EFFECT OF PROTEIN LEVEL AND STOCKING DENSITY ON GROWTH PERFORMANCE OF GREY MULLET (*MUGIL CEPHALUS*) REARED IN MONOCULTURE IN THE NEW DESERT AREAS

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Abstract

The present study was carried out to study the effect of dietary protein level (25% and 30%) and stocking densities (3 and 6 fish / m3) on growth performance of Grey Mullet (*Mugil cephalus*) during the period from 1/ 5 / 2006 to 1 / 11 / 2006. Eight earthen ponds each of 2000 m2 were used representing four treatments two protein levels and two stocking densities, Within each protein level tested each treatment was performed in duplicates. Results obtained can be summarized as follows: 1- regardless of stocking density increasing protein level fed from 25% to 30% increased significantly ($P< 0.05$) the body weight. 2- increasing the protein level fed improved feed conversion ratio, regardless of stocking rate. 3- from economical efficiency treatment (SR1 x P2) was the best in net returns followed by (SR2 x P2), (SR2 x P1) and (SR1 x P1). 4- The best stocking rate of Grey Mullet (*M. cephalus*) fingerlings was (3 fish / m3) under the similar conditions to those of the present study, in the new desert areas.

Key words: Monoculture, Mullet, Earthen ponds, stocking density, Growth, Total production.

INTRODUCTION

Mullet have a worldwide distribution because they feed the lowest trophic levels on plant detritus and algae. They are extremely abundant in estuaries, and are easily caught and transported. They are especially suited for farming in fish ponds (Oren, 1981).

The most common species of fish produced in Egypt are tilapia (40% of production from all sources) and grey mullet (*Mugil cephalus*) (14%). These two

groups account for more than half of all fish production (MSSP, 2001). Fertilization and supplementary feeding led to best growth rate of *M. cephalus* compared to supplementary feeding only (Abd El-Tawab and Yones, 2001).

Bakeer (2006) studied performance of Grey mullet (*M. cephalus*) reared at three different stocking densities in monoculture system under Egyptian condition (1 fish/m^3, 2 fish/m^3 and 3 fish/m^3), he recommended that, the best stocking rate of grey mullet (*M. cephalus*) fingerlings during rearing period of 8 months was 2 fish/m^3 in the new desert areas (Wady-El-Natron, Behira Governorate, Egypt).

Economic success of controlled fish production depends mainly on feed costs, particularly that of protein, since protein is always the most expensive component in artificial fish diets, therefore the determination of nutritional requirements of the fish and the composition of the diet in the determination of the feeding rate may help in saving feed and increasing the farm profitability.

This study was conducted to investigate the water quality criteria, plankton communities, growth parameters, survival rate, total fish production and economic efficiency of Grey mullet (*M. cephalus*) reared at different protein levels and different stocking densities in the new desert areas under mono culture conditions.

MATERIALS AND METHODS

Location

The present study was carried out at the private fish farm at Wady- El-Natron, Behira Governorate, Egypt.

Facilities and fish

The experiment started on the 1st May 2006 and lasted at the 1st November of the same year. Eight brackish water earthen ponds each of 2000 m^2 were used representing four treatments two stocking densities (3 and 6 fish/m^3) and within each density studied two protein levels (25 and 30%) were tested. The initial weights of the fish at the start of the experiment were 10.05 $\pm$ 0.30 g /fish. Fish were fed on the experimental diets two times daily (9 am and 2 pm) six days a

week at a rate of 3% of their biomass weight. Feed amounts were monthly adjusted on basis of the new fish weight.

Experimental diets

Two experimental diets were formulated to contain 25 and 30% crude protein. Feed ingredients of the diet were thoroughly mixed using a vertical mixer, then the mix was made into moist past by addition of water at a rate of 25% of the diet weight. The past was then extended through a commercial mincing machine from which the cutting blades have been removed. The resulting spaghetti like diet (3 mm diameter) was then sun dried for 14 hours before fed to the fish. Compositions of the two experimental diets are illustrated in Table (1).

The two tested diets were analyzed for dry matter, crude protein; ether extract (EE) and ash contents according to A.O.A.C. (1990) Gross energy (GE) contents of the experimental diets were calculated accordding to Omar (1984).

Growth performance parameters

Live body weight and length of individual fish (150 fish/pond) at start and monthly were recorded till the termination of the experiment. The experiment was started on 1 May and lasted for 24 weeks.

