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EVALUATION OF GRADED LEVELS OF STARCH AS BINDER IN LIVESTOCK WAFER FORMULATION

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ABSTARCT

A trial was carried out at the Department of Animal Science Biochemistry laboratory, Federal University Kashere. The objective of the experiment was to evaluate the effect of five levels of starch as binder in the formulation of livestock wafers. Five (5) graded levels of starch inclusion (10, 14, 18, 22 and 26%) were evaluated in the formulation of livestock wafers using completely randomize design. The variables evaluated were tensile strength (g) and the proximate composition (%).The results obtained showed that as the level of starch increased, the tensile strength increased linearly by the equation Y = 85.7x +70.1 (R^2 = 0.974). Proximate variables examined were significantly (P<0.05) influenced by the inclusion level of the binder. Higher significant effects were obtained due to treatment examined in 26% starch for DM (92.70%), Ash (9.38%), and CP (18.23%) CF (21.97%), EE (1.45%), NFE (51.34%). It can be concluded that starch is a good binder in livestock wafer formulation and showed good results. It is therefore recommended that starch at 26% level of inclusion be used in livestock wafer production due to its binding effect and the resultant values of proximate composition components would meet the nutritional requirement of ruminant at maintenance level.

***Keywords**: Starch, binder, wafers, Rice straw.*

INTRODUCTION

Livestock raised in arid and semi-arid areas are generally faced with severe nutritional deficit during feed scarcity period. Livestock production is largely dependent on fibrous feeds mainly crop residues and low quality pasture that are deficient in nitrogen, minerals and vitamins. [Ocheja *et a2020*The nutrients composition of the available forages is low due to long-term exposure to environmental condition such as seasonal patterns of rainfall, in semi-arid and sub humid zones which host over 90% cattle and 70% of sheep and goat production. [(Na Allah *et al* 2019)] Moreover, livestock production in developing countries such as Nigeria experienced sporadic year round shortage in supply of pasture both in quantity and quality despite the abundant supply of feed at the late rainy season. Furthermore, there are increasing indices towards intensification of livestock in Nigeria. [Muhammad *et al* 2007].The major cereal crop residues in the northern guinea savanna zone of Nigeria are maize, sorghum stoves, rice straws and chaffs. These constitute the bulk of ruminant livestock feed in the dry season, A pressing technology can make the feed product into a wafer form . The wafer of feed supplement is made of fibre,especially fresh green as a replacement fot ruminants in order to utilize the the fibre when the quantity and quality of forages decrease (Retnani *et al* 2010) the formulation of livestock feed inform of wafer will offer several advantage; ease of transport, storage and use. It is therefore hoped that the result of the present study will awaken scientist to conduct research in

the production of livestock feeds in form of wafer, for use by Livestock owners in semi-arid Nigeria. [Mohammed et al 2010

MATERIALS AND METHODS

Experimental site

The experiment was carried out at the Biochemistry laboratory of the Department of Animal Science,Federal University Kashere, Gombe State. The study area is located at an elevation of 431m above the sea level. It's coordinate lie between latitude 9°46"0"N and longitude 100°57'0" E, Altitude NPC, 2006 census).The annual rainfall ranges between 800mm-900mm per annum and is characterized by distinct dry season (October - May) and rainy season (June - September). The annual temperature ranges from 30-32° C.

Experimental Material Preparation

The feed stuff materials used were maize bran, starch, maize grain, urea, single super phosphate (SSP), groundnut cake, molasses and rice straw. The ingredients used were divided into 4 categories: Energy sources constituting maize grain, maize bran, rice bran and molasses, Protein sources are groundnut cake and Urea, Mineral source includes salt (NaCl) and single super phosphate (SSP) as source of phosphorus (P), calcium (Ca), and Starch as binder. The levels of starch inclusion in the diets were 12, 14, 18, 22, and 26%. The ingredients were weighed using a digital weighing scale. Urea, SSP, molasses and the binder were dissolved in 2 liters of water; it was then gradually sprinkled on the feed ingredients and thoroughly mixed.

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Experimental Design

Complete randomized design was used, the feed mixture was put into 3 cubic metal containers; each measuring 25 x 10 x 5cm^3 and replicated three times. The mixture was then compressed and then carefully oven dried at 60.5^{o}C for 3 days. Following oven drying, the wafers were carefully removed from the containers and put into a carton for safe keeping for determination of tensile strength.

Determination of Tensile Strength

Tensile strength was determined by subjecting the wafer to pressure from known weight until crack was observed; the wafer was made to withstand a longitudinal stress by placing it on two (2) vertical stands each measuring 15cm above ground and 15cm between stands. The wafer was placed perpendicular to the two (2) stands. Sand bags of known weights were gradually placed until crack was observed, the weight of the sand bags that produce crack were recorded as tensile unit.

Chemical analysis

The wafers formulated were subjected to proximate analysis at the Biochemistry laboratory of the Department of Animal Science, Bayero University, Kano for Crude protein (CP), Dry matter (DM), Crude Fibre (CF), Ether Extract (EE), Acid Detergent Fiber (ADF) and Neutral Detergent Fiber (NDF) while Nitrogen Free Extract was calculated. The samples were analyzed according to the procedure of (Nexperia 2018). Metabolizable energy of the wafers were estimated using the method of (Jim,R and Mika.M 1999):Metabolizable energy [(ME) Mekcal/Kg] = 37(%CP) +81.1(%EE)+35.5(%NFE) Cellulose = ADF – ADL , Hemicellulose = NDF –ADF. Organic matter (OM) = DM - ASH.

