4. RESULTS AND DISCUSION

4.1.First experiment:

4.1.1. Growth traits:

4.1.1.1. Body weight:

Tables 7, 8, 9 and 10 show that the least squares means of body weight of Nile tilapia and silver carp increased gradually by ageing and the differences between means, from the 4th up to the 14th week of the experiment, due to feeding system, stocking rate and the interaction between these two factors, were significant ($P<0.01$& $P<0.001$).

4.1.1.1.1.Effect of feeding treatment:

Tables 7, 8, 9 and 10 show that means of body weights, at the initial weeks, of each of Nile tilapia and silver carp fed supplementary feed were identical with ones fed the natural food enhanced by organic fertilization (poultry litter). From the 4th week up to the 14th week of the experiment, body weights of Nile tilapia fed the supplementary feed were significantly higher than the same specie fed the natural food. Silver carp, due to the effect of feeding treatment, showed the opposite results. These results may be attributed to the feeding habits of the two species as tilapia fish which is an efficient converter of phytoplankton and can utilize a wide varity of food especially artificial feeds, while silver carp feeds primary on phytoplankton (Bitterlich and Gnaiger, 1984). Hepher and Pruginin (1981) cleared that silver carp feed mainly on phytoplankton. In the contrary, Reich (1975), reviewed that, in the polyculture system of three species, common carp, silver carp and tilapia, with supplementary feed, the fertilization increased the common carp yield by 35%, silver carp by 31% but had no effect on the yield of tilapia fish.

4.1.1.1.2. Effect of stocking rate:

Body weight of tilapia fish grown under the three silver carp stocking rates at all studied ages revealed that the significant differences, due to stocking rate, started after the first for tilapia month of raising but these significant differences observed after two months for silver carp. As described in tables 7, 8, 9 and 10, the body weight of Nile tilapia increased with increasing silver carp stocking rate. This result can be attributed to the increasing of the amount of artificial feed which was available for tilapia fish more than

Table (7): Least-square means and standard error of the tested factors affecting on body weight (gm) of Nile tilapia.

Independent variable	No.	initial Mean±SE	2-weeks Mean±SE	4-weeks Mean±SE	6-weeks Mean±SE	8-weeks Mean±SE	10-weeks Mean±SE	12-weeks Mean±SE	14-weeks Mean±SE
Feeding treatment (T)									
T1 (poultry litter)	150	11.3±0.6 a	20.1±0.7 a	34.0±0.8 b	49.0±1.2 b	60.0±1.1 b	71.1±1.2 b	87.6±1.3 b	106.0±3.5 b
T2 (artificial feed)	150	11.3±0.6 a	20.8±0.7 a	43.5±0.8 a	58.9±1.2 a	75.8±1.1 a	95.3±1.2 a	116.6±1.3 a	148.1±3.5 a
Stocking rate (SR)									
SR1 (1000 tilapia + 100 S.carp)	100	11.2±0.8 a	19.7±0.8 a	36.1±1.0 b	52.6±1.5 a	64.4±1.4 b	77.6±1.5 c	95.1±1.6 c	114.9±4.3 b
SR2 (1000 tilapia + 200 S.carp)	100	11.3±0.8 a	21.3±0.8 a	39.8±1.0 a	53.5±1.5 a	67.9±1.4ab	83.3±1.5 b	101.4±1.6 b	128.0±4.3 a
SR3 (1000 tilapia + 300 S.carp)	100	11.3±0.8 a	20.3±0.8 a	40.3±1.0 a	55.8±1.5 a	71.5±1.4 a	88.7±1.5 a	109.7±1.6 a	138.2±4.3 a
T × SR									
T1×SR1	50	11.3±1.1 a	20.5±1.1 a	35.7±1.5 b	54.8±2.1bc	64.9±1.9 c	74.9±2.1cd	95.4±2.2 c	115.1±6.1 c
T1×SR2	50	11.3±1.1 a	20.6±1.1 a	34.2±1.5 b	47.0±2.1 d	59.1±1.9de	71.1±2.1de	86.2±2.2 d	104.6±6.1 c
T1×SR3	50	11.2±1.1 a	19.1±1.1 a	32.2±1.5 b	45.2±2.1 d	56.0±1.9 e	67.2±2.1 e	81.0±2.2 d	98.2±6.1 c
T2×SR1	50	11.1±1.1 a	18.9±1.1 a	36.6±1.5 b	50.4±2.1cd	63.9±1.9cd	80.4±2.1 c	94.7±2.2 c	114.7±6.1 c
T2×SR2	50	11.4±1.1 a	22.1±1.1 a	45.4±1.5 b	60.0±2.1 b	76.6±1.9 b	95.4±2.1 b	116.5±2.2 b	151.4±6.1 b
T2×SR3	50	11.3±1.1 a	21.5±1.1 a	48.5±1.5 a	66.4±2.1 a	87.0±1.9 a	110.2±2.1 a	138.5±2.2 a	178.3±6.1 a
Overall mean	300	11.3±0.4	20.4±0.5	38.8±0.6	54.0±0.9	67.9±0.8	83.2±0.9	102.1±0.9	127.2±2.5

\+ Means with the same letter in each column are not significantly different.

Table (8): Least-squares analysis of variance of the tested factors affecting on body weight (BW) of Nile tilapia.

Source of variation	df	F-ratios							
		initial	2-weeks	4-weeks	6-weeks	8-weeks	10-weeks	12-weeks	14-weeks
Feeding treatment (T)	1	0.00	0.68	63.51***	32.90***	103.13***	204.89***	255.57***	72.77***
Stocking rate (SR)	2	0.01	1.06	4.95**	1.20	6.99***	14.19***	21.93***	7.46***
T×SR	2	0.01	1.78	14.70***	18.88***	35.44***	40.73***	85.62***	22.35***
Remainder df	294								
Remainder MS		58.71	64.96	105.38	224.36	182.48	215.55	247.26	1832.07

Table (9): Least-square means and standard error of the tested factors affecting on body weight (gm) of silver carp.

Independent variable	No.	initial Mean±SE	2-weeks Mean±SE	4-weeks Mean±SE	6-weeks Mean±SE	8-weeks Mean±SE	10-weeks Mean±SE	12-weeks Mean±SE	14-weeks Mean±SE
Feeding treatment (T)									
T1 (poultry litter)	90	164.0±5.8 a	195.0±8.0 a	233.3±8.6 a	301.2±10.1a	366.0±11.7 a	419.5±10.7 a	461.0±8.6 a	505.8±7.4 a
T2 (artificial feed)	90	164.1±5.8 a	177.6±8.0 a	202.9±8.6 b	238.9±10.1b	271.7±11.7 b	311.1±10.7 b	343.3±8.6 b	371.9±7.4 b
Stocking rate (SR)									
SR1 (1000 tilapia + 100 S.carp)	60	163.9±7.1 a	188.0±9.3 a	223.5±10.6 a	289.4±12.3a	359.3±14.3 a	423.4±13.2 a	474.5±10.6 a	523.9±9.1 a
SR2 (1000 tilapia + 200 S.carp)	60	164.3±7.1 a	185.0±9.3 a	215.0±10.6 a	260.5±12.3a	305.6±14.3 b	349.7±13.1 b	383.0±10.6 b	421.0±9.1 b
SR3 (1000 tilapia + 300 S.carp)	60	164.0±7.1 a	185.8±9.3 a	215.9±10.6 a	-260.3±12.3a	291.6±14.3 b	322.9±13.1 b	349.0±10.6 c	371.7±9.1 c
T × SR									
T1×SR1	30	164.0±10.0 a	192.0±13.7 a	230.0±14.9 a	302.7±17.4a	393.8±20.3 a	466.7±18.6 a	521.6±14.9 a	585.2±12.9 a
T1×SR2	30	164.1±10.0 a	196.0±13.7 a	235.5±14.9 a	300.1±17.4a	355.5±20.3 ab	403.2±18.6 b	442.8±14.9 b	489.0±12.9 b
T1×SR3	30	163.9±10.0 a	196.2±13.7 a	234.5±14.9 a	300.8±17.4a	348.7±20.3 ab	388.7±18.6 b	418.7±14.9 b	443.3±12.9 c
T2×SR1	30	163.7±10.0 a	183.3±13.7 a	216.9±14.9 a	276.1±17.4a	324.8±20.3 b	380.1±18.6 b	427.3±14.9 b	462.7±12.9 bc
T2×SR2	30	164.5±10.0 a	174.0±13.7 a	194.4±14.9 a	220.9±17.4b	255.8±20.3 c	296.2±18.6 c	323.2±14.9 c	352.9±12.9 d
T2×SR3	30	164.0±10.0 a	174.4±13.7 a	197.3±14.9 a	219.7±17.4b	234.4±20.3 c	257.1±18.6 c	279.4±14.9 d	300.0±12.9 e
Overall mean	180	164.0±4.1	186.3±5.6	218.1±6.1	270.1±7.1	318.8±8.2	365.3±7.6	402.2±6.1	438.9±5.3

\+ Means with the same letter in each column are not significantly different.

Table (10): Least-squares analysis of variance of the tested factors affecting on body weight (BW) of silver carp.

Source of variation	df	F-ratios initial	2-weeks	4-weeks	6-weeks	8-weeks	10-weeks	12-weeks	14-weeks
Feeding treatment (T)	1	0.000	2.40	6.24**	19.23***	32.51***	50.79***	93.39***	162.23***
Stocking rate (SR)	2	0.001	0.03	0.2	1.86	6.22**	15.63***	37.83***	72.74***
T×SR	2	0.001	0.13	0.52	1.58	0.65	0.73***	1.14	0.34
Remainder df	174								
Remainder MS		3023.25	5683.83	6687.44	9083.83	12318.52	10411.82	6676.33	4978.96

silver carp. This results might also be explained on the basis that stocking of Nile tilapia was still below the normal carrying capacity of the pond for tilapia under the condition of supplemented feeding. Also there was another benefit from the stocking of silver carp with tilapia fish, explained by Reich (1975) who showed that, only a small portion of the algae were digested by silver carp and the undigested parts were excreted in the form of small pellets which were available as food for the other species present, carp and tilapia. In this way silver carp changes natural food, unavailable to other fish, to edible parts. The present results are in agreement with that obtained by McGinty (1985), who used a constant stocking rate of Nile tilapia with increasing stocking rate of largemouth bass in a polyculture system. Fish were fed 32% protein ration, under these experimental conditions he found that, average weight of largemouth bass declined as their stocking density increased, but the average weight and total biomass of originally stocked tilapia increased with increasing largemouth bass stocking density. Cremer and Smitherman, (1980) found that the silver carp is able to filter most types and sizes of phytoplankton in a pond and does not accept pelleted feed.

Table (9) shows that the increase in the stocking rate of silver carp had negative effect on their average body weight. This result may be attributed to the competition between tilapia and silver carp for the natural food available in the pond. Schroeder (1983) found that 50-70% of the tilapia growth originated with a food chain based photosynthetic natural food, even in the presence of a full ration of protein enriched feed pellets. Snow (1983) stated that even low stocking rate, density had a noticeable effect on the rate of growth. Hafez (1991), found that the increase in mullet stocking rate was followed by a decrease in the body weight of tilapia and carp fish under the polyculture system.

