BIOCHEMICAL AND PHYSIOLOGICAL STUDIES ON DIFFERENT FISH SPECIES CULTURED UNDER DIFFERENT STOCKING DENSITY AT MANZALA FISH FARM.

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Abstract

The effect of stocking density on semi-intensive and extensive earthen pond on some biochemical and hematological parameters of fish for five months has been investigated at Manzala fish farm Egypt. Eighteen earthen ponds were stoked with a rate of 1, 1.25, 1.5, 1.75, 10 and 14 fish/m^3. The treatments of 10 and 14 fish/m^3 represented the semi-intensive system, and the other fish densities represented the extensive system. From our results we concluded that the efficacy of the different fish species cultured in semi-intensive have plasma protein, and albumin better than those in extensive culture, but glucose level was higher in semi-intensive than in extensive one. Hb, RBCs and hematocrit are nearly the same. The pH, DO, and OS were higher in semi-intensive ponds than in extensive ponds.

Key words: Biochemical, plasma protein, albumin, glucose, Hb, RBCs, and Hematocrit, polyculture, monoculture, intensive, extensive, water quality, tilapia, mullet, carp.

INTRODUCTION

Synergistic interactions among fish species are manifested by higher growth and yield in polyculture than in monoculture. The bases for these interactions are the increase of available food resources and the improvement of environmental conditions (Milstein, 1992). Polyculture was first practiced in China more than a thousand years ago. It was extremely extensive system, requiring a little management, stocking several fish species at low density, often without application of feeds, and producing relatively low yield at low production costs (Lin, 1982). Semi-intensive ploYculture and monoculture are widely used for fish culture in Egypt, practiced in shallow earthen ponds and in deep dual-purpose irrigation reservoirs. The main species cultured in commercial ponds are Nile tilapia *(Oreochromis niloticus)*, common carp (*Cyprinus carpio)*, silver carp, (*Hypophthalmichtys molitrix)* and stripped mullet, *(Mugil cephalus)* and grey mullet, (*Lisa ramada).* These species are stoked in several combinations, covering a wide range of production. Fish stocking density is a key factor in the optimal management of fish polyculture. It affects the amounts of natural food available per fish, the level of supplemented feeding required (Hepher, 1988), and thus, the intensity of inter- and intra-specific food competition. Fish exposed to Cu show hematological changes in numbers of blood cells, hemoglobin levels, protein

concentrations (Sorensen, 1991). So this study aimed to show the efficacy of the different fish culture species for determination of some biochemical and hematological parameters in extensive and semi-intensive culture.

MATERIALS AND METHODS

The present study was conducted in six earthen ponds (for semi-intensive culture) and twelve earthen ponds (for extensive culture), at Manzala fish farm, Manzala, Dakahalia, Egypt. Aeration devices were used in first six ponds (2 Impeller Paddle wheel Aerator-AR-A232-2 h), while no aeration devices were used in the second twelve ponds. The experimental period were stoked in 20 May and harvested in 20 October 2005. Each treatment had three replications. The design of the experiment can be summarized as described in table (1):

Table 1. The density, culture fish species, feeding and number of earthen fish ponds in the farm were studied.

Treatment number	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6
Stocking density	10 fish/m^3	14 fish/m^3	1 fish/m^3	1.25 fish/m^3	1.5 fish/m^3	1.75 fish/m^3
Fish culture	Tilapia nilotica Common carp Silver carp Mullet Catfish	Tilapia nilotica Common carp Silver carp Mullet Catfish	Tilapia nilotica Common carp Silver carp Mullet Catfish	Tilapia nilotica Common carp Silver carp Mullet Catfish	Tilapia nilotica Common carp Silver carp Mullet Catfish	Tilapia nilotica Common carp Silver carp Mullet Catfish
Nutrition	3% of b. wt. of 25% protein	3% of b. wt. of 25% protein	3% of b. wt. of 25% protein	3% of b. wt. of 25% protein	3% of b. wt. of 25% protein	3% of b. wt. of 25% protein
No ponds	three ponds	three ponds	three ponds	three ponds	three ponds	three ponds

The present study consisted of two parts, which were conducted, in completely randomized design. The first group was used to evaluate the fish stocking density under the semi-intensive system at a rate of 10 and 14 fish/m^3. The second group was used to evaluate the stocking density under the extensive system at a rate of 1, 1.25, 1.5 and 1.75 fish/m^3 as shown in Table 1. The two systems were composed of the same fish species. Nile tilapia (*Oreochromis niloticus)*, Common carp (*Cyprinus carpio)*, Silver carp, (*Hypophthalmichtys molitrix)*, Mullet, (*Mugel cephalus)* and Catfish (*Clarias gariepinus*). A commercial feed pellets (25% crude protein) were given at a rate of 3%

of body weight and automatically and manually distributed twice a day, 5 days a week for semi-intensive and extensive fish ponds, respectively.

