Sustainability in Environment
ISSN 2470-637X (Print) ISSN 2470-6388 (Online)
Vol. 3, No. 4, 2018
www.scholink.org/ojs/index.php/se

Original Paper

Trial of Using Blood from Slaughtered Chicken to Replace Fishmeal in the Feed of African Catfish *Clarias Gariepinus*

Farokh Niass[1*] & Ouleymata Gaye[1]

[1] Section Aquaculture, UFR des Sciences Agronomiques d'Aquaculture et de Technologies Alimentaires (S2ATA), Université Gaston Berger, Saint-Louis, Sénégal

[*] Farokh Niass, Section Aquaculture, UFR des Sciences Agronomiques d'Aquaculture et de Technologies Alimentaires (S2ATA), Université Gaston Berger, Saint-Louis, Sénégal

Received: October 26, 2018 Accepted: November 22, 2018 Online Published: November 29, 2018

doi:10.22158/se.v3n4p393 URL: http://dx.doi.org/10.22158/se.v3n4p393

Abstract

The aim of the work was to reduce the cost of the food produced and to value blood from poultry. It consisted of collecting the poultry blood, turning it into flour and incorporating it into the feed intended to feed Clarias gariepinus fry. Next, an attempt was made to determine the effect of the poultry blood incorporated in the locally produced feed on the growth of Clarias gariepinus fry. To do this we substitute completely the fishmeal that was used, which is expensive with the blood meal that is found to be free. Thus, three lots of 100 Clarias gariepinus fry of 2.01g mean weight were placed in three fiberglass tubs. In each tub we have distributed a specific feed. For each type of food a quantity of 2.5kg was used. A daily ration of 5% of fry biomass was used throughout the study. They were fed 9 times a day. It is noted that the industrial food is better but there is no significant difference between locally made foods that based on fishmeal and that with poultry blood meal. So it is possible to replace fishmeal with poultry blood meal in locally made feeds.

Keywords

fishmeal, blood meal, aquaculture feed, Clarias gariepinus, diet

1. Introduction

Aquaculture is now one of the fastest growing food production sectors, with an annual average growth rate of 8.8% (FAO, 2012). Over the past 50 years, its global production has grown significantly. With a production of less than one million tons in the early 1950s, it increased to 45.5 million tons in 2004. It has grown at an average annual rate of 8.8% since 1970, compared with only 1.2% for capture fisheries (the production of which has stagnated around 90 million tons in recent decades). Today, 50% of fish

on the world market come from aquaculture, while this share was only 9% in 1980. Aquaculture continues to grow at a faster rate than all other sectors of food production of animal origin (FAO, 2006). This prodigious growth is the result of research and innovation in the control of culture management and especially in feeding.

However, these spectacular results in aquaculture are less visible in some parts of the world. This is the case in Senegal where the fish farming sector has not yet reached a viable economic dimension. It continues to occupy a minor place despite its natural potential. Senegal has always recorded low aquaculture production despite its enormous bio-physical potential. One of the major constraint to the emergence of this sector in Senegal is mainly related to the high cost and the quality of the feed. This quality is lacking because of the lack of feed factory but also because of the cost of the ingredients particularly that of fishmeal, is very high. Feed costs represent the greatest expense in the total production cost for aquaculture (Ghanawi et al., 2011; Fatan et al., 2005).

So to increase aquaculture production, we must consider improving the quality of food while reducing its cost, which represents 50% of investments. There are several approaches to reducing the cost of feed. The most effective is replacement of fish meal with alternative plant protein sources (Bulbul et al., 2012). Crop based aquaculture feeds containing soybean meal protein, canola meal, extruded pea seed meal, wheat and corn meal supplemented with lysine and methionine has been used in the formulation of aquaculture feed for catfish, tilapia and carp without affecting the growth performance of the fish (Tacon & Metian, 2009). But Dabrowski (2010) pointed out that replacing of fishmeal protein with plant proteins will result in high proportion of released organic nutrients into ponds because vegetal materials carry some antinutrient factors. To prevent this we tried in this study to use animal protein for replacement of fishmeal. It was with the aim of reducing the cost of the locally produced food and of valuing the blood from poultry slaughterhouses that we had the idea of substituting fish meal with poultry blood meal. It should also be noted that fishmeal is expensive and its quality is sometimes lacking while poultry blood is free and can be stored or processed. To study the performance of the feed containing poultry blood on fish, *Clarias gariepinus* fry have been placed in fiberglass tubs and they were fed for 40 days by two diets. The first diet consisted of a feed containing poultry blood meal and the other consisted of a local feed containing fish meal.