Specific growth rate (SGR) was calculated using the following equation:-

$$SGR\% = 100 (Ln\ W_2 - Ln\ W_1)/T_2 - T_1$$

Where W_2 is the weight at T_2 and W_1 is the weight at T_1 and Ln is the natural log.

Feed efficiency parameters

Feed conversion ratio (FCR) was calculated monthly by using the following equation:

FCR= total gain / feed consumed

Table 1. Composition of the two experimental diets.

Item	Experimental diet	
	Diet (1) 25% CP	Diet (2) 30% CP
Feed Ingredient		
Ground yellow corn	38.0	29.0
Soybean meal (44%)	24.0	33.4
Concentrates (52%)	19.0	21.6
Wheat bran	4.0	2.0
Wheat flour	5.0	4.0
Sun flour oil	9.0	9.0
Vitamin & Mineral premix*	1.0	1.0
Total	100.0	100.0
Calculated diet composition		
Protein %	25	30
Ash, %	7.62	6.83
Ether extract, %	11.93	11.21
Crude fibers, %	3.89	4.14
Gross energy, k cal/kg	4500	4900
Chemical composition, %		
Moisture	9.31	9.44
Crude protein	24.62	30.56
Ether extract	.87	6.46
Ash	7.09	6.61
Crude fiber	4.01	4.36

*Vitamins and minerals mixture each 1 kg of mixture contains:

4.8 M.I.U. vit. A. 0.8 M.I.U. vit D3, 4.0g vit E, 0.8g vit K4.0g vit B12, 4.0g vit B2 0.6g vit. B6, 4.0g vit pantothanic acid 8.0g vit Nicotine acid, 400 mg vit. Folic aclic acid, 20 mg vit Biotin, 200g choine chloride, 4g copper, 0.4g Iodine, 12g Iron, 22g Manganese. 22g Manganese. 22g Zinc, 0.04g selenium.

Organic fertilizer were used in all experimental ponds, to accelerate natural food, at a rate of 200 (Kg / fed) treated (sun dried) chicken manure monthly.

Water Quality Measurements

Temperature, Dissolved Oxygen and pH were measured daily using temperature and Dissolved Oxygen meter (YSI model 57) and pH meter (model corning 345). Transparency and Turbidity were measured daily by Secchi disk. Determinations of phosphorous and ammonia were carried out every two weeks according to methods of Boyd (1990). Phytoplankton and zoo plankton communities in pond were determined every two weeks according to the methods

described by Boyd and Tucker (1998). Samples were collected from different sites of the experimental ponds randomly to represent the water of the whole pond.

Statistical analysis

The statistical analysis of data was carried out applying the computer program Harvey (1990). Differences among means were tested for significancy according to Duncan's multiple range test (1955).

RESULT AND DISCUSSION

Water Quality Criteria and Physical Characteristic

Average water quality criteria as affected by different stocking densities are presented in Table (2). Results revealed that there are no significant differences in water temperature, which was ranged between 26.30 and 26.80 ^{0}C in all treatments. Transparency (Secchi disk reading in cm) was significantly affected by different stocking rates and protein level fed. The maximum averages were obtained for treatments (SR_2 ×P1) and (SR_2 ×P2) (17.75 and 17.81 cm, respectively), where (SR_1 ×P1) and (SR_1 ×P2) were lowest (16.35 and 16.41 cm, respectively). These mean that at higher densities the water are more turbid which may be resulted from fish movement in the ponds. These values (water temperature ^{0}C and Secchi disk reading cm.) are beneficial to fish cultivation. In this connection. Lupatsch *et al,* (2003) and Bakeer (2006) reported that no significant difference in temperature was observed in ponds with different stocking densities, in this respect, Abd – El Twab and Yones (2001) found that temperature of El-Fayoum fish farms ranged between 25.6 to 30.6, which are near to our findings. Temperature and transparency values are in the range recommended for the fish cultured in the four treatments (Boyd, 1990).

Chemical characteristics

Average of pH values for treatments (SR1 ×P1), (SR1 ×P2), (SR2 ×P1) and (SR2 × P2) were 8.5; 8.7; 8.3 and 8.8, respectively. And differences were significant ($P< 0.05$).

