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theme :

Effect of replacement of dietary fish meal by *Panicum maximum* meal on growth performance of *Oreochromisniloticus*

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Thanks

Thanks

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Dedication

I dedicate this modest work to:

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Sommary

Introduction

Introduction

The definition of aquaculture is "the art of multiplying and raising aquatic animals and plants" (**BarnabeG. 1991).** Aquaculture is the intensive or extensive production of fish, mollusks, crustaceans, and algae. Aquaculture refers to various systems of growing plants and rearing animals in continental, coastal, and marine waters that allow for the use and production of a wide range of animal and plant species. (**Benidiri, 2017**)

It is interested in several types of production, the most important of which are:

• Shellfish farming is concerned with shellfish farming.

• Pisciculture is the practice of breeding fish.

• Astaciculture is the breeding of crayfish of the genus Astacia.

• Algoculture is a term used to describe the cultivation of algae.

• Echiniculture is the practice of rearing sea urchins.

• Crustacean farming is referred to as carcinoculture. (**Benidiri, 2017**)

The types of fish farms mainly depend on the investment, the amount of fish produced per unit area and the destination of the products. They are usually characterized by their degree of intensification, itself even defined according to the practices supply; exogenous food generally represents more than 50% of the total cost of production in intensive systems. **(Fermon, 2009**)

There are four types of fish farming:

- Extensive fish farming.
- Semi-intensive fish farming.
- Intensive fish farming.
- Super-intensive fish farming

Extensive fish farming involves using the natural productivity of the body of water (algae, plankton, etc.) Which is favored very little or slightly to produce fish, along with some inexpensive complementary inputs. Unlike in other systems, he is not required to feed the fish. Farms are typically installed in medium or large ponds or bodies of water. The labor required for monitoring and water management of a small pond under 10ares is not distinct from that required for a one (1) hectare dam.This method of fish farming requires little or no capital. However, the amount of fish produced per unit area is modest. (**Sohouandal, 2009**)

Semi-intensive fish farming systems based on fertilization or complementary feeding (array1), with the understanding that natural food supplies a significant portion of the fish's diet in situ. This type of fish farming typically includes associated farms (poultry-fish, cattle-fish). (**Fermon, 2009**)

Intensive fish farmingIn which all of the nutritional needs of the pofish are met by an exogenous supply of whole foods, with no or very little nutritional supply coming from the natural productivity of the basin or body of water where the fish is raised (lake, river). Food used in these systemsfarmed is generally high in protein (25-40%) and thus costly. The quantity of fish produced per unit area is high in intensive aquaculture (Table 1). To intensify breeding and improve conditions, production factors (food, water quality, and fry quality) must be controlled. The production cycle must be constantly monitored. The pens or lcages, with very high water turnover rates, are the main breeding infrastructures of this type of fish farming (**Fermon, 2009**)

In Super-intensive fish farming system, the fish require very careful control: -food:which must be balanced and satisfactory in quantity and quality according to the species and physiological stage of the fish - different water parameters (PH, temperature, oxygenation, etc.), with a frequent renewal An example of this type of farming in Belgium, they raised Tilapias ou Nile carp (*Oreochromisniloticus*) in stainless steel tanks at a density of 300 fish per m3 with a 400% water renewal per hour. They used hot water from the cooling system of a nuclear power plant. Theirproduction is 30 kg/m3/month (fish reach 250 to 500 g/ piece).For fish feed, they used distributors that endby stems that are in the water. Every time the fish pushes the rod with his bough, some food falls into the water here. The fish learn very quickly to feed on demand. (**Lacroix E., 2004**)

At the Mediterranean level, aquaculture has developed at a steady pace and with a trend towards the diversification of farmed species which facilitates the growth of the sector (**IUCN, 2007**)

Fish meal (FM) has been used as a high-quality protein source for aquafeeds because it has well-balanced amino acid profile, high digestibility, abundant vitamins, and minerals, etc. (**Ye et al., 2011; Olsen and Hasan, 2012; Zhang et al., 2018**). However, FM demandexceeding supply due to the expansion of aquaculture, leading to its high price. Therefore, there is an emergency need to find alternative protein sources to reduce the consumption of FM and ensure a stable supply of commercial feed in the aquaculture industry (**Aragona et al., 2017; Ye et al., 2019**).