2. Material and Methods

The study took place at the north office of the National Aquaculture Agency (ANA). It is located in the town of Richard Toll. This commune is established on the banks of the Senegal River (16 ° 27'N, 15 ° 42W), on both sides of the Taouey marigot, which connects the Senegal River to Lake Guiers. Richard Toll is 106 km from Saint Louis and 28 km from Dagana (Figure 1).

The fish that was chosen for this study is *Clarias gariepinus*. To carry out the experiment, three hundred *Clarias gariepinus* fry with an average weight of 2.1g were placed in 3 fiberglass tubs (100 fry per tub).

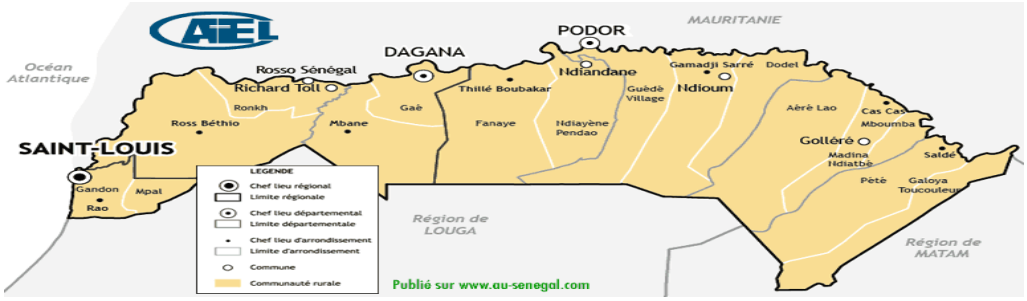


Figure 1. Map of Saint-Louis Region, Northern Senegal

2.1 Collection and Processing of Liquid Blood into Poultry Blood Meal

To get the 2.5kg of pelleted feed needed for the test we used 500g of chicken blood meal. This flour was obtained through a transformation of 7 liters (l) of poultry blood. This quantity of blood was collected with the collaboration of a resident poultry farmer in the village of Khouma. This 7 liters of blood was collected after the slaughter of 135 broilers. The blood was collected on plastic bowls during slaughter and the bowls were subsequently sealed. After the collection the bowls were transported to the laboratory of the station. Not having a machine suitable for the transformation of blood into flour in the station, this stage was done in an artisanal way with the means of edge. It was done in three stages: dehydration, drying and grinding. Dehydration has two stages: dehydration on the micron mesh screen and dehydration on the paper towels. For drying, one step is made in the laboratory and another in the open air and finally the grinding which has two phases: the grinding with a mortar and sieving (Figure 2).

Here are some of the steps in this process (Figure 2):

✓ After collection, the blood is poured into a micron mesh sieve, and then exposed in the office lab to avoid the action of sunlight and moisture. This step is called dehydration on micron mesh sieves. It makes it possible to filter a large quantity of the blood water;

✓ After 72 hours of exposure, we note that the blood lost 70% of the water it contained and a fairly pasty mass is obtained;

✓ This mass was subsequently removed from the sieve and cut into small pieces which were placed on absorbent paper to better remove the water;

✓ The material had become stronger and brittle after 96 hours of exposure in the laboratory;

✓ This mass was once again put on a tray and was covered by a mosquito net to prevent insects from landing there;

✓ The tray has been moved outwards and has been exposed to the open air to obtain a brittle mass to ensure better product quality;

