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LARVICULTURE OF MARINE SHRIMP *Litopenaeus vannaei* WITH THE APPLICATION OF INORGANIC NANOPARTICLES IN THE WATER

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Marine shrimp (*Litopenaeus vannamei*) are normally found from the eastern border of the Pacific Ocean, close to the city of Sonora, in Mexico, to Thumbes, in the north of Peru (BARBIERE; OSTRENSKI, 2002). Pacific White Shrimp, as they are also known, are one of the most important species cultivated in the Americas, especially in Ecuador and in Mexico (CUZON et al., 2004).

The purpose of this study was to undertake stage II (pl3 onward) larviculture of marine shrimp (*L. vannamei*), with the dosing of inorganic nanoparticles in the water, with the aim of achieving greater zootechnical performance and a reduction in the quantity of organic matter in the breeding tanks. These experiments were conducted at a post-larvae production farm located in the municipality of Aracati, Ceará, during the period of greatest adversity during the year for such cultivation in which temperatures are at their lowest and winds their strongest, i.e., during the months of July to August 2018.

The tanks had volumes of 50 m^3 and were filled with sea water that had a salinity level of 35 that was stored in a larger reservoir and then sent to the tanks. These were fertilized with the microalgae *Navicula* sp., without the use of probiotics. In each tank, varying quantities of post-larvae were stored at average quantities of 2,500,000 during the pl 3 and 4 stages, equalling an average stocking density of 50 post-larvae per liter. The post-larvae were cultivated for a period of 8 to 12 days, during which they received a commercial feed eight times per day. The tanks were artificially aerated by a blower and aero-tube and the water was renewed at a rate of 20% of the tank volume every two days. The experiment consisted of nine treatment situations having two repetitions each (totalling 18 tanks). There were nine control tanks and nine treatment tanks that were dosed with 200 mL per day of Biocelerator 500® inorganic nanoparticles, which are designed to stimulate the degradation of organic matter in the water. The Biocelerator was applied directly into the water where the marine shrimp were being cultivated. The temperature of the water, which varied between 28 and 31 ºC, was measured daily during each repetition.

Upon completion of the experiment, results showed final average survival rates that were 17% higher when Biocelerator 500® was applied as compared to the control treatments, and final weights that were 8.4% heavier for the post-larvae as compared to the averages in the control tanks (Table 1).

Table 1. Principle zootechnical performance parameters for the post-larvae upon completion of the experiment.

Treatment	Final averages			
	Initial quantity	Final quantity	Final survival rate (%)	Shrimp number required per 1 KG of meat
Biocelerator	2.500.000	2,100,000	84,00	119
Control	2.500.000	1.795.000	71,80	130

The results presented above highlight the efficiency of the inorganic nanoparticles in increasing the final survival rates and weights of the marine shrimp (*L. vannamei*) . These results are also very similar to those that were obtained in other aquaculture studies that were conducted in eastern Ceará, which were: the zootechnical performance of marine shrimp (*L. vannamei*), cultivated in low salinity water in the nursery phase during a period of 16 days in the municipality of Russas. In this experiment, the animals displayed better results in terms of survival rate, final biomass and feed conversion ratio, and nitrogenous compounds were maintained within the recommended limits in the six testing batteries that were implemented. Better grow-out results were achieved for marine shrimp (*L. vannamei*), and there were better results with respect to zootechnical performance in the municipality of Beberibe.

Regarding tilapia pisciculture, researchers were able to show a reduction in organic matter and improved zootechnical performance levels in each of the treatment situations that were run, most notable of which was a study that was undertaken in the municipality of Icapuí with fry stage tilapia that were bred in natural ponds lined with plastic tarp. Two different stocking densities were adopted in this study (160 and 76 fish m^{-3}) in which better results were obtained for cultivating fish at the higher stocking density, mainly with respect to their final biomass and the quality of the water, since the inorganic nanoparticles were able to maintain the level of dissolved oxygen in the breeding ponds, thereby making it possible to increase the stocking density and, as a result, productivity.