Replacement of fish meal by cheaper ingredients of either animal or vegetable origin in aquatic animal feed is necessary because of the rising cost and uncertain availability of fish meal **(Kaushik, 1990; Higgs et al., 1995**). While partial replacement of dietary fish meal protein with plant protein has been successfully accomplished in a number of teleost fishes (**Tacon, 1993**), only a few reports have appeared on the utilization of plant protein as the sole protein source in fish diets (**Smith, 1977; Gomes et al., 1995; Kaushik et al., 1995**). It is important to evaluate the nutritional value of alternative ingredients and formulate diets based on a mixture of such ingredients, which can replace fish meal in the diet of fish. Knowledge of the digestibility of these various ingredients is a basic requirement for formulating diets (**Cho and Kaushik, 1990**). Digestibility studies on tilapia species have mostly been confined to investigation of fish fed compound feeds of mixed origin. Few studies have been undertaken to evaluate the apparent digestibility coefficients of feed ingredients for tilapia (**Kamarudin et al., 1989; Hossain et al., 1992; Sintayehu et al., 1996; Degani et al., 1997; Fagbenro, 1998**).

The FAO estimates that the number of undernourished people is decreasing, but even today, 1 in 8 people suffer from chronic hunger in the world. In this context where the fight against hunger is a major global problem, fisheries and aquaculture have a role to play. Thanks to the significant contribution of aquatic resources generated by fishing and aquaculture, the average quantity of these resources was 18.4 kg/capita, thus providing 15% of animal protein intake to more than 4.3 billion people (**FAO, 2012**)

Soybean meal is one of the most suitable alternatives to FM for aquatic animal feed due to its high protein content, good balance of essential amino acids (EAA), and cheaper cost (**Ai QH, Xie XJ.2005, Sørensen M et al 2009**). However, the presence of some anti-nutritional factors (ANFs) in soybean meal may result in adverse effects on digestion or absorption of nutrients for some species (**Kumar V et al 2012,Refstie S et al 2005**). Thus, other soy protein sources excluding or containing a small amount of ANFs were found and used in replacement of FM (**Kaushik SJ et al 1995, Yaghoubi M et al 2016**). Soy protein concentrate (SPC), made by moving a portion of the carbohydrates (sugars) from dehulled and defatted soy flakes through aqueous ethanol, has similar content of crude proteins and EAA as compared to FM along with lower ANFs (**N.A.P 1993, Storebakken T et al 1998**). Many studies have assessed the influence of SPC on fish during the past 20 years, and the results showed that different species had unequal levels of tolerance towards SPC. Several studies have demonstrated that SPC can effectively replace FM as a protein source in the diet of *Salmosalar* (**Storebakken T et al 2000**), *Oncorhynchusmykiss* (**Jalili R et al 2013**), and *Trachinotusovatus* (**Wu Y,et al 2015**). But some fish could condone less than 40% FM to be substituted by SPC in the feed of juvenile starry flounder (*Platichthysstellatus*), carp (*Cyprinuscarpio)* and yellowtail (*Seriolaquinqueradiata*) (**Li PY, et al 2015–Takii K.1989**).

Panicum maximum is characterized by its flexibility of use. It is often used on pasture; the grass is not only resistant to trampling and overgrazing (not all varieties), but also to bush fires (regrowth after fire), for hay and silage which constitute an important food reserve for livestock. (**EDO, 1982).**

Panicum maximum's advantages include high productivity, fire resistance and good nutritional value. Indeed, it is an excellent forage grass with high productivity. This high productivity also helps maintain soil fertility. **(Piccard 1979**), adding nitrogen to the soil of a Panicum maximum crop in a humid zone produces 9 to 16 t/ha/year of organic matter. In a non-irrigated, unfertilized crop, a yield of 13.3 tons DM can be obtained in an area receiving 1200 mm of rainfall (**Roberge, 1976**). Cultivated fodder is very palatable when standing, and can be stored as hay or silage, which are highly appreciated by livestock. Given its forest origin, it is resistant to grazing and trampling, and helps combat erosion. *Panicum maximum* adapts to drought and can withstand rainfall of around 400 mm with an 8-month dry season (**ORSTOM, 1982**). The plant is highly palatable to both cattle and small ruminants. It has good nutritional value when cut at the young stage (25 to 35 days). After 40 days, the nitrogen content becomes insufficient. For example, *Panicum maximum* harvested at 40 days can have an energy value of between 0.6 and 0.7 UFL per kg DM and a nitrogen value of between 80 and 160 g MAT per kg DM (**Richard et al., 1989a; Xandé et al., 1989**).

