EVALUATION OF CORN STARCH (*ZEA MAYS*) AS FEED BINDER

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ABSRACT

This experiment was conducted to evaluate the suitability of cornstarch as a local alternative binding agent, which is effective and nutritive. The binding property of cornstarch in feed pellet, increased significantly with the levels of inclusion in fish feed production Ten percent (10%), inclusion level was found to be appropriate in producing desirable water stable pellet that is also firm to handling during transportation and storage.

Keywords: Cornstarch, binding agent, fish feed, pellet.

CITATION

Orire, A. M., Sadiku S. O. E. and Tiamiyu, L. O. 2005. Evaluation of corn starch (*Zea mays*) as feed binder. **Journal of Sustainable Tropical Agricultural Research**. 16:107 - 110.

INTRODUCTION

Tropical countries are blessed with the right climatic environment favouring the production of maize (*Zea mays*) in abundance. From this food crop is obtained a binding agent, the cornstarch, for both on-farm feed production and industrial uses.

Feed, as in other animal production sector, is an essential factor and of more crucial it is in aquaculture where the medium constitutes major threat to the stability of feed before reaching the target (Pigott *et al.*, 1982; Tucker, 1989; Wood, 1993; Fagbenro and Jauncy, 1995). Thus, the attainment of a stable pellet would in the aquatic medium obviously be close to a wholesome delivery and optimum utilization of nutrient by the fish (Sadiku and Jauncey, 1995, 1998; Tiamiyu *et. al*, 2003 a, b), unlike the granulated feed whose nutrients, would almost be lost in water before reaching the target fish (Wood, 1980).

However, the prohibitive cost of the conventional synthetic binders renders pellet feed production at on-farm level a difficult exercise especially for small-scale aqua culturists. Thus, most farmers result to arbitrary inclusion of any available unconventional binding agents in the production of the pellet feed. Therefore, the finding from the research in establishing the appropriate level of cornstarch inclusion will obviously go a along way to solving the problem facing fish farmers at on-farm level, the binder level that will ensure wholesome delivery of nutrients to fish with minimum wastage (Viola *et al*, 1986) .

In addition to the appropriate level of inclusion of cornstarch, the availability of cornstarch at on farm level, will be an appropriate alternative to conventional binding agents that are either too expensive or out of reach of fish-farmers to obtain. The cornstarch is also nutritive. The result therefore, would assist in the reduction of pressure on the already stressed fresh and marine waterbodies resources - the biodiversity of these are seriously threatened due to over exploitation and over-dependence on them for fish supply to teeming population of Nigerians. The finding will invariably boost the aquaculture sub-sector of the economy as a result of reduction in cost of feed and feeding in aquaculture operation.

METHODS

- **Starch processing:** Five kilogramme (5kg) of dried maize (*Zea mays*) was soaked in water, washed and ground into paste. The paste was then squeezed out using a muslin-cloth and the filtrate allowed to settle overnight. The starch sediment from the filtrate was collected and dried in the sun of about 36° C for about 6 hours. The dried starch was then packaged in 5, 10, 15, and 20 grammes for incorporation in the five (5) diets.

- **Feed preparation and pelleting:** Binder level in the isonitrogenous diet formula of 30% crude protein was reconstituted, with the use of corn starch at inclusion levels of 0, 5, 10, 15 and 20 % as diets 1, 2, 3, 4,and 5 respectively (Table 1). The cornstarch was mixed in its powdery form with the formulated feed ingredients and 120 % v/w boiled water was added and stirred thoroughly to obtain good dough. The formed dough was then fed into a motorized miller (Pelleter) with a 3 mm die. The pellet strands were then cut at 5 mm length; sun dried (36°c) for 6 hrs and packed.

Table 1. Percentage composition of diets with varying levels of cornstarch as feed binder.

Feedstuff	Diets				
	1	2	3	4	5
Soybean meal	37.26	37.26	37.26	37.26	37.26
Fish meal	13.64	13.64	13.64	13.64	13.64
Corn bran	16.37	16.37	16.37	16.37	16.37
Guinea corn bran	32.74	32.74	32.74	32.74	32.74
Yam starch	0	5	10	15	20
Vit.-Min-Premis*	20	15	10	5	0
Proximate composition					
moisture	7.43	13.40	16.81	20.21	23.61
Crude protein	28.91	28.91	28.91	28.91	28.91
Ether Extract	9.9	9.9	9.9	9.9	9.9
Ash	26.19	21.19	16.19	11.19	6.19

* *Vitamin-mineral premix is as contained in Sadiku and Jauncey (1995 and 1998).*

Evaluation of physical properties of the pellets:
The following physical tests were conducted on the pellets, namely; pellet ability, dust level, hardness, friability and water stability.

Pelletability: The pelleted feed was sifted to separate the well-formed from the unformed. The percentage pellet ability was obtained by expressing the total number of well-formed pellets as percentage of the total number of pellets produced.

Hardness: The procedure used was to determine the force required to cause a pellet to fragment under pressure. This gives an indication of pellet's degree of hardness. A pellet sample of 5 mm in length was placed longitudinally between two rods in an improvised pentagon nut, and gently tightens the grip. The pentagon nut was then turned and the calibration read when the pellet gets broken. This was repeated for 24 more pellets and average reading taken.

