Identification and Digestibility of Wafer Feed Based on Palm Kernel Cake in Cattle

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Abstract. Wafer feed was a type of processed feed composed of concentrates and forages and manufactured using specialized machinery. Using palm kernel meal as a base, this study attempts to discover wafer feed and calculate the digestibility value of dry matter and organic matter wafer feed for cattle. A fully randomized design with four treatments and four replications was employed in the study. The four wafer feed formulas (formula 1, formula 2, formula 3, formula 4) were each 20 by 20 cm and had a thickness of 4 cm. The digestibility of dry matter and organic matter are among the observations made. Based on physical quality tests (moisture content 15.66 ± 0.79, density 0.75 ± 0.05, and water absorption capacity (185.76 ± 3.85) the results demonstrated that wafer feed could be identified formula 2 4 cm thick wafers had the finest physical look. Additionally, according to biological testing, there was no discernible difference in the dry matter digestibility of feed formulas 1, 2, 3, and 4 (55.49%, 55.39%, 54.77%, and 55.15%) among them. Additionally, there was no discernible difference in the digestibility of organic matter (60.84%, 60.66%, 57.12%, and 59.77%).

Keywords: wafer feed, identification, digestibility, cattle

1 Introduction

Animal feed in the form of wafers is a variation on the cube shape. The feed sources of fiber that are utilized as raw materials are forages and concentrates that are composed according to the nutritional requirements of livestock. During the manufacturing process, the materials are compressed under pressure. Wafer feed, also known as full feed, is a mixture of feed ingredients—such as concentrate and forage or agricultural waste—that have been combined, processed, and numbered into a single unit (uniform). Ruminants are then given this mixture freely in order to provide the nutrients their animals require. Full feed can reduce the amount of feed left in the trough and improve administration efficiency.

The form of wafer feed that was dense and quite concise was expected to: (1) increase the palatability of livestock because of its solid shape, (2) make it easier to handle because it has a compact solid shape making it easier to store and transport., (3) provide added value because in addition to utilizing waste forage, can also utilize agricultural and plantation waste, (4) was not easily damaged by biological factors because it has a low moisture content, and (5) uses simple technology with relatively low energy.

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The principle of wafer manufacturing follows that of particle board manufacture. The process of making wafers requires an adhesive that is able to bind the material particles, so that a compact and dense wafer was produced according to the desired density. The successful development of wafer feed technology must pay attention to; such as feed mixing homogeneity, feed flow rate in the digestive cavity, absorption process and detection of protein content. The properties of the particles are affected by the type and size of the particles, the manufacturing technique, the type and conditions of adhesive distribution of the particles, the density of the particles, the moisture content, and the further processing of the particle board.

Chemical analysis can be used to assess the potential of wafer feed in terms of feeding animals with nutrients, but biological assays can be used to determine the actual value. Determining the value of the digestibility of both dry and organic matter is one of the biological tests that may be performed. demonstrated by the portion lost following metabolism, absorption, and digestion. Calculating the quantity of food taken less the quantity expelled through feces is the basic method for assessing the digestibility of food items. By definition, digestibility refers to the portion of feed nutrients that are considered to be absorbed by cattle and are not eliminated in the feces. Using palm kernel meal as a base, this study attempts to discover wafer feed and calculate the digestibility value of dry matter and organic matter wafer feed for cattle.

2 Research Methods

A 4 x 3 factorial design was employed to determine the wafer feed to be used. The treatment included 3 wafer feed sizes of 20 × 20 cm with varying thicknesses (2 cm, 4 cm, and 6 cm) and 4 distinct wafer feed formulas (formula 1, formula 2, formula 3, formula 4). Elephant grass, palm kernel cake, maize flour, rice bran, cassava, molasses, and premix are among the feed materials used in wafer feed. Table 1 displays the formula for wafer feed.

Table 1. Wafer feed formula based on palm kernel meal

Ingredients	Formula 1	Formula 2	Formula 3	Formula 4
	....	%	....	
Elephant grass	50	40	30	20
Palm kernel cake	20	30	40	50
Corn flour	15	15	15	15
Rice bran	5	5	5	5
Cassava	5	5	5	5
Molasses	5	5	5	5
Premix	0,5	0,5	0,5	0,5

The water content, density, and water absorption have all been noted. A 5 x 5 x 1 cm3 sample was weighed to ascertain its initial weight in order to estimate the moisture content. The test sample was subsequently dried in an oven at 105 °C until the weight remained constant. The importance of wetness The formula used to determine content was: Wetness

$$\text{Content} = \frac{Wi - DWo}{Wi} \times 100\ \%$$

Note : MC = complete ration wafer water content (%)