The present study aimed toinvestigate the effects of replacement of dietary fish meal by *Panicum maximum* on growth performance of Nile tilapia. It provides basic data for the utilizationof soybean protein source in the artificial diet for Fish. Our goal in this study is to find cheaper high-protein feeds for fish and within the reach of all farmers to replace fishmeal.

Chapter I
Material and Methods

Chapter I: Material and Methods

1. Presentation of study area

1.1. Geographic situation

The wilayaof Biskrais located in the south - east of Algeria at the gates of the Sahara. With an altitude of 112 m at sea level. This makes it one of the lowest cities in Algeria. The wilaya covers an area of 21671 km². (**A.N.D.I., 2013**).It's limited:North by the wilaya of BATNA, north-east by the wilaya of Khenchela, north-west by the wilaya of M'sila, south-west by the wilaya of Djelfa, south by El Oued. **(A.N.D.I.,2013**)

Population de la wilaya (Source : D.P.S.B) : La population de la wilaya de Biskra est de 751 670 habitants en 2021 et la densité démographique est de 73 habitants au Km².

1.2. Climate synthesis of the region

The climate of Biskra is a Saharan climate, dry in summer and very pleasant in winter. Rainfall averages between 120 and 150 mm/year. The average year-round temperature is 20.9°C **(A.N.D.I., 2013**).Rains fall irregularly and can be torrential. (**Bensalah, 2009**).In the Biskra region, the month with the highest rainfall is September with a maximum of 30.94 mm, while August is the driest month with a rainfall of 2.08 mm (**Boumaraf, 2019**). The Biskra region is characterized by a high temperature (annual average: 21.6°C), with strong seasonal variations (33.62°C in August and 11.89°C in January) (**Bensalah 2009**).The average humidity is 42.14%. This low value is due to the aridity of the climate and the concentration of warm air masses in the Sahara. (**Meguenni, 2013**)

1.3. Study station layout

The experiments were carried out in a controlled greenhouse on the grounds of the Agronomy department of the Faculty of Natural and Life Sciences at the University of Biskra.

Figure 01 : situation of the greenhouse of the experiment (Google Earth 2022)

Figure 02: Installation of the greenhouse (Original)

2. Biological material

2.1The species studied

The species studied is a hybrid fish obtained by crossing two species tilapia*Oreochromisniloticus***(Linnaeus 1758**) and *Tilapiamossambica***(Peters 1852**).

According to**Günther**(**1889**), the systematics of the Tilapia fish follows:

Branch: Vertebrates

Super class: Pisces

Class: Ostechtyens

Subclass: Teleostians

Order: Perciformes

Family: Cichlidae

Subfamily: Tilapinae

Genre *:Oreochromis Sp.*

The fish in our study come from a local commercial fish farm: YAMAQUA, Ourelel, Biskra.

2.2. Vegetal Material

2.2.1. Description of *Panicum maximum*Jacq.

Panicum maximum belongs to the Poaceae family, the Panicoidae subfamily and the Panicae tribe. Commonly known as Guinea grass, it is a tall, clumping grass 1 m to 3 m high. It sometimes develops recumbent stems that root at the nodes, often giving rise to new shoots. Stems are tall, straight and very strong. Seeds are hairless or hairless, 3 mm long and 1 mm wide. The nodes are very clean, with a collar of downy white hairs. The area where the sheath meets the leaf blade is fringed with numerous hairs. Leaves are long, 10 to 25 mm wide and enveloping, generally hairless. At the end of the rainy season, they develop into a 30 cm to 50 cm panicle. The leaf blade is narrow, long and tapers to a point. The midrib is very pronounced, especially on the upper surface. Inflorescences are very large and slender, and highly branched. Spikelets are numerous, small, silky and often green to purple in color green to purple (**Pernes, 1975**).

