Chemical and Physical Quality of Sago (*Metroxylon sago* Rottb.) Waste Based Wafer Complete Ration for Aceh Beef Cattle

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Abstract

Sago (Metroxylon sago Rottb.) waste up till now had not been exploited in optimal and only partly small are applied as component of feed, especially for ruminant. The potential of sago as animal feed is quite large and will increase in value when processed into wafer complete ration. This experiment was conducted to study chemical and physical quality of sago waste based wafer complete ration which were preserved in various different periods. Determination of chemical and physical variables of wafer complete ration were color, texture, smell, water content, specific density, water activity, and storage capacity. Data were analyzed by analysis to completely randomized factorial design with two factors (A: the levels of sago waste used in wafer complete ration 10.20, 30, and 40%, B: storage time of 2, 4, 6, and 8 weeks). The results indicated that the wafer complete ration with various different formulations did not affect specific density and water activity. A significant different ($P<0.05$) was observed in water content with the highest water value in ration containing 40% sago waste. The period of preservation effect was significant ($P<0.05$) on water content, density and specific density, but did not influence water activity texture and smell. The preserved wafer complete ration for six weeks were still in good condition, but after eight weeks the wafer started to change in physical texture. It is concluded that sago waste based wafer complete ration has high quality in terms of physical and has storage capacity to keep in good condition for six weeks.

Keywords: complete ration, sago waste, wafer

Introduction

Sago (*Metroxylon sago* Rottb.) waste, up till now, had not been exploited in optimal and only partly small are applied as component of feed, especially for ruminant. The potential of sago as animal feed is quite large and will increase in value when processed into wafer complete ration. Wafer complete ration is a feed physically formed to a compact and concise which is expected to ease in handling and transportation, has complete nutritional content, and use relatively simple technology so easy to apply (Trisyulianti *et al*., 2003). Wafer complete ration is feed processing technology, especially in the dry season. Basic research and applications, in particular regarding the potential of improving the quality of sago waste as feed, it until now still not widely applied. Therefore, studies on the utilization of sago waste are continuously still very necessary. Most research has so far directed sago waste in the utilization of sago waste as raw material for biofuels and fungi or bacteria growth substrate for the production of extracellular enzymes (Akmar & Kennedy, 2001). However, the use of information sago waste as raw material for the manufacture of a complete wafer as a livestock feed ration is still very limited.

Observing this, a study needs to be done on the potential of sago waste as raw material for the manufacture of a complete wafer; this is an effort to ration the supply and implementation of strategies that feed technological innovation-oriented economy that is capable of providing complementary feed at any time. This study aims to determine the quality and physical properties of wafer-based complete rations of sago waste residue made up of different formulation and different storage time.

Materials and Methods

Experimental equipment

Equipment used in this study were felt wafer hidrolic machine (temperature of 150 ^{o}C, pressure 200-300 kg/cm^2 for 15-20 minutes), machine mixer, hammer mill, mixing container, AW meter, and termohigrometer.

Complete rations formulation

Complete ration used in this study were concentrates containing raw materials, such as coconut cake, rice bran, sago, molasses, vitamins, minerals and sago waste. Ration treatments consisted of : P1= ration containing 10% sago waste, P2= ration containing 40% sago waste, P3= ration containing 30% sago waste, P4= ration containing 40% sago waste. Complete ration wafer formulations were prepared using the method of trial and error. Ration of a complete wafer composition was shown in Table 1.

Preparing wafer complete rations

Wafer complete ration was prepared as follows : (a) all concentrated sources of raw material was dried by the sun, (b) all raw materials for concentrate were milled using a hammer mill to mash size, (c) treated feed materials (sago waste) was mixed with molasses as an adhesive material (5%) until blended, after being mixed with the concentrate to be a complete ration, mixing was done manually, (d) complete ration was incorporated into rectangular molds measuring 25 cm x 25 cm x 5 cm. After hot compression was performed at a temperature of 150 ^{o}C with a pressure of 200-300 kg/cm^2 for 15-20 minutes, cooling was done by placing sheets of wafer in the open air for 24 hours until the moisture content and the weight was constant, then the results were put in sacks.

Table 1. Composition of wafer complete ration

Feed Material	Treatment			
	P1	P2	P3	P4
Sago waste (%)	10	20	30	40
Rice bran (%)	33.5	30	25	20
Coconut cake (%)	25	23.5	23.5	23.5
Sago (%)	25	20	15	10
Molasses (%)	5	5	5	5
Vitamin (%)	0.5	0.5	0.5	0.5
Minerals (%)	1	1	1	1
	100	100	100	100

P1= ration containing 10% sago waste, P2= ration containing 40% sago waste, P3= ration containing 30% sago waste, P4= ration containing 40% sago waste.