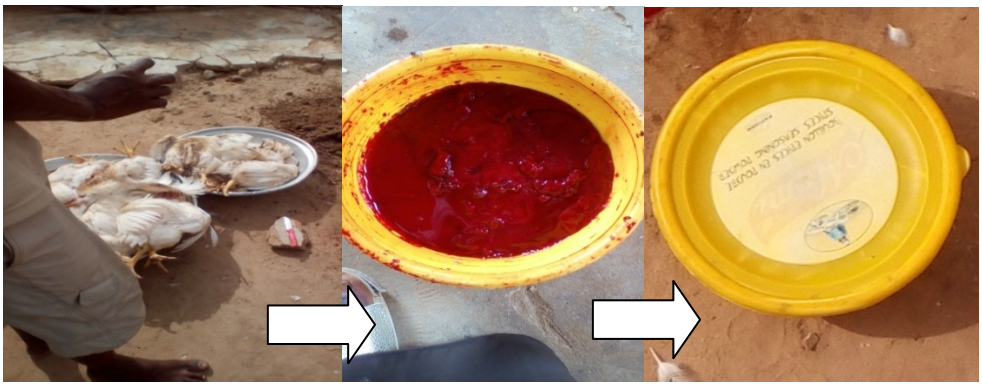
✓ After 72 hours of exposure in the open air a very strong and brittle mass was obtained;

✓ This mass was put in a mortar and it is the grinding phase that followed;

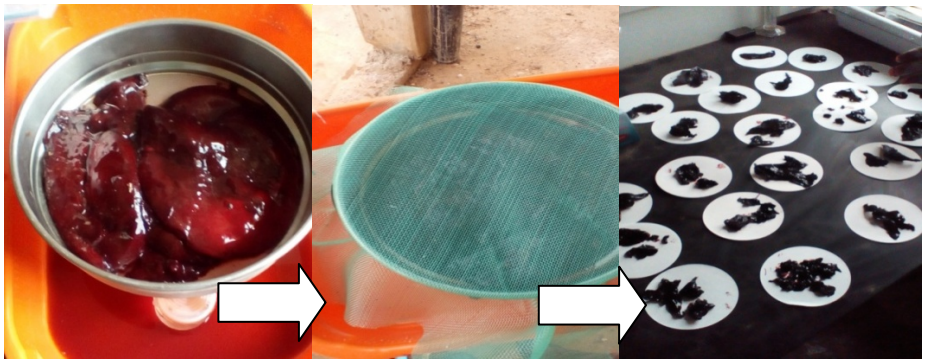
✓ The blood was crushed and sieved thus the poultry blood meal was obtained;

✓ After grinding and sieving, the powder obtained was weighed using the electronic scale and the 500 g of blood meal was obtained;

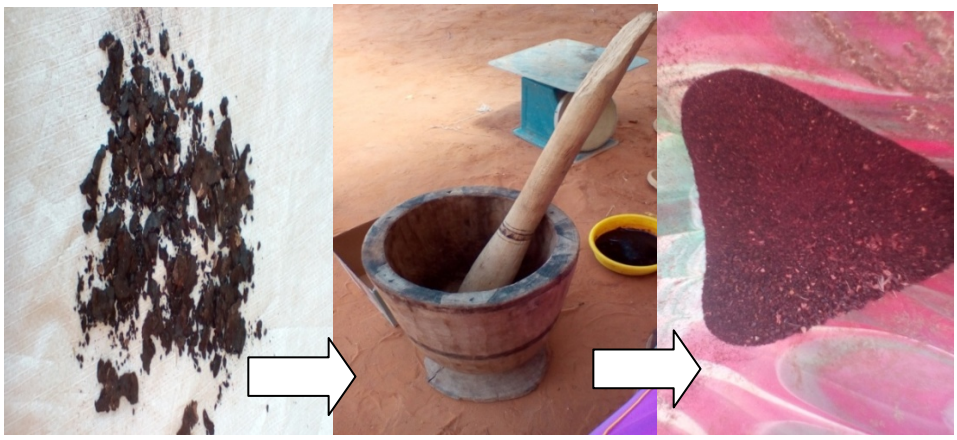
✓ The flour has been stored in a bowl before being used with other local by-products.



A. Slaughtering B. Collected blood in plastic bowl C. Sealed bowl containing blood



D. Drying on the micron mesh screen E. Drying outside F. Drying on paper towels



G. Dried blood H. Grinding I. Blood powder

Figure 2. Pictures of Different Stages of Transforming Poultry Blood into Powder: A) Slaughtering, B) Collected Blood in Plastic Bowl, C) Sealed Bowl Containing Blood, D. Drying on the Micron Mesh Screen, E. Drying Outside, F. Drying on Paper Towels, G. Dried Blood, H. Grinding I. Blood Powder)

2.2 Composition and Process of Manufacturing Experimental Foods

2.2.1 Composition of the Two Experienced Diets

It is with the local by-products that the R1 and R3 diets have been manufactured (Table 1).

