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The Effect of a Different form of Corn Cob Based Complete Feed On the Consumption, Characteristics, and Ruminal Fermentation on Ruminants

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Abstract

Livestock productivity is influenced by environmental factors, which could reach 70%, and genetic factors are only 30%. Of the environmental factors, aspects of the feed had the most impact, which is about 60%. The main feed of ruminants is greenery, however, its availability is very limited, especially in the dry season, thus, conducted the provision of fodder by optimizing the utilization of agricultural / crops waste into a complete forage. One of the crops waste that has significant potential is corn cobs, which is wasted and accumulate and eventually decomposed when it mixed together with other garbage. This waste contains a lot of cellulose and hemicellulose, and can be used as an energy source feed for ruminants.

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This study aims to determine the effect of the form of a corn cob based complete forage with another form of forage, on consumption, characteristic, Rumen Fermentation for local goats. The study was compiled using the completely randomized design with unidirectional pattern (Completely Randomized Design / CRD) 3 x 3 with handling: R1 is flour / mesh form complete forage, R2 is Pellets form complete forage and R3 is Wafer form complete forage. This handling does not affect significantly (P> 0.05) on dry matter intake, organic matter, crude fiber and crude protein. Similarly on Ammonia ruminal fluid and ruminal pH also not significant react(P> 0.05). The results showed that feeding the TMR complete forage in different forms, give no significant effect (P> 0.05), or it can be concluded that, there is no negative effect on the performance of local goats.

Keywords: corn cobs; complete forage in the form of Flour / mesh (TMR); pellets and Wafer; local goats.

1. Introduction

Corncob is an agricultural waste are widely available at the time of the harvest season, even discarded and piled up just like that, so it will decompose when it is mixed together with other garbage, also cause an environmental and water pollution and when it waste carried away to the river.

This waste contains a lot of cellulose and hemicellulose, and in this case fo ruminants can be used as a source of energy forage. Corncobs can be given to ruminants, is a low-quality coarse forage material with a low protein level quality and less palatable, and can quickly overgrow with fungus if not dried as quickly as possible. Nutritional composition of corncobs consists of 90% of BK, 2.8% of PK, 0.7% of LK, 1.5% of ash, 32.7% of SK, the cell walls of 80%, 25% of cellulose, lignin 6% and 32% of ADF [1,2], corncobs has a protein content of (2.94%) with high levels of lignin (5.2%) and a high cellulose level (30%) and digestibility average of 40%.

Efforts to improve the quality of corn cobs as ruminant feed can be done by physical treatment, chemical, biological or a combination of those treatments. Physical treatment by enumeration can be combined with chemical treatment, such as ammoniation and biological treatment, which is fermentation using a microbial cellulolytic starter. The function of the fermentation is able to lower the level of crude fiber and simultaneously increase the digestibility of fibrous feedstuffs while increasing levels of crude protein [3].

The advantage of a corncob waste processing which converted into a complete forage is useful for improving the nutritional content which is also expected for the increased of utilization of corncobs as the alternative for ruminants. then in this experiment, carried out various activities to evaluate the comparison of the best feed form, ranging from the pellet, wafer and Flour / mesh.

2. Materials and Method

2.1 Livestock and Design of Experiments

This study is using 9 local nut-goats were placed in metabolic cages that equipped with the feeding container and urine slot. This enclosure fitted with a plastic ram on the floor of the cage that serves as filtration of feces and urine, plastic funnel and a jar installed under the plastic ram, capturing the urine, so that feces and urine deposited in their respective container. Tools provided: gutters, plastic buckets, glass jar, syringe, basin, electric scales, oven, boiler, gas stove, sample bags, guttering, stove, test tubes. And the material used are corn cobs, rice bran, refined corn, coconut oilcake, soybeans oilcake, molasses, urea, salts and minerals.

The research took place for 3 months with 3 stages of research which are habituation during the first 10 days. Habituation is done so that animal feed used to the feed given, and all feed eaten before, has been completed removed in 10 days. Secondly, the daily consumption measurement and weighing of livestock carried out once a week. Third a period of collection or data collection for 5 days is data taken is the effect of handling of feed.

By using a completely randomized design unidirectional pattern (Completely Randomized Design / CRD), treatment of feed (R1, R2, and R3) and each consisting of three replications.

2.2 The procedures for making complete feed, composition and content of nutrients and feed Sampling

Cobs of corn and other feed ingredients that still rough, must be finely milled in advance by using a grinder. Then each of the feed material is weighed based on the formulation of each treatment, and mixed thoroughly, then exposed to hot steam until cooked. Furthermore, molding is done by using pellets and wafers molding machine.

