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Use of High Content Fish Silage Wet Food in Final Growth out of Pacú (*Piaractus mesopotamicus*, Holmberg 1887) in Northeast Argentina

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Abstract: The effect of two diets containing fish acid silage were studied, the first one offered as dry diet and the second one as a wet diet, in final culture cycle of Pacú. Previous experiences showed that diets without fishmeal maintain same growth rate in semiintensive system, compared to diets containing 8% and 20% fish meal. Feeding trials were carried out in CENADAC (27°32′ S,58°30′ W) in a semi intensive pond culture system for 122 days. Two experimental feed including fish silage, a liquid product obtained of fish residues treated by enzymes action, were formulated. Fish silage was prepared by mincing and blending fish viscera with sufficient formic acid (2.11% v/w) to attain a stable pH of 3.5. Fish were daily fed initially with the dry ration at 1.3% bw/d and at a rate of 0.55 g of protein/100 g of fish with the wet ration. At the end of the experience the average weight observed for dry fed fish was 1,513.5 g and 1,560.3 g for those wet fed. The daily growth was 3.69 g/d for the first group and 3.9 g/d for the second one. The final FCR was 2.72 and 3.01 for each group without significant differences. These results showed that it is possible to grow out pacú with wet self made feed without fish meal and with similar growth that those fed dry diet.

Key words: *Piaractus mesopotamicus*, feed, fish acid silage.

1. Introduction

Pacú (*Piaractus mesopotamicus*) is a fast growing fish species inhabiting the La Plata basin in South America. However the species disappeared over 20 years ago from the Uruguay River and more recently from a great portion of the Paraná river. The disappearance has been mainly due to environmental changes in the basin related to dam construction [1].

Since year 2000, pacú production has increased from 70 to 600 TM/year in Northern Argentina. Large size pacú of 1.2 kg/pc is preferred by local consumers. Reported growth period required to reach this market size under semi-intensive pond culture conditions at low stocking densities (0.2 ind/m2) and no water exchange or supplementary aeration is approximately 16 months [2, 3].

The pacú is considered an omnivorous fish with trend to herbivorous [4], for that reason it is feasible to suppose that it can be fed with a low content or even without fish meal, which would represent a lower productive cost.

Long term pond feeding trials carried out at the CENADAC found out that diets with 8% fish meal or 12% fish acid silage and without fish meal had similar growth that those with a inclusion of 20% fish meal [5].

The use of wet food is a good choice for small fish farmers (lower than 10 TM fish/year) because it can be made daily according to requirement. The fish acid silage can substitute totally or partially fish meal, a high cost ingredient, and promotes the utilization of fish viscera and other fillet residues. Animal residues are a great nutrient and energy reservoir that can be transformed in a product of high biological value such as in the fish acid silage.

Simple equipment is required to make fish acid silage, a meat grinder and a mixer. Same equipment is used to make the wet diet. This type of diets has been widely tested within different species, different levels of acid silage (between 40%-80%) in formula and different types of organic and inorganic acids [6-8].

Microbiological quality of fish acid silage has been proved by several authors [9, 10]. The objective of this study was to evaluate performance of a wet diet compared to a dry one, both with inclusion of fish acid silage.

2. Materials and Methods

Feeding trials were carried out in CENADAC (27°32′ S, 58°30′ W) in a semi intensive pond culture system for 122 days, with three ponds (300 m2 each one) allocated per dietary treatments.

Two experimental feed including fish silage were formulated, the first one (treatment A) offered as dry pellets contained, fish silage (20%), meat meal (18%) soybean meal (41%), and rice bran (17%). The second one (treatment B) offered as wet pellets contained, fish silage (40%), meat meal (10%), soybean meal (30%), and rice bran (16%). The composition of both diets is showed in Table 1.

Fish silage was prepared by mincing and blending fish viscera with sufficient formic acid (2.11% v/w) to attain a stable pH of 3.5 according to Manca and Carrizo [11]. Chemical composition of the silage was as follows: moisture 76.8%, crude protein 12.8%, fat 8.6%, and ash 1.6%. Stabilized acid silage was stored at room temperature inside sealed plastic flasks until used.