Statistical analysis

Data collected for tensile strength were subjected to simple descriptive statistics while proximate compositions were analyzed using analysis of variance (ANOVA). Significant differences between the means were separated using Duncan's multiple range test (DMRT, 1955). Differences between the means were considered significant at 5% level of probability ($P \leq 0.05$).

Table1. Level of starch inclusion (%) as binder of feed ingredients in livestock wafer

Ingredients	T1 = 10%	T2 = 14%	T3 = 18%	T4 = 22%	T5= 26%
Energy Sources					
Maize	17	17	17	17	17
Maize bran	10	10	10	10	10
Rice straw	52	50	46	42	38
Molasses	1	1	1	1	1
Protein sources					
Groundnut cake	5	5	5	5	5
Urea	1	1	1	1	1
Mineral Sources					
Salt (Nacl)	1	1	1	1	1
Single super Phosphate	1	1	1	1	1
Binder					
Starch	10%	14%s	18%	22%	26%

RESULTS AND DISCUSSION

Results

Strength of the wafer (gram)

Table 2 shows the tensile strength of the levels of starch inclusion (10, 14, 18, 22 and 26%) as binder in livestock wafer. The result revealed that as the level of binder increased, the strength also increased.

Table 2: Tensile strength (g) of levels of starch inclusion (%) as binder in livestock wafer

Level of inclusion (%) of the binder	Weight in grams (g)
10	1016
14	1216
18	1383
22	1550
26	1733

Chemical Composition of the formulated Wafer

Table 3. Presents the chemical composition of the wafers prepared from the graded levels of starch as a binder. The values of CP obtained showed significant variation ($p<0.05$) in the formulated wafer. Among the treatments examined highest Crude Protein (21.35%) were obtained from 10% inclusion level whereas the least CP was recorded for 26% inclusion level (17.23%). Dry Matter at 26% inclusion level (92.70%) was recorded while the least is 10% inclusion level (91.26). The values obtained for Ether Extract (EE) ranged between 3.55% to 1.45% at 10% and 26% inclusion levels respectively. Crude Fiber (CF) was significantly ($p<0.05$) different and the values varied from 39.97% in 10% and 21.97% in 26% levels of inclusion while highest CF value was obtained from 10% level of inclusion

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Table 3: Proximate composition (%) of livestock wafer containing graded levels of starch as a binder

Treatment (%)	DM	MC	Ash	OM	CP	CF	EE	NFE
10	91.26^{c}	8.74^{a}	12.25^{a}	86.20^{a}	21.35^{a}	39.97^{a}	3.55^{a}	30.34^{d}
14	91.57^{c}	8.43^{ab}	12.14^{a}	85.79^{ab}	20.41^{ab}	36.99^{b}	2.46^{b}	34.11^{c}
18	92.45^{ab}	7.55^{bc}	11.45^{b}	85.25^{abc}	20.48^{bc}	36.91^{b}	2.05^{bc}	34.37^{c}
22	92.66^{a}	7.34^{c}	9.48^{b}	84.53^{bc}	19.05^{cd}	36.02^{b}	1.80^{bc}	38.67^{b}
26	92.70^{a}	7.30^{c}	9.38^{b}	84.25^{c}	18.23^{d}	21.97^{c}	1.45^{c}	51.34^{a}

a, b, c, d: Means with different superscript within column differ significantly (P<0.05).DM=dry matter, MC=moisture content, ash, OM=organic matter, CP=crude protein, CF=crude fiber, EE= ether extract, NFE=nitrogen ether extract.

Discussion

The increment in tensile strength with increase in the level of starch inclusion was in agreement with (Chalapathi V.Y and Van T.O 2010) who reproted that liquid binders are added to a dry substance in order to draw it together in such a way that it maintains a uniform consistency. (Mazid *et al* 1997) [8] also reported that starch as a binder considerably improved the durability and hardness of low quality of alfafa chops. The CF level was slightly above the range of 35.55-36.01% as reported by Adebis *et al* 2019. The CP content is below the range of 36.65-36.01% as reported by (Retnani *et al* 2010) this may be as a result of difference in the CP of the materials used as difference in the CP level of *Carica Papaya* L. and rice straw and the formulation process. The CP was slightly above the value of 16.79-15.22% as reported by Abdoulaye *et al* 2013.The decrease in moisture content of the wafer as a result of increase in the level of starch inclusion was in agreement with (Abdoulaye et al 2013 who stated that the moisture content of flour decreases when the level is increased. Also the result of MC obtained is slightly lower than that of (Syarief and Halid 2008) and who stated that the activity of microorganisms and enzymes can be suppressed at or lower than 12-14% of moisture content so that the material couldn't easily mold and rot at storage.

CONCLUSION

From the result obtained its therefore, conclude that starch is a good binder in the formulation of livestock wafer and the graded levels examined; it is therefore recommended that starch at 26% level of inclusion is best for livestock wafer formulation due to its high binding ability. While the CP was within the requirements for livestock production, it is therefore recommended for further study.

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