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RESEARCH ARTICLE

THE EFFECT STORAGE OF QUALITY AND PHYSICAL WAFER FORAGE COMPLETE BASED WASTE OIL PALM.

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Abstract

Waste oil palm plantations in the supply potential ruminant feed mainly during the dry season. One feed processing technologies that can be applied for preservation of waste oil palm plantations, a wafer. The purpose of this study was to determine the effect of storage time on physical and nutritional quality of forage complete wafer-based waste oil palm plantations. This study uses a completely randomized design with 2 factors. The first factor is the storage time and the type of feed. Namely 2,4,6 and 8 weeks, while the second factor the use of waste oil palm plantations 0, 25,50,755 and 100%. The parameters observed are the general characteristics of the wafer, the wafer physical quality (water content, water activity, density and water absorption), while the nutritional quality (PK, SK, BETN, NDF and ADF). The results showed the storage time significantly affect the physical and nutritional quality of forage complete wafer, while the use of waste oil palm plantations showed no significant differences. It was concluded that use of waste oil palm plantations can be used up to 75% in the raw material wafer forage penyusuna complete.

Introduction:-

Oil palm plantations in Indonesia at this time began to grow rapidly and become one of the commodities that play a role in the revenue of the country, in addition to contributing considerable plantation waste such as palm fronds, leaves and palm kernel cake. Waste oil palm plantations in the supply potential ruminant feed mainly during the dry season (Rostini, 2017). Utilization of palm fronds as animal feed can be given directly or in the form after processing. But the direct administration of the palm frond is not recommended because it can reduce the productivity of livestock Purba et al. (1997). So that needs to be done processing beforehand.

One feed processing technologies that can be applied for preservation of waste oil palm plantations, a wafer. The shape of the wafer is also easy in the handling and processing, and is expected to be more resistant in storage. Feed processing wafer form using midrib, leaves and palm kernel cake is expected to increase the amount of time that can be an alternative feed to be given to cattle in the dry season or drought (Rostini et al., 2016)

Verma et al., (1996) states that the manufacture of wafers is one of the alternative forms of effective storage and is expected to maintain the balance of the availability of forage. The goal is to collect forage fodder in the rainy season and store for supplies during the dry season. Storage is an attempt to protect food from damage caused by many

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things, such as pests, microorganisms, rodents, insects, and damage to physiological or biochemical (Triyanto *et al.*,. 2013).

Factors that affect the livestock feed material damage during storage among other physical factors such as temperature and relative humidity; biological factors such as mildew, mites, insects, bacteria, rodents; and chemical factors such as changes in the composition of food substances with the availability of oxygen (Rostini, 2014). These three factors interact to changes that occur during the storage process. The purpose of storage is to keep and maintain the quality of commodities stored in a manner to avoid, reduce or eliminate the various factors that can degrade the quality and quantity of the commodity (Retnani, et al., 2009)

The purpose of this study was to determine the effect of storage time on physical and nutritional quality of forage complete wafer-based waste oil palm plantations.

Materials and methods:-

The Raw Material Wafer Forage Complete:-

The raw material wafers used in this study contains corn, bran, cassava flour, field grass, legume, palm fronds, leaves, palm kernel cake, urea, minerals and molasis. Waste oil palm plantations of oil palm plantations folk come in Banjarbaru Wafer manufacturing method forage complete the study begins with palm fronds peeled both manual and using the machine, and then in chopped until smooth. The process of making a complete wafer-based forage palm plantation waste created by: peeled palm fronds, palm leaves and then were scarred by chooper until soft forms like fibers. Dry with sunlight or try dryer when drying the material is inverted reverse order maximum and uniform drying, during 5-8 hours until the moisture content reaches 15-17%. Mixed with palm kernel cake, corn, urea, bran, cassava flour, urea, vitamins and molasses until well blended, complete wafer Nutritional content customized to the needs of local goat nutirisi age of one year. The nutritional requirements of goats refers to the NRC (2004), a material that has been mixed 400 grams inserted in the mold with a size of 20 x 20 x 1.5 cm, after conditioning the wafer sheet for 24 hours, was left in the open air (room temperature). Then the wafer resulting product before the quality is evaluated aerated prior to drying, after which the samples were taken aseptically and transported to the laboratory for analysis.

