Asian Journal of Food Research and Nutrition

Volume 3, Issue 1, Page 117-128, 2024; Article no.AJFRN.111812

Fruit Powder of *Tetrapleura tetraptera* in a Local Feed on the Survival, Some Growth Characteristics and Bromatological Composition of the Flesh of Juveniles of *Clarias gariepinus* (Burchell, 1822) in fastanks

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here:

Original Research Article

Received: 20/11/2023
Accepted: 24/01/2024
Published: 06/03/2024

ABSTRACT

Objective: This study was carried out to evaluate the effect of the supplementation rate of *Tetrapleura tetraptera* fruit powder in a local feed on the survival and some growth characteristics of juveniles of *Clarias gariepinus* in fastanks in the Littoral Region of Cameroon. It was carried out from

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March 29 to June 30, 2023 in the Ard Group Fish Farm located in the Sanaga Maritime Department, Littoral Region of Cameroon.

Methodology: 225 juveniles weighing 10.00 ± 0.76g were divided into five treatments arranged in triplicate in a randomized manner. T0+ branded imported feed (Gouessant), T0- feed without supplement, T0.4, T0.5 and T0.6 which were respectively supplemented with 0.4%, 0.5% and 0.6% of *Tetrapleura tetraptera* fruit powder. Each diet corresponds to a treatment. The fish were fed to satiety until the end of the experiment and every 24 days a control fishing was carried out during which the juveniles per treatment were counted and measurements were taken on the entire population.

Results: The main water parameters were recorded daily before feeding. The highest survival rate (83.33 ± 8.33%) was recorded with subjects fed T0.5 feed. average weight gain (162.97 ± 2.90 g), average daily weight gain (1.73 ± 0.03 g), specific growth rate (3.39 ± 0.01%/g) and condition factor K (1.12 ± 0.00) were significantly higher ($p < 0.05$) and were recorded with the T0.4% treatment. The significantly lower ($p < 0.05$) consumption index (1.89 ± 0.07) was recorded with the subjects also fed T0.4% food. Furthermore, the lowest feed production cost was recorded with the T0% T.tetraptera treatment (868.8 ± 8.82Fcfa).

Conclusion: This study clearly showed that supplementation of *Tetrapleura tetraptera* fruit powder improves tracking and growth performance as well as the feed cost of producing one kilogram of *Clarias gariepinus* market fish.

Keywords: Clarias gariepinus; growth; juveniles; supplementation; tetrapleura tetraptera.

1. INTRODUCTION

Since 2000, Aquaculture has continued to develop more rapidly than other major sectors of food production to thus satisfy the needs for resources of fisheries origin of a population which is constantly growing [1], because fishing is relatively stable since the end of the 1980s [2]. Furthermore, the disparity in the level of development of the sector and the unequal distribution of production remain significant between countries throughout the world [2], thus despite the progress observed in Africa, more particularly in Cameroon, this production remains insufficient and fails to cover the ever-increasing needs of the populations. The main constraints responsible for this insufficiency are the high cost of the feed used (which represents approximately 50% to 60% of the production cost) because they are mostly imported due to the lack of mastery of fish feed production technologies. in the country, juvenile mortalities and their growth often slow down. However, the evolution of large-scale Aquaculture towards a more intensive system requires effective local feeds that maximize survival and growth [3]. Furthermore, in Cameroon there are several agricultural products known as nutrient-rich feed additives which, when added to a local food, could keep fish healthy and promote their growth [3]. Recent studies on the effect of some additives on domestic animals such as *Tetrapleura tetraptera* fruit powder have shown that it contains active ingredients: Flavonoids and Phenols which have growth promoter and immunostimulant properties [4]. From its common name four sides, *Tetrapleura tetraptera* is a species of the Fabaceae family [5], it is a forest tree very widespread in West and tropical Africa. The ripe fruits of this plant are used as condiments, as well as for their medicinal properties in the treatment of digestive diseases, against obesity, against convulsion, leprosy, rheumatism pain, schistosomiasis, asthma and hypertension [6], it is well known in Cameroon and other African countries [7]. The strong smell of the fruit is said to drive snakes out of homes. The species has been widely used in different forms in Ghana: tea, ingredient in the manufacture of sweets, etc. The fruits of *Tetrapleura tetraptera* possess chemicals such as tannin, saponin, flavonoids, alkaloids, and other compounds that give this plant antibacterial activity against *Escherichia coli, Staphylococcus aureus, Pseudomonas aeruginosa, and Salmonella typhi* [8]. Studies have shown that this plant has anti-oxidant and hepatoprotective properties [9]. Furthermore, [10] in their studies determined the antimalarial activity of the ethanolic extract of the fruit of this plant which is also very rich in vitamins [11]. The plant has sedative, anticonvulsant, and analgesic effects [12].