Figure 3: ***Panicum maximum*** **(M.K.ETTIAN1,.G.A GABOGOURI2 G.A MENSAH. 2017)**

2.2.2 Physiologyand cycle ofdevelopment

Panicum maximum is a perennial grass that spreads rapidly by fragmentation of its underground stems or by clump division (apomictic reproduction) (**ORSTOM, 1982 and Warmke, 1954 and Motta, 1953**). The plant also multiplies by seed (**Combes, 1970**) transported by wind, water and birds. *Panicum maximum* seeds can survive periods of drought **Vincente-Chan dler et al. (1964**); they can even even withstand a fire (**Noirot et al. 1986**). The establishment of a *Panicum maximum* can be established by sowing or cutting (**César, 2004)**. The work is easier with seed than with cuttings. The quantities of seed required vary between 2.5 to 10 kg/ha (**Bogdan, 1977; Boudet, 1984; Messager, 1984 and César, 2004**).

3. Work Methodology

3.1. Preparation of breeding system

Installation of tanks: Two sterilized tanks of one cubic meter in volume were imported and installed in the greenhouse under a controlled system.

Figure 04: Breeding ponds (Original)

Filtration System:

A filtration system that is:

A submerged pump and a plastic case contains two layers: the Wadding and gravel.

Figure 05 :filtration box (Original)

Aeration system:

An air generator is placed to bind to air stones.

Exhaust system: which is a water pump connected to a removable plastic tube.

Fish were stored in two tanks with a capacity of 1000 L (30 fish per tank).

3.2. Food preparation

Table1. **Chemical composition of diets substances**

	Diet			
	PM0	**PM30**	**PM60**	**PM100**
Ingredient				
Soybean	410	410	410	410
Farine de poissons	140	98	56	0
Panicummaximum	0	42	84	140
Mais meal	350	350	350	350
Huile	80	80	80	80
CMV (compliment multivitaminés)	20	20	20	20
Chemical composition				
Dry matter	82.12	82.71	83.15	85.01
Moisture	17.88	17.10	15.40	14.63
Crudeprotein	46.45	46.98	47.39	48.21
Ether extract	16.98	17.03	17.60	10.48
Total lipids	10.10	10.30	10.63	11.21
Ash	8.52	7.82	6.37	5.67
Crudefiber	1.45	2.55	3,78	5.45

We chose a food available on the DZIRAPONIC market.

The food is distributed by hand three times a day: at 8:00, 12:00 and 17:00 each day for the duration of the experiment.

3.3. Fish Feed

The food is distributed three times a day: morning, noon and evening. In the first five days, 30% of the food tested and 70% of the control are given.

-Second 5 days: 60% tested and 40% control

-The rest of the days of the experiment, we continued with 100% food tested.

-The daily ration is 5% of the biomass present in the basin.

-The food ration is controlled: the quantity distributed each weighing is increased.

4. The parameters studied

To estimate fish growth during our experiment, some parameters should be calculated as (**Diogo et al, 2018**):

Initial mean weight

The initial mean weight (IMW) is calculated as the ratio of the initial biomass to the initial number of fish.

IMP (g) = Initial biomass (g)/ Initial number of fish

Final mean weight

The final mean weight (FMW) is calculated as the ratio of the final biomass to the final number of fish

FMW (g) = Final biomass (g)/ Final number of fish

Specific growth rate

The specific growth rate (SGR) or daily growth rate (DGR) represents the average daily weight gain over the life of the farm.

SGR (g/d) = (Final Mean Weight – Initial Mean Weight)/ Duration of Experiment

Weight gain

This is the amount of weight gained by individuals during rearing compared to their initial weight.

WG (%) = (Final Average Weight – Initial Average Weight)/Initial Average Weight 100

Body weight gaine

BWG (g/day) = ((Mean final body weight) - (Mean initial body weight))/time (days)

Chapter II
Results

Chapter II: Results

The results presented in Table 2 indicate that there were no significant differences in mortality rates among the different treatments, with all treatments showing rates ranging from 96.67% to 100%. Additionally, there was no significant impact of the diets on body weight gain (BWG), suggesting that the diets did not influence the overall growth of the fish.