4.1.1.1.4. Effect of the interaction between feeding treatment and stocking rate:

Results presented in tables 7, 8, 9, 10 show that variations are significant ($P<0.001$) due to the interaction between feeding treatment and stocking rate, which indicated that these two factors act dependently on each other and also each of them had its own significant effect. Schroeder (1979) in his study with polyculture of common carp, silver carp and tilapia aurea, found that fish yield was linearly positively correlated to fish stocking density.

The interaction was more effective with respect to Nile tilapia as it's significance began from the 4th week of the experiment and continued significantly up to the 14th week of the experiment (table 8) while the interaction, with respect to silver carp was significant only in the 10th week of the experiment (table 10).

The body weights of Nile tilapia decreased with increasing the stocking density of silver carp in ponds fed the first feeding treatment and the opposite trend was obtained in ponds fed supplementary feed. The body weights of silver carp, at the 10th week of the experiment, decreased with increasing stocking rate of silver carp in both ponds fed the two feeding treatments. The latter result is in agreement with the findings of Yousif (1996) that the negative effect of higher densities on cultured fish species were the reduction of growth rate and lowering of survival rate. Hogendoorn and Koops (1983) showed that in polyculture of Nile tilapia and African catfish, the biomass increased with increasing stocking rate, but the individual weight was greatly reduced.

4.1.1.2. Total yield:

4.1.1.2.1. Effect of feeding treatment:

Averages of total yield at the end of the experiment were listed in table (11). As described in this table and fig (1) tilapia gained the highest yield (462 kg) when fed the supplementary feed compared with 324 kg gained by the same fish raised in the first feeding treatment (poultry litter).

Table (11): Total yield of Nile tilapia and silver carp as affected by feeding type and silver carp stocking rate.

	Nile tilapia		Silver carp		total	
Independent variable	yield (kg)	%	yield (kg)	%	yield (kg)	%
Treatment (T)						
T1 (poultry litter)	324	70.1 %	291	100 %	615	92.1 %
T2 (artificial feed)	462	100 %	206	70.8 %	668	100 %
Stocking rate (SR)						
SR1 (1000 tilapia + 100 S.carp)	241	87.3 %	107	48.2 %	348	69.9 %
SR2 (1000 tilapia + 200 S.carp)	269	97.5 %	168	75.7 %	437	87.8 %
SR3 (1000 tilapia + 300 S.carp)	276	100 %	222	100 %	498	100 %
T × SR						
T1×SR1	120	66.7 %	60	45.5 %	180	66.7 %
T1×SR2	108	60.0 %	99	75.0 %	207	76.7 %
T1×SR3	96	53.3 %	132	100 %	228	84.4 %
T2×SR1	121	67.2 %	47	35.6 %	168	62.2 %
T2×SR2	161	89.4 %	69	52.3 %	230	85.2 %
T2×SR3	180	100 %	90	68.2 %	270	100 %

Averages of total yield for Nile tilapia fed the first feeding treatment, calculated as percentage of the largest yield (T2) were found to be 70.13%. The opposite results were obtained with silver carp, as the first treatment gained (291 kg) compared with 206 kg (70.80%) for the second treatment. These results may be attributed to the feeding habits of the two species as described previously. The total fish production (tilapia fish + silver carp) for the first feeding treatment (organic fertilization) was 92.1% of the total fish production for the second feeding treatment (supplementary feeds) and this difference may be due to the high production from tilapia which grew better in the second treatment. These results are in partial agreement with that obtained by Collis and Smitherman (1978), they found that hybrid tilapia when fed on manure, grew 62% compared to hybrids fed on a high protein diet. Moav et al., (1977) found that in polyculture of common carp, silver carp, tilapia aurea and grass carp with applying liquid cow manure the total yield was 58% of the production of that produced in similar polyculture where high protein pellets were fed. Reich (1975) pointed that the production of carp in polyculture with tilapia was somewhat higher than monoculture of tilapia. Barash and Schroeder (1984) found that the substitution of 46% of the pellets by fermented cow manure did not reduce the total fish yield but the complete substitution of the pellets by fermented cow manure caused a 47% decrease in the total yield.

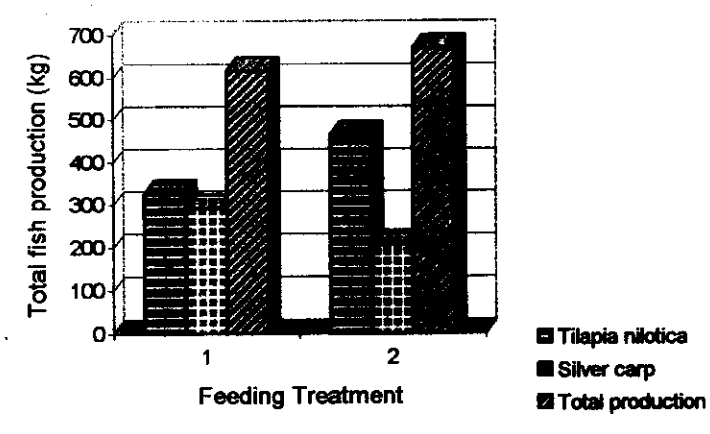
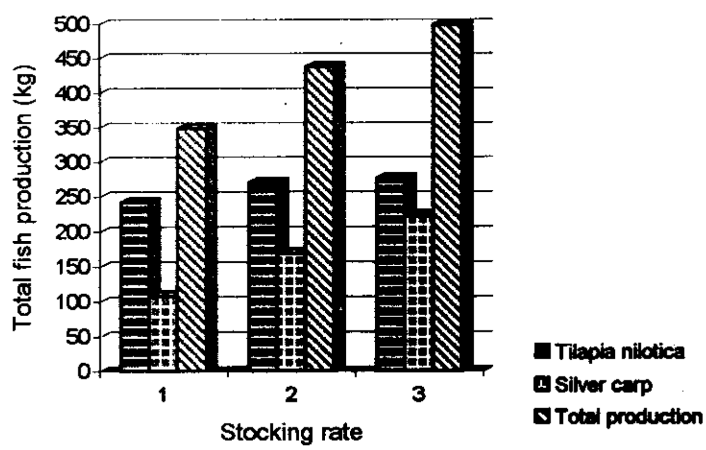


Fig (1): Effect of feeding treatment on the total fish production (total of 3 ponds)

4.1.1.2.2.Effect of stocking rate:

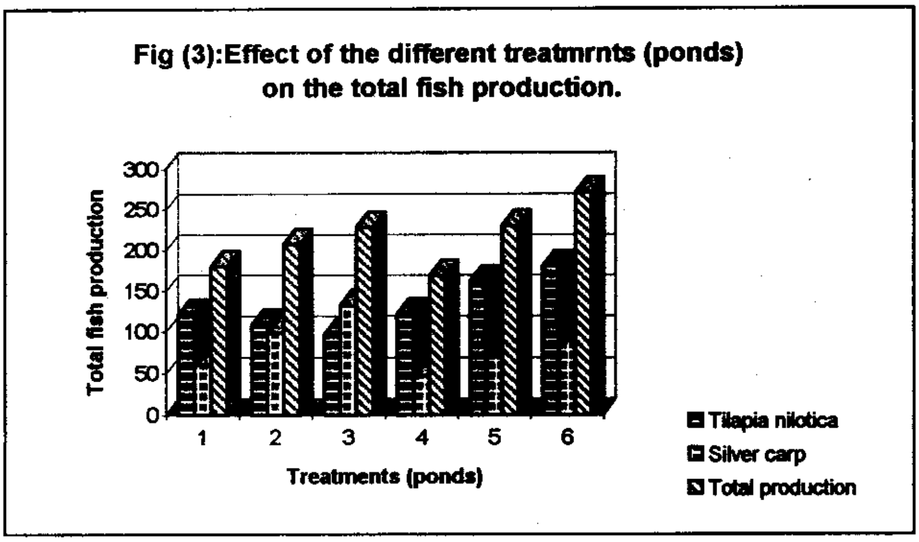
The results listed in (table 11) and outlined in fig (2) indicated that, the total yield for Nile tilapia and silver carp at harvesting as affected by stocking rate regardless of feeding treatment (at the 14th week of the experiment), increased with each increase in stocking rate. Hepher and Pruginin (1981), under the polyculture system, revealed that the improvement in pond oxygen regime occurs due to the presence of silver carp and tilapia. They added that silver carp consume excess algae and when the concentration of algae is excessive, an imbalance between production and consumption of oxygen is created. The consumption of excess algae by silver carp improves and balances this situation. Tilapia feed on the organic ooze of the pond bottom and this ooze increases consumption of oxygen when it is decomposed by bacteria. Therefore tilapia also improve oxygen condition in the pond.

Fig (2): Effect of stocking rate on the total fish production (total of 2 ponds)



4.1.1.2.3. Effect of the interaction between feeding treatment and stocking rate:

As presented in table 11 and fig 3, results revealed that the interaction between type of feeding and stocking rate was found to be significant. This may indicate that for tilapia fish under the manuring system, the total yield of tilapia decreased with each increase in the stocking rate of silver carp. These findings may due to the fact that under this manuring system an interspecies competition on natural food occured and this is reflected negatively on total yield of tilapia. This phenomena disappeared in the second treatment receiving artificial complete diet where tilapia yield increase with each increase in stocking rate of silver carp, thus the competition on food was reduced and more natural food was available for silver carp. On the other hand results revealed that average body weight of silver carp decreased with increasing stocking rate, whoever the total yield increase because of the fact that the number of culture carp was higher at higher densities.



Total fish yield from all experimental ponds, the pond had the second feeding treatment (artificial feed) and the third stocking rate produced the highest yield of tilapia fish (180 kg) while the pond had the first feeding treatment and the third stocking rate produced the smallest yield (96 kg). For silver carp the largest yield obtained from the pond received the first feeding treatment and the third stocking rate (132 kg) but the smallest yield recorded from the pond received the artificial feed and the first stocking rate (47 kg). In general the total fish production (Nile tilapia + silver carp) was recorded from the pond which had the second feeding treatment and the third stocking rate (270 kg). The lowest production obtained from the pond fertilized with poultry litter and had the first stocking rate (180 kg). These results show that using poultry litter as an organic fertilizer produce lower total yield for tilapia than using the supplementary feed , but where manure is available at a nominal cost it is preferable to use it as the net returns would be profitable compared with artificial feed alone. On the other hand silver carp had the largest yields under the organic fetrtilization with poultry litter compared with the supplementary feed. The choice of the optimal stoking rate from the two species and feeding type depend economically on the costs of feeding and the price of the two fish species

4.1.1.3. Specific growth rate (SGR):

Growth is a complex phenomenon but can be viewed most simply as an increase in body cell mass which in animals with a skeleton, such as fish, is accompanied by an increase in axial length. It is now well established in vertebrates, including fish, that growth is regulated by hormones which act together with genetic and nutritional factors to influence the growth performance (Power, 1990).

Averages of SGR of Nile tilapia and silver carp as affected by feeding treatment, stocking rate and the interaction between these two factors are presented in tables 12 and 13, respectively. In general the values of SGR of Nile tilapia due to the effect of the two factors were obviously higher than the values of silver carp.