Table 1. Composition of the Two Experimental Diets (Composition of R1 Composition of R3)

Ingredients	quantity	Unit	Ingredients	quantity	Unit
Bloodmeal	500	g	Fishmeal	500	g
Rice bran	1.125	kg	Rice bran	1.125	kg
Corn flour	250	g	Corn flour	250	g
Peanuts cake	500	g	Peanuts cake	500	g
Vitamin premix	25	g	Vitamin premix	25	g
Mineral premix	25	g	Mineral premix	25	g
Binder	25	g	Binder	25	g
Molasses	25	g	Molasses	25	g
Palm oil	25	g	Fish oil	25	g

2.2.2 Diets R1 and R3 Manufacturing Process

After verifying that all ingredients (Table 1) were available in sufficient quantities, the foods were processed. Both types of food were made in the same way (Figure 3):

The ingredients were first sieved, which facilitated digestion of the granulate feed once consumed, after sieving each by-product was weighed using the electronic balance. This made it possible to respect the dosage. The mixing step followed the weighing. This step is crucial because it allowed to have a very homogeneous product. Once the product was thoroughly mixed, it was extruded (the machine) for granulation. After this phase, the granules were spread on a tarpaulin to allow dehydration and thus avoid rancidity of the finished product. Since the size of the granules obtained was very large compared to the mouth of the fry, the granules were thus crushed to reduce the size of their diameter in order to facilitate their entry into the mouth of the fish. The product was then put into plastic bags and transported to the laboratory for storage (Figure 3).

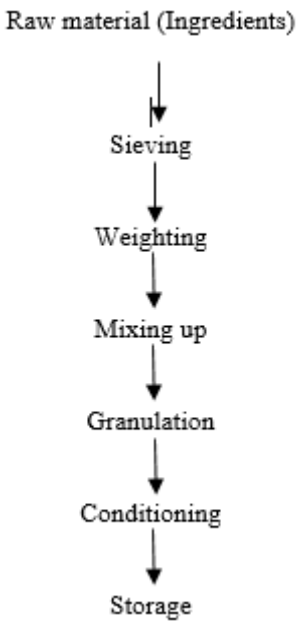


Figure 3. Local Food Manufacturing Process

2.3 Food Testing

The study consisted of putting on three fiberglass tubs lots of 100 fingerlings of *Clarias gariepinus* with an average weight of 2.01g for a duration of 45 days with a control fishing every 10 days. In tubs 1 and 3, locally produced foods were distributed there and in tub 2 an imported industrial feed was distributed there. During the experiment, the physico-chemical parameters (pH, temperature, DO) were taken daily (at 8am in the morning and at 5pm in the afternoon). To manage the quality of the water a renewal to 2/3 of its total volume was carried out every 3 days, the water was also siphoned every 2 days.

The loading of fry in the 3 tanks was done on September 1st. They were kept fasting for 24 hours to reduce stress and also empty their stomachs. It is from the next day that the first food intake was made.

2.3.1 Measuring Physicochemical Parameters

The temperature and the pH were taken twice a day in the morning at 8h before the first food distribution and in the afternoon at 17h. This allowed us to have a clearer information on the quality of the environment to better control the breeding. Sampling was done using a multifunctional device that took both temperature and pH. Level of dissolved oxygen was taken every three days (morning and afternoon).

2.3.2 Feeding

The fry were fed 9 times a day: 3 times in the morning (9h, 11h, and 13h), three times in the afternoon (16h, 17h and 18h) and three times in the evening (20h, 22h and 00h). The frequencies were maintained throughout the experiment. The daily ration rate was equal to 5% of their biomass and this rate did not vary throughout the study. So after each control fishing the amount distributed was adjusted.

2.3.3 Quality Control of the Water

The tubs water was renewed 2/3 every three days. The tubs were siphoned every other day. After each control fishing the tubs water was renewed completely and the tubs were cleaned before putting back the fry.