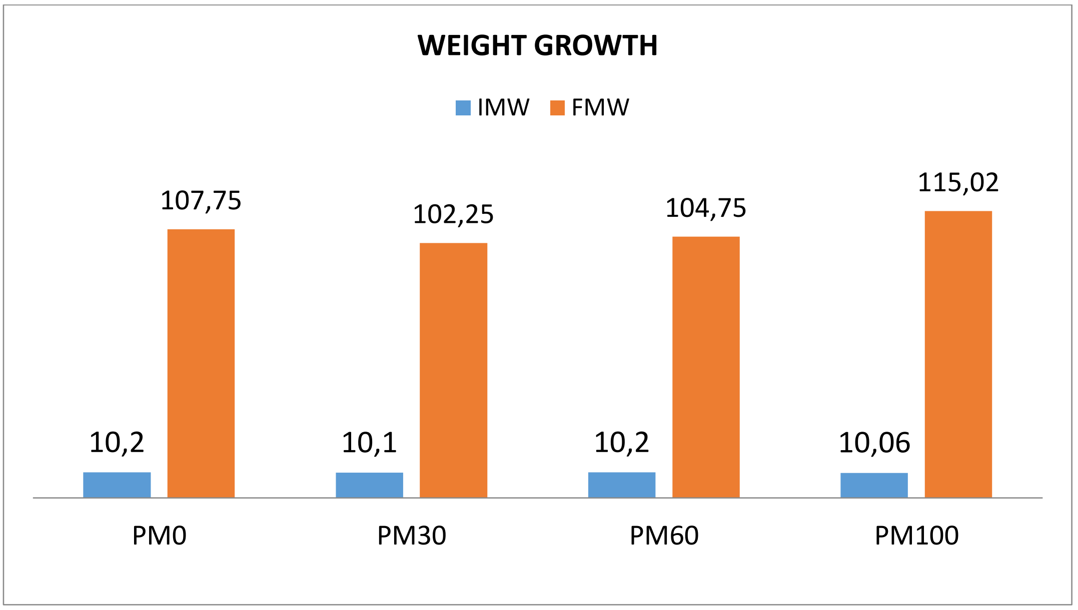

Figure 06 :variation of weight growth of *nile tilapia*

Table 2. Biological performance of *O. niloticus*experimented with different diets

Variables	**Diets**			
	PM0	**PM30**	**PM60**	**PM100**
IMW (g)	10.20 ± 0.02[a]	10.10±0.02[a]	10.20±0.02[a]	10.06±0.03[a]
FMW (g)	107.75±3.24[b]	102.25±3.24[b]	104.75±3.24[b]	115.02±3.24[b]
SR (%)	100±0.00[a]	97.67±1.23[a]	100±0.00[a]	100±0.00[a]
BWG (g/day/ fish)	1.46±0.23[b]	1.34±0.31 [a]	1.38±0.33 [a]	1.46±0.34 [b]
SGR (% /day)	1.17±0.21[ab]	1.79±0.48[b]	1.09±0.15[a]	1.28±0.33[ab]
FCR ($g\ g^{-1}$)	2.66±0.74[b]	1.69±0.46[a]	2.86±0.68[b]	2.64±0.74[b]

Table 3. Body components of tilapia fed various regimens (%)

Body composition	**PM0**	**PM30**	**PM60**	**PM100**
Crudeprotein	76.07±0.47	67.75±1.31	72.98±0.56	87.35±0.89
Crudelipid	3.52±0.12[b]	2.27±0.12[a]	3.46±0.20[b]	3.69±0.11[b]
Moisture	8.41±0.74[b]	7.74±0.42[a]	8.84±0.62[ab]	9.58±0.62[b]
Ash	7.24±0.62	6.41±1.33	6.18±1.77	7.35±0.61

However, when comparing the diets, it was observed that fish fed with PM100 diets exhibited better performance in terms of feed conversion ratio (FCR), specific growth rate (SGR), and protein efficiency ratio (PER) when compared to fish given PM30,PM100, and control diets. This suggests that the PM100 diet may have provided more efficient utilization of the feed, resulting in improved growth parameters.

In Table 3, the study focused on the proximal fresh body components of Nile tilapia. It was found that diet composition did not have a noticeable effect on carcass composition. The protein composition of the carcasses remained consistent across all treatments. However, the water content of the carcass was significantly higher in fish fed with the PM100 diet compared to the other diets. The lowest water content was observed in fish given the standard diet. Furthermore, as the PM content in the meals increased, body lipid levels were shown to decrease. Fish fed with the PM30 diet had significantly lower body lipid levels compared to the other diets. The amount of ash in the body did not differ considerably across treatments.