Wafer tester

Wafer testing are: (a) wafer that has been made to cut the size of 5 cm x 5 cm x 2 cm samples were then taken for the proximate analysis (dry material, ash, crude protein, crude fiber, crude fat, Beta-N, and TDN), testing the physical properties (water content, density and water activity). The wafer was then stored for 2, 4, 6, and 8 weeks. Treated wafer that would be stored, was placed in a sackt to determine the difference.

Statistical analysis

The data obtained from the results of the study were analyzed using completely randomized factorial design with two factors (A: ration, B: storage time) with 3 replications; if significantly different occurred, the data will be tested further with Orthogonal Contrast Test (Steel and Torrie, 1995).

Observed variables

Observed variables in determining the quality and physical properties of the wafer was done by analyzing the nutrients of complete ration wafer (proximate analysis), wafer content (AOAC, 1984), density wafer (Trisyulianti *et al*., 2003), water activity (Syarief and Halid, 1993) , texture and storage capacity (2, 4, 6, and 8 weeks).

Results and Discussion

Chemical composition of wafer complete rations

Chemical composition of wafer complete rations and sago waste (dry matter, ash, crude protein, crude fiber, crude fat, Beta-N, and TDN) of four treatments was shown in Table 2 and Table 3.

Table 2. Chemical composition of wafer complete rations

	Treatment			
	P1	P2	P3	P4
Dry matter (%)	87.03	86.02	86.08	85.09
Ash (% DM)	5.44	5.53	5.67	6.03
Crude protein (% DM)	14.92	15.13	14.33	13.53
Crude fiber (% DM)	12.73	11.93	11.23	11.53
Crude fat (% DM)	5.74	6.51	7.06	7.61
Beta-N (% DM)	58.36	59.56	60.26	58.06
TDN (% DM)	71.17	71.93	70.48	69.03

Results of analysis: Nutritional Laboratory, Department of Animal Husbandry, Unsyiah (2011). P1= ration containing 10% sago waste, P2= ration containing 40% sago waste, P3= ration containing 30% sago waste, P4= ration containing 40% sago waste.

Table 3. Chemical composition of sago waste

Dry matter (%)	Ash (% DM)	Crude fat (% DM)	Protein (% DM)	Crude fiber (% DM)	Carbohydrate (% DM)
85.29	4.30	0.16	4.99	33.33	50.61

Results of analysis: Nutritional Laboratory, Department of Animal Husbandry, Unsyiah (2011)

Water levels

Wafer complete rations with a kind of different composition of sago waste significant affected (P<0,05) moisture content. The water content of the composition of the residue on the wafer with real sago 40% was higher when compared to other wafer sago waste. Wafer complete rations with a composition of dreg sago 10% had fewer cavities causing evaporation that occured over the resistor, while the wafer with a composition of 40% had the sago waste cavities that were more numerous and large causing evaporation was running fast. Moisture contents of each treated wafer was indicated in Table 4.

Table 4. Water content value of wafer complete rations

Treatment	Storage time			
	2 weeks	4 weeks	6 weeks	8 weeks
P1	13.44±0.12[a]	14.00±0.34	14.07±0.87	14.30±0.77
P2	14.34±0.20	13.59±0.55[b]	14.90±0.61	15.80±0.61
P3	14.44±0.15	14.35±0.45[b]	13.89±0.15	14.56±0.67
P4	13.00±0.56[a]	14.45±0.67	13.56±0.54	14.12±0.65

The value of flats with different superscripts in the same column showed a significantly different (P <0.05). P1= ration containing 10% sago waste, P2= ration containing 40% sago waste, P3= ration containing 30% sago waste, P4= ration containing 40% sago waste.

Storage time of wafer complete rations affected significantly (P<0.05) water content. Average value of the highest water levels in storage was for 2 weeks, because the wafers absorb water from the environment. Average value for six weeks was not stable, this was caused by humidity and temperature values that changed frequently. The interaction between factor A (wafer complete ration) and factor B (storage time) were not significantly different to water content although P2 treatment had the highest water content which was equal to 15.80±0.61. Storage conditions were likely to increase the water content. This occurred due to the influence of humidity, and ambient temperature during the storage periods. The activity of microorganisms can be on tap on the water content of 8-12%, so that the feed material was not easy to mold and rot (Verma *et al.*1996).

Wafer density

Density of the wafer determined the dimensional stability and physical appearance of a complete wafer feed (Jayusmar *et al*., 2002). Wafer density was a measure of the cohesiveness of the sheet and the particle size depended on the density of materials used and the amount of pressure exerted during the four sheets of wafer manufacturing process. Wafers that have a high density of the feed would provide a solid and hard texture; so it would be easily in both the storage and handling of shocks during transportation and was expected to last longer in storage (Trisyulianti *et al.,* 2003). Ration of a complete wafer density value was indicated in Table 5.