2.3.4 Growth Control

For growth the controlled parameters were as follows:

- Biomass

At the beginning of the experiment, we putted in the tub1 a biomass of 201 g, in the tub 2 a biomass of 200.68 g and in the tub 3 a quantity of 201.38 g. These biomasses increased throughout the study. Food rations were calculated according to the new values of the biomasses obtained. This means that after each control fishing the food rations were adjusted as well as the quantity of distributed feed.

- The average weight of individuals

The initial average weight was around 2.01 g for the 3 tubs. With the variation of the biomasses and the mortalities noted during the study we found that the average weight of the individuals also changed for the 3 tubs.

Average weight = Biomass/Number of individuals

- The individual weights and size of the 10 individuals randomly selected during each control fishing

At each control fishing10 individuals were randomly selected and their individual weight was measured using the electronic scale and a small test tube.

- Daily gain of average weight

It allows to study the effectiveness of the food used on the daily growth of the fish. It is calculated by the following formula:

GMQ (g/d) = Weight gain g)/duration of the experiment (number of days)

- Conversion index

It is used to evaluate the effectiveness of the diets used on the growth of fish.

IC = amount of distributed feed/gain of weight

- Survival rate

This rate allowed us to know the effect of substitution of fish meal by blood meal in the diet on the survival of fishes.

TS in% = (final number of individuals/initial number of individuals) × 100.

3. Results

Throughout the experiment there was a slight temperature fluctuation in the three tubs. The average morning temperature in the three tubs was about 28 ° C. And for the evening this value was between 29 ° C and 30 ° C. Regarding the pH, the data varied according to the tubs. It was higher at tub 3 with 7.395 for the evening. The pH of tub 1 was 7.385 at night. These values are the average pH values

obtained during the study. The Dissolved Oxygen (DO) was higher in the tub 3 with a means of 6.423 ppm followed by that of the tub 2 with 6.12 ppm as average DO. The smallest DO average value was obtained at tub 1 with 5.769 ppm. Table 2 summarizes the averages of the physicochemical parameters during the experiment.

Table 2. Averages of Physico-Chemical Parameters during the Experiment

Tub	Tub1		Tub2		Tub3	
Parameters	Morning	evening	Morning	evening	Morning	evening
Temperature (°C)	28.97	29.43	28.64	29.64	28.89	29.54
pH	7.22	7.38	7.22	7.32	7.24	7.39
Dissolved oxygen (ppm)	5.84	5.76	5.96	6.12	6.11	6.42

Figure 4 shows the variation of biomasses during the study. At loading, it was found that the biomass was almost identical for all tubs. But at the end of the experiment, the biomass contained in the tub 2 exceeded that of tub 1 and tub 3. It was followed by the one of the tub 1 which has exceeded barely the biomass of the tub 3. We obtained at the end of the experiment the following biomasses: tub 2: 2005.92 g; tub 1: 551.99 g and tub 3: 498.46 g.

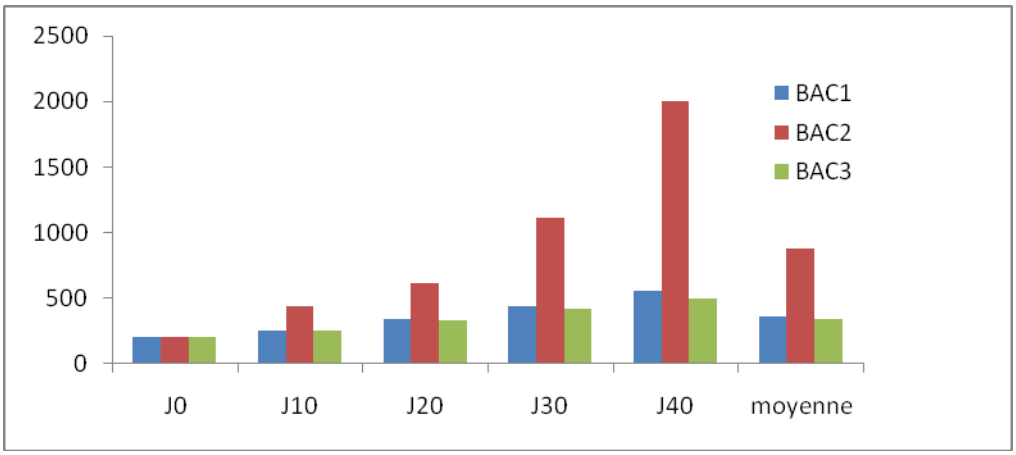


Figure 4. Variation of the Biomass (Y axis in g) in the 3 Tubs (BAC1; BAC2; BAC3) Throughout the Experiment (from Loading J0 to 40 Days J40) and Average of These Variations (Moyenne)

