube hay was made by using a manual cube machine with 1 m × 1 × 1 m (length × width × height) in size. Each production cycle of cube takes 10 minutes. The cube was tied by a rope inside the machine with 7 kg of weight for each cube.

The second experiment was conducted for five months, including feed production and cattle feeding. In this experiment, 36 cattle had been used and 240 kg of feed had been made. The cattle were fed *ad libitum* at the shelter, at Cibitung, West Java, Indonesia. Completed Randomized Design with two factors (feed formulation and feed shape) was used in this

Table 1 Nutrient requirements for shipping cattle (MLA 2011)

Nutrient	TDN	Protein	Starch	Ca	P
Requirements	59,62	10,5-12	< 20%	> 0.55%	> 0.25%

Descriptions: TDN = Total digestibility nutrient; Ca = Calcium; and P = Phosphorus.

Table 2 Ration formulation based on dry matter percentage

	T1 (%)	T2 (%)	T3 (%)	T4 (%)	T5 (%)	T6 (%)
Leucaena leaves	30	30	0	0	0	20
Indigofera leaves	0	0	30	30	20	0
Napier Grass	0	10	0	10	0	0
Straw	60	50	60	50	65	65
Cassava dregs	0	0	0	0	5	5
Molasses	10	10	10	10	10	10

Descriptions: T1 = 30% leucaena leaves, 60% straw, 10% molasses; T2 = 30% leucaena leaves, 10% napier grass, 50% straw, 10% molasses; T3 = 30% indigofera leaves, 60% straw, 10% molasses; T4 = 30% indigofera leaves, 10% napier grass, 50% straw, 10% molasses; T5 = 20% indigofera leaves, 65% straw, 5% cassava dregs, 10% molasses; and T6 = 20% leucaena leaves, 65% straw, 5% cassava dregs, 10% molasses.

Table 3 Nutrient content of each rations formulations based on dry matter percentage

	DM (%)	Ash (%)	CP (%)	Fat (%)	CF (%)	Starch (%)	TDN	Ca (%)	P (%)
T1	38.940	13.490	10.144	2.028	25.990	48.370	55.310	0.840	0.252
T2	37.160	13.000	10.598	2.152	25.970	48.240	56.230	0.846	0.258
T3	38.091	14.540	10.135	0.912	26.740	47.182	53.090	0.786	0.459
T4	36.311	14.050	10.589	1.036	26.720	47.052	54.010	0.792	0.465
T5	30.314	11.220	10.970	1.808	26.280	48.998	58.450	0.710	0.428
T6	30.880	10.520	10.976	2.552	25.780	49.790	59.930	0.746	0.290

Descriptions: T1 = 30% leucaena leaves, 60% straw, 10% molasses; T2 = 30% leucaena leaves, 10% napier grass, 50% straw, 10% molasses; T3 = 30% indigofera leaves, 60% straw, 10% molasses; T4 = 30% indigofera leaves, 10% napier grass, 50% straw, 10% molasses; T5 = 20% indigofera leaves, 65% straw, 5% cassava dregs, 10% molasses; T6 = 20% leucaena leaves, 65% straw, 5% cassava dregs, 10% molasses, DM = dry matter; CP = crude protein; CF = crude fiber; TDN = total digestibility nutrient; Ca = Calcium; and P = Phosphorus.

experiment. Cattle had been fed the feed treatments for 10 hours, from 10 am until 8 pm. The parameters observed in this experiment were cattle consumption. At the feeding sites, we made a 1-meter gap between cattle to avoid feed competition by reducing aggressive interactions among them (Shaver 1997).

RESULTS AND DISCUSSION

Experiment 1. Cattle Consumption on Six Different Feed Formulations

The result of the cattle consumption and eating duration on six different formulations are shown in Table 4. The result showed no significant difference ($P>0.05$) from each treatment for cattle total consumption and eating duration. According to O'Driscoll *et al.* (2010), nutrition requirement significantly impacts animal satiety. There could be no significance between treatments because each treatment has a similar nutrient content. Also, Sonneveld (1965) found that dry-matter (DM) intake is positively correlated with herbage DM content at low crude fiber and soluble carbohydrate levels. All treatments contain similar low crude fiber and soluble carbohydrate levels, which also cause no significant effect between treatments. It indicates that all treatments with different formulations do not affect cattle consumption. For further research, we preferred treatments that are high in availability, easily handled, and low cost.

The three best formulations were selected for the following observation. Due to the insignificant result, the chosen formulations were the formulations that consist of feedstuffs that are easy to handle in feed processing, low in production cost, and have high availability. The preferred formulations were treatments 2, 3, and 5. Treatment 2 was the treatment that used 30% leucaena leaves, 10% napier grass, 50% straw, and 10% molasses. This treatment was chosen because there are many available resources on leucaena leaves, napier grass, and agricultural by-products such as straw and molasses in the NTT region (Piggin 2003). Compared to treatment 1, treatment 2 was preferable because there was no addition in napier grass on treatment 1. Even though there is abundant napier grass available in the NTT region, it is not easy to handle in feed processing, especially in the drying treatment, because of its high water content. Napier grass has a higher water content than other forages (Mahyuddin *et al.* 1988). High water content causes napier grass will need a longer time to be dried. Treatment 3 consisted of 30% indigofera, 60% straw, and 10% molasses. This treatment was chosen because indigofera and hay straw is highly available outside the NTT region. Treatment 3 was the case when the feed was produced outside the NTT region. Treatment 5 consisted of 20% indigofera, 65% straw, 5% cassava dregs, and 10% molasses. In this treatment, cassava dregs as concentrate did not make any difference in consumption. The concentrate has higher nutrient content, high availability, low bulkiness, and is easily handled.

