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Substitution of Papaya Tree Trunks (*Carica Papaya*) as Rough Feed on the Quality of FH Cow Milk

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Abstract: The study aims to determine the effect of papaya tree trunk substitution (Carica papaya) as roughage on the quality of FH cow milk in Boyolali. This study used 16 lactating FH cows with an average body weight of 431.75 + 50.99 kg (CV = 11.82%) and an average milk production per day of 11.12 + 0.96 liters (CV = 8.61%). The average production period of cows is the 2nd lactation period, 2nd to 5th months. The study used a Completely Randomized Design with four treatments and four replications; feed treatments in dry matter were T0: 30% concentrate, 10% tofu dregs, 60% elephant grass, T1: 30% concentrate, 10% tofu dregs, 40% elephant grass, 20% papaya stems, T2: 30% concentrate, 10% tofu dregs, 20% elephant grass, 40% papaya stems, T3: 30% concentrate, 10% tofu dregs, 0% elephant grass, 60% papaya stems. Parameters of milk quality aspects include milk specific gravity, protein content, fat content, lactose, solid non-fat and total solid. This study showed differences in fat content and total solids between T0, T1, T2 and T3, but there was no treatment effect on milk production, Specific gravity, protein content, lactose and SNF milk. This study concludes that using papaya tree trunks as a substitute for fresh greens can maintain the milk productivity of FH cows. Giving 40% papaya tree trunks combined with 20% elephant grass as a roughage produces the same milk production as providing 60% elephant grass.

Keywords: *FH Cow, Papaya Tree Trunk, Milk Quality.*

Introduction

Dairy cattle feed consists of roughage and concentrates as a source of nutrients to produce milk. Roughage, in the form of grass or greens, is the main feed, and concentrate, in the form of agricultural and industrial waste, is formulated into feed that functions as a strengthening/complementary feed. Green feed in the dry season is very limited or lacking, so alternative roughage is needed as a replacement.

Boyolali is one of Indonesia's central milk production areas, known as a 'milk city'. Dairy Cattle Farmers in Boyolali always face a common problem: limited green fodder as roughage for cows in the dry season. Dairy cattle feed consists of roughage and concentrates as a source of nutrients to produce milk. Roughage in the form of grass or greens is the main feed, and it is focused on the form of agricultural, industrial waste formulated into feed that functions as strengthening/complementary feed. The limitations of green fodder in the dry season must be overcome by finding alternative feed parts such as toereplaceder.

Boyolali, as a livestock center, is a fairly large papaya (*Carica papaya*) producing area of around 280,286 quintals (BPS, 2019). One part of the papaya plant that has not been utilized is the stem, especially old and unproductive plants or those with low productivity that must be replaced. Papaya stems can be used as alternative animal feed when there is a shortage of green fodder. The effect of providing papaya stems as roughage for dairy cows needs to be studied to determine the milk quality produced. Papaya is a plant originating from southern Mexico and northern South America. This plant spread to the African and Asian continents as well as India. From India, this plant spread to various tropical countries, including Indonesia, in the 17th century (Setiaji, 2009).

The utilization of papaya plants is still limited to the fruit and leaves, while the stems, which are the largest part, have not been utilized, even though the papaya stems produced are twice as much as the fruit. The plant's stem is round and straight, hollow in the middle, and not woody. The stem segments are where the long, round, and hollow leaf stalks are attached (Suprapti, 2005). This study aimed to determine the effect of substituting papaya tree stems (Carica papaya) as roughage on the quality of FH cow milk in Boyolali. This study hypothesizes that papaya tree stems as roughage can maintain the quality of FH cow milk in Boyolali. The results of this study will strengthen feed security for livestock and become part of the integration of agriculture and animal husbandry to enhance food security in Indonesia.

Materials and Methods

This study used 16 lactating FH cows with an average body weight of 431.75 + 50.99 kg (CV = 11.82%) and an average daily milk production of 11.12 + 0.96 liters (CV = 8.61%), which farmers in Singosari Village, Mojosongo District, Boyolali Regency kept. The cows were kept in a tethered cage with a place to feed and drink. The average production period of the cows was the 2nd lactation period, 2nd to 5th months. The cows were given rations according to their needs based on their production, in the form of concentrate (bran-pollard), elephant grass, tofu dregs and papaya tree trunks. Papaya tree trunks were given in thinly chopped form, making them easy for livestock to consume. The equipment was a shredder, a 50 kg digital hanging scale with an accuracy of 10 gr, liters of milk, milk buckets and cage cleaning tools. This research was conducted in 2 stages, namely, stage 1 preliminary research for 1 month to prepare for the introduction of research feed and administration of deworming drugs to equalize the initial condition of cattle. The second data collection stage for 1 month includes daily ration consumption, production and milk composition for 1 month. The rations given were concentrate, tofu dregs and elephant grass as a control, while the treatment rations were concentrate, tofu dregs, elephant grass and papaya tree trunks. Rations were given according to needs and production (NRC 2001), while drinking water was given ad libitum.