Furthermore, a Nile Tilapia (*O. niloticus*) grow-out study was also conducted in the same municipality, using the same aforementioned natural breeding ponds, in which the fish presented greater levels of development when inorganic nanoparticles were dosed at a liter per day, as compared to a different product that is purported to reduce organic matter in the water. Parameters such as survival rate, final average weights, final biomass, average daily weight gain and apparent feed conversion ratio were greater regarding the cultivation of the fish in the intensive production system that was evaluated. The fish in this treatment situation (one liter per day) yielded an off- flavor rating of zero in accordance with taste testers, as compared to when 200g day^{-1} of the product was used, which resulted in the fish yielding a low off-flavor rating amongst taste testers. Lastly, when using a different organic matter reducing product at a dosage of 60 g $week^{-1}$, the fish presented a moderate off-flavor rating. Despite the fact that the data was not submitted to statistical analyses, one may infer that when the inorganic nanoparticles were used, the fish had little to no off-flavor characteristics that could be detectable by smell or taste. Such a result is indicative of the quality of the fish meat at the end of the cultivation cycle, especially when using a weekly dosage of this product with which it is possible to increase the fish's market value.

KEYWORDS: marine shrimp, zootechnical performance, larviculture, organic matter

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OFF-FLAVOUR DETECTION IN TILAPIA CULTIVATED IN CONDITIONS IN WHICH AN INORGANIC NANOPARTICLE-BASED PRODUCT THAT STIMULATES THE ACTIVITY OF MICROORGANISMS THAT REDUCE ORGANIC MATTER WAS APPLIED

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ABSTRACT: Off-flavour characteristics consist of undesirable odours/flavours that are acquired by fish during the process of pisciculture. The fish take on these odours by absorbing substances through their gills that are produced by cyanobacteria and remain dissolved in the water. These substances can also be ingested by the fish intentionally or accidentally as it is feeding.

Such off-flavour problems occur most frequently in fish that are farmed in intensive pisciculture conditions or reared in natural ponds, where the frequent feed intervals and consequent accumulation of nutrients engenders an intense proliferation of cyanobacteria (*Oscillatoria* spp., *Anabaena* spp. e *Simploca* spp.). The cyanobacteria are responsible for the production of geosmin (GEO), which is associated with the flavour or odour of earth or mud, and the production of 2-methylisoborneol (MIB), which is responsible for the flavour or odour associated with mould.

This study had the aim of identifying the threshold for the GEO and MIB compounds in samples of fish that can be sensed through either smell or taste by tasters that are sensitive enough to do so. The fish that were used for the taste test were tilapia that were farmed in breeding ponds to which an aqueous solution of inorganic nanoparticles that stimulates the activity of microorganisms that reduce organic matter was applied. The Nile tilapia, or *Oreochromis niloticus*, were reared for a period of 183 days in three breeding ponds that were filled with groundwater at the Agrícola Famosa farm, which is located in the municipality of Icapuí, in the state of Ceará, approximately 230 kilometres from the capital city of Fortaleza.

The fish were then cultivated in the fingerling and growing stages for a period of 185 days. These GIFT (Genetically Improved Farmed Tilapia) were purchased from Fazenda Aquabel in the district of Icaraí de Amontada, in the state of Ceará. The fish were put into three plastic tarp lined breeding ponds (corresponding to three different levels of treatment). Each pond had a useful volume of 600 m^3, but were filled with 500 m^3 of water, and had a stocking density of 13 fish/m^3. Therefore, 6,500 fish received each level of treatment.

The fish had initial average weights and average lengths of 20.3±0.4 g and 9.6±0.8 cm, respectively. They were fed at an initial daily rate of 6% of their biomass, eight times per day. The feeding was then reduced to a rate of 1.5% of their biomass, six times per day. The fish were fed with a nutritionally balanced, extruded aquafeed containing 35% and 32% raw protein, respectively, that was thrown directly onto the surface of the water. During the cultivation of the animals, a product was added to the breeding ponds to aid in the reduction of the organic matter in the water. **Known as Biocelerator 500®**, this product is a colourless, aqueous solution of inorganic nanoparticles which was applied in Treatments 1 and 2 at dosages of 1 litre/week and 200mL/day, five days per week, respectively.

Biomix Gel®, a bioremediator for use in reducing the amount of organic matter in water, was used as treatment agent 3 at a dosage of 60 g/week. In order to complete the off-flavour test, five fish from each treatment pond were taken out and processed into fillets. The Qualitative Descriptive Analysis (QDA) is a methodology that is used for determining the terms and procedures that are suitable for evaluating a specific product.