Average of Dissolved Oxygen (DO) values were ranged between 5.21 to 6.80 mg/l. These values may be beneficial to fish cultivation and indicate also that dissolved oxygen concentrations were decreased at early morning in all experimental ponds. These values were agreed with the findings of Boyd and Tucker (1998).

Unionized (free) ammonia

Values (NH_3) were low to be toxic to fish, and it was, 0.22 mg/l and lay in the normal range Table, 2).

These values are beneficial to fish cultivation Wurts (2003) and Bakeer (2006) concluded that the toxic levels for unionized ammonia for short time exposure usually to between 0.6 to 2.0 mg/l for pond fish. Averages of salinity and total hardness were not significantly affected by treatments (Table, 2). These values showed no variations and they lay in the desirable range for mullet cultured in the four treatments (Oren, 1981 and Bakeer, 2006).

Average of phosphorous had ranged between 1.81 to 2.34 mg/l Table (2) and showed no nutrient limitations (Boyd, 1990).

Hydro–Biological Features (Plankton communities).

Phytoplankton

Results presented in Table (3) illustrated the effect of stocking rates and protein levels fed of grey mullet on phytoplankton communities.

The total phytoplankton productivity for treatments (SR1 ×P1), (SR1 ×P2), (SR2 ×P1) and (SR2 ×P2) were found to be 2140; 2027; 1505 and 1560 thousand organism / L, respectively. The results in Table (3) indicate that the highest

phytoplankton values were obtained by the lowest density. The present study indicated also that green algae are the dominant followed by euglena; blue green algae and diatoms in the all treatment mullet groups. This means that, *M. cephalus* fingerlings preferred diatoms and blue green algal in their feeding habits and this recommended by Essa and Salama (1990) and Bakeer (2006).

This community phytoplankton reported in this study is in agreement with observation of Bakeer (2006). On the other hand Abd-El Twab (1994) gave different community Composition of phytoplankton, which may be due to the differences in the ecological conditions of the ecosystems studied.

Zooplankton

Results presented in Table (3) illustrated the effect of stocking densities on zooplankton communities in mullet ponds.

The average zooplankton productivity for treatments (SR1 ×P1), (SR1 ×P2), (SR2 ×P1) and (SR2 ×P2) were found to be 4971; 4507; 2869 and 2914 organism /l, respectively. Results revealed that the lowest total zooplankton counts were obtained by the treatment (SR2 ×P1) and (SR2 ×P2) followed in an increasing order by (SR1 ×P1) and (SR1 ×P2) treatments, respectively. Results in Table (3) revealed also that the highest counts of Rotifer for treatment (SR1 ×P1) while the lowest treatment in (SR2 ×P1), which it was considered as (100%). The counts of copepod for treatments (SR1 ×P1), (SR1 ×P2), (SR2 ×P1) and (SR2 ×P2) were only 151; 158; 82 and 85 organism/l, respectively. The present study indicates that rotifer is dominant group in the water ponds followed by crustacea in all treatment ponds. This means *M. cepalus* fingerlings preferred crustacean organisms in their feeding habits and the results of Essa and Salama (1990) and Bakeer (2006) reported same finding. These results may be due to the feeding habits of mullet species. The results indicted that the community composition of phytoplankton and zooplankton in all treatment ponds fluctuated greatly with stocking densities and feeding habits of mullet whether phytoplankton phagic or zooplankton phagic.

Body weight (BW)

Averages of body weight (BW) as affected by stocking rate and protein level fed of grey mullet are illustrated in Table (4). Averages of initial BW for the experimental groups had ranged between (9.5 to 10.5) and differences among the experimental groups were insignificant indicating that the distribution of the fish into the groups was completely random.

Averages of (BW) of groups fed the higher protein level (30%CP) were significantly ($P < 0.05$) higher than that fed on the 25% protein level.

These results may indicate that the dietary protein level required for faster growth of grey mullet reared in earthen pond lay above 25% CP.

These results are in complete agreement with those reported by (Lovell 1981), who postulated that, the optimal protein level in practical diets of warm water fish for maximum growth and body development was about 30 to 36% and higher protein levels were required for maximum growth rate in all plant protein diets than diets containing some fish meal. The growth depression of fish stocked at higher densities (Table, 4) may attribute to crowding social interactions (Moav 1977) aggression of the fish living in smaller space.