In animal feed, the fruit powder of this plant has long shown its effectiveness on survival and growth in poultry. This is the case of Kana et al. [13] who showed through their study that *T. tetraptera* fruit powder at 0.2% can be used as a

feed additive to replace antibiotics for better growth performance and to produce chicken meat without antibiotic residues. Studies by Nweze et al. [14] reported that the inclusion in feed of T. tetraptera fruit powder in water releases aqueous extracts of this plant allowing growth acceleration, improving blood parameters and controlling load. intestinal microbial pathogen of poultry. Furthermore, no data is mentioned regarding its use in *Clarias gariepinus.*

According to the organic, mineral and phyto-chemical composition of *Tetrapleura tetraptera* obtained by Tchiegang and Mbougueng [15,16], its capacity to nuance microbial populations, its capacity to stimulate growth as shown in previous studies by Kana et al. [13,14] and its availability in all seasons in Cameroon, it is stipulated that the supplementation of powder from the fruits of *Tetrapleura tetraptera* to the feed of juveniles of *Clarias gariepinus* would improve zootechnical performances and economic profitability compared to foods not containing powder of this fruit.

2. MATERIALS AND METHODS

2.1 Area of Study

The study was carried out from March 29 to June 30, 2023, 94 days of experimentation within the Ard Group Fish Farm located in the Littoral Region, Sanaga Maritime Department, Dibamba District at the “Logbadjeck” Village which extends between 3º48'39" and 3°58'42" North latitude 10°06'0" and 10º06'04" East longitude. The average altitude is 42 meters [17].

2.2 Biological Material and Duration of the Study

The study lasted 94 days, with the aim of evaluating the monitoring rate, growth parameters as well as the cost of production of the feed. 225 *Clarias gariepinus* fry with an average weight of 7±1.5g were taken from the fry production of the Ard Group Fish Farm.

2.3 Origin of *Tetrapleura tetraptera* Fruit

The fruits of Tetrapleura tetraptera were purchased from the local market, crushed, sifted, then the powder was incorporated into the feed at different rates.

2.4 Diets Preparation

During the experiment, the imported feed Le Gouessant, used had a diameter of 2 mm for the first month and 3 mm for the second and third, this feed was used as a positive control (T_{0+}), on the other hand the local feed for its part was formulated by the linear programming method using Microsoft Excel 2016 software which made it possible to determine the quantities specific to each ingredient. The percentage composition of the local feed is recorded in Table 1. After the formulation, followed the manufacture of the feed in a concrete way and the process was as follows: To make the local feed, the ingredients were purchased from the local feed mill. Once the purchasing operation was completed, they were crushed to make them powdery and fine, they were then weighed according to the previously established formula. Manually, these ingredients and the oil were mixed for a period of 10 to 12 minutes. A sample of the mixture obtained was taken to be analyzed in the laboratory (Table 1) and the rest was separated into four equal parts, each part thus being subject to a rate of supplementation with the fruit powder of *T. tetraptera* purchased at the local market. This is how T_{0-} (Local feed supplemented with 0% *T. tetraptera*), $T_{0.4}$ (Local feed supplemented with 0.4% T. tetraptera), $T_{0.5}$ (Feed local supplemented with 0.5% T. tetraptera) and $T_{0.6}$ (local feed supplemented with 0.6% *T. tetraptera*) were obtained. The final mixtures that became experimental feeds were moistened 1/5 with water and were subsequently shoveled. The excavator die (2mm or 3mm) was installed before the start of the production process according to the particle size corresponding to the size of the species. Then, the different feeds are passed through it, producing filaments of 2mm or 3mm in diameter. The feed from the excavator was collected on tarpaulins and spread out in the sun to eliminate some of the water to improve shelf life. Once dry, these were packaged in hermetically sealed plastic bottles.

$T_{0+=}$ Commercial feed
$T_{0-=}$ Local feed supplemented with 0% *T. tetraptera;*
$T_{0.4=}$ Local feed supplemented with 0.4% *T. tetraptera*);
$T_{0.5=}$ Feed local supplemented with 0.5% T. tetraptera;
$T_{0.6=}$ Local feed supplemented with 0.6% *T. tetraptera*

2.5 Experimental Design

From a cohort of *Clarias gariepinus* juveniles obtained after artificial reproduction and larval monitoring at the Farm,

Table 1. Centesimal composition of the local feed

Ingredients (Kg)	T_{0+}	T_{0-}
Fishmeal	/	39.00
Soya flour	/	23.00
Peanut cake	/	31.00
Corn flour	/	4.00
Cassava flour	/	3.00
Premix 5%*	/	1.5
Peanut oil	/	4
Salt	/	0.5
Total	/	106.00
Calculated chemical composition (% of Dry matter)		
Protein	/	45
Digestible Energy (Kcal/kg)	/	2175.39
Fat	/	8.18
Calcium	/	2.78
Phosphore	/	1.55
Lysine	/	3.35
Méthionine	/	1.14
Chemical composition analyzed (% of Dry matter)		
Protein	46	38.4
Lipids	10	11.18
Fibers	2.7	5.7