Table 1: Composition of ingredients in the ration of research

	Treatment (%)		
Feed ingredients	**K**	**P**	**W**
Corncobs	45	45	45
Bran	15	15	15
Cornstarch	10	10	10
Coconut oilcake	5	5	5
Tapioca	10	10	10
Soybean oilcake	7	7	7
molasses	5	5	5
Urea	1	1	1
Salt	1	1	1
Mineral	1	1	1
Total	100	100	100

K = Control / mesh Complete Feed

P = Pellets Complete Feed

W = Wafer Complete Feed

Table 2: Nutrient content of complete feed on each treatment

Nutrients	Contents (%)		
	K	**P**	**W**
Dry ingredients	81,76	80,79	79,34
Organic ingredients	78,90	76,24	75,20
Crude protein	10,12 (+2,4)	10,12 (+2,4)	10,12 (+2,4)
Crude fiber	20,24 (+4,15)	20,24 (+4,15)	20,24 (+4,15)
BETN	61,07	66,17	59,91
NDF	48,21	38,03	41,17
ADF	3,53	16,08	26,43

Description: The result of the calculation of complete feed ration formulation

2.3 Sampling

In the sampling period for 5 days, there are four samples taken for further laboratory analysis, ie; sample of; feed, feces, urine and ruminal fluid

- Feed: to calculate the feed consumption. Is the difference between the remaining of the feed with the feed given. Remaining of feed during the 5-day sampling period homogeneously mixed and then sampled as much as 10% for laboratory analyses
- Feces: Total feces were weighed each day during the five-day sampling period. Then homogeneously mixed, then sampled as much as 10% for laboratory analyses
- Urine: Urine is collected in a container that had previously been filled with 100 ml of sulfuric acid 1 M to prevent the loss of N (final pH of the urine is set to pH <3). Total urine that is collected in a day recorded in volume and diluted 4 times with the distilled water to prevent the deposition of uric acid. A collection of urine samples for 3 days mixed and stored at a temperature of -200C to be analyzed in the laboratory.
- The Ruminal Fluid: Sampling of ruminal fluid taken with system Stomach Tube [4] using a vacuum pump, and performed at the end of the study or the last day of the collection phase of each period. Capturing ruminal fluid is done 4 hours after feeding. Ruminal fluid samples that have been taken subsequently measured its pH, and then filtered with gauze, and then centrifuged to obtain a clear Ruminal fluid. The Ruminal ammonia measurement is by using Microdiffusion Conway method [5] Chemistry Laboratory Faculty of Animal Feed Hasanuddin University.

2.4 Laboratory Analysis

Feed and feces samples were analyzed for the content of dry matter and organic matter.

a. Dry ingredients

Weigh plastic, firstly dried, for approximately 1 hour in the oven at 105 ° C, then cool the bottle in a desiccator for 15 minutes and weigh (x). A total of 5 grams of sample (y) were weighed and put into a weighing bottle, then put in the oven at 105 ° C for 4-6 hours. After that, cooled in a desiccator for 15 minutes and then weighed again.

b. Organic ingredients

Determination of organic materials is based on the method [6] by first determining the ash content in feedstuffs. Ash materials specified by burning of samples in a furnace at a temperature of 400-600oC for 6 hours so that all organic substances will evaporate.

Then the sample is weighed, weighing 5 grams and put into a porcelain cup. Cup and its contents placed over a Bunsen burner, then put in an electric furnace to be burned / converted into ash at temperatures 400-600oC. After the ash turned white as a whole, and then chill in eksikator. After one hour the samples is weighed again.

c. pH of Ruminal Fluid

Ruminal fluid pH was measured by using a pH meter. pH meter is turned on, let the pH meter stable for 15-30 minutes. Standardization with the buffer solution with the pH standard of 7. Rinse with the distilled water and then dry with a tissue. Insert electrode into tubes containing the samples of ruminal fluid, the pH value is set by looking at the numbers on the monitor screen.

d. Data Analysis

Data were analyzed by analysis of variance with the help of Statistical Product and Service Solution (SPSS) version 15. If the treatment significantly affects, then will be performed a further test [7]

3. Results and Discussion

Analysis of variance showed the insignificant influence on the consumption of dry ingredients of complete feed with a different shape. From Table 4, it can be seen that R2 has a consumption of dry ingredients of 943 g higher compared with the other treatment, it is a representation of the level of palatability and the form of feed pellets, it is supported by [8].

The High-low level of feed consumption of ruminants livestock is influenced by external factors, namely: shelter (cage), palatability, nutritional intake, feed form /shape, and internal factors are: taste, physiological status, body weight and livestock production itself.