Figure 5 shows the variation of average weights of individuals in the tubs according to the diets. The average weight at the beginning was 2.01 g for the three tubs. At the end of the experiment, the tub 3 had the lowest average weight with 5.66 g. For tub 1 the average weight was 6.13 g.

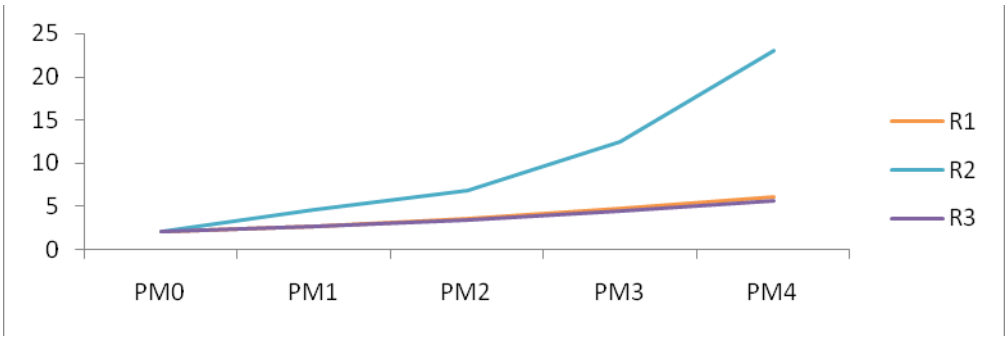


Figure 5. Variation of Mean Weight (Y-axis in g) of Fry during the Experiment from Loading (PM0) to the 4th Fishing Control (PM4) in the 3 Tubs Corresponding to the 3 Diets (R1, R2 and R3)

Throughout the experiment, the smallest daily weight gain was 0.05g/d and it happened at tub 3. The largest gain was obtained at tub 2 (1.058g/d), it happened in the last 10 days. For tub 1, the smallest daily growth was 0.061 g and the largest was 0.13 g and for tub 3 these values were 0.05 g/day and 0.127 g/day respectively (Table 3).

Table 3. Daily Growth in Grams (g) Throughout the Experiment

	D1-D10	D11-D20	D21-D30	D31-D40	Mean	Standard deviation
Diet R1	0.061	0.098	0.120	0.130	0.102	0.031
Diet R2	0.255	0.222	0.569	1.058	0.526	0.388
Diet R3	0.050	0.075	0.104	0.127	0.089	0.034

The largest conversion index (2.029) was obtained with diet 3. For diet 1, the Conversion Index (CI) was 1.774 and for diet 2 the CI was 0.676. So between diets 1 and 3 the conversion was better for diet 1 (Figure 5).

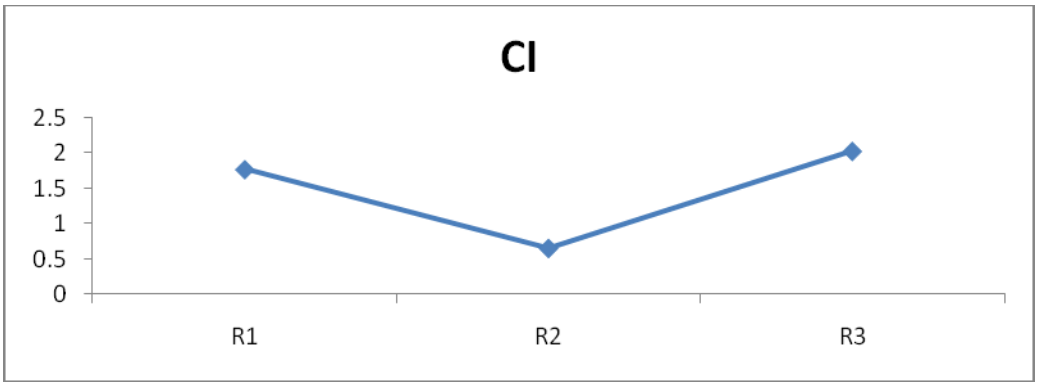


Figure 6. The Conversion Index of the 3 Diets (R1, R2 and R3)

During the study, a mortality was noted on all 3 tubs. But it was stronger at tubs 2 and 3 (respectively 13 and 12 dead fry). And for the tub 1 the number of dead fry was 10. Figure 7 gives the survival rates (SR) in the 3 tubs at the end of the experiment.