Premix 5%; Metabolizable energy = 2078 Kcal/Kg; Crude protein = 40%; Lysine = 3.3%; Methionine = 2.40; Calcium = 8%; Phosphorus = 2.05%. T_{0+} = imported feed ; T_{0-} = local feed. **T_{0+} = Centesimal composition of the commercial feed **T_{0-}=** Centesimal composition of the local feed*

225 subjects with an average weight of 10.00 ± 0.76g and an average total length of 9.37 ± 1.2 cm were taken at random and distributed in fifteen happas of 0.4x0.4x0.8 m^3 arranged in a completely randomized manner in triplicate, thus being the subject of five treatments. Everything was placed in a $5m^3$ fastanks with a depth of 1m, supplied with 32Ø PVC pipes and drained with 63Ø PVC pipes.

2.6 Conduct of the Test

Feeding took place three times a day at fixed times of 8 a.m., 1 p.m. and 6 p.m. until the end of the experiment; control fishing was carried out at regular intervals of 24 days (between 05:30 a.m. and 06:00 a.m. H 30 mins). During control fishing, the measurement of total length and weight was carried out respectively with a graduated ruler and a JIANYU brand scale with a sensitivity of 1 ± 0.00g. The measurement of physicochemical parameters (temperature using a probe thermometer and pH using the liquid pH-metric test) was carried out every day as well as the renewal of water in the tanks. The measurements obtained are recorded in Table 2. A TDS/EC/PH/SALT/SG/ORP brand multi-parameter was used for taking the temperature and the JBL brand analysis kit for taking the physicochemical parameters.

2.7 Bromatological Composition of the Fish Flesh

2.7.1 Analysis of fish flesh

Analyzes: the analyzes carried out mainly included protein, lipid, ash, dry matter, fiber, and energy contents.

The methodology: The biochemical parameters contained in the samples were determined according to international methods.

- Protein: mineralization by acid attack of 0.1g of sample, distillation by steam distillation and determination with sulfuric acid (Kjedahl method, standard NF ISO 11261);
- Lipid: the lipid content is determined by the Soxhlet method (AOAC,1990). This method is based on the solubilization of lipids in nonpolar organic solvents;
- Ash (%): the percentage of ash relative to dry matter is determined by incineration of 2g of the sample in a muffle furnace at 550°C for 6 hours (AOAC, 1990);
- Dry matter: the percentage of dry matter is determined by drying 05g of the sample in

the oven at a temperature of 105°C until a constant dry mass is obtained (AOAC, 1990);

- Humidity rate (%): It is measured on samples of approximately 5 g, placed in an oven at 1050C for 24 hours;
- Fiber (%): the method described by AOAC (1995), "Official Methods for raw fiber" was used.

2.7.2 Zootechnical parameters

- **Survival rate** (SR)

SR (%) = 100 × NF/Ni
NF = number of fish at the end of the experiment and Ni = number of fish at the start of the experiment.

Growth characteristics

- **Live weight**

  At the start of the test and every 14 days thereafter, fish from each experimental unit were weighed. The weekly weight gain was obtained by taking the difference between 2 consecutive average weekly live weights

- **Average weight gain (AWG in g)**

= final average fish weight (FAFW in g) - initial average fish weight (IAWG in g);

- **Average daily gain (ADG in g/day)**

  = (FAWG-IAWG)/t With IAW = initial average weight (g), FAW = final average weight (g), t = duration of the experiment (in days);

- **Specific growth rate (SGR in %day)**

  = [(ln Pmf –ln Pmi)/ rearing time (day)] x 100; Pmi = initial average weight (g), Pmf = final average weight (g);

- **Feed conversion ratio (FCR)**

  = Quantity of feed distributed / Body mass gain;

- **Condition factor (K)**

  = W×100/ LT3 with W: weight (g), LT: Total length (cm).

- **Bromatological composition of the fish flesh**

2.8 Statistical Analyzes

Data on survival rate, growth and economic characteristics were subjected to one-way analysis of variance (ANOVA 1). In the event of significant differences between the means of the treatments, Duncan's test was applied to separate at the significance level of 5%. SPSS 20.0 (Statistical Package for Social Sciences) statistical software was used for these analyses.