Sampling and analysis of blood

Blood samples from each fish species (five fish species), were obtained (3x3x6 {three replicates, three times for six treatments}) at the end of three late months throughout the culture season for each treatment. Fish were anesthetized with MS222 (50mg/L) and bled by venipuncture of the tail. The blood was collected in two sets. One set were collected in heparinized tubes for heamatological analysis and the other set tubes were centrifuged at 3000 rpm for 15 minutes and plasma was removed and stored until analysis. The plasma glucose levels were measured using GOD-PAP method (enzymatic colorimetric method) according to Trinder (1969) using Boehringer Mannheim kits. Serum total protein content and serum albumin were determined according to King and Wooton (1959).

Hemoglobin level was determined colorimetrically by measuring the formation of cyanomethemoglobin after using commercial kits. Red blood cells (RBCs, cells μ/L) were counted under light microscope using Neubauer haemocytometer after dilution of blood with phosphate buffering saline. Hematocrit value were immediately determined directly by placing fresh blood in glass capillary tubes and centrifuged for 5 min in a microhematocrit centrifuge.

Water quality:

Physico-chemical parameters of water monitored monthly. Temperature and dissolved oxygen (DO) were determined directly by a portable digital oxygen meter (YSI model 58, USA), and pH by a digital pH meter (Accumet 340,). Water salinity was determined by conductivity meter (Orion 630,). Nitrate, nitrite and free ammonia were determined by a HACH water analysis kits (DR 2000, USA). Total phosphorus, orthophosphate, total alkalinity, chlorophyll "a" were determined by using standard methods (APHA, 2000).

Statistical analysis

Statistical analysis was performed using the analysis of variance (ANOVA). Duncan's Multiple Range Test was used to determine the significant differences between means at $P<0.05$. Standard errors of treatment means were also estimated. All statistics were carried out by using Statistical Analysis Systems (SAS) program (SAS, 2000).

RESULTS AND DISCUSSION

The biochemical characteristics of blood (T. protein, S. albumin and plasma glucose) from all fish species cultured are summarized in table (2). Total protein ranged from 4.8±0.06 to 4.2±0.03, 5.9±0.46 to 5.1±0.06, 6.2±0.08 to 5.2±0.04,

4.8±0.07 to 4.1±0.06, and 5.3±0.09 to 4.5±0.03 g/dl in tilapia, common carp, silver carp, Mullet and Claris respectively. While, serum albumin ranged from 1.59±0.06 to 1.37±0.04, 1.89±0.08 to 1.72±0.08, 1.93±0.09 to 1.75±0.09, 1.62±0.04 to 1.42±0.04, 1.71±0.08 to 1.48±0.06 g/dl in tilapia, common carp, silver carp, Mullet and Claris respectively. Finally, plasma glucose ranged from 99±5.0 to 61±4.0, 119±8.0 to 83±6.0, 108±8.0 to 85±4.0, 93±6.0 to 75±4.0, and 109±7.0 to 93±4.0 mg/dl in tilapia, common carp, silver carp, Mullet and Claris respectively. The quantitative determination of the total serum protein reflects the liver capacity of protein synthesis and denotes the osmolality of the blood and the renal impairments. So it is of valuable effect in the diagnosis of the stressed on the fish

In the present study, the blood glucose was significantly increased in first and second treatments in all fish species, this agreement with Mousa (2004) who found that the decrease was attributed to either a stage of hydration and change in water equilibrium and/or disturbances in the liver protein synthesis. Hyperglycemia was continued also at the five and six treatment for all fish species, while on third and fourth treatments, hypoglycemia was recorded. Alteration of blood sugar levels revealed a stress response of fish (Nemcsok *et al.*, 1987). These results are in agreement with those of Mousa (2004). The hyperglycemia induced by any toxicant might be explained by the inhibition of the neuroeffector sites in the adrenal medulla leading to hypersecreation of adrenalin, which stimulates the breakdown of glycogen to glucose (Gupta, 1974).