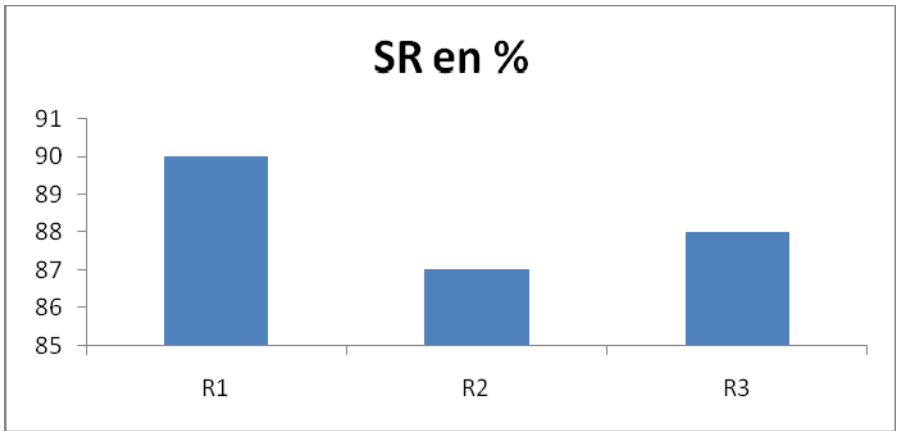


Figure 7. Survival Rates (%) of the Fry in the Three Tubs Corresponding to the 3 Diets (R1, R2 and R3)

4. Discussion

For a good growth of *Clarias gariepinus*, the temperature should be between 26 and 30 °C (Baras & Jobling, 2002). For this study the average temperature obtained in 3 tubs is included in this interval so we can say that this parameter is not a handicap for the experiment. For the first 20 days we note that the temperature oscillated between 28 and 30 °C this high temperature range is due to the fact that this period coincides with the period of heat to Richard Toll which reverberated on the fiberglass tubs. The temperature was higher in the afternoons.

The optimum pH range for *Clarias gariepinus* growth is between (6.5 and 9) (Kanangire, 2001). For the study, it is noted that the pH for the 3 tubs is included in this range because the average is between 6 and 7. The variation noted for this parameter for certain dates is mainly due to the quality of the water and also to the quality of diets. Since *Clarias gariepinus* can live in water where the pH is very low so the value of some daily pH does not constitute an obstacle for their survival.

The dissolved oxygen in the tubs is between 5 and 7ppm. The concentration is higher during the first days of the experiment especially in tubs 1 and 3. This is justified by the fact that during these periods, the fish consumed more DO and that the deposition of the food at the bottom resulted in a low DO concentration in the water. The DO greater than 3 mg/l reported by Viveen et al. (1985) is favorable for the growth of *C. gariepinus* and is the optimum for good growth of *C. gariepinus* fingerling. So the concentration obtained for the tubs is acceptable for good growth.

According to Micha (1973), the daily growth of *Clarias gariepinus* can reach up to 3 g/d, which far exceeds the results obtained in this study. These results show that the fry are growing better with the diet R2 because the food is better than the others in terms of its size, its diameter is smaller than that of

the mouth of the fry. Its flotation is also very remarkable. For the other two diets namely R1 which is based on blood meal and R3 which is based on fish meal, we can say that the two diets are not well used for the first days by fry not only because of the size of the pellets but also the fry were not used to these diets so they had trouble for consumption. This justifies the low daily growth rate obtained in the 2 tubs.

Mortality is noted in all tubs. These mortalities are for the most part results of cannibalism because throughout the experiment the sorting was not carried out in the tubs. So the bigger ones consume the smaller ones. Mortality is also caused by handling and fishing.