A group of tasters was selected in accordance with their individual capacities to discern differences in sensory characteristics, i.e., to detect differences and intensity between sensory attributes. They were also required to describe these attributes and be capable of using their abstract reasoning. Each of the QDA procedures were undertaken in a room that was specifically configured for the sensory analysis testing. Each phase of the testing required something different of the tasters, who were asked to complete an odour recognition test and identify the off-flavour characteristics in cooked and raw tilapia samples. The samples were separated by treatment type and each taster received ten samples (five raw and five cooked). Each sample was delivered in a plastic container that was opaque and sealed.

The cooked samples were cooked for six minutes in a pan containing water on medium heat. Afterwards, the tasters evaluated the samples in terms of smell and taste. Results showed that the fish that were reared in treatment ponds 1 and 2, in which the Biocelerator 500® was applied, were found to be superior in quality to those that were reared in treatment pond 3, in which the Biomix Gel® was applied.

This demonstrated the higher efficiency of Biocelerator 500® in reducing the organic matter content of the water in these intensive pisciculture fish farming conditions. The fish that were farmed in the treatment pond in which 1 litre of Biocelerator 500® was dosed per week (treatment 1) received off-flavour scores of zero from the sensory analysis evaluators. Alternatively, regarding treatment pond 2, in which 200 mL/day of Biocelerator 500® was applied five days per week, evaluators rated the fish as having low off-flavour intensities.

Lastly, with respect to treatment pond 3, in which the Biomix Gel® was applied at a dosage of 60 g/week, the fish *were rated as having moderate off-flavour intensity*. Despite the fact that the data was not submitted to statistical analyses, one may infer that when the Biocelerator 500® was used, the fish had little to no off-flavour characteristics that were detectable by smell or taste. Such a result is indicative of the quality of the fish meat at the end of the growing cycle, especially when using a weekly dosage of this product with which it is possible to increase the fish's market value.

KEYWORDS: grow-out, organic matter off-flavour, Nile tilapia

NURSERY PHASE *Oreochromis niloticus* CULTIVATION IN LOW SALINITY WATER DOSED WITH A PRODUCT THAT STIMULATES MICROBIOLOGICAL ACTIVITY IN AQUATIC ENVIRONMENTS

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ABSTRACT: This study evaluated the zootechnical performance of the Nile tilapia *Oreochromis niloticus*) during the fry stage and assessed the behaviour of the physical and chemical parameters of the water while applying ***Biocelerator 500®***, an aqueous solution of inorganic nanoparticles that stimulates the breakdown of organic matter, at various daily doses. The tilapias were fed four times per day (08:00; 11:00; 13:00; and 16:00) at an initial rate of 15% of the biomass of the fish, reduced later to 6% of the biomass, using a commercial feed containing 40% and 35% raw protein, respectively.

The feeding rate was adjusted fortnightly according to the updated data of the average weights of the fish. The experimental design that was adopted was completely randomized and had a 4 x 3 factorial arrangement. The product was dosed four times a day (0 mL; 2 mL; 4 mL; and 6 mL, i.e., T0; T2; T4; and T6, respectively) in each 3 m^3 (3x1x1m) farming tank, with three repetitions each. The tanks were adapted with artificial aeration 24 hours per day and did not have anti-bird screens. Twelve concrete tanks, stocked with 25 fish/m^3, were used (initial weights and lengths of 1.45±0.9 g and 4.15±0.5 cm, respectively).

These fish were produced and sexually reversed at the José William Bezerra e Silva Pisciculture Centre of the Instituto Federal de Educação, Ciência e Tecnologia do Ceará (Federal Institute of Education, Science and Technology of Ceará) - IFCE, Aracati Campus), which is also where this experiment was conducted. There was a total of 75 fish per tank, which was equal to an initial biomass of 0.11 kg per tank. This experiment had a duration of 56 days and occurred during the fry stage of the fish. Fifty percent of the water of the tanks was replaced once per week, which did not involve the syphoning of the bottom of the tanks for the removal of organic matter.