The hematological parameters (Hb, RBCs count/mm and PCV) from all fish species cultured are shown in Table (3). The hemoglobin level ranged from 6.8±0.15 to 6.4±0.14, 10.7±0.18 to 10.3±0.1, 10.8±0.19 to 10.1±0.14, 7.6±0.14 to 7.2±0.13, and 11.5±0.22 to 10.9±0.19 g/dl in tilapia, common carp, silver carp, Mullet and Claris respectively. While, RBCs ranged from 1.484±0.052 to 1.379±0.052, 2.430±0.066 to 2.320±0.068, 2.420±0.060 to 2.377±0.062, 1.717±0.053 to 1.640±0.051, and 2.650±0.088 to 2.580±0.094 g/dl in tilapia, common carp, silver carp, Mullet and Claris respectively. Finally, PCV ranged from 14.32±1.07 to 14.08±1.15, 22.7±2.27 to 22.15±2.02, 23.36±2.25 to 23.05±2.17, 16.50±1.18 to 16.02±1.12, and 24.80±2.71 to 24.05±2.42 mg/dl in tilapia, common carp, silver carp, Mullet and Claris respectively. The decrease in RBCs, Hb and Ht were the most common effects usually expected in all animals exposed to chemical and toxicological metabolites in which the hemopoietic tissues are the target organs of their effect. Most toxic substances, including herbicides, suppress the processes of erythropoiesis and Hb synthesis. Also, the decreases in RBCs, Hb and Ht, may be due to the elimination of RBCs from the circulation as a result of the toxicity of the herbicides which induced

extravasations of blood as previously mentioned by Mousa (2004). Also Levy *et al* (2006) found that fish hematological parameters, as well as, glucose, cortisol and ions did not show significant differences among the four tested densities.

Physico-chemical characteristics in water under different treatments are shown in Tables 4. The pH values in the treatment range was 8.45- 9.6. The pH values in extensive ponds did not differ significantly. But in this study the results showed that within extensive culture treatments was none significantly difference for pH values. These results were agreed with that obtained by Shaker *et al.* (2002**).** While, the pH values differed significantly between semi-intensive and extensive fish pond. Dissolved oxygen (DO mg/l) concentration range was 4.3-6.9 mg/l in all treatments. DO concentrations in extensive ponds were not significantly differing, while it differed significantly between semi-intensive ponds and others. The use of paddle wheel in semi-intensive ponds increased DO to be higher than that of other ponds. The pH, Temperature and dissolved oxygen values are very pertinent for fish aquaculture. The pH, temperature and DO values in all pond lies within the favorable limits needed for the growth and survival of fish.

The mean values of ammonia-nitrogen were 2.5, 2.7, 1.3, 1.4, 1.5 and 1.6 mg/l for semi-intensive and extensive treatments (1-6) respectively. The concentrations of toxic NH_3-N in this work were lesser than those recorded in fertilizer fish ponds by Shaker *et al.* (2002). The increase of NH_3-N in semi-intensive ponds than other treatment ponds may be due to the decomposition of organic matter and direct excretion of ammonia by fish. The NO_2 and NO_3 concentrations were highly concentrations in semi-intensive treatments than other treatments. These results in agreement with those obtained by Islam (2002) and Mousa (2004). The average concentrations of total alkalinity (T. alk.) and total hardness (T.H) were suitable for fish growth and survival. These results were harmony with those obtained by Mousa (2004). The average concentrations of total phosphorus (T.P) and orthophosphate (O.P) were lower in semi-intensive than others. These results may be due to the water change in semi-intensive pond that led to the decrease of organic matter in these ponds. The average concentration of chlorophyll "a" increased with decreasing fish density per m^3.

Fish production is illustrated in table 5. The final average weights of Nile tilapia were 222.5 and 235 g for semi-intensive and extensive ponds, respectively. It is clear that the average weight of Nile tilapia and mullet were highly in semi-intensive than extensive pond. These results may be due to feed habitat in different systems, while silver carp, and common carp were higher in extensive than in semi-intensive ponds. These results due to these fish depend on natural food and organic matter. The total

fish productions for all treatments were 10374, 13911, 1743.5, 2042.5, 2142.5 and 2286.5 kg/feddan for all treatments (1-6), respectively. These results clear that the fish production increased with increasing stocking fish density. These results are agreement with those obtained by Shaker *et al.* (2002), Sumagaysay and Lourdes (2003) and Yang Yi *et al.* (2003) who found that phytoplankton based food chain was relatively unimportant in pond culture that relies on artificial feed to promote fish growth.