Table 3: The mean of BK, BO, SK, Protein, Fat, ADF and NDF Consumption

Consumption parameter	Treatment			P > 0,05
	R1	R2	R3	
Dry ingredients (g/hr)	764	943	822	ns
Organic material (g/hr)	602	719	618	ns
Crude Fiber (g/hr)	183	229	203	ns
Crude Protein (g/hr)	75	66	67	ns
Crude Fat (g/hr)	40	50	44	ns
ADF (g/hr)	180	225	199	ns
NDF (g/hr)	368	460	408	ns

R1 = Control / mesh Complete Feed

R2 = Pellets Complete Feed

R3 = Wafer Complete Feed

Complete feed in pellets shape is likely drier and smoother when compared to the shape of the wafer feed and TMR feed. According to [9]. High Values of feed consumption due to more subtle forms of feed and also because the dry form of air causes the cattle consume water more frequently that helps the process of hydrolysis, the rate of feed digestibility and rapid gastric emptying process resulting in increased feed consumption

Generally, consumption of organic material, resembling the pattern of dry ingredients consumption, this also occurs in the treatment of different forms of complete feed on livestock, which is not significant.

Similarly, consumption of dry ingredients of treatment R2 has a value of consumption of organic materials that is higher (719 g) than the other treatments, it is in line with the opinion of [10] stated that the organic material is closely related to dry ingredients, as organic materials represent the largest part of the dry ingredients / material. High and low-level consumption of organic material will be influenced by the level of dry ingredient consumption.

Consumption of coarse fibers of this experiment showed the insignificant effect, but showed a tendency to follow the pattern of the consumption of dry ingredients and organic ingredients, with the highest consumption of coarse fiber found in treatment R2 namely Pellets 229. According to [11] states that: food consumption is influenced mainly by factors of quality of food and the factor of energy needs of the livestock which is concerned. The different consumption of coarse fibers of each treatment may also be influenced by the animal itself. For ruminants .fraction of fiber in the food serves as a primary energy source, which mostly cellulose and hemicellulose from the fiber can be digested by microbes contained in their digesting system [12].

The highest value of the consumption of crude protein was in treatment R1 namely 75g, it does not follow the pattern of the value of of crude fiber, dry ingredients and organic ingredient, unlike the case with the opinion of [13] stated that protein of feed in line with the consumption of dry ingredients and organic ingredients.

Coarse Protein consumption value of the treatment of different forms of complete feed is higher if compared with the research of [14] that is equal to 12:32 grams / head / day.

This is because the feed ingredients, types of livestock, as well as the weight of the cattle used are different. In addition to the factors of livestock, feed and environmental factors will also influence the consumption of crude protein.

According to [15] that the level of consumption differences are influenced by several factors, among others, the factors of cattle (weight and age), the level of digestibility of feed, feed quality and palatability

From the results of ADF analysis of variance showed no significant effect on the treatment of different forms of complete feed, but numerically following the pattern of the consumption of dry matter/ingredient and organic ingredients with the highest value of treatment is R2 225 grm. [16], the content of the ADF in the feed may affect ADF consumption in livestock. ADF is a part of the crude fiber composed of lignin and silica, while the NDF is composed of cellulose, hemicellulose, and protein of cell walls.

Further described by [17] that each feed material has a variation of degradation and highly dependent on the part of the plant, age, level of lignification which is a specific characteristic of the feed material.

The value of the consumption of NDF follows the pattern of consumption values of ADF, which did not significantly affect the treatment of different forms of complete feed of the goats. The highest Consumption value was in treatment R2 which is 460 grm. it might be due to the treatment of the consumption of dry matter R2 also has the highest value in accordance with the opinion of [18].

NDF is a fibrous cell wall constituent consisting of cellulose, hemicellulose, lignin, silica and N cell wall. NDF is a fraction of coarse fibers which are difficult to digest so that the higher dry matter intake causes the higher of NDF consumption.

And furthermore is described by [9] that the increased consumption of feed for livestock in line with the increased of quality and digestibility of feed which has been given, while the digestibility of feed depends on the fiber content that can be utilized by livestock.

Table 4: digestibility of BK, BO, Fiber, Protein, Fat, N and ADF / NDF

Digestibility Parameters	Treatment			P > 0,05
	R1	R2	R3	
Dry ingredients (%)	69	75	71	ns
Organic Ingredients (%)	74	79	76	ns
Coarse fiber (%)	55	64	59	ns
Crude Protein (%)	58	66	62	ns
Crude Fat (%)	80	84	82	ns
Nitrogen (%)	58	66	61	ns
ADF (%)	27	41	32	ns
NDF (%)	26	41	32	ns

R1 = Control / mesh Complete Feed

R2 = Pellets Complete Feed

R3 = Wafer Complete Feed

Dry matter digestibility analysis of variance showed insignificant influence. The value of each treatment is almost the same, but numerically treatment P2 is a treatment of that has the highest value it is in line with the value of the consumption of the dry material is also high compared with other treatment of. The absence of a significant impact on treatment of digestibility of the dry material due to the composition and type of feed ingredients of each treatment are all the same, the only difference being found on the final shape of the feed according to [19] that the digestibility of the dry material can be influenced by the composition of the feed material, the comparison between the composition of the feed materials with other feed ingredients, feed treatments, enzyme supplementation in feed, livestock and feeding level