Table 1. Nutrient Composition and Research Treatment Rations

Nutrient Content	Elephant Grass	Tofu Dregs	Bran-Pollard	Papaya Stems
DM (%)	22,51	28,80	88,41	15,71
CP (% on 100%DM)	5,61	3,24	13,99	0,76
Crude Fat (% on 100%DM)	1,45	2,06	2,07	0,91
Crude Fiber (% on 100%DM)	19,34	4,90	14,26	13,71
Ash (% on 100%DM)	4,03	2,70	5,02	1,58
TDN (% on 100%DM)	65,71	79,27	70,93	68,48
Treatment Ration	**.....% DM.....**			
T0	60	10	30	0
T1	40	10	30	20
T2	20	10	30	40
T3	0	10	30	60

This study used a Completely Randomized Design with four treatments and four replications. The parameters observed were milk quality, namely Specific Gravity (SG), milk protein content, milk fat, milk lactose and total solid (TS). The data obtained were analyzed using analysis of variance to determine if there was a difference between treatments tested with Duncan's multiple range test (Steel and Torrie, 1989).

Results and Discussion

The results of the study showed that papaya tree trunks can be consumed by dairy cattle well; this is because thinly chopped papaya tree trunks have a soft texture and are easy to chew, have a distinctive aroma so that their palatability is high, their water content is high, they are filling so that their bulkiness is high. The nutrient content of papaya tree trunks is as follows:

Milk Production and Composition

The average results of milk production and composition are shown in Table 4 below:

Table 4. Average Milk Production and Composition

Milk production and composition	Treatment			
	T0	T1	T2	T3
Milk Product (liter)	10.625	11.075	12.5	12.125
BJ	1.027	1.028	1.027	1.028
Fat (%)	5.115[a]	4.478[ab]	4.919[a]	3.248[b]
Protein (%)	2.955	2.964	2.973	2.934
Lactose (%)	04,425	04,419	04,438	04,399
SnF (%)	8.009	8.047	8.072	7.998
TS (%)	13.122[a]	12.355[ab]	12.988[a]	11.245[b]

Note: Different lowercase superstrip letters in the same row indicate significant differences (P<0.05) between treatments.

The quality of milk produced by the udder glands is determined by the number and Performance of the epithelial cells that synthesize milk. This can work well if supported by an adequate supply of feed nutrient substrates (Sudjatmogo, 1998).

A. Milk Production

Milk production in treatments T0, T1, T2 and T3 was not significantly different (P>0.05). This shows that the provision of papaya stems at various levels as roughage gives the same results in milk production, namely an average of 11.57 + 0.89. This also shows that papaya stems are suitable for roughage for dairy cattle because they can maintain milk production. Dairy cows can utilize the nutrient content of papaya stems for milk production. Papaya tree stems help in protein absorption and increase nutrient efficiency (Syafri et al., 2014). The content of enzymes and bioactive components in papaya stems increases the digestion process's effectiveness, affecting the results of the production product. Tree stems contain various bioactive compounds such as papain enzymes, flavonoids, saponins, and tannins, which positively affect cow health and the quality of milk produced (Mustopa et al., 2022). The papain enzyme in papaya tree stems helps break down feed protein into amino acids more easily absorbed by the cow's body, thereby increasing nutritional efficiency and milk production (Syafri et al., 2014).

B. Milk Specific Gravity

Milk Specific Gravity of treatments T0, T1, T2 and T3 showed no significant difference (P>0.05). This indicates that the provision of papaya stems at various levels as roughage gives the same results in milk-specific gravity, which is an average of 1.027 + 0.001%. This shows that the nutrients from papaya stems can maintain the consistency of milk quality, as seen from the specific gravity of milk. The particular gravity of milk is determined by the components dissolved in milk, including fat, protein and lactose. The content of nutrients, enzymes and bioactive papaya stems can be digested and used for milk synthesis by dairy cows. According to (Suhendra, 2020), the total solid and dry matter values of feed can affect the specific gravity of milk. Overall, providing papaya stems

in dairy cattle feed can increase milk production, protein, fat, and lactose content in milk (Mustopa et al., 2022).