CONCLUSION

From this study the results concluded that the efficacy of the different fish species cultured in semi-intensive have plasma protein, and albumin better than those in extensive culture, but glucose level was higher than in extensive one. But the Hb, RBCs and hematocrit are nearly the same. So, biochemically the different fish species cultured in semi-intensive culture have an efficacy better than in extensive polyculture. Also semi-intensive culture must be increased for increase the production in the lowest area.

Table 2. The average level of three samples serum total protein (g/dl), s. albumin (g/dl), and plasma glucose (mg/dl) in different fish species during the culture season.

Treat. / Fish sp.	Items	Tilapia sp	Common carp	Silver carp	Mullet	Claris
Treat. 1	T. protein (g/dl)	4.7±0.05^{a}	5.8±0.06^{a}	5.7±0.09^{b}	4.5±0.04^{b}	5.1±0.03^{b}
	S. Albumin (g/dl)	1.52±0.02^{a}	1.89±0.08^{a}	1.82±0.07^{a}	1.55±0.05^{b}	1.68±0.03^{a}
	glucose (mg/dl)	99±5^{a}	119±8^{a}	108±8^{a}	89±5^{a}	103±9^{a}
Treat. 2	T. protein (g/dl)	4.8±0.06^{a}	5.9±0.46^{a}	6.2±0.08^{a}	4.8±0.07^{a}	5.3±0.09^{a}
	S. Albumin (g/dl)	1.59±0.06^{a}	1.88±0.09^{a}	1.93±0.09^{a}	1.62±0.04^{a}	1.71±0.08^{a}
	glucose (mg/dl)	92±2^{a}	112±10^{a}	102±10^{a}	93±6^{a}	109±7^{a}
Treat. 3	T. protein (g/dl)	4.3±0.02^{b}	5.4±0.04^{b}	5.3±0.06^{c}	4.2±0.05^{c}	4.6±0.06^{c}
	S. Albumin (g/dl)	1.49±0.05^{b}	1.73±0.08^{a}	1.84±0.08^{a}	1.52±0.04^{b}	1.62±0.06^{a}
	glucose (mg/dl)	65±3^{c}	87±6^{b}	87±5^{b}	74±3^{b}	92±4^{b}
Treat. 4	T. protein (g/dl)	4.2±0.03^{b}	5.5±0.03^{b}	5.2±0.04^{c}	4.3±0.03^{c}	4.5±0.03^{c}
	S. Albumin (g/dl)	1..44±0.03^{b}	1.87±0.02^{a}	1.76±0.08^{a}	1.48±0.03^{b}	1.53±0.06^{b}
	glucose (mg/dl)	61±4^{c}	83±6^{b}	88±6^{b}	75±4^{b}	95±5^{b}
Treat. 5	T. protein (g/dl)	4.1±0.08^{b}	5.3±0.08^{c}	5.5±0.05^{c}	4.1±0.06^{d}	4.5±0.02^{c}
	S. Albumin (g/dl)	1.39±0.04^{c}	1.74±0.09^{a}	1.86±0.09^{a}	1.48±0.05^{b}	1.49±0.07^{b}
	glucose (mg/dl)	72±3^{b}	94±5^{b}	85±4^{b}	77±3^{b}	93±4^{b}
Treat. 6	T. protein (g/dl)	4.2±0.06^{b}	5.1±0.06^{d}	5.2±0.08^{d}	4.3±0.03c	4.6±0.28^{c}
	S. Albumin (g/dl)	1.37±0.04^{c}	1.72±0.08^{b}	1.75±0.09^{a}	1.42±0.04^{b}	1.48±0.06^{b}
	glucose (mg/dl)	73±4^{b}	92±5^{b}	87±5^{b}	81±4^{b}	93±5^{b}

Means with tha same letters in the same column for the same item are not significantly different.(P> 0.05) using ANOVA.

Table 3. The average level of three samples haemoglobin (g/dl), erythrocytic count ($X10^6$/cmm), and haemocrit (%) in different fish species during the culture season.