Wafer formulations Forage Complete:-

Formula forage complete wafer is structured to meet the needs of growing goats aged 1-2 years, the composition of the forage complete wafer presented in Table 1.

Table 1:- Material preparation Complete Forage Wafers (%)

Feed ingredients	**PT0**	**PT1**	**PT2**	**PT3**	**PT4**
Field Grass	30	30		7,5	
Leguminose	30	0	30	7,5	
Palm Laves		12	12	18	24
Palm stem		12	12	18	24
Rice palm kemel		6	6	9	12
Rice bran	13,2	13,2	13,2	13,2	13,2
Flour cassava	7,5	7,5	7,5	7,5	7,5
Corn	13,3	13,3	13,3	13,3	13,3
Urea	0,5	0,5	0,5	0,5	0,5
vitamin	0,5	0,5	0,5	0,5	0,5
Molasses	5	5	5	5	5
Amoun	100	100	100	100	100

The parameters observed are the general characteristics of the wafer, the physical quality of the wafer (water content, water activity, density and water absorption), while the nutritional quality (PK, SK, BETN, NDF and ADF), for storage of 2, 4, 6 and 8 weeks , each treatment wafer is stored in a plastic bag to know perbedaanmya. Data were analyzed using the Fingerprint Variety. If there is a real difference then continued with Orthogonal Contrast Test (Steel danTorrie, 1997).

Results and Discussion:-

The General State of Complete Forage Wafers:-

General keaadan forage complete wafer resulting from this research have color, flavor and storage density at up to 8 weeks, although the composition of the constituent materials of different wafers. The general state of the wafer is presented in Table 2.

Table 2:- Mean forage complete wafer physical characteristics during storage

Variabels	PT0	PT1	PT2	PT3	PT4
Color	Cholate	Cholate	Cholate	Cholate	Cholate
Aroma	Smell of forage	Smell of forage	Smell of forage	Smell of forage	Smell of forage
Density	Solid	Solid	Solid	Solid	Solid

Information PT0 = 50% field grass + 50% Legume. PT1 = 50% Waste palm plantation + 50% legume . PT2 = 50% Waste palm plantation + 50% grass field. PT3 = 50% Waste Palm Plantation + 25% Legume + 25% Grass Field. PT4 = 100% Palm Waste

Table 2 shows the resulting wafer has a brown color and aromatic forage complete. The brown color due to the occurrence of non-enzymatic browning reactions in the wafer manufacturing process. The scent because the process pressure and temperature at the time of pressing the wafer forage complete. Whereas the use of fronds, leaves and palm kernel cake showed no significant differences. This is in line with the opinions Herath (2008) disebakan brown color due to a non enzymatic browning reaction and the reaction between glucose and amino acids and aroma as a result of heating the building blocks of the wafer

This wafer density based on Table 2 are very solid. It is caused by too much emphasis on the machine felt, but it is also their cassava flour as an adhesive that is capable of binding the particles of the material so that the wafer produced solid and compact in accordance with the desired density. Trisyulianti et al. (2003) suggested that the condition of wafers having a very solid density due to pressure and pressing the wafer manufacturing process forage complete. In addition the composition of the materials used are mostly waste oil palm plantations have crude fiber content is quite high, approximately 48.24% of palm fronds, palm residue of 35.98% (Rostini, 2017). While Jayusmar et al. (2002) states that the higher the fiber content in the feed material cavity generated by the wafer bigger and more.

Moisture and Water Activities Complete Forage Wafers:-

The water content of the wafer is the amount of water left behind in the cell cavity, the cavity between the intracellular and particles during wafer manufacturing process (Trisyulianti et al., 2003). Water activities closely related to moisture content. Water activity is the amount of free water used for the growth of microorganisms (Syarif and Halid, 1993). The water content and water activity forage complete wafer during storage is presented in Table 3.