4.1.1.3.1. Effect of feeding treatment:

SGR of Nile tilapia from the initial week up to 14th week of the experiment and within biweekly intervals, show that using supplementary feeding gave higher values than using poultry litter in most intervals. Peralata and Teichert-Coddington (1989) reported that most tilapia are known to accept artificial feeds immediately after yolk-sac absorption. Shiau and Huang (1989), using hybrid tilapia, found that body weight gain was proportional to the protein content of the diet. They added that tilapia fish requires about 24% protein to produce maximum growth when reared in seawater. With respect to SGR of silver carp using the artificial feeding, it gave lower values than using poultry litter. As previously mentioned in case of body weights these results may be attributed to the availability of supplementary feeding for tilapia fish and the competition with silver carp for natural food available in the ponds. The micro-herbivorous feeding habits of tilapia allowed the fish to access the naturally occurring micro-flora and fauna of the pond, which may have provided sufficient additional food for tilapia fish. The more rapid growth of the pellet-fed fish also indicates that the pellets may be nutritionally considered as complete food for tilapia fish.

4.1.1.3.2. Effect of stocking rate:

Increasing of stocking rate by silver carp was followed by increasing the amount of supplementary feeding which was more suitable for Nile tilapia in the presence of natural food. Therefore, with increasing stocking rate, SGR of Nile tilapia increased while SGR of silver carp decreased. These results are in agreement, partially, with those obtained by Abdel-Wares (1993).

Table (12): Specific growth rate (SGR) of Nile tilapia during the experimental periods as affected by feeding type and silver carp stocking rate.

Independent variable	0-2 weeks	2-4 weeks	4-6 weeks	6-8 weeks	8-10 weeks	10-12 weeks	12-14 weeks	Average of total period
Feeding treatment (T)								
T1 (poultry litter)	3.84	3.50	2.44	1.35	1.13	1.39	1.27	2.13
T2 (artificial feed)	4.07	4.92	2.02	1.68	1.53	1.35	1.59	2.45
Stocking rate (SR)								
SR1 (1000 tilapia + 100 S.carp)	3.76	4.04	2.51	1.35	1.24	1.36	1.26	2.22
SR2 (1000 tilapia + 200 S.carp)	4.23	4.17	1.97	1.59	1.36	1.31	1.55	2.31
SR3 (1000 tilapia + 300 S.carp)	3.91	4.57	2.17	1.65	1.44	1.42	1.54	2.38
T × SR								
T1×SR1	3.97	3.70	2.86	1.13	0.96	1.61	1.25	2.22
T1×SR2	4.00	3.38	2.12	1.53	1.23	1.28	2.29	2.12
T1×SR3	3.56	3.48	2.26	1.43	1.22	1.25	1.28	2.07
T2×SR1	3.55	4.41	2.13	1.58	1.53	1.09	1.28	2.22
T2×SR2	4.41	4.80	1.86	1.63	1.46	1.33	1.75	2.46
T2×SR3	4.29	5.42	2.09	1.80	1.58	1.52	1.68	2.63

Table (13): Specific growth rate (SGR) of silver carp during the experimental periods as affected by feeding type and silver carp stocking rate.

Independent variable	0-2 weeks	2-4 weeks	4-6 weeks	6-8 weeks	8-10 weeks	10-12 weeks	12-14 weeks	Average of total period
Feeding treatment (T)								
T1 (poultry litter)	1.15	1.20	1.70	1.30	0.91	0.63	0.62	1.07
T2 (artificial feed)	0.53	0.89	1.09	0.86	0.90	0.66	0.53	0.78
Stocking rate (SR)								
SR1 (1000 tilapia + 100 S.carp)	0.91	1.15	1.72	1.44	1.09	0.76	0.66	1.11
SR2 (1000 tilapia + 200 S.carp)	0.79	1.00	1.28	1.06	0.90	0.61	0.63	0.90
SR3 (1000 tilapia + 300 S.carp)	0.83	1.00	1.25	0.76	0.68	0.52	0.42	0.78
T x SR								
T1×SR1	1.07	1.18	1.83	1.75	1.13	0.74	0.77	1.21
T1×SR2	1.19	1.22	1.62	1.13	0.84	0.62	0.66	1.04
T1×SR3	1.20	1.19	1.66	0.99	0.72	0.50	0.38	0.95
T2×SR1	0.75	1.12	1.61	1.08	1.05	0.78	0.53	0.99
T2×SR2	0.37	0.74	0.85	0.98	0.98	0.58	0.59	0.73
T2×SR3	0.45	0.79	0.72	0.43	0.62	0.55	0.47	0.58

4.1.1.3.3. Effect of the interaction between feeding treatment and stocking rate:

Specific growth rate of tilapia and silver carp, in polyculture system, during the experimental intervals decreased due to the interaction between first treatment (poultry litter) and increasing stocking rates. While due to the interaction between second feeding treatment and increasing stocking rate, SGR of Nile tilapia increased and SGR of silver crap decreased. The best SGR values for tilapia, due to the interaction, were recorded with fish during the first four weeks as the rates ranged between 3.76-4.57 while in the rest weeks the rates ranged between 0.96-2.86. The best SGR values for silver carp, due to the interaction, were recorded with fish during the first eight weeks as the rates ranged between 0.37-1.83 while in the rest weeks the rates ranged between 0.38-1.13.

4.1.1.4. Body length and depth:

Tables 14, 15, 16 and 17 show that supplementary feeding increased body length of Nile tilapia more than the poultry litter. The opposite trend was obtained with silver carp. The significance increase began from the 4th week for tilapia and silver carp. Due to the effect of the 3rd stocking rate, the increase of body length of Nile tilapia was more pronounced compared with the other two densities and the significance among means began early from the 2nd week. While with respect to silver carp, the increase was more due to the effect of the 1st stocking rate and the significance began lately from the 8th week of the experiment. Therefore, means of body length of tilapia due to the interaction between the second feeding treatment and the 3rd stocking rate were high compared with other interactions. But with respect to silver carp, means of length were high due to the interaction between the first feeding treatment (natural food) and the first stocking rate.

Tables 18, 19, 20 and 21 show that supplementary feeding increased body depth of Nile tilapia more than poultry litter. The opposite trend was obtained with silver carp. The significance increase began from the 6th week for tilapia and from the second week for silver carp. Due to the effect of the 3rd stocking rate, the increase of body depth of Nile tilapia was more compared with the other rates and the significance among means began from the 4th week for tilapia. Results revealed also that the increase in body depth was more pronounced at the highest stocking densities of carp compared with the lower densities where differences in this trait among the groups started to be significant at the 6th week after experimental start.

Table (14): Least-square means and standard error of the tested factors affecting on body length (cm) of Nile tilapia.

Independent variable	No.	initial Mean±SE	2-weeks Mean±SE	4-weeks Mean±SE	6-weeks Mean±SE	8-weeks Mean±SE	10-weeks Mean±SE	12-weeks Mean±SE	14-weeks Mean±SE
Feeding treatment (T)									
T1 (poultry litter)	150	8.1±0.1 a	9.9±0.1 a	12.6±0.1 b	13.9±0.1 b	15.1±0.1 b	16.0±0.1 b	17.2±0.1 b	17.9±0.1 b
T2 (artificial feed)	150	8.1±0.1 a	10.8±0.1 a	13.0±0.1 a	14.7±0.1 a	16.0±0.1 a	17.4±0.1 a	18.3±0.1 a	19.7±0.1 a
Stocking rate (SR)									
SR1 (1000 tilapia + 100 S.carp)	100	8.1±0.2 a	9.5±0.1 b	12.0±0.2 b	14.5±0.2 a	15.3±0.1 b	16.5±0.1 b	17.3±0.1 c	18.4±0.2 b
SR2 (1000 tilapia + 200 S.carp)	100	8.1±0.2 a	10.2±0.1 a	13.0±0.2 a	13.9±0.2 b	15.5±0.1 b	16.8±0.1 a	17.7±0.1 b	18.8±0.2 ab
SR3 (1000 tilapia + 300 S.carp)	100	8.2±0.2 a	10.4±0.1 a	13.4±0.2 a	14.4±0.2 a	15.9±0.1 a	16.9±0.1 a	18.3±0.1 a	19.1±0.2 a
T × SR									
T1×SR1	50	8.1±0.2 a	9.4±0.2 c	12.4±0.2 c	14.6±0.2 b	15.4±0.2 c	16.3±0.1 c	17.5±0.2 c	18.2±0.2 c
T1×SR2	50	8.1±0.2 a	10.1±0.2 ab	12.6±0.2 c	13.5±0.2 c	14.8±0.2 d	15.9±0.1 d	17.2±0.2 c	17.9±0.2 cd
T1×SR3	50	8.2±0.2 a	10.3±0.2 a	12.8±0.2 c	13.6±0.2 c	15.0±0.2 cd	15.9±0.1 d	17.0±0.2 c	17.4±0.2 d
T2×SR1	50	8.1±0.2 a	9.7±0.2 bc	11.7±0.2 b	14.4±0.2 b	15.2±0.2 cd	16.7±0.1 b	17.2±0.2 c	18.5±0.2 c
T2×SR2	50	8.1±0.2 a	10.6±0.2 a	13.5±0.2 a	14.4±0.2 b	16.2±0.2 b	17.7±0.1 a	18.2±0.2 b	19.6±0.2 b
T2×SR3	50	8.1±0.2 a	10.5±0.2 a	14.0±0.2 a	15.2±0.2 a	16.8±0.2 a	17.9±0.1 a	19.6±0.2 a	20.9±0.2 a
Overall mean	300	8.1±0.1	10.1±0.1	12.8±0.1	14.3±0.2	15.6±0.1	16.7±0.1	17.8±0.1	18.8±0.1

\+ Means with the same letter in each column are not significantly different.

Table (15): Least-squares analysis of variance of the tested factors affecting on body length (BL) of Nile tilapia.