Fish sp. / Treat.	Items	Tilapia sp	Common carp	Silver carp	Mullet	Claris
Treat. 1	HB (g/dl)	6.5±0.15[a]	10.3±0.16[a]	10.6±0.12[a]	7.3±0.16[a]	11.2±0.21[a]
	RBCs ($X10^6$/cmm)	1.484±0.052a	2.397±0.062a	2.398±0.059a	1.701±0.047a	2.625±0.093a
	PCV (%)	14.08±1.15[a]	22.70±2.27[a]	23.22±2.13[a]	16.35±1.09[a]	24.52±2.36[a]
Treat. 2	HB (g/dl)	6.5±0.16[a]	10.5±0.14[a]	10.8±0.19[a]	7.2±0.13[a]	10.9±0.19[a]
	RBCs ($X10^6$/cmm)	1.398±0.055b	2.414±0.072a	2.419±0.063a	1.640±0.051a	2.580±0.094a
	PCV (%)	14.32±1.07[a]	22.52±2.13[a]	23.05±2.17[a]	16.42±1.13[a]	24.60±2.52[a]
Treat. 3	HB (g/dl)	6.6±0.12[a]	10.6±0.12[a]	10.1±0.14[a]	7.6±0.14[a]	11.5±0.22[a]
	RBCs ($X10^6$/cmm)	1.379±0.052b	2.398±0.077b	2.377±0.062a	1.717±0.053b	2.650±0.088a
	PCV (%)	14.22±1.09[a]	22.15±2.02[a]	23.05±2.04[a]	16.50±1.18[a]	24.05±2.42[a]
Treat. 4	HB (g/dl)	6.5±0.14[a]	10.3±0.13[a]	10.2±0.15[a]	7.2±0.14[a]	11.3±0.24[a]
	RBCs ($X10^6$/cmm)	1.401±0.055b	2.320±0.068b	2.380±0.060a	1.680±0.050	2.600±0.085b
	PCV (%)	14.28±1.11[a]	22.28±2.11[a]	23.15±2.16[a]	16.02±1.12[a]	24.50±2.62[a]
Treat. 5	HB (g/dl)	6.8±0.15[a]	10.7±0.18[a]	10.2±0.16[a]	7.6±0.15[a]	11.5±0.21[a]
	RBCs ($X10^6$/cmm)	1.470±0.058b	2.410±0.52b	2.390±0.066a	1.710±0.058a	2.630±0.088a
	PCV (%)	14.12±1.14[a]	22.40±2.17[a]	23.26±2.19[a]	16.28±1.17[a]	24.80±2.71[a]
Treat. 6	HB (g/dl)	6.4±0.14[a]	10.6±0.13[a]	10.5±0.16[a]	7.4±0.13[a]	11.3±0.19[a]
	RBCs ($X10^6$/cmm)	1.440±0.055b	2.430±0.066b	2.420±0.060a	1.680±0.050a	2.600±0.080a
	PCV (%)	14.32±1.15[a]	22.50±2.18[a]	23.36±2.25[a]	16.30±1.16[a]	24.70±2.77[a]

Means with tha same letters in the same column for the same item are not significantly different.(P> 0.05) using ANOVA.

Table 4.Total annual mean of some physico-chemical parameters of water samples collected from Manzalla fish farm during the experimental period under different stocking densities..