Wi = initial weight (g)
DWo = oven dry weight (g)

Determination of density, the test sample was weighed and measured for length, width and thickness. Density calculation is calculated by the formula:

$$\text{Density} = \frac{W}{(P \times T \times L)}$$

Note: W =Weight of sample test (g)
P = is the test sample's length in cm.
L = test sample width (cm)
T = test sample thickness (in centimeters)

Determination of water absorption, the test sample was weighed before and after immersion for 5 minutes. Calculation with the formula:

$$\text{Water absorption } (\%) = \frac{W2 - W1 \times 100\%}{W1}$$

Note : W1 = Weight before immersion (g)
W2 = Weight after immersion (g)

Table 2 displays the findings of the proximate analysis of nutritional content based on the dry matter calculation (%).

Table 2. The results of the proximate analysis of nutrient content based on the calculation (%) of dry matter

Nutrient content	Formula 1	Formula 2	Formula 3	Formula 4
	………………… % ………………………			
Moisture content	20,46	10,28	12,20	9,42
Ash	3,86	3,31	7,94	7,74
Crude protein	9,89	9,80	14,45	17,20
Coarse Fiber	44,90	40,40	32,85	34,83
Crude Fat	0,79	0,74	1,28	1,06
nitrogen-free extracts	40,56	45,75	43,49	39,17

Dry matter digestibility and organic matter digestibility were noted in relation to wafer feed digestion. Four cows, weighing between 200 and 220 kg and approximately 2.5 years old, were the livestock employed. Based on data on dry matter consumption collected during the preliminary phase, the feed is provided. In order to determine the amount of feed consumed, the feed that is supplied and any leftover feed are both weighed. The following day, before feeding, leftover feed was weighed. Samples, comprising about 10% of the total, were taken daily and dried in an oven set at 60°C for seven days. Samples of the supplied feed and samples of residual feed were combined proportionately per head at the conclusion of the study, and the samples were subsequently ground to a size of 1 mm to examine the composition of organic and dry materials. Stool collection, which involves collecting excrement daily for seven days in a row on the final day of the collection period in order to weigh all of the daily excrement and take a sample (about 10%) for analysis of the dry matter and organic matter content.

computation of the consumption of dry materials and organic matter

DMC (kg/head/day) = (% DM gift x total gift) - (% DM remainder x total remainder)

OMC (kg/head/day) = (% OM x DM gift) - (% OM remainder x DM remainder)

Note : DMC = dry matter consumption

OMC = organic matter consumption

Calculation of digestibility of dry matter and organic matter digestibility

$$DMD\ (\%) = \frac{DMC\ (kg) - DM\ feses\ (kg)}{DMC\ (kg)} \times 100\%$$

$$OMD\ (\%) = \frac{OMC\ (kg) - OM\ feses\ (kg)}{OMC\ (kg)} \times 100\%$$

Note : DMD = dry matter digestibility

OMD = organic matter digestibility

3. Result and Discussion

Wafer Feed Moisture Content. Moisture content is a very important factor in determining feed quality, because it is related to nutritional value and shelf life. Wafer water content is the amount of water that remains in the cell cavities, intra cellular cavities and between particles during the adhesive hardening process. Feed ingredients that have a high water content, the percentage of nutritional value is lower and their shelf life is relatively shorter, this is because the feed ingredients are will be easily attacked by fungi, so that the quality of feed decreases and can cause poisoning for livestock. The average value of water content (%) wafer feed in each treatment is listed in Table 3.

Table 3. Average water content of wafer feed based on palm kernel meal

Thickness	Formula 1	Formula 2	Formula 3	Formula 4
	....	%	....	
2 cm	17,86 ± 0,42b	15,76 ± 0,29a	15,67 ± 0,34a	15,86 ± 0,24a
4 cm	17,67 ± 0,73b	15,66 ± 0,79a	15,76 ± 0,67a	15,69 ± 0,15a
6 cm	17,58 ± 0,59b	15,78 ± 0,55a	15,86 ± 0,55a	15,79 ± 0,45a

Description: Different superscripts in rows or columns show highly significant differences ($P>0.01$)

The wafer feed thickness measurement treatment and the wafer feed formula treatments differed in terms of water content, according to the analysis of variance results. Additional testing utilizing the Orthogonal Contrast Test revealed that while the water content of the Formula 2, 3, and 4 wafer feeds was not statistically different from the Formula 1 wafer feed, it was in a very considerably different range. Table 3 demonstrates that the wafer feed water content ranges from 15.66 ± 0.79% to 17.86 ± 0.42%. The lowest water content wafer feed is shown in Formula 2 with a thickness of 4 cm. The difference in the value of the water content between one material and another can affect the water content of the wafer feed [2]. The water content of the wafer feed produced is above the maximum tolerance limit of 14%, this means that the resulting wafer feed is thought to have a shorter shelf life. A feed will have optimal shelf life if the water content is below 14% [5]. In line with the results of the study of Miftahudin et al (2015), the activity of microorganisms can be suppressed at a moisture content of 12-14%, so that the feed ingredients are not easily moldy and rot.