Source of variation	df	F-ratios							
		initial	2-weeks	4-weeks	6-weeks	8-weeks	10-weeks	12-weeks	14-weeks
Feeding treatment (T)	1	0.05	3.75	6.49**	21.40***	52.75***	152.14***	68.16***	92.34***
Stocking rate (SR)	2	0.07	13.26***	23.00***	4.44**	6.48**	3.57*	18.84***	5.74**
T×SR	2	0.01	0.21	10.42***	9.84***	18.25***	18.98***	39.64***	23.79***
Remainder df	294								
Remainder MS		2.80	1.70	2.19	2.19	1.37	0.95	1.32	2.65

Table (16): Least-square means and standard error of the tested factors affecting on body length (cm) of silver carp.

		initial	2-weeks	4-weeks	6-weeks	8-weeks	10-weeks	12-weeks	14-weeks
Independent variable	No.	Mean±SE	Mean±SE	Mean±SE	Mean±SE	Mean±SE	Mean±SE	Mean±SE	Mean±SE
Feeding treatment (T)									
T1 (poultry litter)	90	25.33±0.30 a	25.64±0.37 a	27.73±0.37 a	30.56±0.36 a	32.14±0.33 a	33.56±0.29 a	33.58±0.24 a	35.66±0.24 a
T2 (artificial feed)	90	25.33±0.30 a	25.17±0.37 a	26.16±0.37 b	27.79±0.36 b	29.72±0.33 b	30.47±0.29 b	31.48±0.24 b	32.63±0.24 b
Stocking rate (SR)									
SR1 (1000 tilapia + 100 S.carp)	60	25.32±0.36 a	25.07±0.46 a	27.23±0.46 a	29.27±0.45 a	31.82±0.40 a	33.30±0.35 a	34.43±0.30 a	36.60±0.29 a
SR2 (1000 tilapia + 200 S.carp)	60	25.37±0.36 a	25.27±0.46 a	26.53±0.46 a	29.47±0.45 a	30.80±0.40 ab	31.77±0.35 b	31.88±0.30 b	33.95±0.29 b
SR3 (1000 tilapia + 300 S.carp)	60	25.32±0.36 a	25.88±0.46 a	27.07±0.46 a	28.78±0.45 a	30.18±0.40 b	30.97±0.35 b	31.42±0.30 b	31.88±0.29 c
T × SR									
T1×SR1	30	25.30±0.51 a	25.33±0.64 a	27.67±0.65 ab	29.93±0.63 ab	32.90±0.57 a	34.33±0.50 a	34.60±0.42 a	37.80±0.41 a
T1×SR2	30	25.37±0.51 a	25.20±0.64 a	27.27±0.65 ab	31.60±0.63 a	31.27±0.57 abc	33.53±0.50ab	33.07±0.42 b	35.10±0.41bc
T1×SR3	30	25.33±0.51 a	25.40±0.64 a	28.27±0.65 a	30.13±0.63 ab	32.27±0.57 ab	32.80±0.50 b	32.37±0.42 b	34.07±0.41 c
T2×SR1	30	25.33±0.51 a	25.80±0.64 a	26.80±0.65 ab	28.60±0.63 bc	30.73±0.57 bc	32.26±0.50b	34.27±0.42ab	35.40±0.41 b
T2×SR2	30	25.37±0.51 a	25.33±0.64 a	25.80±0.65 b	27.33±0.63 c	30.33±0.57 c	30.00±0.50 c	30.70±0.42 c	32.80±0.41 d
T2×SR3	30	25.30±0.51 a	25.37±0.64 a	25.87±0.65 b	27.43±0.63 c	28.10±0.57 d	29.13±0.50 c	29.47±0.42 d	29.70±0.41 e
Overall mean	180	25.33±0.21	25.41±0.26	26.94±0.27	29.17±0.26	30.93±0.23	32.01±0.20	32.58±0.	34.14±0.17

\+ Means with the same letter in each column are not significantly different.

Table (17): Least-squares analysis of variance of the tested factors affecting on body length (BL) of silver carp.

		F-ratios							
Source of variation	df	initial	2-weeks	4-weeks	6-weeks	8-weeks	10-weeks	12-weeks	14-weeks
Feeding treatment (T)	1	0.000	0.82	8.86**	28.82***	27.38***	58.17***	41.48***	82.62***
Stocking rate (SR)	2	0.006	0.87	0.64	0.62	4.23*	11.43***	30.13***	67.42***
T×SR	2	0.002	0.41	0.71	2.70	4.14*	1.60	9.14**	4.10*
Remainder df	174								
Remainder MS		7.84	12.48	12.64	11.95	9.64	7.38	5.25	4.98

Table (18): Least-square means and standard error of the tested factors affecting on body depth (BD) of Nile tilapia.

Independent variable	No.	initial Mean±SE	2-weeks Mean±SE	4-weeks Mean±SE	6-weeks Mean±SE	8-weeks Mean±SE	10-weeks Mean±SE	12-weeks Mean±SE	14-weeks Mean±SE
Feeding treatment (T)									
T1 (poultry litter)	150	2.71±0.06 a	3.38±0.04 a	4.21±0.05 a	4.65±0.06 b	5.04±0.04 b	5.07±0.03 b	5.40±0.04 b	5.80±0.05 b
T2 (artificial feed)	150	2.69±0.06 a	3.49±0.04 a	4.31±0.05 a	4.83±0.06 a	5.18±0.04 a	5.52±0.03 a	5.81±0.04 a	6.38±0.05 a
Stocking rate (SR)									
SR1 (1000 tilapia + 100 S.carp)	100	2.69±0.07 a	3.37±0.05 b	4.17±0.06 b	4.92±0.08 a	5.05±0.04 b	5.15±0.04 b	5.48±0.05 b	5.93±0.07 b
SR2 (1000 tilapia + 200 S.carp)	100	2.70±0.07 a	3.53±0.05 a	4.22±0.06 b	4.44±0.08 b	5.22±0.04 a	5.36±0.04 a	5.58±0.05 b	6.12±0.07 b
SR3 (1000 tilapia + 300 S.carp)	100	2.71±0.07 a	3.40±0.05 ab	4.40±0.06 a	4.87±0.08 a	5.07±0.04 b	5.38±0.04 a	5.76±0.05 a	6.23±0.07 a
T × SR									
T1×SR1	50	2.70±0.10 a	3.44±0.07 ab	4.12±0.08 b	4.88±0.11 ab	5.27±0.06 a	5.06±0.05 de	5.60±0.06 b	6.02±0.09 c
T1×SR2	50	2.70±0.10 a	3.49±0.07 ab	4.18±0.08 b	4.39±0.11 c	5.06±0.06 b	5.20±0.05 cd	5.40±0.06 c	5.90±0.09 c
T1×SR3	50	2.72±0.10 a	3.20±0.07 c	4.34±0.08 ab	4.67±0.11 bc	4.80±0.06 c	4.95±0.05 e	5.20±0.06 d	5.48±0.09 d
T2×SR1	50	2.68±0.10 a	3.30±0.07 bc	4.22±0.08 ab	4.95±0.11 ab	4.80±0.06 c	5.24±0.05 c	5.36±0.06 cd	5.84±0.09 c
T2×SR2	50	2.69±0.10 a	3.56±0.07 a	4.26±0.08 ab	4.48±0.11 c	5.38±0.06 a	5.52±0.05 b	5.75±0.06 b	6.34±0.09 b
T2×SR3	50	2.70±0.10 a	3.60±0.07 a	4.46±0.08 a	5.08±0.11 a	5.33±0.06 a	5.80±0.05 a	6.32±0.06 a	6.97±0.09 a
Overall mean	300	2.69±0.04	3.43±0.03	4.26±0.03	4.74±0.04	5.11±0.03	5.30±0.02	5.61±0.03	6.09±0.04

+ Means with the same letter in each column are not significantly different.

Table (19): Least-squares analysis of variance of the tested factors affecting on body depth (BD) of Nile tilapia.

Source of variation	df	F-ratios							
		initial	2-weeks	4-weeks	6-weeks	8-weeks	10-weeks	12-weeks	14-weeks
Feeding treatment (T)	1	0.05	3.40	2.30	4.34*	7.15 **	110.13***	62.84***	59.17***
Stocking rate (SR)	2	0.02	2.58	4.52**	11.93***	4.47**	11.48***	9.84***	5.25**
T×SR	2	0.00	6.77***	0.04	1.58	32.37***	22.64***	56.56***	41.28***
Remainder df	294								
Remainder MS		0.46	0.27	0.33	0.59	0.20	0.14	0.21	0.43

Table (20): Least-square means and standard error of the tested factors affecting on body depth (BD) of silver carp.

Independent variable	No.	initial Mean±SE	2-weeks Mean±SE	4-weeks Mean±SE	6-weeks Mean±SE	8-weeks Mean±SE	10-weeks Mean±SE	12-weeks Mean±SE	14-weeks Mean±SE
Feeding treatment (T)									
T1 (poultry litter)	90	6.11±0.08 a	6.46±0.10 a	7.14±0.10 a	7.51±0.10 a	8.41±0.10 a	8.34±0.11 a	9.06±0.07 a	8.09±0.06 a
T2 (artificial feed)	90	6.11±0.08 a	6.16±0.10 b	6.51±0.10 b	7.10±0.10 b	7.69±0.10 b	7.63±0.11 b	8.03±0.07 b	7.84±0.06 b
Stocking rate (SR)									
SR1 (1000 tilapia + 100 S.carp)	60	6.10±0.10 a	6.10±0.12 a	7.05±0.13 a	7.58±0.13 a	8.20±0.12 a	8.56±0.13 a	9.17±0.08 a	8.90±0.08 a
SR2 (1000 tilapia + 200 S.carp)	60	6.12±0.10 a	6.36±0.12 a	6.78±0.13 ab	7.13±0.13 b	8.27±0.12 a	7.77±0.13 b	8.23±0.08 b	7.35±0.08 c
SR3 (1000 tilapia + 300 S.carp)	60	6.11±0.10 a	6.45±0.12 a	6.65±0.12 b	7.23±0.13 b	7.69±0.12 b	7.63±0.13 b	8.23±0.08 b	7.64±0.08 b
T × SR									
T1×SR1	30	6.10±0.14 a	6.46±0.17 a	7.20±0.18 a	7.78±0.18 a	8.33±0.17 ab	8.85±0.18 a	9.47±0.12 a	9.23±0.11 a
T1×SR2	30	6.10±0.14 a	6.37±0.17 a	7.00±0.18 ab	7.27±0.18 ab	8.67±0.17 a	8.13±0.18 b	8.97±0.12 b	7.00±0.11 e
T1×SR3	30	6.12±0.14 a	6.54±0.17 a	7.23±0.18 a	7.49±0.18 ab	8.23±0.17 ab	8.03±0.18 b	8.73±0.12 b	8.03±0.11 c
T2×SR1	30	6.10±0.14 a	5.74±0.17 b	6.90±0.18 ab	7.37±0.18 ab	8.07±0.17 b	8.27±0.18 b	8.87±0.12 b	8.56±0.11 b
T2×SR2	30	6.13±0.14 a	6.36±0.17 a	6.57±0.18 bc	6.98±0.18 b	7.87±0.17 b	7.40±0.18 c	7.50±0.12 c	7.70±0.11 d
T2×SR3	30	6.10±0.14 a	6.37±0.17 a	6.07±0.18 c	6.96±0.18 b	7.15±0.17 c	7.22±0.18 c	7.73±0.12 c	7.25±0.11 e
Overall mean	180	6.11±0.06	6.31±0.07	6.83±0.07	7.31±0.07	8.05±0.07	7.98±0.07	8.54±0.05	7.96±0.04

\+ Means with the same letter in each column are not significantly different.

Table (21): Least-squares analysis of variance of the tested factors affecting on body depth (BD) of silver carp.

Source of variation	df	F-ratios							
		initial	2-weeks	4-weeks	6-weeks	8-weeks	10-weeks	12-weeks	14-weeks
Feeding treatment (T)	1	0.002	4.40*	18.30***	7.98**	25.20***	22.77***	112.65***	7.86**
Stocking rate (SR)	2	0.001	2.19	2.52	3.57*	6.47**	15.19***	41.74***	111.32***
T×SR	2	0.016	2.26	3.31*	0.23	2.81	0.21	6.71**	28.15***
Remainder df	174								
Remainder MS		0.598	0.91	0.99	0.94	0.92	1.00	0.42	0.36

Therefore, means of body length and depth of tilapia due to the interaction between supplementary feeding and the 3rd stocking rate were high compared with other interactions. But in case of silver carp, means of body length and depth were high due to the interaction between natural feeding and the first stocking rate. The present result with tilapia is not in accordance with the findings of Abdel-Wares (1993) who reported that increasing of tilapia stocking rate from 3000 to 6000 fish\feddan followed by a decrease in body weight, body length and depth.