Item \ Treat.	Treat. 1	Treat. 2	Treat. 3	Treat. 4	Treat. 5	Treat. 6
Temp. (°C)	27.5±1.1 a	27.4±0.7 a	27.1±0.6 a	27.2±0.8 a	27.2±1.0 a	27.2±0.6 a
pH	8.6±0.4 b	8.45±0.4 b	9.5±0.5 a	9.6±0.6 a	9.55±0.5 a	9.56±0.5 a
D. O (mg/l)	6.7±0.7 a	6.9±0.9 a	4.3±0.5 b	4.5±0.5 b	4.4±0.5 b	4.4±0.4 b
NH_3 (mg/l)	2.5±0.4 a	2.7±0.6 a	1.3±0.1 b	1.4±0.1 b	1.5±0.2 b	1.6±0.2 b
NO_2 (mg/l)	0.37±0.02 b	0.46±0.3a	0.12±0.03 c	0.14±0.04 c	0.16±0.04 c	0.22±0.05 c
NO_3 (mg/l)	0.36±0.01 b	0.42±0.02a	0.16±0.03d	0.16±0.05c	0.19±0.06 c	0.25±0.06c
T. N (mg/l)	5.5±0.6 a	5.9±0.8 a	3.3±0.4 b	3.25±0.9 b	3.36±0.6 b	3.4±0.08 b
Salinity (g/l)	2.0±0.1 b	1.9±0.1 b	2.6±0.1 a	2.6±0.1 a	2.6±0.1 a	2.7±0.1 a
T. alk (mg/l)	290±50 b	295±42 b	375±64 a	380±60 a	380±56 a	385±52 a
T. P (mg/l)	0.92±0.06b	0.96±0.04b	1.56±0.04a	1.72±0.17a	1.74±0.19a	1.76±0.21a
O. P (mg/l)	0.32±0.06b	0.34±0.07b	0.76±0.11a	0.77±0.14a	0.76±0.13a	0.75±0.19a
Chlorophyll "a" mg/l	24.5±4.6 b	27.5±3.1 b	114.6±12.6 a	96.5±14.1 a	96.5±10.1 a	99.5±6.9 a

Means with tha same letters in the same row are not significantly different.(P> 0.05) using ANOVA.

Table 5. Fish production and net production of different aquaculture systems at Manzala fish farm after the experimental period .

Item \ Treat.	Unit	Treat. 1	Treat. 2	Treat. 3	Treat. 4	Treat. 5	Treat. 6
Nile Tilapia	A. Wt -g	225±26	220±26a	240±29a	240±36a	230±30a	230±20a
	T. Wt kg	8899±3b	12111±456a	846±99c	930±91c	1021±79c	1052±109c
Mullet	A. Wt -g	250±26a	250±36a	350±22a	270±38a	250±29a	250±16a
	T. Wt kg	475±22b	650±26a	85.0±16e	192.5±19d	259.5±28d	380.5±29c
Common Carp	A. Wt -g	900±101b	875±110b	1700±130a	1050±109b	980±92b	590±75c
	T. Wt kg	540±26b	700±36a	212. 5± 18c	420±20b	392±14b	472±16b
Silver Carp	A. Wt -g	550±30c	500±30c	1400±76a	1150±75b	1050±64b	810±44bc
	T. Wt kg	110±10c	100±10c	280±14a	230±12b	210±12b	162±16c
Catfish	A. Wt -g	1750±156a	1750±166a	1600±165a	1350±172ab	1300±148ab	1100±120b
	T. Wt kg	350.0±42a	350 ±32a	320±22a	270±20b	260±30b	220.0±18b
Total production	Kg	10374±356b	13911±356a	1743.5±372c	2042.5±136c	2142.5±118c	2286.5±98c
Net production	Kg	8642±304b	11499±324a	1679.5±316c	1956.75±136c	2041.16±112c	2161.75±88c

Means with tha same letters in the same row are not significantly different .(P> 0.05) using ANOVA.

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دراسات بيوكيميائية وفسيولوجية على أنواع مختلفة من الأسماك المستزرعة تحت كثافات مختلفة فى مزرعة المنزلة

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قسم الفسيولوجى و الكيمياء الحيوية بالمعمل المركزي لبحوث الثروة السمكية بالعباسة- أبــو حمــاد شرقية- مصر.

تم دراسة تأثير الكثافة فى الأستزراع السمكى الشبة مكثف والعادى فى الأحواض الترابيــة على بعض العوامل البيوكيميائية والفسيولوجية لبعض الأسماك المستزرعة لمدة خمسة أشــهر فــى مزرعة المنزلة دقهلية مصر. استخدمت ١٨ حــوض ترابــى بمعــدل ١٠و ١٤و ١و ١,٢٥و ١,٥ و١,٧٥ سمكة لكل متر مكعب. وكانت المعاملة الأولى والثانية تمثل الشبة مكثف وباقى المعــاملات تمثل الأستزراع العادى. أظهرت النتائج ان الأسماك المستزرعة فى الشبة مكثف تحتوى على مصل البروتين والألبومين افضل من المعاملات الأخرى ولكن نسبة السكر فى البلازما أعلى من الأستزراع العادى. وكانت نسبة الهيموجلوبين وعدد كرات الدم الحمراء ونسبة الهيماتوكريت تقريبا متساوية.