3. RESULTS

3.1 Water characteristics

Water characteristics varied during the study period. The highest temperature was 28.17 ± 1.10 and the lowest was 26.77 ± 0.26. The pH varied from 6.73 ± 0.25 to 6.80 ± 0.16 over the entire study period

3.2 Zootechnical Parameters

The summary of the zootechnical parameters of the juveniles of *C. gariepinus* during the trial is summarized in Table 3. It appears from this summary that apart from the survival rate, all other results of the characteristics studied were significantly affected ($p < 0.05$) by the supplementation of *T. tetraptera* fruit powder in the local feed.

Table 2. water characteristics during the experimental period

Caracteristics	Breeding period (days)			
	1-24	25-48	48-72	73-94
Temperature (°C)	28.17 ± 1.10	27.97 ± 1.14	27.80 ± 1.10	26.77 ± 0.26
pH	6.73 ± 0.12	6.93 ± 0.05	6,80 ± 0.16	6.73 ± 0.25

Table 3. Zootechnical performance of *Clarias gariepinus* juveniles fed local feed supplemented with *T. tetraptera* fruit powder

Caractéristiques	Treatments					
	T_{0+}	T_{0-}	$T_{0.4}$	$T_{0.5}$	$T_{0.6}$	p
IW (g)	10.00 ± 0.76	10.00 ± 0.76	10.00 ± 0.76	10.00 ± 0.76	10.00 ± 0.76	0.862
FW (g)	210.51 ± 5.58^{a}	159.69 ± 5.29^{cd}	172.97 ± 3.52^{b}	163.03 ± 2,59^{c}	154.60 ± 2.72^{d}	0.000
SR (%)	75.00 ± 8.30	72.22 ± 4.81	77.78 ± 4.80	83.33 ± 8.33	80.56 ± 4.81	0.329
AWG (g)	200.51 ± 6.58^{a}	149.69 ± 0.95^{cd}	162.97 ± 2.90^{b}	153.03 ± 1.40^{c}	144.60 ± 1.45^{d}	0.000
ADWG (g/j)	2.13 ± 0.69^{a}	1.59 ± 0,10^{cd}	1.73 ± 0.03^{b}	1.62 ± 0.01^{c}	1.53 ± 0.15^{d}	0.000
SGR (%/j)	3.60 ± 0.03^{a}	3.30 ± 0.01^{c}	3.39 ± 0.01^{b}	3.32 ± 0.09^{c}	3.27 ± 0.10^{d}	0.000
FCR	1.17 ± 0.07^{c}	1.93 ±0.13^{b}	1.89 ±0.08^{b}	2.11 ± 0.07^{a}	2.20 ± 0.12^{a}	0.000
CF	0.82 ± 0.00^{c}	0.71 ±0.00^{d}	1.12 ± 0.00^{a}	0.99 ±0.09^{b}	1.01 ± 0.00^{b}	0000

a,b,c,d: (p<0.05) values with different letters on the same line are significantly different. IW= initial weigth; T0+ = Imported feed; T0- = Local feed supplemented with 0% T.tetraptera; T0.4% T. tetraptera = Local feed supplemented with 0.4% T. tetraptera; T0.5 = Local feed supplemented with 0.5% T.tetraptera; T0.6 = Local feed supplemented with 0.6% Tetrapleura.t. ; T= tetrapleura; FW= final weigth; SR=survival rate; AWG: Average weight gain ADWG: Daily weight gain; ; SGR= Specific growth rate; FCR: Feed conversion ratio CF: Condition factor K; g= gram; %= percenta

3.3 Survival Rate

The survival rates of juveniles fed with the different feeds during the experiment are recorded in the histogram in Fig. 1. Analysis of this histogram reveals that the highest survival rate (83.33 ± 8. 33%), but not significant ($p > 0.05$) was obtained with juveniles fed with feed supplemented with 0.5% *T. tetraptera* (T0.5%) compared to juveniles fed with T_{0+} feeds, T_{0-}, $T_{0.4}$% and $T_{0.6}$% T.t which respectively recorded the rates of 75.00 ± 8.30%, 72.22 ± 4.81%, 77.78 ± 4.80%, 80.56 ± 4.81%. However, juveniles fed with feeds supplemented with different levels of T. tetraptera recorded the highest survival rates but not significantly different ($p > 0.05$) compared to juveniles fed with imported control feeds T_{0+} and T_{0-} without supplement.

3.4 Growth Parameters

3.4.1 Average daily weight gain

Fig. 2 shows the evolution of the average daily weight gain of fish maintained with the different feeds as a function of time. The evolution of the average daily weight gain curve has a regular and increasing pattern, however, with the supplementation of the feed with powder from the fruit of *T. tetraptera*, the juveniles fed with the feed supplemented at 0.4 % of *T. tetraptera* recorded the average daily weight gain (2.13 ± 0.69g/d) significantly higher ($p < 0.05$) compared to juveniles fed with feed supplemented at 0.5% (1 .62 ± 0.01), 0.6% (1.53 ± 0.15) and without T_{0-} supplement (1.59 ± 0.10).