Table 3:- Water content and complete wafer water forage activities during storage

Variables	**PT0**	**PT1**	**PT2**	**PT3**	**PT4**	**Average**
Water content (%)						
2 weeks	12.98	12,12	13,76	13,78	13,96	13,41[a]
4 weeks	13,47	12,63	13,98	13,98	14,18	13,69[a]
6 weeks	13.92	13,12	14,26	14,26	14,63	14,07[b]
8 weeks	14.63	13,42	14,87	14,87	14,92	14,52[b]
Average	13,47[a]	12,82[a]	14,22[b]	14,22[b]	14,42[b]	
Water activities (aw)						
2 weeks	0,81	0,81	0,82	0,81	0,82	0,82
4 weeks	0,79	0,81	0,78	0,78	0,8	0,79
6 weeks	0,77	0,83	0,81	0,82	0,79	0,81
8 weeks	0,83	0,79	0,79	0,78	0,74	0,78
Average	0,8	0,81	0,8	0,80	0,79	

Information PT0 = 50% field grass + 50% Legume. PT1 = 50% Waste palm plantation + 50% legume, PT2 = 50% Waste palm plantation + 50% grass field. PT3 = 50% Waste Palm Plantation + 25% Legume + 25% Grass Field. PT4 = 100% Palm Waste

Based on Table 3. The retention significantly increases the water content of forages complete wafer ($P < 0.05$). 8 storage time produce the highest water level that is equal to 14.52% and the lowest was 2 weeks storage time at 13.41%. The use of waste oil palm plantations showed significant differences between the treatment of the water content of the wafer, where the highest water levels on the use of waste perkebunann100% (pt4) and the lowest in the treatment of 50% use of palm fronds (PT1). It is strongly influenced by environmental conditions, because the wafer can absorb water from the surrounding environment where the temperature and humidity humadity change during storage that is between 78.65 to 79.64 and 27,14-28.64 temperature ^{o}C.

Wafer with the addition of waste oil palm plantations have fewer cavities than using grass field, so that evaporation occurs more slowly, while the wafer with a mixture of waste oil palm plantations and grass have more cavities and large evaporation of fast walking. Wafer storage time for 8 weeks increases the water content of the wafer. The average of the highest water content was obtained at 8 weeks of storage that is equal to 14.52% and the lowest in two weeks storage that is equal to 13.41%. The water content of the wafer that is always changing according to Giger-Reverdin (2000) that the factors that affect the water content during storage among other physical factors, such as temperature, relative humidity, air composition of storage space, biological factors such as mites, bacteria, when, insects and rodents. If the storage is done with a water content of the right to avoid the influence of the weather which can change the composition of the nutrient then dry rations can be stored for years (Parde et al., 1991) The smaller number of water activity which is owned by agricultural commodities, then the smaller water is also available and the more difficult it is a micro-organism to grow and develop (Stewart et al., 1998).

Absorption Air density and Forage Wafer Complete During Storage. The density is a measure of compactness and size of particles in the wafer, wafer density determines the dimensional stability and physical appearance wafer. The mean density and water absorption forage complete wafer presented in Table 4.

Table 4:- Average density and absorptive power of complete forage wafers

variables	PT0	PT1	PT2	PT3	PT4	Average
Density (g/cm3)						
2 weeks	0,80	0,86	0,84	0,83	0,82	0,85[b]
4 weeks	0,78	0,81	0,8	0,79	0,78	0,80[b]
6 weeks	0,74	0,75	0,72	0,74	0,75	0,75[a]
8 weeks	0,70	0,7	0,69	0,70	0,69	0,70[a]
Average	0,75	0,78	0,76	0,77	0,76	
Water absorption (%)						
2 weeks	87,54	84,65	83,76	83,12	82,97	84,41[b]
4 weeks	82,64	80,82	80,25	80,68	79,64	80,81[b]
6 weeks	76,38	74,23	73,67	72,64	77,76	74,94[a]
8 weeks	72,32	70,63	69,23	68,59	70,12	70,18[a]
Average	79,72	77,58	76,73	76,26	77,62	