Values of digestibility of organic materials generally follow the value of dry matter intake and digestibility of dry matter. This also happens to the treatment of organic matter digestibility, the highest value in the treatment is P2 , this has previously been described by [20] which states that the level of consumption of organic material will be influenced by the level of dry materials intake. This is because most of the dry material component consists of the organic material component, the difference lies in the content of the ashes. And further described by [21] states that the amount of feed will affect digestibility. Digestibility is closely associated with the consumption of feed. Thus, no difference between the digestibility of the organic dry material and _ also caused because there are also no differences in the consumption of the organic dry material and organic treatments. In addition, the value of the digestibility of the organic and dry material will correlate positively with the digestibility of the ration in the body of cattle, this case in accordance with the opinion of [4] that the digestibility of the organic material and dry material illustrated the efficiency of the nutritional content of food rations to be used by ruminal microbes

From the results of analysis of variance showed the insignificant effect on the digestibility of crude fiber to the different complete feed, it can be seen from Table 4, but from the number of Treatment R2 have the highest value in comparison with other treatments. This happens due to types, quality and sources of fiber of feed for each treatment are all the same, this is in line with the opinion of [22] which states that the digestibility of crude fiber depends on the content of crude fiber in the diet and the amount of crude fiber consumed. Crude fiber content that is too high can interfere the digestive process of other substances. In addition, microbial factors in livestock body also affect it, in accordance with the opinion of [23], crude fiber digestibility is influenced by several factors, such as fiber content in feed, crude fiber constituent composition and activity of microorganisms

Results of analysis of variance showed the insignificant influence of ADF and NDF digestibility on a different complete feed, However, there are variations of each treatment which is given, with the pattern of digestibility rate follows the pattern of consumption of ADF and NDF, this can happen due to every feed material possessed its own characteristics and degradation, furthermore explained by [17] that each feed material has a variation of degradation and highly dependent on the part of the plant, age, level of lignification which is a specific characteristic of the feed material. Besides, the animal may also affect the digestibility of ADF and NDF, as described by [22], the value of digestibility of NDF and ADF can be caused by livestock species, the physical form of the food, the amount of feed consumed, the composition of the feed material, the rate of food in the gastrointestinal tract and the ambient temperature

Table 5: The mean of NH3 ruminal fermentation, ruminal fluid pH, blood plasma urea.

Condition of Ruminal Fermentation	Treatments			P > 0,05
	R1	R2	R3	
NH3 (mg/dl)	24	22	29	ns
pH ruminal fluid	6,8	7,0	6,8	ns
Blood Plasma Urea (mg/dl)	52	47	42	ns

R1 = Control / mesh Complete Feed

R2 = Pellets Complete Feed

R3 = Wafer Complete Feed

The analysis of variance showed no significant effect of NH3 on a different complete feed of goats, but numerically it can be seen that R3 treatments of complete feed in the form of a wafer has the highest value of NH3 compared with the other treatments. NH3 value of R1 is R2 is 24, and R3 is 29, These values are categorized as the normal value of NH3 for goats. According to [24] that the ruminal fluid ammonia levels in goats ranges from 20 to 50 mg/dl. Further described by [19] The optimum range of NH3 in the ruminal ranges between 85-300 mg/dl 1 or 6-21 mM

Results of analysis of variance showed an insignificant effect of ruminal fluid pH on a different complete feed on goats. But the average value of ruminal fluid pH of goats can be categorized as normal as presented in Table 5. The mean R1 is 6.8 , R2 is 7.0 and R3 is 6.8 as described by [25] that the normal ruminal fluid pH in goat range 6-7, Ruminal microbial activity is influenced by pH. Basically, the process of degradation in ruminal takes place normally occurs at pH 6 - 7. It is supported by the opinion of [26]. Protein degradation took place at pH 6 - 7. Further described by [27] which states that the pH value is categorized into the optimum pH in the range of 6 - 7. That is one indicator of the occurrence of the good degradation of feed, because at this pH level, the microbes producing crude fiber digesting enzymes can live optimally in the ruminal.

Results of analysis of variance showed an insignificant effect of blood plasma urea on a different complete feed of goats. But numerically the highest blood plasma urea contained in R1 which is 52, R2 47 and R3 42. These figures can still be considered as normal. These may be caused due to the content of urea in the blood is influenced by the protein content in the feed. According to [28] that the normal urea concentration range is between 26.6 to 56.7 mg/dl.

4. Conclusion

Corn cob processing into various forms of complete feed (wafer form, flour, pellets) can all be selected as a strategy to optimize the utilization of corn cob as ruminant feed

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