Overall, these findings suggest that the PM100 diet positively influenced the performance metrics such as FCR, SGR, and PER, indicating better feed utilization by the fish. While the diet composition did not impact carcass composition or protein levels, it did affect water and lipid content, with the PM100 diet resulting in higher water content and lower body lipid levels.

Chapter III
Discussion

Chapter III: Discussion

In this study, the possibility of replacing FM with mixed plant protein in the diet of gibel carp was investigated. The results showed that 20% of dietary FM and 22% of terrestrial animal protein could be replaced by mixed plant protein if digestible protein requirement in the diet was satisfied, the antinutritional factors from oil seed meals (soybean meal, rapeseed meal, and cottonseed meal) was low, and single-cell protein (blood meal, yeast hydrolyzate, spirulina) was supplement. All FM and terrestrial animal protein can be replaced by mixed plant protein if essential amino acid requirements are satisfied. Blood meal and spirulina were added to the plant-supplied diet because of their high lysine and threonine contents. Yeast hydrolyzate and spirulina were used as attractants and immune potentiators. However, without the supplementation of essential amino acids, growth performance decreased significantly.

In general, all feeds, manufactured solely from agricultural by-products, provided better growth performance compared to the commercial control feed. Conversely, these two foods have the lowest nutrient quotients. The growths recorded for the food (soy meal, cotton meal, millet meal and rice meal) and the control are similar. The difference in performance between the test feeds (soybean meal, cotton meal, maize bran and millet and soybean meal, cotton meal, maize meal and rice meal) and the control would result from the best degree of convertibility (by fish) ingredients incorporated into these foods.

In othersfood (soya meal, cotton meal, maize and millet meal) and (soya meal, cotton meal, maize meal and millet meal) would be more digestible and readily available to fish. **Bamba et al2005 ,(öprücü&Özdemir 2005)** indicate that the digestibility of a food depends on the nature of the ingredients used. They mention that ingredients may appear to be excellent sources of nutrients, but of low nutritional value, because of the variability in their digestibility, absorption and availability of nutrients (amino acids, minerals). **Melard (1999)** reported that protein digestibility coefficients for soybeans and corn in tilapia Oreochromisniloticus are 96% and 85% respectively, compared to 87% for fishmeal. In addition, according to**Ouattara (2004)**, corn bran (ingredient A1 and A2) provides better growth for fish than wheat (component of the control food) and rice (component of food A3).

This suggests that the observed growth gap may be related to the nature of the ingredients used, as highlighted by**Burel et al. (2000) and Köprücü&Özdemir (2005).** With regard to the bromatological composition of the distributed foods, in particular the mineral and lipid content of the foods consumed should be considered. The amounts of these two nutrients are higher than the control food. However, according **to Rivière (1978**), an increase in lipid levels, at reasonable proportions in the food, can induce an economy of protein use in fish, without altering the quality of this food. He also points out that calcined bone meal, due to its good calcium (35.02%) and phosphorus (15.52%), improves nitrogen, carbohydrate, lipid and energy metabolism. In terms of essential amino acids, the four test foods have a similar profile which is close to that of the egg (reference protein). However, **Viola et al (1994)** reported that industrial feed manufacturers routinely use synthesized or crystallized amino acids to obtain a balanced feed.

However, **Rønnestad et al. (2000)** demonstrated that tilapia and other fish value and assimilate these artificially synthesized inputs less efficiently than those derived from natural by-products**. Campbell (1978)** also reports that tilapia *O. niloticus* do not digest certain ingredients well, including cracked corn and broken rice. However, cracked corn is present in the control feed. The difference in performance observed between the test feeds (soybean meal, cottonseed meal, corn and millet bran), soybean meal, cottonseed meal, corn and rice bran) and soybean meal, cottonseed meal, millet and rice bran) could be due to corn, rice and millet bran. These three by-products, which essentially distinguish these test feeds, do not have the same nutritional values. As pointed out by **Rivière (1978)** and **Arzel et al. (1999),** rice bran has a high cellulose (11%) and silica (around 70% of total minerals) content, which reduces its digestibility and energy value compared to millet and maize bran. The same authors also revealed the presence of tannin in millet and wheat bran, and that most of the phosphorus present is in the form of phytate (an anti-nutritional substance), which reduces its digestibility compared with maize bran. Furthermore, **Ouattara(2004)** shows that corn bran promotes better fish growth than wheat and rice bran. For the latter author, wheat bran is more conducive to growth than rice bran. However, rice and millet bran are used in feed formulation (soy, cottonseed, millet and rice cakes).