The above results are in accordance with results obtained in body weight and specific growth rate of the two fish species used in the present study. Hafez (1991) found a strong correlation between body weight and body length for tilapia, mullet and carp fish.

4.1.1.5. Condition factor (K):

Growth in the fish can be readily monitored by measuring the increase in weight and length. Another parameter which may be used as an index of growth is the condition factor, which provides a measure of " fatness" of fish and food conversion efficiency, (Power, 1990). Condition factor also measure the "plumpness" or "robustness" of fish, and are easily calculated from routinely collected length-weight data. Condition is frequently assumed to reflect not only characteristics of fish such as health, reproductive state and growth but also characteristics of the environment such as habitat quality, water quality and prey availability (Liao et al., 1995).

Condition factor of fish is essentially a measure of relative muscle to bone growth and the differing growth responses of these tissues to diet treatment may be reflected by changes in condition factor (Ostrowski and Garling, 1988). Condition factor was considered to be a sufficient measure of shape, although shape is usually not considered as a character of interest to breeding programmes, since it has no obvious economic value (Nilsson, 1992).

4.1.1.5. 1. Effect of feeding treatment:

The estimated condition factor of Nile tilapia in the two feeding treatments (table 22) show that the most robust fish were in the second treatment (supplementary feeds) at most periods studied of the experiment and condition factors paralleled with previous fish growth results. The differences between the values of condition factor of the two feeding treatments irrespective of stocking density were significant at all periods except for the two periods at 6 and 10 weeks after the experimental start (table 24).

For silver carp, table 24 shows that the most robust fish were in the first treatment (fertilization with poultry litter) and the significant differences between the values of condition factor of the two feeding treatments were observed from 6 weeks of the experiment (table 25). The high values of condition factor (K) for Nile tilapia fed the second feeding treatment and the high values of (K) for silver carp fed the first feeding treatment attributed to the availability of supplementary feed for Nile tilapia in the second feeding treatment and the natural food for silver carp in the first feeding treatment in adequate quantities and the increase in feeding rate resulted in higher condition factor since the fish grow well when the supply of food is adequate. Similar results in which condition factors increased with the feeding rate have been reported by Chau and Teng, 1982). Dioundick and Stom (1990) demonstrated that, for *O. massambicus*, the values of condition factors decreased with increasing the α-cellulose percent from 0 to 10% of the diet.

4.1.1.5.2. Effect of stocking rate:

Results presented in tables 22 and 23, revealed that stocking density, regardless of feeding treatment, released significant effects on condition factor during the whole experiment periods for Nile tilapia. The best K values were obtained during the first four weeks after experimental start for the favour of the lowest stocking density. Then continued superiority, by the second stocking rate within the following 4 weeks. Within the rest weeks, best values were affected by the 3rd stocking rate.

The effect of stocking rate on condition factor of silver carp was different throughout the whole period of experiment. The large values were at most of weeks due to the effect of the first stocking rate.

The interaction between feed treatment and stocking rate did not show clear tendency, however its effect was significant ($P<0.01$) in the last weeks of the experiment.

4.1.1.6. Correlation coefficients between body measurements:

Table 26 show that the coefficients of correlation between BW and each of BL and BD and also between BL and BD of both Nile tilapia and silver carp were high, positive, and significant ($P<0.001$) and the values ranged from 0.66 to 0.94 from the first week up to

Table (22): Least-square means and standard error of the tested factors affecting on condition factor (K) of Nile tilapia.

Independent variable	No.	initial Mean±SE	2-weeks Mean±SE	4-weeks Mean±SE	6-weeks Mean±SE	8-weeks Mean±SE	10-weeks Mean±SE	12-weeks Mean±SE	14-weeks Mean±SE
Feeding treatment (T)									
T1 (poultry litter)	150	1.86±0.03a	2.10±0.05 a	1.70±0.06 b	1.83±0.02 a	1.76±0.02 b	1.76±0.01 a	1.71±0.03 b	1.85±0.02 b
T2 (artificial feed)	150	1.88±0.03a	1.86±0.05 b	2.01±0.06 a	1.82±0.02 a	1.82±0.02 a	1.77±0.01 a	1.93±0.03 a	1.90±0.02 a
Stocking rate (SR)									
SR1 (1000 tilapia + 100 S.carp)	100	1.88±0.04 a	2.29±0.06 a	2.20±0.07 a	1.71±0.03 c	1.81±0.02 a	1.73±0.02 b	1.83±0.03 a	1.86±0.02 a
SR2 (1000 tilapia + 200 S.carp)	100	1.89±0.04 a	1.90±0.06 b	1.73±0.07 b	1.94±0.03 a	1.81±0.02 a	1.76±0.02 ab	1.88±0.03 a	1.87±0.02 a
SR3 (1000 tilapia + 300 S.carp)	100	1.83±0.04 a	1.75±0.06 b	1.65±0.07 b	1.82±0.03 b	1.75±0.02 b	1.80±0.02 a	1.74±0.03 b	1.89±0.02 a
T × SR									
T1×SR1	50	1.88±0.05 a	2.63±0.09 a	1.92±0.10 b	1.75±0.04 cd	1.79±0.03 a	1.80±0.03 b	1.79±0.05 bc	1.91±0.03 ab
T1×SR2	50	1.88±0.05 a	1.97±0.09 b	1.63±0.10 c	1.93±0.04 ab	1.82±0.03 a	1.79±0.03 b	1.70±0.05 cd	1.81±0.03 c
T1×SR3	50	1.81±0.05 a	1.70±0.09 b	1.56±0.10 c	1.80±0.04 c	1.67±0.03 b	1.68±0.03 c	1.63±0.05 d	1.84±0.03 bc
T2×SR1	50	1.88±0.05 a	1.95±0.09 b	2.48±0.10 a	1.67±0.04 d	1.82±0.03 a	1.67±0.03 c	1.87±0.05 b	1.81±0.03 c
T2×SR2	50	1.81±0.05 a	1.84±0.09 b	1.82±0.10 bc	1.96±0.04 a	1.81±0.03 a	1.73±0.03 bc	2.06±0.05 a	1.94±0.03 a
T2×SR3	50	1.85±0.05 a	1.79±0.09 b	1.74±0.10 bc	1.83±0.04 bc	1.82±0.03 a	1.92±0.03 a	1.85±0.05 b	1.95±0.03 a
Overall mean	300	1.87±0.02	1.98±0.04	1.86±0.04	1.82±0.02	1.79±0.01	1.77±0.01	1.82±0.02	1.87±0.01

+ Means with the same letter in each column are not significantly different.

Table (23): Least-square analysis of variance of the tested factors affecting on condition factor (K) of Nile tilapia.

Source of variation	df	F-ratios initial	2-weeks	4-weeks	6-weeks	8-weeks	10-weeks	12-weeks	14-weeks
Feeding treatment (T)	1	0.37	10.50***	15.53***	0.08	4.85 *	0.50	34.19***	4.55*
Stocking rate (SR)	2	0.75	19.25***	19.20***	20.09***	2.97*	3.27*	4.42**	0.71
T×SR	2	0.07	9.41***	2.39	1.47	4.50**	28.74***	4.68**	9.83***
Remainder df	294								
Remainder MS		0.13	0.41	0.47	0.07	0.04	0.03	0.11	0.04

Table (24): Least-square means and standard error of the tested factors affecting on condition factor (K) of silver carp.

Independent variable	No	initial Mean±SE	2-weeks Mean±SE	4-weeks Mean±SE	6-weeks Mean±SE	8-weeks Mean±SE	10-weeks Mean±SE	12-weeks Mean±SE	14-weeks Mean±SE
Feeding treatment (T)									
T1 (poultry litter)	90	0.99±0.01 a	1.11±0.02 a	1.07±0.01 a	1.03±0.02 b	1.05±0.02 a	1.12±0.02 a	1.20±0.01 a	1.11±0.01 a
T2 (artificial feed)	90	0.99±0.01 a	1.06±0.02 a	1.08±0.01 a	1.09±0.02 a	1.00±0.02 b	1.04±0.02 b	1.07±0.01 b	1.04±0.01 b
Stocking rate (SR)									
SR1 (1000 tilapia + 100 S.carp)	60	0.99±0.02 a	1.14±0.02 a	1.07±0.02 b	1.16±0.02 a	1.08±0.02 a	1.15±0.02 a	1.15±0.01 a	1.05±0.01 b
SR2 (1000 tilapia + 200 S.carp)	60	0.99±0.02 a	1.11±0.02 a	1.12±0.02 a	0.97±0.02 c	0.98±0.02 b	1.05±0.02 b	1.16±0.01 a	1.06±0.01 b
SR3 (1000 tilapia + 300 S.carp)	60	0.99±0.02 a	1.01±0.02 b	1.04±0.02 b	1.06±0.02 b	1.03±0.02 ab	1.05±0.02 b	1.10±0.01 b	1.12±0.01 a
T × SR									
T1×SR1	30	0.99±0.02 a	1.17±0.03 a	1.07±0.03 ab	1.10±0.03 b	1.06±0.03 a	1.22±0.03 a	1.26±0.02 a	1.08±0.02 a
T1×SR2	30	0.98±0.02 a	1.13±0.03 a	1.15±0.03 a	0.90±0.03 c	1.08±0.03 a	1.06±0.03 b	1.21±0.02 a	1.13±0.02 a
T1×SR3	30	0.99±0.02 a	1.03±0.03 bc	0.98±0.03 c	1.08±0.03 b	1.02±0.03 a	1.08±0.03 b	1.12±0.02 b	1.12±0.02 a
T2×SR1	30	0.99±0.02 a	1.11±0.03 ab	1.06±0.03 b	1.21±0.03 a	1.10±0.03 a	1.08±0.03 b	1.04±0.02 c	1.01±0.02 b
T2×SR2	30	0.99±0.02 a	1.08±0.03 abc	1.09±0.03 ab	1.04±0.03 b	0.88±0.03 b	1.03±0.03 b	1.10±0.02 b	0.98±0.02 b
T2×SR3	30	0.99±0.02 a	1.00±0.03 c	1.09±0.03 ab	1.03±0.03 b	1.04±0.03 a	1.01±0.03 b	1.08±0.02 bc	1.13±0.02 a
Overall mean	180	0.99±0.01	1.09±0.01	1.07±0.01	1.06±0.01	1.03±0.01	1.09±0.01	1.13±0.01	1.08±0.01

+ Means with the same letter in each column are not significantly different.

Table (25): Least-square analysis of variance of the tested factors affecting on condition factor (K) of silver carp.