3.4.2 Feed conversion ratio

Fig. 3 illustrates the variation in the feed conversion ratio of juveniles of *C. gariepinus* depending on the treatments over the entire period of the experiment. The significantly ($p < 0.05$) lower conversion ration recorded with the juveniles fed the imported feed T_{0+} (1.17 ± 0.07) compared to the rest of the treatments. With the supplementation of the feed with powder from the fruit of *T. tetraptera*, the significantly ($p < 0.05$) lower conversion ratio was recorded with the juveniles fed with feed containing 0.4% powder. of *T. tetraptera* fruit $T_{0.4}$ (1.89 ± 0.08) compared to feed $T_{0.5}$ (2.11 ± 0.07) and $T_{0.6}$ (2.20 ± 0.12) but comparable to the conversion ratio of the feed without supplement T_{0-} (1.93± 0.13).

3.4.3 Specific growth rate

Fig. 4 illustrates the variation in the specific growth rate depending on the treatments of *C. gariepinus* juveniles. Overall, analysis of variance revealed a significant difference ($p < 0.05$) in specific growth rate between treatments over the entire study period. With the supplementation of the feed with the powder of the fruit of *T. tetraptera*, the juveniles fed with the feed supplemented at 0.4% recorded a significantly ($p < 0.05$) higher growth rate (3.39 ± 0.01) compared to juveniles fed the feed supplemented at 0.5% (3.32 ± 0.09), 0.6% (3.27 ± 0.10)

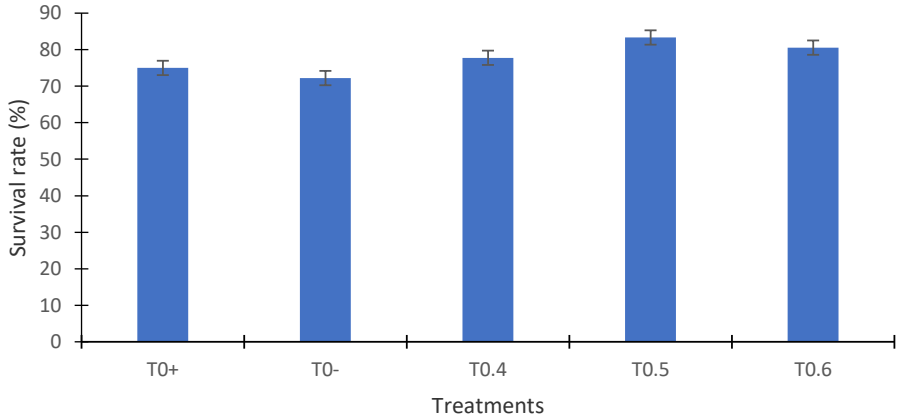

Fig. 1. Variation in survival rate of juvenile *C. gariepinus* depending on the treatments over the entire duration of the experiment

a,b,c,d: ($p<0.05$) values with different letters on the same line are significantly different. IW= initial weigth; T0+ = Imported feed; T0- = Local feed supplemented with 0% T.tetraptera; T0.4% T. tetraptera = Local feed supplemented with 0.4% T. tetraptera; T0.5 = Local feed supplemented with 0.5% T.tetraptera; T0.6 = Local feed supplemented with 0.6% Tetrapleura.t. ; T= tetrapleura;

and those fed the feed without supplement (3.30 ± 0.01). Furthermore, all these treatments recorded significantly ($p < 0.05$) lower growth rates compared to the T0+ treatment (3.60 ± 0.03), juveniles fed imported feed.

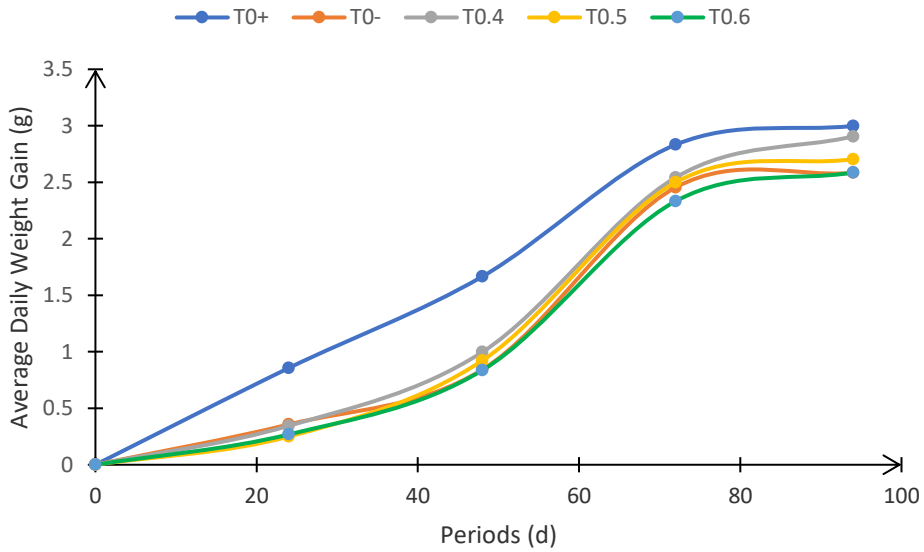

Fig. 2. Evolution of the average daily weight gain of juveniles of *C. gariepinus* as a function of time