The difference in performance between the test feeds (soybean meal, cottonseed meal, maize and millet bran) and soybean meal, cottonseed meal, maize and rice bran) could be due to millet and rice bran. In fact, these two ingredients, which distinguish (soy, cotton, maize and millet meals) from (soy, cotton, maize and millet meals), do not provide fish with the same zootechnical performance. According to **Rivière (1978)** and **Arzel et al. (1999),** millet bran provides better growth than rice bran. The growth rates recorded in the present study are comparable to those obtained by Davis & Stickney (1978). Indeed, these authors observed no difference in growth performance in *Oreochromisaureus* tilapia fed on two diets, one containing fishmeal and the other without fishmeal, but containing 74% soybean meal.

Many previous studies have revealed that poor growth performance of cultured fishes could result from the high level replacement of FM with single-plant ingredients (**Watanabe et al., 1998; Gomez-Requeni et al., 2004; Kaushik et al., 2004; Panserat et al., 2008**), such as soybean meal (**Alexis and Nengas, 2001**), rapeseed meal (**Burel et al., 2000**), and cottonseed meal (**Luo et al., 2012**), whether in carnivorous *Trachinotusovatus*,**(Wu et al., 2015 and Ma et al., 2019**) or in herbivorous (*CtenopharyngodonIdella*)**(Jiang et al., 2016**) fish. Therefore, using a combination of protein ingredients with various nutritive properties can improve amino acid profile, dilute or even mitigate antinutrition factors, and consequently allow higher inclusion of alternative protein sources in the diet of cultured fish.

However, in this study, PM diet, in which the dietary FM content was totally replaced by plant protein combination, showed lower growth performance in fish than 30FM, 10FM, and PMAa diet. The ability of fish to utilize crystalline amino acids is well reported (**Kaushik and Seiliez, 2010**), and limiting amino acid supplementation in plant-based diets is necessary to complement the low amino acid profile. We found that the growth performance and feed utilization of fish receiving PMAa treatment, in which plant protein combination was supplemented with limiting amino acids, were not significantly different from those of fish receiving 30FM and 10FM treatments and were much higher than those of fish receiving PM treatment. Similar observations have been reported in rainbow trout (**Kaushik et al., 1995; Watanabe et al., 1998**) and sea bass (*Dicentrarchuslabrax*) (**Tibaldi et al., 1999**), where FM was replaced by a mixture of vegetable protein and adequate supplement of limiting amino acids without negative effects on growth.

There have been several experiments in which the replacement of FM with high proportions or complete plant proteins in diets did not only result in decreased feed intake and growth performance but also caused oxidative stress or subhealth status (**Sitjà-Bobadilla et al., 2005; Hansen et al., 2007**). Single-cell proteins, such as spirulina and yeast, contain various water-soluble fractions, such as free amino acids, small peptides, nucleotides, vitamins, and minerals. In this study, spirulina and yeast hydrolyzate, which were used as attractants and immunopotentiators to cover for the shortage of FM replacement (**Burgents et al., 2004; Sheikhzadeh et al., 2019**), were supplied in the low-FM diet. Based on the results, total replacement of FM with compound plant proteins in the diet of gibel carp is a possibility, and it provides a promising approach for the sustainable development of aquaculture.

It is known that fish can adapt to different nutritional conditions. In the past, plant proteins have been widely used in many fish diets for the partial or total replacement of FM, which may be one of the options to reduce the production costs in the aquaculture industry [**El-Saidy DMSD, Gaber MMA**.**2015**]. Among the plant proteins, soy products are nutritionally superior ingredients of feeds for aquatic animals [**Song Z,2014**]. Several studies have reported that when dietary SPC inclusion was below 60% a satisfactory growth and feed utilization was obtained in juvenile cobia [**SalzeG,et al 2010**] and juvenile starry flounder [**Li PY,2015**]; while further increase of SPC inclusion in the diet led to lower diet utilization and higher mortality in the fish. However, **(Zhao et al. 2010**) showed that the survival and SGR of Nile tilapia was not affected even by the total replacement with SPC even the total replacement [**Zhao H,et al 2010**]. In the present study, fish fed the 15% SPC inclusion diet had a relatively better growth performance, and other treatments showed a gradual decrease with increasing SPC concentration.