Information PT0 = 50% field grass + 50% Legume. PT1 = 50% Waste palm plantation + 50% legume, PT2 = 50% Waste palm plantation + 50% grass field. PT3 = 50% Waste Palm Plantation + 25% Legume + 25% Grass Field. PT4 = 100% Palm Waste

Wafer storage time up to 8 weeks showed significant differences among the treatments on the real level ($p < 0.05$). Wafer preparation materials do not show significant differences, but there is a tendency as much use of waste oil palm plantation showed a decrease in the density and water absorption. More and more storage density wafer level drops forage complete. Highest at 2 weeks of 0.85 g / cm3 and the lowest at 8 weeks of storage that is equal to 0.70 g / cm3. This shows the storage time affects the density of the wafer, where the wafer that has a high density value has a shelf life long enough. This is similar to Retnani et al., (2010) states that the density of the wafer will lead to increasing the surface area and more efficient storage space and ease of transportation .. otherwise wafers that have high levels of low density will show the wafer is not too dense. Storage time significantly affect water absorption forage complete wafer ($P < 0.05$). The highest water absorption value in the treatment of 2 weeks at 84.41% and the lowest at 70.18% 8 weeks of storage. The high absorption of water on the storage of 2 weeks is due to the fiber content in the material making of the wafer, where the use of waste oil to 75% in the wafer did not show significant differences in the water absorption forage complete wafer. This is in accordance with the opinion Siregar (2005) states that there is a positive relationship between water absorption of particles with chemical composition fiber fraction constituents of the wafer. The decrease is due to absorption caused by the expansion of the particles of the weakening of the bond wafer and wafer particle (Trisyulianti et al., 2003).

Quality Nutrition During Storage Wafer Forage Complete:-

Quality nutritional wafers forage complete greatly influenced by storage time, where the longer storage showed a decrease in the quality of wafer forage complete . The average of wafers forage complete nutritional quality presented in Table 4.

In Table 5. In the mean in almost all treatments decrease the quality of nutrition for good storage of crude protein, crude fiber and Beth-N. The decrease in crude fiber at each storage time of 2 to 8 weeks, wafer adhesive waste oil palm plantation with cassava flour, due to the degradation of crude fiber by the activities of microorganisms on the wafer. Activity of microorganisms in the wafer due to the nutrients contained in the coarse fibers on the wafer such as cellulose, hemicellulose, polysaccharides and lignin (Anggorodi, 1994). During storage, these microorganisms remodel lignocellulosic bonds contained in the lignin within the fiber. This resulted in microorganisms utilize carbon sources therein during the storage process takes place. decrease in crude fiber content in the study also caused by an increase in the water content of forages complete wafer (Table 3) each week of storage that affect the growth and activity of microorganisms during storage so that the weekly crude fiber decreased storage.

Table 5:- Protein content, crude fiber and NFE contents of wafers forage complete

Nutrient	PT0	PT1	PT2	PT3	PT4	Average
Crude Protein (%)						
2 weeks	11,13	12,54	11,98	12,64	12,01	$12,06^{b}$
4 weeks	11,09	12,14	11,72	12,44	11,89	$11,86^{a}$
6 weeks	11,02	11,97	11,6	12,16	11,64	$11,68^{a}$
8 weeks	10,89	11,65	11,52	11,97	11,04	$11,41^{a}$
Average	$11,03^{a}$	$12,08^{b}$	$11,71^{a}$	$12,30^{b}$	$11,65^{a}$	
Crude Fiber (%)						
2 weeks	26,72	27,12	28,88	25,61	25,86	26,84
4 weeks	26,23	26,86	28,28	25,24	25,63	26,45
6 weeks	26,12	26,34	27,79	25,06	25,11	26,08
8 weeks	25,97	26,12	27,24	24,92	24,98	25,85
Average	26,26	26,61	28,05	25,21	25,40	
NFE (%)						
2 weeks	32,15	35,32	33,64	44,03	40,54	36,74
4 weeks	30,65	35,08	31,27	43,96	40,27	37,05
6 weeks	31,41	34,89	31,14	43,62	40,06	36,62
8 weeks	31,18	34,59	30,98	43,09	39,87	36,34
Average	$31,34^{a}$	$34,97^{a}$	$32,26^{a}$	$43,68^{b}$	$40,19^{b}$	