a,b,c,d: ($p<0.05$) values with different letters on the same line are significantly different. T_{0+} = Imported feed; T_{0-} = Local feed supplemented with 0% T.tetraptera; $T_{0.4}$= Local feed supplemented with 0.4% T. tetraptera; $T_{0.5}$ = Local feed supplemented with 0.5% T.tetraptera; $T_{0.6}$ = Local feed supplemented with 0.6% Tetrapleura.t. ; T= Tetrapleura

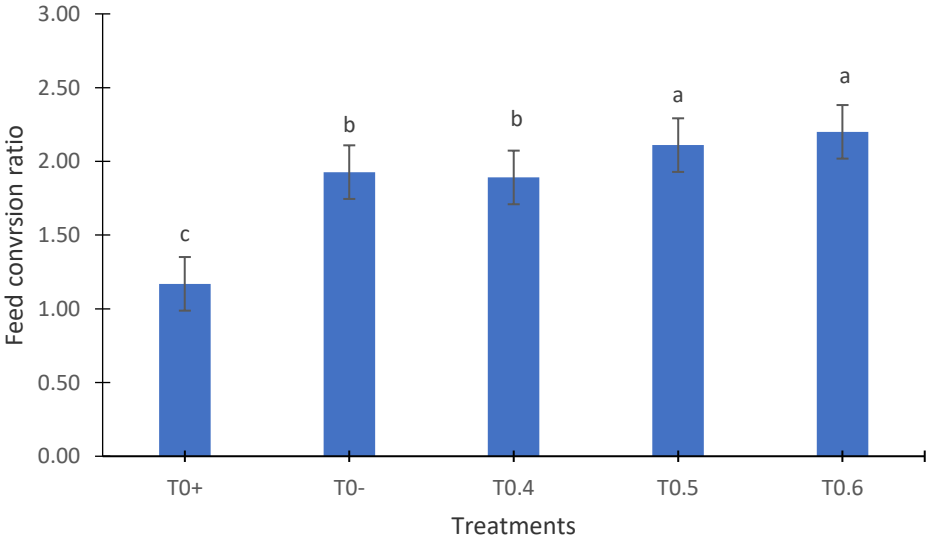

Fig. 3. Variation in the consumption index of juveniles of *C. gariepinus* depending on the treatments over the entire duration of the experiment

a,b,c,d: ($p<0.05$) values with different letters on the same line are significantly different. T_{0+} = Imported feed; T_{0-} = Local feed supplemented with 0% T.tetraptera; $T_{0.4}$= Local feed supplemented with 0.4% T. tetraptera; $T_{0.5}$ = Local feed supplemented with 0.5% T.tetraptera; $T_{0.6}$ = Local feed supplemented with 0.6% T.tetraptera. ; T= tetrapleura.

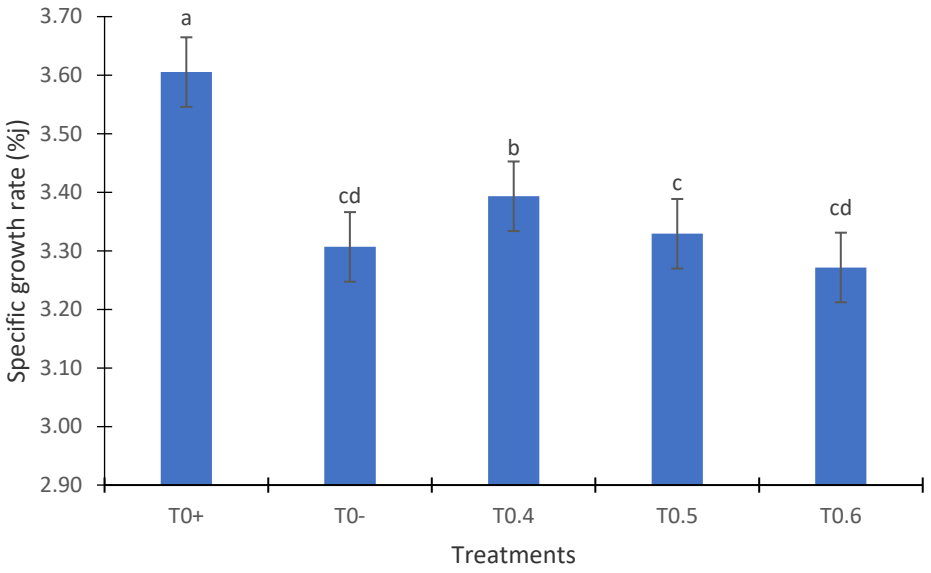

Fig. 4. Variation in the specific growth rate of juveniles of *C. gariepinus* depending on the treatments over the entire duration of the experiment