Water quality variables were monitored twice daily, including temperature, dissolved oxygen and pH during the early morning and late in the afternoon prior to feeding.

Table 1 Feed rations tested during the feeding trial (values expressed as percentage).

Ingredients	Dry food (A)	Wet food (B)
Meat meal	18	10
Fish silage	20	40
Soy meal	41	30
Rice bran	17	16
(PO4)2Ca3	2	2
Vitamin	1	1
Salt	1	1
Total	100	100
Crude protein	32	25
Moisture	10	33

Fish were fed once daily, six days per week, initially at 1.3% of their body weight per day for those fed with dry ration and at a rate of 0.55 g of protein/100 g of fish per day for those fed with wet ration.

The way to estimate the amount of wet feed is shown in Box 1. Food conversion ratio (FCR) was calculated in dry basis in order to compare both diets.

Box 1 Step by step wet feed calculate mode:

Q = protein content (g)/100 g of fish, so 0.55 g

prot/100 g fish = 5.5 g prot/kg fish;

B = biomass of fish (kg), e.g.: 150 kg of fish;

A = amount of feeding protein = Q × B (g) e.g.: 5.5

g/kg × 150 kg = 825 g of feeding protein;

PF = protein in feed (g/kg feed) e.g.: 25% = 250 g

of protein/kg of feed;

DD = daily diet = A/PF = Kg feed;

e.g.: 825 g/250 g/kg = 3.3 kg feed.

Ten percent of fish population was sampled on a monthly basis, to determine fish growth, fish health and to recalculate required feeding rate.

All the fish were weighted at the end of the experiment. Survival rates and overall yield were determined, as well as feed conversion ratio (FCR = food offered/weight gained) and daily growth (DG = (final weight-initial weight)/time).
Statistical data analysis was performed and treatments groups were compared using one-way ANOVA, according to Hintze [12].

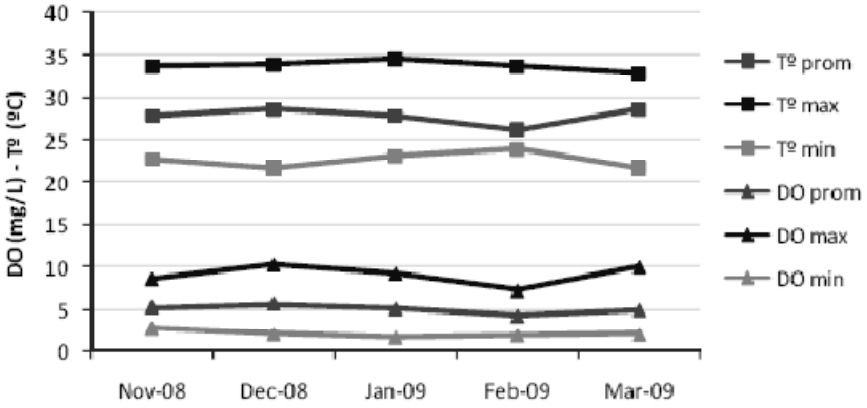
3. Results and Discussion

3.1 Water Quality Results

Mean water temperature during the feeding trial was 26.5 °C (Fig. 1), with maximum value found on January of 34.6 °C, and a minimum at the end of summer, March of 21.7 °C. Mean dissolved oxygen resulted 4.5 mg/L. Dissolved oxygen levels reached maximum and minimum peaks during January, ranging from 10.2 mg/L in the afternoon to 1.66 mg/L in the early morning. Water pH values displayed an average of 7.71 over the culture cycle, with slight daily and seasonal variation ranged from 7.50 to 7.88.

Results show no different from those obtained at the same site in different years of typical summer season [5, 13].

Fig. 1 Mean dissolved oxygen and water temperature registered during culture cycle.



3.2 Growth Response

Average final fish weights were 1,513 g for those fishes that consumed dry feed and 1,560 for the group fed with wet diet; differences between treatments were statistically significant ($P = 0.001$).