Wafer complete rations with different composition of sago waste had no effect on density. Week-long storage of two bonds between the particles of the material was still strong. Wafer density decreased at week 4 to week 8. The interaction between factor A (wafer complete rations) and factor B (storage time) did not significantly affect the density of the wafer feed. The lowest density value obtained was in treatment P3 which was 0.45±0.04 g/cm^3, while the highest 0.78±0.04 g/cm^3. Density values were not stable due to high relative humidity caused the liquid condensed on the surface of the material; so that the surface material became wet, and was very conducive to microbial growth and damage.

Table 5. Wafer complete rations density with various storage times (g/cm^3)

Treatment	Storage times			
	2 weeks	4 weeks	6 weeks	8 weeks
P1	0.50±0.01 ^{b}	0.56±0.05 ^{b}	0.48±0.02 ^{a}	0.52±0.00 ^{b}
P2	0.78±0.04 ^{c}	0.65±0.06 ^{c}	0.58±0.05 ^{b}	0.50±0.08 ^{a}
P3	0.66±0.05 ^{c}	0.45±0.04 ^{a}	0.49±0.06 ^{b}	0.49±0.09 ^{b}
P4	0.78±0.33 ^{c}	0.52±0.06 ^{a}	0.51±0.01 ^{a}	0.61±0.00 ^{b}

The value of flats witth different supperscripts in the same column showed a significantly different at (P<0.05). P1= ration containing 10% sago waste, P2= ration containing 40% sago waste, P3= ration containing 30% sago waste, P4= ration containing 40% sago waste.

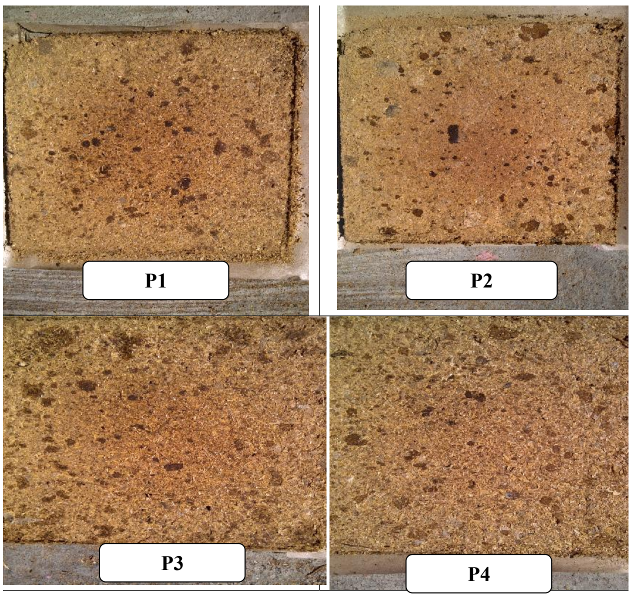

Figure 1. Wafer complete rations density with various storage times. P1= ration containing 10% sago waste, P2= ration containing 40% sago waste, P3= ration containing 30% sago waste, P4= ration containing 40% sago waste.

Water activities

Wafers with a variety of different composition of sago waste did not significantly affect the activity of water (Table 6). Storage time did not significantly affect the activity of water. Water activity at the beginning of week 2 to 8 was still high. Water activity was the amount of free water used for growing microorganisms (Syarief and Halid, 1993). Storage up to 4 weeks did not change the color to black. The interaction between factor A and factor B showed no significantly different results. The lowest water activity obtained at P1 was equal to 0.60±0.05. This was because the humidity was low, the liquid surface of the material would evaporate a lot; so that microbial growth was hampered by dehydration and a dark surface material.

Tabel 6. Wafer complete rations of water activity with various storage times

Treatment	Storage time			
	2 weeks	4 weeks	6 weeks	8 weeks
P1	0.60±0.05	0.75±0.08	0.79±0.00	0.72±0.00
P2	0.72±0.02	0.73±0.03	0.79±0.00	0.75±0.00
P3	0.69±0.09	0.70±0.06	0.80±0.08	0.77±0.07
P4	0.70±0.06	0.74±0.07	0.82±0.07	0.80±0.01

The value of flats wits different supperscripts in the same column showed a significantly different at ($P<0.05$). P1= ration containing 10% sago waste, P2= ration containing 40% sago waste, P3= ration containing 30% sago waste, P4= ration containing 40% sago waste.

Conclusion

Wafer complete rations with different composition of sago waste does not affect the specific gravity, density of water activity, but affected water levels with the highest value found in the wafer with a composition of 40% sago waste. Storage for 8 weeks old greatly increases the water content, lower specific gravity and density, but does not affect the activity of water. The wafers stored up to 6 weeks is still in a good condition, but at 8 weeks of storage, the surface of the wafer start to rancid black.

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