The growth of the animals was measured fortnightly, in which a sample of approximately 25% of the stocked fish was collected from the cultivation tanks with the aid of a net. This sample of fish provided data, such as their average weights and lengths, which were obtained using a digital semi-analytical balance and an ichthyometer, respectively. The parameters survival rates, final biomass generated, average daily weight gain and apparent feed conversion ratio were also determined at the end of the experiment for each level of treatment.

The authors noted that the fish developed best in the treatment in which 4 mL of the product was applied daily (T4). Under these conditions, the fish reached final average weights and lengths of 50.23±7.19g and 13.67±5.96 cm, respectively, as compared to 45.81±7.06g and 13.58±3.46 cm;

45.29±5.13g and 13.56±7.06 cm; and 43.20±4.84g and 13.54±8.07 cm for T6; T2 and T0, respectively.

This demonstrates higher levels of zootechnical performance in fish when using Biocelerator 500®, a compound consisting of inorganic nanoparticles that stimulate the degradation of organic matter in water. Researchers also noted that the highest survival rate for the fish was recorded for the treatment in which a 2 mL daily dose of the product was applied (T2) (98.67±1.89%), followed by treatment levels T6; T4; and T0, which had survival rates of 96.07±0.53%; 95.33±0.94%; and 93.33±2.71%, respectively.

The highest levels of final biomass and daily increases in weight were noted for the treatment in which a 4 mL dose of the product was applied daily (T4). Those fish attained values of 3.59±0.094 kg and 0.87±0.102 g day^{-1}, respectively, followed by the treatments T6; T2; and T0, which provided the following values: 3.37±0.180 kg and 0.79±0.100 g day^{-1}; 3.35±0.056 kg and 0.78±0.066 g day^{-1}; and 3.04±0.124 kg and 0.75±0.060 g day^{-1}, respectively.

Lastly, regarding the apparent feed conversion ratio, the best result was also noted for treatment T4 (1.17±0.081), following by treatments T6 (1.20±0.025), T2 (1.25±0.161) and the control treatment (T0), which returned a value of 1.35±0.109 (Table 1). As such, the authors demonstrated the efficiency of Biocelerator 500® in reducing the amount of organic matter in the water with respect to each of the treatment levels that were tested, most notably that level in which a daily dosage of 4 mL was applied. In conclusion, one may compare the degradation of the organic matter at the bottom of the experimental control tank in which the product was not applied (T0), to that of the tank in which Biocelerator 500® was used, which also demonstrates the reduction of organic matter in the water (Figure 1).

Table 1. Survival rate (S), final biomass (B), final average weight (W), final average length (L), average daily weight gain (ADWG) and apparent feed conversion (AFC) for the fish upon completion of the cultivation (fry stage) with the application of Biocelerator 500® at different daily dosages. The figures are expressed as averages ± standard deviations.

Treatment	S (%)	B (kg)	W (g)	L (cm)	ADWG (g day^{-1})	AFC
T0	93.33±2.71	3.04±0.124	43.20±4.84	13.54±8.07	0.75±0.060	1.35±0.109
T2	98.67±1.89	3.35±0.056	45.29±5.13	13.56±7.06	0.78±0.066	1.25±0.161
T4	95.33±0.94	3.59±0.094	50.23±7.19	13.67±5.96	0.87±0.102	1.17±0.081
T6	96.07±0.53	3.37±0.180	45.81±7.06	13.58±3.46	0.79±0.100	1.20±0.025