Density of Wafer Weft. One of the physical properties of wafers that has a significant impact on their appearance, handling during transportation, and storage space efficiency is their feed density. In addition to indicating the wafer feed's density, the density value establishes the final wafer feed's physical composition. Table 4 displays the wafer feed's average density value (g/cm3).

Table 4: Wafer feed average density based on palm kernel meal

Thickness	Formula 1	Formula 2	Formula 3	Formula 4
	.... g/cm3			....
2 cm	0,55 ± 0,15 b	0,70 ± 0,20 a	0,68 ± 0,15 a	0,68 ± 0,15 a
4 cm	0,48 ± 0,25 b	0,75 ± 0,05 a	0,68 ± 0,05 a	0,68 ± 0,15 a
6 cm	0,45 ± 0,20 b	0,65 ± 0,15 a	0,65 ± 0,20 a	0,65 ± 0,05 a

Description: Different superscripts in rows or columns show highly significant differences (P>0.01)

The analysis of variance data demonstrated that there were variations in density between the wafer feed thickness size treatment and the wafer feed formula treatments. The orthogonal contrast test results demonstrated that the wafer feed density for Formula 1 showed a highly significant difference compared to the wafer feed for Formula 2, 3 and 4, while the density of wafer feed for Formula 2, 3 and 4 was not significantly different. In Table 3 it demonstrate that the wafer feed density ranges from 0.45 ± 0.05 g/cm3 to 0.75 ± 0.05. The different density values are thought to be influenced by the composition of the raw materials used and the uneven distribution of the raw materials during the wafer printing process. The highest density of wafer feed is shown in Formula 2 with a thickness of 4 cm. The high density value is expected to facilitate in handling and transportation, and has a longer shelf life due to the dense arrangement of the particles so that the water content does not change easily. In line with [5] statement, the density of raw materials is highly dependent on the amount of pressure exerted during the manufacturing process and the size of the thickness, the higher the density value of a feed, the more durable it will be.

Water Absorption. The ability of the wafer feed to draw in surrounding water (air humidity), which attaches to the material particles or is held in the pores between the material particles, was measured by a variable called water absorption. Table 5 displays the wafer feed's average water absorption rate (%).

Table 5 shows the wafer feed's average water absorption capacity based on palm kernel meal.

Thickness	Formula 1	Formula 2	Formula 3	Formula 4
	.... %			....
2 cm	183,66 ± 3,55	184,76 ± 3,95	184,76 ± 3,65	182,76 ± 3,75
4 cm	182,86 ± 3,65	185,76 ± 3,85	183,76 ± 3,55	182,76 ± 3,95
6 cm	184,56 ± 4,55	183,76 ± 4,55	183,76 ± 4,35	183,76 ± 4,25

The wafer feed thickness measurement treatment and the wafer feed formula treatment did not differ in their effects on water absorption, according to the analysis of variance results.

Because of the way that water interacts with the material particles, the water absorption value and the thickness expansion value are intimately correlated. This is consistent with the claim made in [3] that the density value is inversely related to the water absorption value, which is directly proportional to the thickness expansion value.

both organic and dry matter consumption. The balance of nutrients during digestion plays a major role in determining maximum feed consumption. This is due to the fact that the primary stimulation that the hypothalamus receives as a hunger center is dietary needs. Nutrient imbalance in diet can impact the amount of feed consumed. Carbohydrates and other factors can influence rumen fermentation, which in turn can alter feed consumption. Rumen fermentation is primarily responsible for the balance of nutrients in the ration [1]. Table 5 presents the average dry matter and organic matter consumption results for cattle.