As shown in Table (4) the average final body weight of grey mullet were 148.60, 97.36, 180.64 and 138.60 for (SR1 ×P1), (SR2 ×P1), (SR1 ×P2), and (SR2 ×P2), respectively. Daily gains were between 0.71 and 0.94 g/day. These values are in agreement with that reported by Abd – El Tawab and Yones (2001), Abdel Hakim *et al.* (2006) and Bakeer (2006) who found that the growth of grey mullet was influenced by the different stocking densities. The obtained results reported that the stocking rate of 3 fish /m^3 with 30% protein level (SR1 ×P2), led to assign the largest growth of grey mullet.

Survival Rate

Averages survival rate as affected by different stocking densities are presents in Table (4). The results revealed that there are, significant differenced in

survival rate, which has ranged between 85.00% and 90.3% in all treatments. Generally the result presented in Table (4) indicated that both stocking density and protein level fed had remarkable effects on grey mullet survival. These results are in accordance with the finding of Eid *(2006)* who reported that the survival rates of grey mullet appear with significant differences as affected by different stocking densities.

Total fish production (Kg /pond)

Total fish yield (Kg /pond) of the grey mullet in relation to stocking rates are presented in Table (5). Results revealed that total fish yields at harvesting for (SR1 ×P1), (SR1 ×P2), (SR2 ×P1), and (SR2 ×P2) were found to be 764.99, 978.70, 993.07 and 1422.03 Kg / Pond, respectively. These results indicate that increasing the stocking rates from 3 to 6 fish/m^3 resulted in an increase in fish total yield and the increases were pronounced at higher protein levels fed. These increasing in total yield without increase in profitability compared to the lowest stocking rate 3 fish /m^3 with 30% CP (SR2 ×P2). These results may indicate that in monoculture system of grey mullet stocking rate 3 fish /m^3 with 30% CP (SR2 × P2) is required for better yield and led to assign economic value same observation were reported by Abd – EL Tawab (1994) and Abd- EL Tawab and Yones (2001).

Regarding to the more effective stocking ratio 3 fish /m^3 for marketable size, it was obvious that stocked 3 fish/m^3 in ponds were valuable (Table, 5).

Economical Efficiency

Results presented in Table (5), show the effect of fish stocking and protein levels on the economic efficiency of grey mullet including costs and returns of the applied treatments.

The results indicated that the total cost of the treatments (SR_1 ×P1), (SR_1 × P2), (SR_2 ×P1) and (SR_2 ×P2) and were 3647.96, 5114.8, 4377.82 and 8310.15 L.E for pond, respectively. These results revealed that the total costs of (SR_1 ×P1) were the lowest than the others. On the other hand, the total costs of (SR2 ×P2)

were the highest due to the increasing input costs in feeding. Also, Table (5) shows that net results were 6914.41, 10055.05, 8035.55 and 9465.22 L.E per pond for (SR1 ×P1), (SR1 ×P2), (SR2 ×P1) and (SR2 ×P2), respectively. These results indicate that (SR1 ×P2) was the best in net returns followed by (SR2 ×P2), (SR2 × P1) and (SR1 ×P1).

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Table 2. Physical and chemical characteristics of experimental ponds water during the present study

Parameters	3 Fish /m^3 (S R1)		6 Fish /m^3 (S R2)	
	25% protein (P1)	30% protein (P2)	25% protein (P1)	30%` protein (P2)
Temperature (C0)	26.30a	26.51a	26.81a	26.60a
Seccki disk (cm)	16.35b	16.41 b	17.75a	17.81a
Dissolved Oxygen (mg/l)	6.80a	5.31b	6.80a	5.21b
pH	8.5a	8.7a	8.30a	8.8a
NH (mg/L)	0.17a	0.21b	0.17a	0.22b
Salinity (g/l)	8.15a	8.20a	8.18a	8.20a
Total hardness (mg/l)	275a	278a	270a	271a
Available phosphorus	2.31a	1.82b	2.34a	1.81b

Means with the same letter in the same row are not significantly difference on the 5% level.
SR1 X P1 = 3 Fish / m3 x 25% protein, SR2 X P1 = 6 Fish / m3 x 25% protein
SR1 X P2 = 3 Fish / m3 x 30% protein, SR2 X P2 = 6 Fish / m3 x 30% protein

Table 3. Average numbers of phytoplankton and zooplankton in the ponds water of mullet reared at different densities and protein level fed