Figure 1

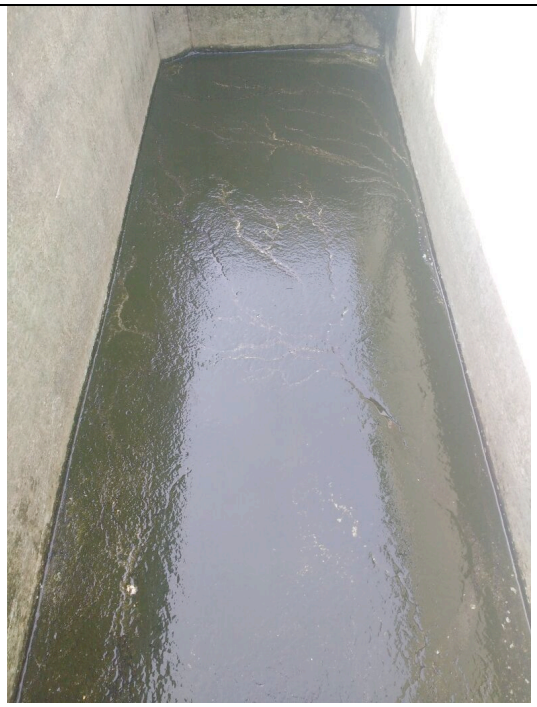

Figure 2

Figure 1. Bottom of the tank upon completion of cultivation depicting the treatment with the microorganism stimulant (left) and without it (right), which demonstrates the efficiency of the product in helping to degrade the organic matter in the water.

KEYWORDS: fry stage, performance, organic matter, *Oreochromis niloticus*.

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THE EFFECT OF STOCKING DENSITY ON TILAPIA PISCICULTURE DURING THE NURSERY PHASE WHILE APPLYING AN INORGANIC NANOPARTICLE-BASED PRODUCT THAT STIMULATES THE ACTIVITY OF MICROORGANISMS THAT CONSUME ORGANIC MATTER

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ABSTRACT: This study had the purpose of evaluating the farming of tilapia during the nursery phase at two different stocking densities while also applying an inorganic nanoparticle-based product that stimulates the activity of the microorganisms that consume and reduce organic matter in the water. The Nile tilapia (*Oreochromis niloticus*) were cultivated over a period of 41 days in two breeding ponds that were filled with groundwater at the Agrícola Famosa farm, which is located in the municipality of Icapuí, in the state of Ceará, approximately 230 kilometres from the capital city of Fortaleza. These GIFT (Genetically Improved Farmed Tilapia) were purchased from Fazenda Aquabel in the district of Icaraí de Amontada, in the state of Ceará.

The fish were put into two plastic tarp lined breeding ponds, each of which had a useful volume of 600 m^3 that were filled with 500 m^3 of water. The fish had initial average weights and lengths of 2.5±0.2 g and 5.2±0.5 cm, respectively. They were fed at a daily rate of 8% of their biomass, eight times per day; this rate was then reduced to 5.5% of their biomass, six times per day. The fish were fed with a nutritionally balanced, extruded aquafeed containing 40% raw protein that was thrown directly onto the surface of the water.

The experiment consisted of two levels of treatment at two different stocking densities: 80,000 and 38,000 fish, equalling 160 fish/m3 and 76 fish/m^3, which were logged as treatments 1 and 2 (T1 and T2), respectively. During the cultivation of the animals, a product was added to the breeding ponds to aid in the reduction of the organic matter in the water. Known as ***Biocelerator 500®,*** this product is a colourless, aqueous solution of inorganic nanoparticles which was applied in Treatment 1 at a dosage of 200mL/day, five days per week.

At the end of the experiment, a sample of the fish was collected with a net from each of the breeding ponds (each with their own level of the treatment design) in order to measure their final average weights and lengths, which were determined using a digital semi-analytical balance and an ichthyometer, respectively. The zootechnical performance indicator parameters of the Nile tilapia (*Oreochromis niloticus*) for the two levels of treatment, which were determined at the end of the breeding cycle, were the following: final average weight, final average length, survival rate, final biomass, average daily weight gain and apparent feed conversion ratio.

Study results showed that the fish developed more fully under lower stocking density conditions (Treatment 2), in which the values for final average weight, final average length, survival rate, final biomass, average daily weight gain and apparent feed conversion ratio were 19.98±8.27 g; 10.37±2.72 cm; 99.27%; 1,586.73 kg; 0.41 g/day and 0.74, respectively, as compared to 38.62±11.78 g; 15.76±3.15 cm; 99.94%; 1,586.73 kg; 0.84 g/day and 0.51, respectively (Table 1).

These results illustrate the efficiency of Biocelerator 500® in the cultivation of the fish under conditions of greater stocking density, mainly with respect to the parameters final biomass and water quality, since Biocelerator 500® was able to maintain the level of dissolved oxygen in the breeding ponds, making it possible to increase the stocking density, which, in turn, increased productivity levels.