Leucaena and indigofera leaves as a legume have a similar physical quality as well as napier grass and straw as grasses (Widjaya *et al*. 2018). In general, indigofera is more preferred than leucaena because of its high availability on Java island, while leucaena is preferred if the production process is conducted in the

NTT region. The same goes for straw and napier grass. Straw is preferred compared to napier grass because high in availability and easily handled. Straw needs three days to be dried, while napier grass needs seven days to be dried in the dry season.

Experiment 2. Cattle Consumption on Three Different Feed Formulations and Four Feed Form

There is a significant effect (P<0.05) that had been found on feed form to cattle consumption, but there is no significant effect (P>0.05) that had been found on feed formulation. The highest consumption is in wafer treatment, followed by cube, pellet, and dried pellet. There is no significant differences between formulation because the nutrition level of the three different formulas was formulated on the same nutrition requirements, including similar low crude fiber and soluble carbohydrate levels. Also, there is no interaction between feed form and formulation. It means that the only treatment affecting feed consumption is the physical quality of feed form (Table 5).

High consumption in wafer is caused by its physical quality. This result is similar to Sellers and Loy (2007) that forage pellets do not have high consumption, while forage wafers have a similar consumption to forage feeding. Forage that is easy to be sheared (break into smaller particle sizes) is consumed higher than forage that is not easy to be sheared (Beauchemin 1991). The physical quality of the forage wafer is easy to break, has a pleasant smell, nice color, and is preferable to grazing cattle. Grazing cattle that had never been given any feed besides forages primarily cannot directly consume a feed that is not familiar to them (Machado *et al*. 2016). Cattle in NTT are raised mainly by grazing system (Wirdahayati & Bamualim 1994), so the cattle are only accustomed to consuming forages. Therefore, feed that has the most similarities to forages is preferable compared to feed that is not similar to forages. Cube form has the highest similarity to forage because it is made from forage without too much forming treatment. Pellet has a lower consumption result than cube and wafer because pellet physical quality is compacted and has a strong bond between feed particles (Thomas & Poel 2020), which is not similar to forages. Forages contain a high water level, are bulky, and have large particle sizes. The dried pellet has a zero-consumption result. This dried pellet has a similar characteristic to a regular pellet made by using a roller pellet. Dried pellet physical quality is dry, dense, and has smaller particle sizes compared to forages. The difference is that the dried pellet has a rough surface than the typical pellet. The natural characteristics of cattle feedstuffs are fibrous, forage-like smell, and the surface is not rough. However, the dried pellet has a rough surface, burnt smell, and lack of fibrous sensation. The results showed that dried pellet is not preferable than the other feed forms.

CONCLUSION

Different formulations of feed composition on the same nutrient level content do not affect kupang cattle feed consumption, while different feed forms affect the total feed consumption. Three preferred formulations (T2, T3, and T5) have been chosen considering their feed availability, feed processing handling, and feed cost. The highest cattle feed consumption was found on wafer feed forms, followed by cube, pellet, and dried pellet. Forage wafer feeding with any formulation on the same nutrient level is the best feed to diminish the adaptation period of cattle that are introduced to a new feed.

Table 4 Cattle consumption and duration from 6 different feed formulations

Treatments	Consumption (g/hours)	Duration (hours)	Duration (minutes)
T1	387.0±63.8	2.64±0.45	158.58±27.04
T2	372.6±106.3	2.90±0.99	174.17±59.17
T3	323.0±83.3	3.30±1.03	198.27±61.68
T4	326.8±78.9	3.20±0.71	191.82±42.55
T5	419.4±58.1	2.42±0.33	145.22±19.60
T6	394.8±60.9	2.58±0.41	154.99±24.65

Descriptions: T1 = 30% leucaena leaves, 60% straw, 10% molasses; T2 = 30% leucaena leaves, 10% napier grass, 50% straw, 10% molasses; T3 = 30% indigofera leaves, 60% straw, 10% molasses; T4 = 30% indigofera leaves, 10% napier grass, 50% straw, 10% molasses; T5 = 20% indigofera leaves, 65% straw, 5% cassava dregs, 10% molasses; T6 = treatment 6 (20% leucaena leaves, 65% straw, 5% cassava dregs, 10% molasses; and Duration = time needed to finish 1 kg of feed.

Table 5 Cattle consumption on three different feed formulations and four different feed forms

	T2 (g)	T3 (g)	T5 (g)	Total (g)
Pellet	1533.33±755.35	1583.33±1953.47	1350.00±736.55	1488.89±1115.16^{c}
Wafer	3950.00±369.51	4416.67±2577.35	4633.33±498.88	4333.33±1359.60^{a}
Dried Pellet	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00^{d}
Cube	2205.00±67.06	3168.00±864.29	2845.84±177.05	2739.61±613.14^{b}
Total (g)	1922.08±1523.67	2292.00±2246.67	2207.29±1842.60	2140.46±1846.30

Descriptions: Different superscripts a,b,c, and d show a significant difference between treatments (P<5%).

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