Organisms	3 Fish /m^3		6 Fish /m^3	
	25% protein	30% protein	25% protein	30% protein
phytoplankton (thousands organism/L)				
Blue green algae	480	489	310	350
Green algae	690	683	515	510
Diatoms	290	255	175	188
Eug lena	680	600	505	512
(Biomass) thou. Org./l	2140	2027	1505	1560
% of the smallest value	142.19 %	134.6 %	100 %	103 %
Zooplankton (organism/L)				
Rotifera	2900	2551	1850	1870
Copepoda	151	158	82	85
Cladocera	170	178	82	89
Crustacea	1750	1620	855	870
(Biomass) Org./l	4971	4507	2869	2914
% of the smallest value	173.26 %	157.09 %	100 %	101.56 %

Table 4. Effect of stocking rate and protein levels on growth performance of grey mullet

Variable	Avg. Initial body weight g/fish	Avg. final body weight g/fish	Avg. weight gain g/fish	Growth rate g/day	%of the smallest value	% survival rate
Stocking rote (SR)						
SR_1 (3 fish/pond)	10.2[a]	164.63a	154.43[a]	0.85[a]	141.66[a]	90.2[a]
SR_2 (6 fish/pond)	9.8[a]	117.97[b]	108.17[b]	0.60[b]	100.00[b]	85.8[b]
Protein level (P)						
Low (25%)	10.6[a]	122.98[b]	112.38[b]	0.62[b]	100.00[b]	85.5[b]
High (30%)	9.4[a]	159.62[a]	150.22[a]	0.83[a]	133.87[a]	90.0[a]
SR x P						
$SR_1 \times P_1$	10.3[a]	148.60[b]	138.3[b]	0.76[b]	158.33[b]	85.8[b]
$SR_2 \times P_1$	9.8[a]	97.36[c]	87.56[c]	0.48[c]	100.00[c]	85.00[c]
$SR_1 \times P_2$	10.5[a]	180.64[a]	170.14[a]	0.94[a]	195.83[a]	90.3[a]
$SR_2 \times P_2$	9.5[a]	138.60[b]	129.1[b]	0.71[b]	147.9[b]	85.5[b]

Means with the same letter in each column are root significantly different.

Table 5. Economical efficiency of grey mullet (Kg/pond) in L.E.

Item	3 Fish/m^3		6 Fish/m^3	
	25% protein	30% protein	25% protein	30% protein
Production Kg/pond	764.99	978.70	993.07	1422.03
% of the smallest value	100%	127.93%	129.8%	185.88%
Operating costs				
Fish fingerlings	6000	6000	12000	12000
Treated chicken manure	300	300	300	300
Food fixed costs	2447.96	3914.8	3177.82	7110.15
Taxes	200	200	200	200
Labor	500	500	500	500
Depreciation	500	500	500	500
Total costs in L.E	3647.96	5114.8	4377.82	8310.15
Total return/pond	10562.37	15169.85	12413.37	17775.37
Net return L.E /pond	6914.41	10055.05	8035.55	9465.22
%Net returns to total costs	189.54%	196.58%	183.55%	113.89%

REFERENCES

1. A.O.A.C. 1990. Official methods of analysis, 15th edit, Association of Official Analysis Chemists. PP. 1298, Virginia.
2. Abd- El Tawab, A. A. M. 1994. Some studies in effects of some mineral elements on production performance of Mugilidae family reared in Egyptian fish farms M.Sc, University.
3. Abd-El-Tawab, A. A. M. and A. A. Yones. 2001. Environmental and nutritional studies on rearing of mullet; *M. cephalus* in Fayoum fish farms. Egyptian J., Nutrition and Feeds, 4: 719 – 730.
4. Abd-El , Hakim. N. F., Mohammed S. Lashen, Mohammed, N. Bakeer and Abd-El- Rahman, A. Khattaby 2006. Effect of different feeding levels on growth performance and pond productiveity of Nile tilapia (O. *nilotocus*), Grey mullet

(*M. cephalus*) and common carp (*C. carpio*) reared in polyculture system. Egypt J. of Aquatic Biology and Fishenies 10 (4).