The lower average weight of the fish in Treatment 1, in the lower stocking density scenario, may be related to the greater degree of competition among the fish for food within the same breeding environment due to the greater amount of fish present. It should be noted that on a previous occasion at this very farm, other attempts at greater stocking density were undertaken with other products, but these projects had to be aborted in order to avoid the high rates of mortality amongst the fish, since the demand for frys required for the fingerling and growing-out stages is quite significant, making it necessary to have a large quantity of them as well as the need to increase the stocking density.

Table 1 below shows survival rate (S), final biomass (B), final average weight (W), final average length (L), average daily weight gain (ADWG) and apparent feed conversion (AFC) of the fish upon completion of the growth cycle when the stocking density was experimentally manipulated during the nursery phase. The figures are expressed as averages. The final average weights (W) and the final average lengths (L) are expressed as the average ± the standard deviations that arose from the individual measurement of the fish.

Treatment	S (%)	B (kg)	W (g)	L (cm)	ADWG (g/day)	AFC
T1 (160 fish/m^3)	99,27	1586,73	19,98±8,27	10,37±2,72	0,41	0,74
T2 (76 fish/m^3)	99,94	1467,82	38,62±11,78	15.76±3.15	0,84	0,51

KEYWORDS: stocking density, production, Nile tilapia.

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THE EFFECT OF STOCKING DENSITY ON THE ZOOTECHNICAL PERFORMANCE OF NILE TILAPIA, *Oreochromis niloticus*, DURING THE FRY STAGE IN ASSOCIATION WITH THE APPLICATION OF A PRODUCT THAT STIMULATES THE MICROORGANISMS THAT CONSUME ORGANIC MATTER IN WATER

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ABSTRACT: This study aimed to verify the effect of stocking density on the development of Nile tilapia (*Oreochromis niloticus*) and evaluate the behaviour of the physical and chemical parameters of the water with the application of ***Biocelerator 500®***, a compound that consists of inorganic nanoparticles that stimulate the activity of microorganisms that consume organic matter in water. The experiments were executed in concrete tanks while the fish were in the fry stage. The tilapias were fed four times per day (08:00; 11:00; 13:00; and 16:00) at an initial rate of 16% of the biomass of the fish, reduced later to 8% of the biomass, using a commercial feed containing 40% and 35% raw protein, respectively.

The feeding rate was adjusted fortnightly according to the updated data of the average weights of the fish. The experimental design that was adopted was completely randomized and had a 5 x 3 factorial arrangement. A 4mL dose of the Biocelerator 500® was applied daily, in accordance with the results of a previous experiment, in each 3 m^3 (3x1x1m) farming tank, with three repetitions each. The tanks were adapted with artificial aeration 24 hours per day and did not have anti-bird screens. Fifteen concrete tanks were used in which the stocking densities of the animals were manipulated as follows: 25; 50; 75; 100 e 125 fish m^{-3}, that is, 75; 150; 225; 300 and 375 fish in each tank, corresponding to treatments T25; T50; T75; T100 and T125, respectively.

The fish, which had already been sexually reversed to male, were acquired from the Centro de Pesquisas Ictiológicas (Center for Icthyological Research) Rodolpho Von Ihering at the Departamento Nacional de Obras Contra as Secas - DNOCS (National Department of Works to Combat Drought), which is located in the municipality of Pentecoste, in the state of Ceará. The fish had initial weights and lengths of 1.09±0.49 g and 3.71±0.63 cm. The study was undertaken at the José William Bezerra e Silva Pisciculture Centre at the Instituto Federal de Educação, Ciência e Tecnologia do Ceará (Federal Institute of Education, Science and Technology of Ceará) - IFCE, Aracati Campus.

This experiment had a duration of 70 days and occurred during the fry stage of the fish. Fifty percent of the water of the tanks was replaced once per week, which did not involve the syphoning of the bottom of the tanks for the removal of organic matter. The growth of the animals was measured fortnightly, in which a sample of approximately 25% of the stocked fish was collected from the cultivation tanks with the aid of a net. This sample of fish provided data, such as their average weights and lengths, which were obtained using a digital semi-analytical balance and an ichthyometer, respectively.