Source of variation	df	F-ratios							
		initial	2-weeks	4-weeks	6-weeks	8-weeks	10-weeks	12-weeks	14-weeks
Feeding treatment (T)	1	0.003	3.70	0.53	5.59**	4.23*	8.45**	52.44***	21.24***
Stocking rate (SR)	2	0.030	8.91***	5.15**	14.38***	5.84**	6.38**	4.42**	10.22***
T×SR	2	0.043	0.12	5.26**	4.30*	11.60***	1.56	8.94***	10.28***
Remainder df	174								
Remainder MS		0.017	0.03	0.02	0.04	0.02	0.04	0.01	0.01

the end of the experiment. Hafez (1991) found that the coefficients of correlation between BW and BL for tilapia, mullet and carp fish ranged between 0.70 and 0.90. Also the present results are relatively in agreement with that obtained by Winkelman and Peterson (1994) for chinook salmon, they found that the phenotypic correlation between BW and BL ranged between 0.60 and 0.95.

Table (26): Correlation coefficients between body measurements of Nile tilapia and silver carp at the different ages studied.

		Initial	2-weeks	4-weeks	6-weeks	8-weeks	10-weeks	12-weeks	14-weeks
Tilapia	BW-BL	0.92***	0.76***	0.78***	0.89***	0.88***	0.82***	0.87***	0.94***
	BW-BD	0.76***	0.87***	0.68***	0.66***	0.66***	0.80***	0.78***	0.77***
	BL-BD	0.79***	0.74***	0.77***	0.76***	0.71***	0.79***	0.72***	0.81***
Silver carp	BW-BL	0.91***	0.91***	0.93***	0.90***	0.89***	0.93***	0.91***	0.93***
	BW-BD	0.84***	0.86***	0.83***	0.90***	0.76***	0.93***	0.84***	0.67***
	BL-BD	0.84***	0.83***	0.81***	0.86***	0.77***	0.87***	0.79***	0.70***

4.1.2. Carcass traits:

Fish filleting is an important process for preparing a much better fish flesh than dealing directly with whole fish. Fish filleting has the following advantages; it is easier to prepare, more convenient for the consumer to cook, easier for packing and transportation, especially when the refrigerated space in the transportation means is limited (Hussein, 1990).

4.1.2.1. Nile tilapia:

Table (27) summarizes the effect of the two feeding treatment (fertilization with poultry litter T1 and supplementary feeds, T2) and the effect of the three stocking rates of silver carp on the percentages of carcass components. As shown in table (27), the overall means were 49.0, 38.2, 32.1, 10.4, 7.4 and 55.6% for dressing percentage, flesh, head, skeleton, viscera and by-products percentages, respectively. The average dressing percentage obtained in this study 49.0%, is in agreement with that obtained by Clement and Lovell (1994), who found that the percentage of processing yield was 51.0%. The flesh percentage in the present study was higher (38.2%) than that obtained by the same authors

(20.3%), and was lower than that obtained by Hussein (1990), who found that the flesh percentage of tilapia fish was 66.4%. Concerning with the percentage of by-product, the value 55.6% was higher than 33.6% that obtained by Hussein (1990) for tilapia fish.

4.1.2.1.1. Effect of feeding treatment:

As shown in table 27 tilapia fish fed the second treatment (supplementary feeds) compared with fish raised under the first feeding treatment (organic fertilization with poultry litter) show higher percentage of dressing (50.3 vs. 47.7%) and flesh (39.2 vs. 37.3%) and lower percentages of head (30.8 vs. 33.3%), viscera (7.1 vs. 7.7%) and by-products (54.5 vs. 56.8%). The differences between these components due to feeding treatment were significant ($P<0.05$) for flesh and by-products percentages and highly significant ($P<0.001$) for dressing and head percentages. The feeding treatment had no effect on the percentage of skeleton and viscera (table 28). From these results it could be conclude that fish fed supplementary feed beside the natural feed available in the pond had higher percentages of flesh and dressing, and this indicates that balanced diet provides tilapia fish with extra amounts of protein, fat, minerals and vitamins required for fish growth and consequently flesh production. Li and Lovell (1992 b) with channel catfish found that the increase in protein percentage of diet from 26-32% was followed by increase in the dressing percentage. Hillestad and Johnsen (1994) with Atlantic salmon found the dress-out percentage was significantly lower by about 27- 35% than for the 42% protein diets.

4.1.2.1.2. Effect of stocking rate:

The second stocking rate (SR2) had higher percentage of dressing 50.1% compared with 49.2 and 47.6% for first (SR1) and third stocking rate (SR3), respectively, and the differences between dressing percentages were significant ($P<0.05$). Also the SR2 had higher percentage (11.6%) of skeleton compared with the SR1 (9.4%) and SR3 (10.2%) and the differences were highly significant ($P<0.001$). The effect of stocking rate on the other carcass components were insignificant (table 28).

4.1.2.1.3. Effect of the interaction between feeding treatment and stocking rate:

The dressing percentage for the different interactions between the two factors ranged from 44.7-52.9% and the differences between the six interactions were highly significant ($P<0.001$), the higher dressing percentage was obtained by fish in the second

Table (27): Least-square means and standard error of the tested factors affecting on carcass composition of Nile tilapia.

Independent variable	No.	Body weight Mean±SE	Dressing % Mean±SE	Flesh % Mean±SE	By-products% Head % Mean±SE	By-products% Skeleton % Mean±SE	By-products% Viscera % Mean±SE	By-products% Total Mean±SE
Feeding treatment (T)								
T1 (poultry litter)	30	78.1±12.4 b	47.7±0.52 b	37.3±0.62 b	33.3±0.50 a	10.4±0.22 a	7.7±0.44 a	56.8±0.76 a
T2 (artificial feed)	30	137.2±12.4 a	50.3±0.52 a	39.2±0.62 a	30.8±0.50 b	10.4±0.22 a	7.1±0.44 a	54.5±0.76 b
Stocking rate (SR)								
SR1 (1000 tilapia + 100 S. carp)	20	99.0±15.2 a	49.2±0.64 ab	38.8±0.76 a	31.7±0.62 a	9.4±0.27 b	8.0±0.54 a	53.9±0.93 b
SR2 (1000 tilapia + 200 S. carp)	20	94.2±15.2 a	50.1±0.64 a	38.5±0.76 a	31.9±0.62 a	11.6±0.27 a	6.7±0.54 a	56.3±0.93 ab
SR3 (1000 tilapia + 300 S. carp)	20	129.8±15.9 a	47.6±0.64 b	37.4±0.76 a	32.6±0.62 a	10.2±0.27 b	7.6±0.54 a	56.7±0.93 a
T × SR								
T1×SR1	10	97.8±21.5 b	51.0±0.91 a	41.5±1.08 a	32.6±0.87 abc	9.5±0.38 b	8.0±0.76 a	53.5±1.32 c
T1×SR2	10	66.6±21.5 b	47.4±0.91 b	36.0±1.08 b	33.4±0.87 ab	11.4±0.38 a	7.4±0.76 a	58.3±1.32 ab
T1×SR3	10	69.9±21.5 b	44.7±0.91 c	34.4±1.08 b	33.9±0.87 a	10.3±0.38 b	7.8±0.76 a	58.3±1.32 a
T2×SR1	10	100.2±21.5 b	47.5±0.91 b	36.0±1.08 b	30.8±0.87 bc	9.4±0.38 b	8.0±0.76 a	54.2±1.32 c
T2×SR2	10	121.7±21.5 b	52.9±0.91 a	41.1±1.08 a	30.4±0.87 c	11.8±0.38 a	6.0±0.76 a	54.4±1.32 bc
T2×SR3	10	189.7±21.5 a	50.4±0.91 a	40.4±1.08 a	31.2±0.87 abc	10.0±0.38 b	7.4±0.76 a	54.9±1.32 abc
Overall mean	60	107.7±8.8	49.0±0.37	38.2±0.44	32.1±0.37	10.4±0.16	7.4±0.31	55.6±0.54

\+ Means with the same letter in each column are not significantly different.

Table (28): Least-squares analysis of variance of the tested factors affecting on carcass composition of Nile tilapia .

Source of variation	df	F-ratios body weight	F-ratios Dressing %	F-ratios Flesh %	By-products % Head %	By-products % Skeleton %	By-products % Viscera %	By-products % Total
Feeding treatment (T)	1	11.35***	12.24***	4.37*	12.17***	0.01	0.93	4.58*
Stocking rate (SR)	2	1.62	4.11*	0.88	0.55	16.59***	1.49	2.77
T×SR	2	3.74*	16.78***	17.61***	0.22	0.38	0.53	1.88
Remainder df	54							
Remainder MS		4614.9	8.23	11.63	7.64	1.46	5.78	17.36

stocking rate and fed the supplementary feed (52.9%). But the lowest one was obtained by fish at the third stocking rate and fed with natural food enhanced by poultry litter. Also the interaction between the two factors had highly significant effect (P<0.001) on the flesh percentage, as the flesh percentages of fish, fed the first feeding treatment decreased with increasing stocking rates but increased in fish fed the second feeding treatment, with each increase the second stocking rates of carp up to the second stocking rate.

4.1.2.2. Silver carp:

As described in table (29) the overall mean of flesh percentage of silver carp was 49.5% and this value is higher than that reported by Billard (1995) for silver carp, who showed that, the fillet percentage was 45% and lower than 72.83% which recorded by Hussein (1990) for the same specie. On the other hand the percentage of by-products (50.2%) is higher than that obtained by the first author, for silver carp, (27.17%), and this results may be attributed to the difference in fish size used in the two studies.

4.1.2.2.1. *Effect of feeding treatment:*

As described in tables (29 and 30) feeding treatment had no significant effect on the percentage of dressing (DP), head percentage and viscera. The second feeding treatment had significant effect on the percentages of flesh (P<0.001). The carcasses of fish seemed to be affected by the first treatment (fertilization) which resulted in higher percentages of skeleton (7.4 vs. 6.0%), by-products (51.3 vs. 49.1%) and lower percentage of flesh (48.2 vs. 50.8%).

4.1.2.2.2. *Effect of stocking rate:*

As described in tables (29 and 30) the three stocking rates had insignificant effects on carcass composition.

4.1.2.2.3. *Effect of the interaction between feeding treatment and stocking rate:*

Table 30 show that the effect of the interactions between stocking rates and feeding treatments was insignificant except for flesh percentage (P<0.05). The carcasses of fish of second feeding treatment and the three stocking rates had flesh percentage ranged from 50.2 to 51.8%, while the carcasses of fish of the first feeding treatment and the three stocking rates had flesh percentages ranged from 46.8-49.6%.

Table (29): Least-square means and standard error of the tested factors affecting on carcass composition of silver carp.