Soybean meal is widely used as the primary protein source in different formulations due to its nutritional composition, ample availability, and low cost (**Gatlin et al. 2007, Tangendjaja 2015, Wang et al. 2017, Bruce et al. 2018, Ye et al. 2019**). Numerous studies have demonstrated the feasibility of substituting fishmeal in the diet of various fish species of commercial interest without affecting their growth or productivity (**Elangovan& Shim 2000, Heikkinen et al. 2006, Bruce et al. 2018, Zhang et al. 2018**). However, the availability and utilization of nutrients in fish feed vary with the type of processing methods used to produce soybean meal (**Tangendjaja 2015, Bruce et al. 2018**). These differences might be associated with antinutritional components such as trypsin inhibitors, phytic acid, and saponins, among others, which can have adverse effects on nutrient digestibility and assimilation, affecting fish growth (**Gatlin et al. 2007, Wang et al. 2017**).

Conclusion

Conclusion

In Algeria, the Tilapia species is farmed because of its hardiness to climatic conditions, especially in the Saharan zone. especially in the Saharan zone, where water temperature and salinity stimulate growth and reproduction (**Cherif and Djoumakh, 2015**).

Following the success of the first experiment involving the launch of tilapia production in Algeria in 2001 tilapia production in Algeria, a shipment estimated at 1.5 t of tilapia fry was delivered. These intended for restocking dams, basins and rivers, have stood up well to the cold climate the cold climate of Algeria's northern regions. Algeria has now moved on to the artificial production stage. artificial production. This involves the creation of farms specializing in tilapia cultivation using tilapia using modern techniques (by private promoters), some 30 aquaculture farms for tilapia farms).

This study determined the effect of feed manufactured from plant by-products on Tilapia growth. The experiment was carried out over a 2-month period, with weight and size measurements taken every week after the tanks had been cleaned.

Our results show that fish fed with guinea grass (*Panicum maximum*) have a good average weight of 33.54g and a better average length of 12.22 cm. These values are higher than those of fish fed with fish meal.

The results obtained allow us to conclude that fish fed with the test feed show growth performance comparable, if not superior, to that of fish fed with commercial feed. In addition, this Guinean grass feed is less expensive than commercial feed, and more attractive in terms of reduced production costs per unit of weight gain.

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Résumé

Notre étude vise à fabriquer des aliments de haute qualité nutritionnelle pour un tilapia hybride appelé Oreochromis sp, en exploitant une plante riche en protéines appelée herbe de Guinée (Panicum maximum) .C'est pourquoi nous proposons cette méthode pour comparer les aliments fabriqués et témoins (aliments commerciaux). Les résultats de la recherche ont montré que l'aliment fabriqué donnait de bons résultats par rapport à l'aliment témoin en termes de gain de poids et de taille.

Mots clés; Tilapia rouge, herbe de Guinée, aliments transformés, prise de poids.

Absract

Our study aims to manufacture feeds of high nutritional quality for a hybrid tilapia called Oreochromis sp, by exploiting a protein-rich plant called Guinea grass (*Panicum maximum*).Therefore we propose this method to compare the manufactured and control feeds (commercial foods).

The research results showed that the fabricated food performed well compared to the control food in terms of weight and height gain.

Key words; Red tilapia, guinea grass, processed foods, weight gain.

ملخص

تهدف دراستنا إلى تصنيع غذاء ذي جودة غذائية عالية لبلطي هجين يسمى البلطي الأحمر Oreochromis sp باستغلال نبات غني بالبروتين يسمى اعشاب غينيا

(*Panicum maximum*) لهذا نقترح هذه الطريقة المقارنة بين العلف المصنع والعلف الشاهد (الأعلاف التجارية).

أظهرت نتائج البحث ان العلف المصنع اعطى نتائج جيدة مقارنة بالعلف الشاهد بالنسبة لزيادة الوزن و الطول .

الكلمات الدالة ؛ البلطى الأحمر ، اعشاب غينيا ، الأغذية المصنعة ، زيادة الوزن .