The parameters survival rates, final biomass generated, average daily weight gain and apparent feed conversion ratio were also determined at the end of the experiment for each level of treatment. It should be noted that it rained on certain days during the cultivation of the fish, which reduced the amount of daily feeding. Researchers noted that the fish developed best under the conditions in which a stocking density of 25 fish m^{-3} (T25) was adopted.

These animals attained final average weights and lengths of 29.47±10.16 g and 11.32±1.21 cm, respectively, followed by the treatment in which a stocking density of 50 fish m^{-3} (T50) was chosen, for which the fish had final average weights and lengths of 26.95±8.24 g and 11.18±1.19 cm, respectively. However, when higher stocking densities were adopted, the results obtained were similar: 23.20±8.66 g and 10.64±1.31 cm; 22.55±6.19 g and 10.28±0.89 cm; and 21.85±10.85 g and 9.98±1.53 cm for the treatments in which stocking densities of 100; 75 and 125 fish m^{-3} (T100; T75 e T125, respectively) were chosen.

These results demonstrated the efficiency of Biocelerator 500® in helping to digest the organic matter when higher stocking densities are used in pisciculture. Regarding the average daily weight gains that were recorded, the results followed a similar trend, as reflected in these values: 0.41±0.102 day^{-1}; 0.37±0.103 day^{-1}; 0.32±0.108 day^{-1}; 0.31±0.073 day^{-1}; and 0.30±0.139 day^{-1}, respectively. Researchers also noted that higher survival rates were recorded amongst the fish that were placed in the treatment in which a stocking density of 25 fish m^{-3} (95.33±0.94%) was adopted, followed by treatments T75; T50; T100 and T125, which returned survival rates of 94.67±0.53%; 93.33±1.89%; 87.17±0.24% and 76.67±0.19%, respectively.

These results demonstrated that higher fish mortality rates are associated with higher stocking densities; albeit, the treatment in which a stocking density of 75 fish m^{-3} stands out as being the second-best result achieved. The largest final biomass was recorded for the treatment that featured the highest stocking density, treatment T125, which resulted in a total of 6.28±1.082 kg. The final biomasses of the remaining densities decreased in order as follows: 6.07±0.390 kg; 4.82±0.781; 3.77±0.043 and 2.23±0.147, respectively.

Lastly, regarding the apparent feed conversion ratio, the best result was recorded for treatment T25 (1.83±0.122), followed by T50 (2.00±0.031), T75 (2.09±0.050), T100 (2.09±0.160) and that of treatment T125, which yielded a result of 2.47±0.268, indicative of the greater use of feed associated with the highest stocking density (Table 1).

As such, the study results demonstrated the effectiveness of Biocelerator 500® in in the reduction of organic matter in the water, thereby improving the development of the fish in the lowest stocking density experimental condition, i.e., 25 fish m^{-3} (T25). However, as larger stocking densities were experimented with, the results were similar, mainly with respect to the final average weights and lengths and average daily weight gains.

In conclusion, one may note the degradation of the organic matter at the bottom of the tank in which the Biocelerator 500® was applied, which also demonstrates the reduction of organic matter in the water.

Table 1 below shows survival rate (S), final biomass (B), final average weight (W), final average length (L), average daily weight gain (ADWG) and apparent feed conversion (AFC) for the fish upon completion of the cultivation (fry stage) with the application of an enzyme that stimulates the degradation of organic matter, at differing stocking densities. The figures are expressed as averages ± standard deviations.

Treatment	S (%)	B (kg)	W (g)	L (cm)	ADWG (g day^{-1})	AFC
T25	95.33±0.94	2.23±0.147	29.47±10.16	11.32±1.21	0.41±0.102	1.83±0.122
T50	93.33±1.89	3.77±0.043	26.95±8.24	11.18±1.19	0.37±0.103	2.00±0.031
T75	94.67±0.53	4.82±0.781	22.55±6.19	10.28±0.89	0.31±0.073	2.09±0.050
T100	87.17±0.24	6.07±0.390	23.20±8.66	10.64±1.31	0.32±0.108	2.09±0.160
T125	76.67±0.19	6.28±1.082	21.85±10.85	9.98±1.53	0.30±0.139	2.47±0.268

KEYWORDS: fry stage, zootechnical performance*Oreochromis niloticus*.