Friability: Fifty grams (50 g) of pellet sample was put in a container and fixed on to a rotary machine at different preset speed levels of rotation per minute (rpm) (e.g.40, 63, 80, and 100 rpm) for 20 minutes. The dust generated from the agitated pellets was then collected through 2 mm sieve, and was weighed and expressed as a percentage of the sample weight.

Water stability: Fifty gram (50 g) of pellet samples was placed in a beaker into which 200 ml of tap water was added. It was allowed to stand but with an occasional gentle shaking for 20 seconds every 2 minutes for 20 minutes. The content of the beaker was then passed over a 2 mm sieve, the particles retained was then sun-dried (about 36° C) for about 6 hours, and then weighed. The weight was then expressed as a percentage of the original sample dry weight. This was done for all the diets in respect to their starch level.

Dust: Fifty grams (50 g) of pellet sample was placed under normal stress-condition, such as handling, packaging and transportation for a period of two (2) weeks. The dust particles produced was collected through a 2mm sieve and was its weight expressed as a percentage of the original sample weight.

Experimental design: Completely randomized block design was used for the experiments on pellet ability, hardness, dust and water stability while a 5x4 factorial design i.e. 5 starch levels of inclusion in the feed x 4 levels of rpm was adopted for pellet friability.

Statistical analysis: The data was subjected to arc-sine transformation (Zar 1984) before being analyzed by a one-way Analysis of Variance (ANOVA). Means comparison was done using multiple range of test (Steel and Torrie, 1960).

RESULT

In Table 2, the pelleted Cornstarch (binder) shows a significant difference among the parameters measured; the percentage dust level was found to be significant ($p<0.05$) among different starch levels. The dust level was highest at 5% level of starch inclusion and lowest at 15% level. The pellet ability percentage also differs significantly ($p<0.05$) with 20% starch level exhibiting the highest percentage of pellet ability. Similarly, the hardness of the feed also varied significantly with varying level of starch inclusion ($p<0.05$). The feed with 20% starch level was hardest while that with 5% level of inclusion was the weakest. On water stability test, there was a significant difference with feed with 10% starch level yielding the most stable pellet while that with 20% level of binding inclusion yielded the least water stable. Friability test, showed that each feed were significantly different from each other irrespective of the rotation per minutes (rpms). Moreover, the friability percentage was highest at 5% and 20% level of inclusions at 80 rpm and 100 rpm respectively and was lowest at 0% starch level at 40rpm (Table 3)

Table 2. Physical Parameters of Cornstarch based feed

	Starch Level				
Parameter	0%	5%	10%	15%	20%
Dust	0.12b	0.18c	0.10ab	0.07a	0.12b
Pellet ability	90.11a	92.86b	90.52a	90.52a	95.66c
Hardness	5.16b	3.36a	5.12b	3.76a	5.16b
Water stability	46.03c	46.53d	47.24e	45.66b	41.61a

Data on the same row carrying different letters differ significantly from each other ($p<0.05$

Table 3: Friability of feed with different level of cornstarch inclusion.

Rotation per minute (rpm)	Level of starch inclusion				
	0%	5%	10%	15%	20%
40	0.04a	0.10c	0.05ab	0.06bc	0.10c
63	0.07a	0.12b	0.08a	0.12b	0.13b
80	0.09a	0.19c	0.11a	0.13ab	0.16c
100	14bc	0.12ab	0.10a	0.10a	0.19c

Data on the same row carrying different letters differ significantly from each other ($p<0.05$).

DISCUSSION

The pellets with 15% starch inclusion had the lowest dust level. At 20% level of inclusion, when the pellet was hardest, the dust level was equally high and water stability lowest (Table 2). However, at 10% level of starch inclusion the pelletabilty was at its optimum (90.5), with minimum percent dust level (10%), and with good water stability which equally depicted reasonable hardness. On the friability evaluation, there was a decrease in friability percentage from 0.11 to 0.10 at 100 rpm at 10 % level of starch inclusion (Table 3). Thus, at 10% level of inclusion the pellets yielded minimum dust and exhibited good water stability. These properties thereby make 10% the appropriate level of cornstarch inclusion which would ensure stable pellets that will not easily disintegrate in the aquatic medium (De Silva and Anderson, 1995). According to Winter (1994), unstable feeds, which disintegrate in water in less than an hour, can lose about 20-30% of its nutrient. A good feed should be water stable with minimum leaching of water soluble component of the diet to ensure optimum utilization of feed (Jobling, 1994; De Silva and Anderson, 1995)

According to Jauncey (1992) a good feed should spend at least 20 minutes in water before disintegration, and as for cornstarch this is attained at 10% level of inclusion. This period is considered long enough for the fish farmer to know whether his fishes are interested in the feed or not, however, this is varied among species of fish and their feeding habit (Pigot et al., 1989; Winter, 1994; Stivers, 1970; Nandeesha, 1993 and Jose, 1994). Moreover, pellets for slow eating fishes and crustaceans must remain for hours in water without disintegration (Ronald, 1989)

Therefore, it can be concluded that at 10% level of inclusion of cornstarch in feed, there will be attainment of pellets that is firm to handling and water stable.

ACKNOWLEGEMENT

We are grateful to the International Foundation for Science Research Project of the Department of Fisheries, Federal University of Technology Minna – Nigeria for providing the mill for the research and made available its computer for processing the result and the manuscript

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