Independent variable	No.	body weight Mean±SE	Dressing % Mean±SE	Flesh % Mean±SE	By-products % Head % Mean±SE	Skeleton % Mean±SE	Viscera % Mean±SE	Total Mean±SE
Feeding treatment (T)								
T1 (poultry litter)	15	470.0±15.4 a	55.6±0.51 a	48.2±0.51 b	32.2±0.36 a	7.4±0.24 a	10.2±0.39 a	51.3±0.50 a
T2 (artificial feed)	15	383.8±15.4 b	56.9±0.51 a	50.8±0.51 a	32.7±0.36 a	6.0±0.24 b	9.2±0.39 a	49.1±0.50 b
Stocking rate (SR)								
SR1 (1000 tilapia + 100 S. carp)	10	466.1±18.9 a	56.0±0.63 a	49.3±0.62 a	32.9±0.45 a	6.7±0.29 a	9.3±0.47 a	50.2±0.61 a
SR2 (1000 tilapia + 200 S. carp)	10	416.8±18.9 ab	56.4±0.63 a	49.3±0.62 a	32.0±0.45 a	6.5±0.29 a	10.1±0.47 a	50.0±0.61 a
SR3 (1000 tilapia + 300 S. carp)	10	398.3±18.9 b	56.4±0.63 a	46.8±0.62 a	32.4±0.45 a	7.0±0.29 a	9.7±0.47 a	50.3±0.61 a
T × SR								
T1×SR1	5	525.8±26.7 a	54.4±0.89 b	46.8±0.88 c	33.4±0.63 a	7.6±0.41 a	9.5±0.67 ab	52.3±0.87 a
T1×SR2	5	454.8±26.7 ab	56.6±0.89 ab	49.6±0.88 ab	31.1±0.63 b	6.9±0.41 ab	11.3±0.67 a	50.3±0.87 abc
T1×SR3	5	430.4±26.7 bc	55.9±0.89 ab	48.2±0.88 bc	32.0±0.63 ab	7.6±0.41 a	9.8±0.67ab	51.2±0.87 ab
T2×SR1	5	406.4±26.7 bc	57.7±0.89 a	51.8±0.88 a	32.4±0.63 ab	5.9±0.41 b	9.1±0.67 ab	48.2±0.87 c
T2×SR2	5	378.8±26.7 bc	56.3±0.89 ab	50.2±0.88 ab	32.9±0.63 ab	6.1±0.41 b	8.9±0.67 b	49.7±0.87 abc
T2×SR3	5	366.2±26.7 c	56.8±0.89 ab	50.2±0.88 ab	32.8±0.63 ab	6.3±0.41 b	9.6±0.67 ab	49.7±0.87 bc
Overall mean	30	427.1±10.9	56.3±0.36	49.5±0.36	32.4±0.26	6.7±0.17	9.7±0.27	50.2±0.35

+ Means with the same letter in each column are not significantly different.

Table (30): Least-squares analysis of variance of the tested factors affecting on carcass composition silver carp.

Source of variation	df	F-ratios: body weight	Dressing %	Flesh %	By-products %: Head %	Skeleton %	Viscera %	Total
Feeding treatment (T)	1	15.72***	3.42	13.26***	0.95	14.72***	3.14	9.56**
Stocking rate (SR)	2	3.44**	0.11	0.31	0.97	0.69	0.68	0.06
T×SR	2	0.59	2.13	3.21*	2.50	0.52	1.56	2.03
Remainder df	54							
Remainder MS		58.71	3.98	3.90	1.99	0.82	2.25	3.78

4.1.2.3. *Correlation coefficients between body measurements and carcass traits:*

As described in table (31) for Nile tilapia there are high, positive and highly significant correlation between dressing percentage (DP) and each of BW (0.35), BL (0.41) and BD (0.47), the increase in each of BW, BL or BD followed by increase in (DP). These results coincided with that obtained by Morkramer et al., (1985), who found that there were high and positive phenotypic correlation between each of the net carcass weight of rainbow trout and each of body weight (0.99), body length (0.87)and body breadth (0.84). On the other hand Craig and Wolters (1988) obtained negative correlation coefficients between dress-out percentage of crayfish *Procambarus clarkii* and each of body length (-0.45 and -0.40), body depth(-0.26 and -0.35) and body weight (-0.58 and -0.60) for females and males, respectively. Positive and significant correlation (0.38) was found between BW and DP for silver carp and negative and insignificant correlation between DP and each of BL (-0.30) and BD (-0.23). Morkramer et al., (1985) found high and positive correlation between weight and net carcass weight (0.99) for rainbow trout.

Table (31): Correlation coefficients between body measurements and carcass component percentages of Nile tilapia and silver carp.

Nile tilapia								
	BW	BL	BD	Dressing %	Flesh %	Head %	Skeleton %	Viscera %
Dressing %	0.35**	0.41***	0.47***					
Flesh %	0.31*	0.31**	0.42***	0.86***				
Head %	-0.14	-0.14	-0.20	-0.46***	-0.26*			
Skeleton %	0.11	0.20	0.15	0.27	0.02	0.03		
Viscera %	-0.24	-0.23	-0.16	0.24	0.04	0.05	-0.11	
By-product %	-0.01	-0.03	-0.06	-0.46***	-0.20	0.65***	0.31*	0.49***
Silver carp								
	BW	BL	BD	Dressing %	Flesh %	Head %	Skeleton %	Viscera %
Dressing %	0.38*	-0.30	-0.23					
Flesh %	-0.48*	-0.38*	-0.31	0.90***				
Head %	0.10	0.13	0.08	-0.42*	-0.36*			
Skeleton %	0.35*	0.27	0.26	-0.09	-0.52***	0.01		
Viscera %	0.23	0.12	0.36*	-0.41*	-0.25	-0.21	-0.23	
By-product %	0.47***	0.39*	0.29	-0.92***	-0.99***	0.35*	0.44**	0.36*

Flesh percentage (FP) in tilapia carcasses correlated positively and significantly with BW (0.31), BL (0.31), K (0.35) and BD (0.42). While in silver carp, the coefficients of correlation coefficient between FP and each of BW (-0.48), BL (-0.38) and BD (-0.31) were negative.

From the coefficients of correlation, it is noticed that the increase in tilapia BW, BL, and BD were followed by increase DP and FP and decreasing the percentage of total by-products, while the opposite trend was obtained with respect to silver carp.

From table 31 there were positive, high and significant correlation between DP and FP for tilapia fish (0.86) and silver carp (0.90). The coefficients of correlation between flesh percentage and by-products percentage were negative (-0.2 and -0.99) for tilapia and silver carp, respectively, however the coefficients of correlation between by-products percentage and each of it's components (head, skeleton and viscera percentage) were positive for the two species.

4.1.3. Chemical composition of flesh:

The chemical analysis of fish flesh for moisture, protein, lipids and ash percentages was routinely conducted on experimental fish at the end of feeding experiment. Carbohydrates is normally determined by differences but only small amounts of them are present in fish.

4.1.3. 1. Nile tilapia:

Average percentages and their standard errors of moisture, dry matter, protein, fat and ash in the flesh are presented in table 32. The average percentages were found to be 78.55, 21.45, 85.51, 8.32 and 6.88% for moisture, dry matter, protein, fat and ash percentage, respectively, and these percentages are coincided with that obtained by Clement and Lovell (1994) for some components and differed from the other. They found that the fillet percentages of moisture, protein, fat and ash were 75.3, 20.3, 5.7 and 2.5%, respectively. Hafez (1991) found that the fillet percentages of moisture, protein, fat and ash were 76.4, 78.9, 15.9 and 6.9%, respectively.

4.1.3. 1. 1. Effect of feeding treatment:

Table 32 shows the chemical composition for tilapia fish flesh as affected by the two feeding treatment (organic fertilization and supplementary feed). The averages of moisture percentages were 78.78 and 78.33%, dry matter percentages were 21.22 and 21.67%, respectively. These percentages are relatively higher than that obtained by Lin et al., (1997), they found that the moisture percentage for hybrid tilapia *(Oreochromis niloticus × O. aureus)* ranged between 73.1 to 73.8%. Analysis of variance as presented in table (33) shows that feeding treatment had no significant effect on the percentages of moisture and dry matter. Tilapia flesh from fish fed the first feeding treatment (organic fertilization) had higher percentages of protein (87.02 vs. 84.00%) and ash (7.54 vs. 6.23%) but lower percentages of fat (6.12 vs. 10.53%) compared with flesh obtained from the second feeding treatment (supplementary feeds) and the difference between percentages under the two feeding treatments was significant (table 33). The higher fat content of fish fed the pellets than the fat content of those raised with poultry litter was probably due to the high energy content of the commercial pellets, and these results are partially agreed with those obtained by Barash and Schroeder (1984), who found that tilapia fat content was higher for fish fed with pellets compared with that raised with fermented cow manure and the differences were significant. Eves et al., (1995) also found that the growth and proximate analysis of *Oreochromis niloticus* fed with septage were smaller and contained less fat, than pellet-fed fish. Also Moav et al., (1977) indicated that the total body fat contents of the common carp were 20%, 15% and 6% when fed with high protein pellets, grain pellets and liquid cow manure, respectively. From the means outlined in table 32 it is we noticed that the larger size fish class usually had statistically lower muscle protein and ash percent and higher muscle fat percent and these results are in agreement with that obtained by Brown and Murphy (1991) for juvenile striped bass, but Poston and Rumsey (1983) indicated that ash and protein percentages of rainbow trout were solely dependent on fish size.

4.1.3. 1.2. Effect of stocking rate:

Analysis of variance (table, 33) shows that stocking rate had insignificant effect on percentages of moisture and dry matter but significant effect was found with percentage of protein ($P<0.001$) , fat ($P<0.05$) and ash ($P<0.05$). Table 32 show that the first stocking rate (SR1) had the lowest protein percentage (82.82%) and the largest fat percentage (9.98%) whereas the third stocking rate (SR3) had the largest percentage of protein

Table (32): Least-square means and standard error of the tested factors affecting on the composition of flesh of Nile tilapia.

Independent variable	No.	body weight Mean±SE	moisture % Mean±SE	dry matter % Mean±SE	protein % Mean±SE	fat % Mean±SE	ash % Mean±SE
Feeding treatment (T)							
T1 (poultry litter)	30	78.1±12.4 b	78.78±0.26 a	21.22±0.26 a	87.02±0.91 a	6.12±0.68 b	7.54±0.29 a
T2 (artifical feed)	30	137.2±12.4 a	78.33±0.26 a	21.67±0.26 a	84.00±0.91 b	10.53±0.68 a	6.23±0.29 b
Stocking rate (SR)							
SR1 (1000 tilapia + S.carp)	20	99.0±15.2 a	78.32±0.32 a	21.68±0.32 a	82.82±1.11 b	9.98±0.84 a	6.86±0.35 ab
SR1 (1000 tilapia + S.carp)	20	94.2±15.2 a	78.21±0.32 a	21.79±0.32 a	86.35±1.11 a	6.68±0.84 b	7.58±0.35 a
SR1 (1000 tilapia + S.carp)	20	129.8±15.9 a	79.13±0.32 a	20.87±0.32 a	87.37±1.11 a	8.32±0.84 ab	6.21±0.35 b
T × SR							
T1×SR1	10	97.8±21.5 b	78.93±0.45 ab	21.07±0.45 ab	82.38±1.57 b	8.55±1.18 ab	7.80±0.50 a
T1×SR2	10	66.6±21.5 b	78.93±0.45 ab	21.54±0.45 ab	89.65±1.57 a	3.82±1.18 c	7.74±0.50 a
T1×SR3	10	69.9±21.5 b	78.95±0.45 ab	21.05±0.45 ab	89.03±1.57 a	5.98±1.18 bc	7.08±0.50 ab
T2×SR1	10	100.2±21.5 b	77.72±0.45 b	22.29±0.45 a	83.25±1.57 b	11.41±1.18 a	5.92±0.50 bc
T2×SR2	10	121.7±21.5 b	77.96±0.45 ab	22.04±0.45 ab	83.05±1.57 b	9.54±1.18 a	7.42±0.50 a
T2×SR3	10	189.7±21.5 a	79.30±0.45 a	20.70±0.45 b	85.71±1.57 ab	10.56±1.18 a	5.34±0.50 c
Overall mean	60	107.7±8.8	78.55±0.18	21.45±0.18	85.51±0.64	8.32±0.48	6.88±0.20

\+ Means with the same letter in each column are not significantly different.