5. Bakeer M. N. 2006. Performance of Grey Mullet (*Mugil cephalus* L.) reared in the new desert areas. J. of the Araban Aquaculture society .Vol 1 . No. 2 , 44 – 56.
6. Boyd, C. E. 1990. Water quality in ponds for Aquaculture Alabama Agriculture Experiment Station Aubum University, Alabama. P. 462.
7. Boyd E. C. and C. S. Tucker. 1998. Opond Aquaculture water quality management , kluwer, Boston.
8. Duncan, D. B. 1955. Multiple range and multiple F test. Biaetrics, 11: 1 – 42.
9. Eid, A. M. S. 2006. Effect of stocking density on growth performance and production of grey mullet (*Mugil cephalus*). Egypt. J. Agric. Res., 84(1A), 51 – 59.
10. Essa, M. A. and M. E. Salama. 1990. Observations on the use of organic fertilizerin rearing ponds of young grey mullet (*M. Cephalus*). Communication in Science and Development Research ., Vol . 31 , 177- 194.
11. Lovell , R. T. 1981. Laboratory manual for fish feed analysis and fish nutrition studies Aubyrn University , Alabama.
12. Lupatsch, I., T. ktz and D. L. Angel. 2003. Assessment of the removal eficiently of fish farm effluents by grey mullets, Israel Oceanographic and Limnlogical Research , Nationl Center for Mari culture , POB 1212 , 88112 Eilat, Israel . 34 (15) , 1367 – 1377.
13. Moav, R. 1977. Intensive polyculture of fish in freshwater ponds , part 1 . Substitution of expensive feeds by liquid cow manure , Aquaculture. 10 : 25 .
14. MSSP 2001. Technical report, Marine Aquaculture Development in Egypt. Multi – Sector Support Programmer (November, 2001) by Dr. Ian Goulding.
15. Omar, E. A. 1984. Effect of type feed level and frequency of feeding on growth performancy and feed utilization by mirror carp; *Cyprinus carpio* L. ph.D. Diss In Agric. Sci Fac . Agric .Georg. Agust Univ. Gottingen Germany.
16. Oren, O. H . 1981. Aquaculture of grey mullet . Book,507 p.p.
17. Wurts, W. A. 2003. Daily PH cycle and ammonia taxicity . World Aquaculture Magazine, 34(2), 20.

تأثير مستوى البروتين في العليقة ومعدلات التسكين على أداء النمو لأسماك البوري المرباة في النظام الأحادي النوع في المناطق الصحراوية الجديدة.

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١. *المعمل المركزي لبحوث الأسماك بالعباسة – شرقية – مصر.*

٢. *كلية الزراعة – قسم الإنتاج الحيواني – جامعة القاهرة.*

أجريت الدراسة بهدف دراسة أثر مستوى البروتين فى العليقة (٢٥ – ٣٠%) ومعدلات التخزين (٣ – ٦ سمكة للمتر المكعب) على أداء النمو لأسماك البوري المرباه في أحواض ترابية خلال الفترة من ٢٠٠٦/٥/١ إلى ٢٠٠٦/١١/١ . تم إستخدام ثمانية أحواض ترابية حجم الحوض ٢٠٠٠م^{٢} لتمثل أربعة معاملات آي مستويين من البروتين ومعدلات التسكين .

تم تكرار كل معاملة مرتين.

وكانت النتائج المتحصل عليها تتلخص في الأتي:

١- بغض النظر عن معدلات التسكين فإن زيادة مستوى البروتين فى العليقة من ٢٥% إلى ٣٠% أدى إلى زيادة معنوية في معدلات أوزان الجسم .

٢- زيادة مستوى البروتين فى العليقة أدى إلى تحسين في معدلات النمو النوعي بغض النظر عن معدلات التخزين المختبرة .

٣- من الناحية الإقتصادية أعلي صافي ربح تم الحصول عليه من المعاملة ٣ سمكة/ م^{٣} مع مستوى بروتين ٣٠ % يلي ذلك المعاملة ٦ سمكة / م^{٣} مع مستوى بروتين ٣٠ % ثم المعاملة ٦ سمكة / م^{٣} مع مستوى بروتين ٢٥ % وأخيرا المعاملة ٣ سمكة / م^{٣} مع مستوى بروتين ٢٥ %

٤-أفضل معدل تسكين يمكن استخدامه من إصبعيات البوري الحر بمتوسط وزن ١٠ جرام كان ٣ سمكة/م٣ تحت الظروف المماثلة لظروف التجربة في الأحواض الترابية في المناطق الصحراوية الجديدة وذلك للحصول على أفضل إنتاج وعائد إقتصادي.