The Conversion Indices (CI) for the three tubs are different. CI is better for the tub 2 with 0.676, it is followed by that of the tub 1 with 1.774 and comes in third position that of the tub 3 with 2.029. We know the most the conversion index is small more the food is efficient. So for the locally made feed diet 1 is better than diet 3.

Light is for *Clarias* gariepinus a limiting factor because they are more dynamic and they better consume food in dark places. So we must point out that during all the study the fish were put under the light even during the nights the lamps of the room are lit so they are not safe from the light.

For the economic aspect, the R3 is more expensive because the fishmeal which is the base is expensive and the kilogram costs 420 Francs CFA while for the R1 the cost of the blood meal is free.

5. Conclusion

Blood meal can be obtained and used instead fishmeal because the results obtained are very favorable for blood meal. Obtaining blood meal contributes to solve two major problems: the cost of the food which can be reduced but also there the valorization of the blood coming from the slaughterhouses of poultry. The use of this source of protein (blood meal) of animal origin is more suitable than that of vegetal origin which produce more waste in rearing ponds. It is also important to point out that fishmeal contributes to the fishing pressure exerted on the pelagic resources of the ocean.

References

Baras, E., & Jobling, M. (2002). Dynamics of intracohort cannibalism in cultured fish. *Aquaculture Research*, *33*, 461-479. https://doi.org/10.1046/j.1365-2109.2002.00732.x

Bulbul, M., Kader, M. A., Koshio, S., Ishikawa, M., & Yokoyama, S. (2012). Effect of replacing fishmeal with canola meal on growth and nutrient utilization in kuruma shrimp Marsupenaeus japonicus. *Aquacult. Res.*, *45*(5), 848-858. https://doi.org/10.1111/are.12026

Dabrowski, K. (2010). Replacement of fish meal in aquaculture diets with plant ingredients as a means of improving seafood quality. *OECD Challenges for Agricultural Research*, 165-173.

FAO. (2006). La situation mondiale des pêches et de l'aquaculture 2006. *Rome*, *220*.

FAO. (2012). Situation mondiale des pêches et de l'aquaculture 2012. *Rome*, *241*.

Fatan, N. A., Al-Dohail, M. A. S., Syed Muhammad, S. R., & Hashim, R. (2005). Daily variation in

digestive protease activities in juvenile *Oreochromis* sp., Clarias gariepinus and Mystus nemurus: A basis for the mixed feeding schedule. In *7th Indian Fisheries Forum* (pp, 9-11). Bangalore, India.

Ghanawi, J., Roy, L., Allen Davis, D., & Patrick, S. I. (2011). Effects of dietary lipid levels on growth performance of marbled spinefoot rabbitfish Siganus rivulatus. *Aquaculture*, *310*, 395-400. https://doi.org/10.1016/j.aquaculture.2010.11.012

Kanangire, C. K. (2001). Effet de l'alimentation des poissons avec Azolla sur l'écosystème agropiscicole au Rwanda. Dissertation présentée en vue de l'obtention du grade de Docteur en Sciences. In *Facultés universitaires Notre—Dame de la paix, Namur, Belgique* (p. 220).

Micha, J. C. (1973). Etude des populations piscicoles de l'Ubangui et tentatives de sélection et d'adaptation de quelques espèces à l'étang de pisciculture (Study on fish populations in Ubangui and tentative selection and adaptation of some species to pond aquaculture). In *Nogent-sur-Marne, France: Centre Technique Forestier Tropical (CTFT)* (p. 147).

Tacon, A. G., & Metian, M. (2009). Fishing for feed or fishing for food: Increasing global competition for small pelagic forage fish. *Ambio*, *38*(6), 294-302. https://doi.org/10.1579/08-A-574.1

Viveen, W. J. A. R., Richter, C. J. J., Van Oordt, P. G. W., Janssen, J. J. A. L., & Huisman, E. A. (1985). *Manuel pratique de pisciculture du poisson chat africain (Clarias gariepinus)*. Direction Générale de la Coopération Internationale du Ministère des Affaires Etrangères, la Haye, Pays-Bas et Département de Pisciculture et des pêches de l'Université Agronomique de Wageningen, Pays-Bas et Groupe de Recherche d'Endocrinologie Comparative, Département de Zoologie de l'Université d'Utrecht, Pays-Bas.