a,b,c,d: (p<0.05) values with different letters on the same line are significantly different. T_{0+} = Imported feed; T_{0-} = Local feed supplemented with 0% T.tetraptera; $T_{0.4}$= Local feed supplemented with 0.4% T. tetraptera; $T_{0.5}$ = Local feed supplemented with 0.5% T.tetraptera; $T_{0.6}$ = Local feed supplemented with 0.6% T.tetraptera. ; T= tetrapleura

3.4.4 Condition factor K

The condition factor K was significantly higher ($p < 0.05$) in juveniles fed with feed supplemented with 0.4% *T. tetraptera* T0.4 (1.12 ± 0.00) compared to juveniles fed with other foods. However, for juveniles fed with the two other supplemented foods T0.5% (0.99 ± 0.09) and T0.6% (1.01 ± 0.00) the condition factor K did not present a significant difference. ($p > 0.05$). But compared to juveniles fed with control feeds T0+ (0.82 ± 0.00) and T0- (0.71 ± 0.00), the condition factor K was significantly lower ($p < 0.05$) than those fed with supplemented feeds T0.4, T0.5 and T0.6.

3.4.5 Bromatological composition of the fish flesh

The bromatological composition of the fish flesh from the different treatments is recorded in Table 4. From this table, it appears that whatever the level of supplementation, the percentage of dry matter (96%) of the flesh fish remains the highest. same and higher than that of juveniles fed with control foods T_{0+} and T_{0-} (95%). The protein level of this fish flesh was high for the juveniles fed with feed $T_{0.4}$ (63.6%), followed in a decreasing manner by those fed with feed T_{0+} (59.3%), $T_{0.5}$ (55.3%), $T_{0.6}$ (54.9%) and T_{0-} (49.2%), the protein levels in the flesh of juveniles maintained with supplemented foods are therefore higher than the levels obtained by fish maintained with the local control feed T0-. As for the lipid levels, the juveniles fed with feeds T_{0+} and $T_{0.4}$ had the same value (15%), but it remains low compared to those obtained by the juveniles fed with $T_{0.5}$ (17%) and $T_{0,6}$ (16.4%). Fish in the T_{0}-% *T.tetraptera* treatment recorded the lowest value (14%). Fiber was more present in subjects fed with the T_{0+} feed (8%) followed by feeds supplemented or not. The energy levels of juveniles fed the supplemented feeds increased with the level of supplementation, $T_{0.4}$ (394.02 Kcal/g), $T_{0.5}$ (398.60 Kcal/g) and $T_{0.6}$ (399.15 Kcal/g), and were superior to subjects fed with control feeds T_{0+} (398.398 Kca/g) and T_{0-} (386.40 Kcal/g).

4. DISCUSSION

The average survival rates recorded during the experiment varied from 72.22 ± 4.81% to 83.33 ± 8.33% depending on the treatments, this range is higher than that obtained by Sodamola et al. [18] which was 68 ± 2.44% to 77± 2.44%, when they evaluated the effect of *Tetracarpidium conophorum* leaves on growth performance and histopathology on juveniles of *C. gariepinus [18]*.

Table 4. Bromatological composition of the flesh of *C. gariepinus* fish by treatment

Characteristics studied	Treatments				
	T_{0+}	T_{0-}	$T_{0,4}$	$T_{0,5}$	$T_{0,6}$
Dry matter (%)	95	95	96	96	96
Humidity level (%)	5	5	4	4	4
Protein (%)	59,3	49,2	63,6	55,3	54,9
Lipids (%)	15	14	15	17	16,4
Ashes (%)	7,9	8,3	8,4	10,3	9,6
Fiber (%)	8	7,8	7,6	7,3	7,5
Energy (kcal/g)	392,98	386,4	394,02	398,6	399,15

T_{0+} = Imported feed; T_{0-} = Local feed supplemented with 0% T.tetraptera; $T_{0.4}$= Local feed supplemented with 0.4% T. tetraptera; $T_{0.5}$ = Local feed supplemented with 0.5% T.tetraptera; $T_{0.6}$ = Local feed supplemented with 0.6% Tetrapleura.t. ; T= tetrapleura.