Information PT0 = 50% field grass + 50% Legume. PT1 = 50% Waste palm plantation + 50% legume, PT2 = 50% Waste palm plantation + 50% grass field. PT3 = 50% Waste Palm Plantation + 25% Legume + 25% Grass Field. PT4 = 100% Palm Waste

Table 5 shows the wafer forage complete storage time showed significant differences to the crude protein content, where the longer storage of the rough protein content of forage complete wafer decreased, although not significantly different ($P < 0.05$) but there was a trend decline in protein content every week. This is because the storage time will remodel the building blocks of microorganisms wafer resulting drop in crude protein content. While the content of ingredients Extracts Without Nitrogen (BETN). The average storage time of the wafer BETN waste oil palm plantation with cassava flour at each storage treatment showed no significant differences which ranges from 36.74% -36.34% whereas penyusuna material wafer significant effect on levels of Beth-N wafer forage complete. The higher use of waste oil palm plantations showed levels of Beth-N gets rose highest at treatment PT3 (75% of waste oil palm plantations). Storage time resulted in a drop in the content of Beth-N, a decrease is caused by microorganisms during storage of digested materials are easily degraded carbohydrates, wherein carbohydrate is the major component contained in BETN first to be devoured This is in accordance with the opinion Siregar (2005) states that BETN is used as energy by the microbes in its growth. An increase in microbial activity in degrading the substrate, it will affect also the energy consumption (BETN) which is the more so in the current high microbial activity can reduce the content of the storage period BETN.

Content of NDF and ADF Wafers Forage Complete During Storage:-

At 2 weeks of storage, NDF (Neutral Detergent Fiber) and ADF (Acid Detergent Fiber) all forage complete wafer are not significantly different; but on the storage of 8 weeks a significant decrease, although not significantly different ($p < 0.05$).

Table 6:- NDF and ADF contents of wafers forage complete

Nutrient	PT0	PT1	PT2	PT3	PT4	Average
NDF (%)						
2 weeks	75,82	74,54	73,56	75,15	74,98	74,81
4 weeks	71,09	70,14	70,86	71,04	70,67	70,76
6 weeks	69,02	69,97	69,82	70,18	69,72	69,74
8 weeks	68,89	69,65	68,89	69,12	70,12	69,33
Average	71,21	71,08	70,78	71,37	71,37	
ADF(%)						
2 weeks	54,23	52,56	51,87	52,76	52,72	52,83
4 weeks	55,13	53,78	53,32	53,24	53,63	53,82
6 weeks	57,08	55,34	54,72	56,25	56,12	55,90
8 weeks	57,19	56,21	55,24	56,92	56,98	56,51
Average	55,91	54,47	53,79	54,79	54,86	

Information PT0 = 50% field grass + 50% Legume. PT1 = 50% Waste palm plantation + 50% legume, PT2 = 50% Waste palm plantation + 50% grass field. PT3 = 50% Waste Palm Plantation + 25% Legume + 25% Grass Field. PT4 = 100% Palm Waste

In all treatments, the difference between 2 weeks and 8 weeks of storage are shown in the NDF (-4.89%) and ADF (4:35%). The content of NDF to treatment with the addition of waste oil palm plantations shows the lowest value it allegedly because of pressure exerted printing process is not dense enough so that the storage process undergo stretching and lead content of the material decreases. This is in accordance opinions Arief (2001), that the decline in NDF content caused during the storage process occurs lignocellulosic bonds and bond stretching lignohemiselulosa that cause the cell contents are bound to be soluble in neutral detergent. This causes the cell contents (NDS) will increase, while the feed components are not soluble in the solvent detergent (NDF) declined. This is explained also by Yunilas (2009) states that with decreasing levels of NDF indicates there has been a breakdown of cellulose so that the feed will be more easily digested by cattle.

Conclusion:-

Wafer forage complete based waste of oil palm plantations and 75% did not affect the physical quality and characteristics of forage complete wafer. Storage to 8 weeks old degrade the quality of wafer forage complete.

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