C. Milk Protein

The milk protein content in treatments T0, T1, T2 and T3 showed no significant difference (P>0.05). This indicates that the provision of papaya stems at various levels as roughage gives the same results in milk protein content, namely an average of 2.96 + 0.26%. This shows that nutrients from papaya stems can be digested and absorbed well for milk synthesis, resulting in milk with the same protein content. The papain enzyme in papaya stems also increases the effectiveness of milk protein production because papain affects the breakdown of feed protein into amino acids and, at the same time, increases the absorption process of feed nutrients for milk protein synthesis. Papain helps break down feed protein into amino acids that are more easily absorbed by the cow's body, thereby increasing the protein content in milk (Mustopa et al., 2022). Protein synthesis must be supported by an adequate supply of feed nutrient substrates (Sudjatmogo, 1998); the synthesis and secretion content of milk protein is influenced by the blood flow of the mammary glands Collier (1985).

D. Milk Fat

Milk fat production in treatments T0, T1 and T2 was not significantly different (P>0.05). While in treatment, T0, compared to T3, showed a significant difference (P<0.05). This is because the crude fat in papaya stems is low, thus affecting the milk fat content. The availability of TDN, Crude Fiber and Crude Fat in the ration affects milk fat synthesis. Consumption of TDN, Crude Fiber (CF) and Crude Fat (CF) levels of feed that are relatively the same results in almost the same VFA production, especially acetic and butyric acids. Acetate and butyrate are the main fatty acids in milk fat synthesis. According to Sutardi (1981), milk fat content highly depends on feed CF and acetic acid production. In line with what was conveyed (Laryska, 2013), The fat content of milk is influenced by crude fiber in feed ingredients.

E. Milk Lactose

The levels of milk lactose in treatments T0, T1, T2 and T3 did not show any significant differences (P>0.05). This indicates that the provision of papaya stems at various levels as roughage gives the same results on the levels of milk lactose, which is an average of 04.42 + 0.016%. This shows that the nutrients from papaya stems can maintain the consistency of milk quality, as seen from the lactose levels. The lactose content of milk is usually influenced by the quality of feed, breed, lactation period and milk production (Sidik, 2003). Glucose is generally the former of milk lactose, which usually comes from feed carbohydrates. In addition, according to (Prihatiningsih, 2015), milk lactose is formed from carbohydrates, where propionic acid is converted into glucose in the liver.

F. Solid non-Fat (SnF)

The SnF levels of milk in treatments T0, T1, T2 and T3 showed no significant differences (P>0.05). This indicates that the provision of papaya stems at various levels as roughage gives the same results on the lactose levels of milk, which is an average of 8.031 + 0.107%. This shows that the nutrients from papaya stems can maintain the consistency of milk quality, as seen from the SnF levels of milk. Solid non-fat is a component that forms milk other than fat and water. It can also be called dry matter without fat, depending on protein, lactose, and fat (Ontario, 2012). The higher the protein lactose content, the higher the solid non-fad content. (Arifa, 2023) explains that the Solid non-fad content is influenced by the feed content given to livestock; the better the feed quality, the higher the milk quality.

G. Total Solid

The results showed that the total solid content between T0 and T2 compared to T3 was significantly different (P <0.05). However, between treatments T1 and T3, there was no significant difference (P> 0.05). The total solid content for treatments T0 and T2 had the same results, showing the highest values of 13.12% and 12.99%; this indicates that giving 40% papaya stems gave the same total solid results as the treatment without giving papaya stems. These results show that giving 40% papaya stems can maintain the total solid content of milk, making it suitable as a dairy cow feed ingredient. The total solid content is closely related to the milk fat content, as shown by the results of this study, where the total solid content between treatments T0 and T2 gave the same effect. This is the opinion of Lampert (1975), who reported that the percentage of fat content, non-fat solids and milk density causes high and low levels of total solids. According to SNI 3141.1:2011, it is stated that the indicator of fresh milk that meets health standards is to have a minimum Total solid content of 10.80%. Total solid is a milk component other than water, including fat, protein, lactose and ash. The components of total solids in milk are protein, fat, lactose, vitamins, and minerals (Wibowo, 2013); they further explained that increasing milk production would result in a decrease in total solids; this is due to differences in the distribution of nutrients between livestock that have low milk production and those that have high milk production. The better the feed quality and its provision, the better the milk quality produced (Nurhadi, 2008).

Conclusion

This study's conclusion is that using papaya tree trunks as a substitute for fresh greens can maintain the milk productivity of FH cows. Giving 40% papaya tree trunks combined with 20% elephant grass as roughage produces the same milk production as giving 60% elephant grass.

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