Table 6: Average Dry Matter and Organic Matter Consumption in Cattle

Variable	Feed Treatment			
	Formula 1	Formula 2	Formula 3	Formula 4
CDM(kg/head/day)	5.41	5.43	5.49	5.46
COM (kg/head/day)	4.41	4.43	4.49	4.46

Cattle fed formulas 1, 2, 3, and 4 consumed an average of 5.41%, 5.43%, 5.49%, and 5.46% of dry matter, whereas 4.41%, 4.43%, 4.49%, and 4.46% of organic matter were consumed. The analysis of variance data demonstrated that there was no significant difference ($P>0.05$) between the dry matter and organic matter wafer feed based on palm kernel meal consumed by cattle in each formulation treatment, resulting in no difference in each treatment. The advantages of making complete feed include increasing efficiency in feeding and reducing the remaining feed in the trough, forage with low palatability after being mixed with concentrate can encourage increased consumption, to limit concentrate consumption. Palatability was the primary explanation for the variation in dry matter intake between feed and animals with low productivity. High digestibility of a feed is typically linked to feed palatability [5].

Dry matter and organic matter digestibility. The chemical makeup of feed has an impact on digestibility, and the amount of fibrous feed has a significant impact. Field grass, fermented grass, and concentrates are made up of dry matter and organic matter fractions in animal feed ingredients. The primary nutrients required by cattle for growth and development in the metabolic process were found in organic materials. The organic matter automatically increases as a result of the increased digestibility of the parts of it that are made up of proteins and carbs. Table 7 displays the average digestibility of both dry matter and organic matter in cattle**.**

Table 7. Average Digestibility of Dry Matter and Organic Matter in Cattle

Variable	Feed Treatment			
	Formula 1	Formula 2	Formula 3	Formula 4
DDM (%)	55.49	55.39	54.77	55.15
DOM (%)	60.84	60.66	57.12	59.77

Dry matter digestibility in feed formulas 1, 2, 3, and 4, specifically 55.49%, 55.39%, 54.77%, and 55.15%, was tested biologically. In the meantime, the digestibility of organic matter in feed formulas 1, 2, 3, and 4 is 60.84%, 60.66%, 57.12%, and 59.77%, respectively.

The analysis of variance results demonstrated that there were no significant differences ($P>0.05$) in the dry matter digestibility of the organic matter and dry matter of the wafer feed based on palm kernel meal among adult ongole cross-breed cattle in any formulation treatment. One way to assess the ration's quality is to look at its dry matter digestibility. The greater the amount of dry matter that can be digested, the more nutrients that can beutilized by livestock for growth [4].
The amount of nutrients that can be broken down by rumen bacteria and digestive enzymes is demonstrated by the digestibility of dry matter in ruminants. A feed ingredient is considered greater quality if its percentage of dry matter digestibility is higher. Feed with a low digestibility score is less able to provide nutrients for both basic survival and animal production, whereas feed with a high digestibility score highlights the significant contribution of specific nutrients to livestock [3].

Since organic matter makes up the majority of dry matter and includes extracts devoid of nitrogen, crude protein, crude fat, and crude fiber, the digestibility of organic matter and dry matter are strongly correlated. The amount of nutrients, including lipids, carbohydrates, and proteins, that cattle can digest is indicated by the organic matter's digestibility. The amount of crude fiber and the activity of rumen microbes, particularly cellulolytic bacteria, determine how digestible nutrients are for ruminants. This is independent of the quality of feed protein. Among the cellulolytic species, some have a dual role in the digestion of crude fiber: they are cellulose, hemicellulose, and starch digesters.

Because ash degradation in dry matter components is limited and microorganisms have a greater capacity to decompose organic matter components than dry matter, organic matter has a higher digestibility than dry matter. In this investigation, the digestibility value of organic matter was higher than the digestion value of dry matter. This is due to the fact that ash is still present in dry stuff but absent from biological substance.

Because of rumen microbial activity, a higher crude fiber concentration can result in a lower amount of digestible organic matter. Rumen microbe development and activity can be maximized by minimizing the activity of harmful bacteria in the rumen. With an increase in the number of rumen microbes, activity in fermentatively degrading feed organic matter into simple soluble compounds can increase, resulting in increased absorption of organic substances. This supports the theory put forth by [1] that the amount of digested meal increases with the number of microorganisms present in the rumen.

4. Conclusion

According to the results, the optimum wafer physical appearance was identified by using physical quality tests (moisture content 15.66 ± 0.79, density 0.75 ± 0.05, and water absorption capacity 185.76 ± 3.85) on wafers with formula 2 4 cm thick. The biological test of wafer feed's dry matter digestibility on feed formulas 1, 2, 3, and 4 revealed no appreciable differences in the digestibility of the feed (55.49%, 55.39%, 54.77%, and 55.15%).

Additionally, there was no discernible difference in the digestibility of organic matter (60.84%, 60.66%, 57.12%, and 59.77%).

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