Furthermore, it is lower than 92 - 96% obtained by Almeda et al. [19] when they evaluated the effects of *Alium sativium* on the growth performance of *C. gariepinus*, at 94.67 ± 0.00% - 100.00 ± 0.00% obtained by Yemdjie et al. [20] evaluating the effect of supplementing *Afrostyrax lepidophyllus* bark powder in local food on growth, nutrient utilization and flesh composition of juveniles of *C. gariepinus*. These differences in results could be attributable to the action of molecules (type and concentration) capable of boosting the immune system contained in the additives used and to the breeding conditions [10].

The average daily weight gain of the fish varied from 1.53 ± 0.15 g/d to 2.13 ± 0.69 g/d depending on the treatments, these values are higher than those obtained by Almeda et al. [19] evaluating the effects of *Alium sativium* on the growth performance of *C. gariepinus* which was from 0.36g/d to 0.59g/d and to that recorded by Yemdjie et al. [20], when they studied the effect of supplementation of *Alium sativium* powder. bark of *Afrostyrax lepidophyllus* in local feed on the growth, use of nutrients and composition of the flesh of juveniles of *C. gariepinus* obtaining for their best treatment 1.028 g/d. This variability of results could be due to the growth activating and immune system stimulatory effects of the photochemical elements contained in *T. tetraptera* fruit powder [18].

The specific growth rate results ranged from 3.27 ± 0.10%/day to 3.60 ± 0.03%/day. These values are within the trend recommended by Barnabé [21] which is 3g%/day for juvenile catfish. Furthermore, they are higher than the values obtained by Yemdjie [20] with the treatments containing 1% and 1.5% of powder from the bark of *Afrostyrax lepidophyllus* which were respectively 2.3%/day and 2.2%/day but lower than the value obtained with the treatment containing 2% powder from the bark of *Afrostyrax lepidophyllus* (4.9%/day) when they studied the effect of supplementing powder from the bark of *Afrostyrax lepidophyllus* in local food on growth, nutrient utilization and flesh composition of juvenile *C. gariepinus* and . This disparity in results could be due to the growth activating and immune system stimulatory effects of the photochemical elements contained in *T. tetraptera* fruit powder [18].

The feed consumption ratio significantly ($p < 0.05$) varied during the experiment between the treatments, ranging from 1.17 ± 0.07 to 2.24 ± 0.07. The values obtained with the T_{0+} (1.17 ± 0.07) and $T_{0.4}$ (1.89 ± 0.08) treatments are satisfactory compared to 1.8 recommended by CABI [22] for intensive cage rearing. of *C. gariepinus*. In addition $T_{0.4}$ (1.89 ± 0.08) corroborates with the value obtained by Almeda [19] on the effects of *Alium sativium* on the growth performance of *C. gariepinus* which was 1.9 ± 0.00. But in general, the values obtained with the supplemented diets $T_{0.4}$ (1.89 ± 0.08), $T_{0.5}$ (2.11 ± 0.07) and $T_{0.6}$ (2.20 ± 0. 12) are lower than the values 0.80 ± 0.07, 1.18 ± 0.14 and 1.20 ± 0.07 that had been obtained [20] with their supplemented diets when they evaluated the effect of supplementation of the powder of bark of *Afrostyrax lepidophyllus* in a local food on growth, nutrient utilization and flesh composition of juvenile *C. gariepinus*. The difference in indices between these authors could be due to the quantity and quality of foods consumed by the subjects, the type of infrastructure used for the experiments as well as the study area.

The condition factor K recorded during the experiment values ranging from 0.71 ±0.00 to 1.12 ±0.00 depending on the treatments. These values are in the same range as those (0.77 ±

0.56 to 1.06 ± 0.01) obtained by Yemdjie [20] when they studied the effect of supplementing the bark powder of *Afrostyrax lepidophyllus* in a local feed on the growth, nutrient utilization and flesh composition of juvenile *C. gariepinus*. This corroboration would be due to the similar actions of the different phytobiotics used [11] and [13].

5. CONCLUSION

At the end of this study evaluating the effect of the supplementation rate of *T. tetraptera* fruit powder in a local feed on survival and some characteristics of growth of juveniles of *C. gariepinus*, the aim was to verify whether the supplementation of powder from the fruits of *T. tetraptera* in a local feed for juveniles of *C. gariepinus* would promote their survival and improve their growth compared to feeds not containing the powder of this fruit. This is to contribute to improving the production of commercial fish (*C. gariepinus*) through the use of phytobiotics. It appears that apart from the survival, growth characteristics and feed cost of production of juveniles of *C. gariepinus* fed with foods supplemented at different levels (0.4%, 0.5% and 0.6%) of the fruit powder of *T. tetraptera* were significantly different ($p < 0.05$) compared to the control treatments. Generally speaking, fish fed with feed supplemented with 0.4% *T. tetraptera* fruit powder obtained the best performances.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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