Fish growth during the feeding trial with both diets is shown in Fig. 2. Average daily growth resulted of 3.69 g/day for the dry feed group and 3.90 g/d for wet diet group, without statistically significant differences ($P = 0.5$). Previously reported studies ranged between 2.62 g/d [14], and 5.65 g/d [5] during final growth phase. Present values are located between those reported by these authors.

Galli Merino et al. [13] reported a daily growth of 3.7 g/d using commercial feed composed only with vegetables ingredients, similar results were obtained with the dry feed in this experiment.

The high percentage of soybean meal (41%) used in treatment A and the antinutritional factors contained in this ingredient may explain the lower growth (although not statistically significant). Perez et al. [15] in an "*in vitro*" digestibility assay with pacú, found a high sensitivity to inhibitors present in soybean meal. Alkaline proteases were highly inhibited in presence of moderated concentrations of soybean extract.

The survival rate was 100% and the harvest at the end of the experience resulted of 2.57 TM/ha for both treatments (Table 2). Wicki et al. [3] reported a final production of 2.89 TM/ha for a two summer pacú culture at 0.2 ind/m2 density. The difference was due to the lower density used in the present experiment (0.17 ind/m2).

Average food conversion rate (FCR) resulted of 2.72 for treatment A and 3.01 for treatment B, without statistically significant differences ($P = 0.39$). The FCR obtained resulted higher than those reported by Wicki et al. [14] of 2.37 and Wicki and Luchini [5] of 1.96, both using dry feed and a lower feeding rate (1%).

Value of 2.66 was reported by Galli Merino et al. [13] with commercial feed and the same system culture. Average FCR obtained with wet diet resulted higher compared with those reported by Toledo et al. [7] of 1.78. This author suggests a feeding rate of 0.43 g CP/100 g fish for *Clarias gariepinus.* High feeding rates could be the response of high FCR with little weight gain.

Fig. 2 Growth of pacú with different diets.

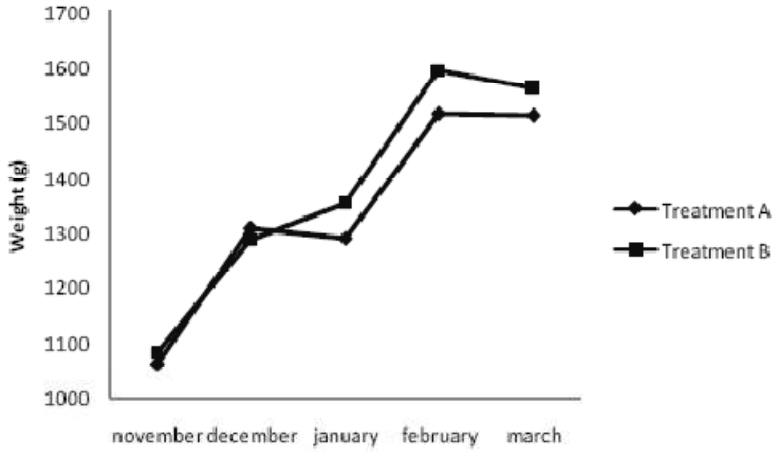


Table 2 Growth performance of Pacú fed different diet, dry (A) and wet (B).

	Treatment A	Treatment B
Initial weight (g)	1,062.84	1,084.32
Final weight (g)	1,513.50	1,560.34
Survival (%)	100	100
Culture period (days)	122	122
Days fed (days)	78	78
final harvest (kg/ha)	2,572.95	2,575.16
FCR	2.72	3.01
DG (g/d)	3.69	3.90

4. Conclusion

Pacú accepts wet diet easily, with weight gain compared to dry diet. In future experiences it will be determined if the better growth obtained with wet diet has been due to better feed quality of wet diet or higher feeding rates.

Good quality pellets are obtained with 40% fish acid silage included in feed. Feeding rate must be adjusted in future studies in order to obtain lower FCR.

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