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ZOOTECHNICAL PERFORMANCE OF TILAPIA CULTIVATED IN CONDITIONS IN WHICH COMPOUNDS THAT STIMULATE THE ACTIVITY OF MICRO-ORGANISMS THAT REDUCE THE AMOUNT OF ORGANIC MATTER WERE APPLIED

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ABSTRACT: Tilapia are omnivorous, rustic fish that are capable of adapting easily to confinement in various levels of productive intensity. They can thereby tolerate low levels of dissolved oxygen and relatively high levels of ammonia when they are farmed in intensive systems. This study had the purpose of monitoring the zootechnical performance of tilapia that were farmed in breeding ponds whose water was dosed with a product consisting of inorganic nanoparticles that stimulate the activity of the micro-organisms that consume and reduce organic matter.

For this study, the Nile tilapia, or *Oreochromis niloticus*, were reared for a period of 183 days in breeding ponds that were filled with groundwater at the Agrícola Famosa farm, which is located in the municipality of Icapuí, in the state of Ceará, approximately 230 kilometres from the capital city of Fortaleza. The fish were then cultivated in the fingerling and growing-out stages for a period of 185 days. These GIFT (Genetically Improved Farmed Tilapia) were purchased from Fazenda Aquabel in the district of Icaraí de Amontada, in the state of Ceará.

The fish were put into three plastic tarp lined breeding ponds (corresponding to three different levels of treatment). Each pond had a useful volume of 600 m^3, but were filled with 500 m^3 of water, and had a stocking density of 13 fish/m^3. Therefore, 6,500 fish received each level of treatment. The fish had initial average weights and average lengths of 20.3±0.4 g and 9.6±0.8 cm, respectively. They were fed at an initial daily rate of 6% of their biomass, eight times per day. The feeding was then reduced to a rate of 1.5% of their biomass, six times per day. The fish were fed with a nutritionally balanced, extruded aquafeed containing 35% and 32% raw protein, respectively, that was thrown directly onto the surface of the water.

During the cultivation of the animals, a product was added to the breeding ponds to aid in the reduction of the organic matter in the water. Known as ***Biocelerator 500®,*** this product is a colourless, aqueous solution of inorganic nanoparticles which was applied in Treatments 1 and 2 at dosages of 1 litre/week and 200mL/day, five days per week, respectively. Biomix Gel®, a bioremediator for use in reducing the amount of organic matter in water, was used as treatment agent 3 at a dosage of 60 g/week.

At the end of the experiment, a sample of various fish was collected with a net from each of the breeding ponds (each with their own level of the treatment design) in order to measure their final average weights, which were determined using a digital semi-analytical balance. The parameters survival rates, final biomass generated, average daily weight gain and apparent feed conversion ratio were also determined.

The authors also noted that the development of the fish was more robust in treatment ponds 1 and 2 where the Biocelerator 500® was applied, showing survival rates, final average weights, final biomasses, average daily weight gain and apparent feed conversion ratios of 99.11 and 99.42%; 784.4 and 747.0 g; 5,053.10 and 4,827.11 Kg; 4.24 and 4.04 g/day; and 1.35 and 1.45, respectively, which were all superior to those results associated with treatment 3 in which the Biomix Gel® was used.

The results for treatment 3 were the following: 98.97%; 739.1 g; 4,754.63 Kg; 4.00 g/day and 1.43, respectively (Table 1), which illustrated the efficiency of the enzyme in reducing the organic matter content of the water (Biocelerator 500®) in this intensive fish farming system.

Table 1. Survival rate (S), final average weight (W), final biomass (B), average daily weight gain (ADWG) and apparent feed conversion (AFC) of the fish at the end of the 185 days in which the fish were reared in ponds lined with plastic tarp while dosing two compounds that stimulate the micro-organisms that reduce organic matter concentrations in the water.

Treatment	S (%)	W (g)	B (Kg)	ADWG (g/day)	AFC
Biocelerator (1 L/week)	99,11	784,4	5053,10	4,24	1,35
Biocelerator (200 mL/day)	99,42	747,0	4827,11	4,04	1,45
Biomix (60 g/week)	98,97	739,1	4754,63	4,00	1,43

KEYWORDS: zootechnical performance, grow-out, organic matter, production, Nile tilapia.