Table (33): Least-squares analysis of variance of the tested factors affecting on the composition of flesh of Nile tilapia.

Source of variation	df	F-ratios					
		body weight	Moisture %	Dry matter %	Protein %	Fat %	Ash %
Feeding treatment (T)	1	11.35***	1.51	1.51	5.56*	20.85***	10.56**
Stocking rate (SR)	2	1.62	2.44	2.44	4.65**	3.89*	3.83*
T×SR	2	3.74*	1.52	1.52	2.86	0.75	1.52
Remainder df	54						
Remainder MS		4614.89	2.04	2.04	24.55	14.03	2.45

(87.37%) and the lowest percentage of ash (6.21%). Yousif (1996) found that stocking density of *O.niloticus* had significant effect on the chemical composition of the whole fish but Abdel-Wares (1993) found insignificant effect of stocking density (3000, 4500 and 6000 fish/feddan) on the chemical composition of tilapia raised in earthen ponds and this may due mainly to smaller fish size used in his study.

4.1.3. 1.3. Interaction between feeding treatment and stocking rate:

The interaction between stocking rates and feeding treatment (natural food or supplementary feeds) had insignificant effect on the chemical composition of tilapia flesh (table 33).

4.1.3. 2. Silver carp:

Average percentages and their standard errors of moisture, dry matter, protein, fat and ash in the flesh are presented in table 34. The average percentages are 78.44, 21.56, 81.02, 8.00 and 7.83% for moisture, dry matter, protein, fat and ash percentage, respectively.

4.1.3. 2. 1. Effect of feeding treatment:

As described in tables 34 and 35 feeding type (natural or supplementary feeding) had a significant effect on chemical composition of silver carp flesh except protein percentage. Silver carp flesh from fish fed on natural food only (first treatment) had larger percentages of dry matter (22.14 vs. 20.98%), protein (84.39 vs. 77.65%), fat (9.52 vs. 6.48%) and lower percentages of ash (6.99 vs. 8.67%) and moisture (78.86 vs. 79.02%) compared with that fed the supplementary feed. These results are in agreement with that reported by (Billard, 1995) for carp, he reviewed that; the protein content of carp fish is higher in fish fed zooplankton and benthos compared with a feeding regime based on cereals but artificial feed, such as cereals and formulated pellets which increases the amount of fat. But these results are not in agreement with that obtained by Barash and Schroeder (1984) who found that the differences in fat percentage, in carcasses of silver carp fish fed supplemental feed or raised in the ponds fertilized with the manure, were statistically insignificant.

4.1.3. 2.2. Effect of stocking rate:

Tables 34 and 35 show that stocking rate had insignificant effect on the percentages of protein, fat and ash but there was significant effect of stocking rate on the moisture and

Table (34): Least-square means and standard error of the tested factors affecting on the composition of flesh of silver carp.

Independent variable	No.	body weight Mean±SE	moisture % Mean±SE	dry matter% Mean±SE	protein % Mean±SE	fat % Mean±SE	ash % Mean±SE
Feeding treatment (T)							
T1 (poultry litter)	15	470.0±15.4 a	78.86±0.38 b	22.14±0.38 a	84.39±3.17 a	9.52±0.65 a	6.99±0.62 a
T2 (artifical feed)	15	383.8±15.4 b	79.02±0.38 a	20.98±0.38 b	77.65±3.17 a	6.48±0.65 b	8.67±0.62 a
Stocking rate (SR)							
SR1 (1000 tilapia + S.carp)	10	466.1±18.9 a	78.04±0.46 b	21.96±0.46 a	83.27±3.88 a	8.57±0.80 a	7.17±0.76 a
SR1 (1000 tilapia + S. carp)	10	416.8±18.9 ab	77.87±0.46 b	22.7130.46 a	83.33±3.88 a	7.89±0.80 a	7.50±0.76 a
SR1 (1000 tilapia + S. carp)	10	398.3±18.9 b	79.41±0.46 a	20.59±0.46 b	76.47±3.88 a	7.55±0.80 a	8.82±0.76 a
T × SR							
T1×SR1	5	525.8±26.7 a	77.84±0.65 b	22.16±0.65 a	83.24±5.49 a	10.68±1.13 a	6.58±1.08 b
T1×SR2	5	454.8±26.7 ab	77.11±0.65 b	22.89±0.65 a	85.39±5.49 a	9.76±1.13 ab	7.28±1.08 ab
T1×SR3	5	430.4±26.7 bc	78.63±0.65 ab	21.37±0.65 ab	84.55±5.49 a	8.14±1.13 abc	7.i2±1.08 ab
T2×SR1	5	406.4±26.7 bc	78.24±0.65 ab	21.76±0.65 ab	83.29±5.49 a	6.47±1.13 bc	7.76±1.08 ab
T2×SR2	5	378.8±26.7 bc	77.63±0.65 ab	21.37±0.65 ab	81.27±5.49 a	6.02±1.13 c	7.72±1.08 ab
T2×SR3	5	366.2±26.7 c	80.20±0.65 a	19.81±0.65 b	68.39±5.49 a	6.95±1.13 bc	10.52±1.08 a
Overall mean	30	427.1±10.9	78.44±0.27	21.56±0.26	81.02±2.24	8.00±0.46	7.83±0.44

+ Means with the same letter in each column are not significantly different.

Table (35): Least-squares analysis of variance of the tested factors affecting on the composition of flesh of silver carp.

Source of variation	df	F-ratios body weight	Moisture %	Dry matter %	Protein %	Fat %	Ash %
Feeding treatment (T)	1	15.72***	4.82*	4.79*	2.27	10.96**	3.62*
Stocking rate (SR)	2	3.44*	3.39*	3.37*	1.03	0.43	1.31
T×SR	2	0.59	0.52	0.51	1.18	1.04	1.02
Remainder df	24						
Remainder MS		3573.48	2.11	2.11	150.59	6.35	5.81

dry matter percentages of silver carp flesh. Theses results are in agreement with that obtained by Abdel-Wares (1993), who found that stocking rate (3000, 4500 and 6000 fish/feddan) had insignificant effect on the chemical composition of Nile tilapia *O.niloticus.*

4.1.3. 2. 3. Interaction between feeding treatment and stocking rate:

As shown in tables 34 and 35 the interaction between the two factors studied (feeding treatment and stocking rate) had insignificant effect on the chemical composition of silver carp flesh. The flesh of the smallest fish had relatively lower percentages of dry matter, protein and fat but had larger percentages of ash and moisture.

4.1.3.3. Correlation coefficients between body measurements and chemical composition of flesh:

As described in table 36, coefficients of correlation between moisture percentage in flesh of tilapia and each of BW, BL and BD were low, positive and statistically not significant, while in case of silver carp the coefficients were high, negative and significant.

The coefficients of correlation between protein percentage of tilapia flesh and each of the body measurements BW, BL and BD were moderate, negative and statistically significant, while in case of silver carp the coefficients were low, positive and not significant.

The coefficients of correlation between fat percentage of tilapia flesh and each of BW, BL and BD were moderate, positive and significant, while in case of silver carp, the coefficients were high, positive and significant.

With respect to dry matter and ash percentage, the coefficients of correlation were low and negative in case of tilapia, while with silver carp, the coefficients of dry matter were high, positive and significant.

The correlation coefficient between moisture percent and protein percent in tilapia and silver carp was positive (0.40) and highly significant ($P<0.001$) but the correlation coefficient between moisture percent and fat percent was negative (-0.43) and highly significant ($P<0.001$) and the correlation coefficient between moisture percent and ash content was positive (0.17) but not significant. These results generally are in accordance with the previous finding of Li and Lovell (1992) who decided that protein and moisture in the muscle of channel catfish increased with corresponding decreases in muscle fat.

Table (36): Correlation coefficients between body measurements and chemical composition of flesh of Nile tilapia and silver carp.

Nile tilapia							
	BW	BL	BD	Moisture%	Dry matter %	Protein %	Fat %
Moisture %	0.13	0.16	0.12				
Dry matter %	-0.13	-0.16	-0.12	-1.00			
Protein %	-0.32**	-0.26*	-0.43***	0.40***	-0.40***		
fat %	0.37**	0.32**	0.45***	-0.43***	0.43***	-0.82***	
Ash %	-0.21	-0.15	-0.27*	0.17	-0.17	0.34**	-0.65***
Silver carp							
	BW	BL	BD	Moisture%	Dry matter %	Protein %	Fat %
Moisture %	-0.62***	-0.66***	-0.44**				
Dry matter %	0.62***	0.66***	0.44**	-1.00			
Protein %	0.18	0.09	0.04	-0.23	0.22		
fat %	0.77***	0.59***	0.70***	-0.59***	0.59***	-0.13	
Ash %	-0.39*	-0.28	-0.27	0.35*	-0.35*	-0.04	-0.43**

From the above results, it could be concluded that with Nile tilapia the relationships between body measurements and each of moisture and fat, were positive, while with respect to protein and dry matter were negative. In case of silver carp, this relationship was negative with moisture and positive with dry matter, protein and fat.

4.1.4. Chemical composition of by-products:

By-products or fish wastes are those non-edible parts of the fish body. They include fish head, skin, bones and cartilage, fins, scales and viscera which includes gonads, intestine and liver. After some processing, fish wastes represent a good source for animal nutrition which can be prepared as protein source for laying hens and broilers due to its high contents of fish protein containing the essential amino acids.

4.1.4.1. Nile tilapia:

Table (37) shows that the overall means for moisture and dry matter were 69.28 and 30.68%, respectively, Based on dry matter the percentages of protein, fat and ash in tilapia by-products were 48.76, 18.50 and 28.41%, respectively.

Table (37): Least-square means and standard error of the tested factors affecting on the composition of by-products of Nile tilapia.

Independent variable	No.	body weight Mean±SE	moisture % Mean±SE	dry matter% Mean±SE	protein % Mean±SE	fat % Mean±SE	ash % Mean±SE
Feeding Treatment (T)							
T1 (poultry litter)	30	78.1±12.4 b	69.74±0.57 a	30.19±0.57 a	50.97±0.80 a	12.27±1.64 b	32.95±1.10 a
T2 (artificial feed)	30	137.2±12.4 a	68.83±0.57 a	31.17±0.57 a	46.55±0.80 b	24.74±1.64 a	23.88±1.10 b
Stocking rate (SR)							
SR1 (1000 tilapia +100 S.carp)	20	99.0±15.2 a	65.13±0.69 b	34.77±0.70 a	46.62±0.98 b	22.83±2.01 a	26.47±1.35 b
SR2 (1000 tilapia +200 S.carp)	20	94.2±15.2 a	71.03±0.69 a	28.98±0.70 b	49.65±0.98 a	13.23±2.01 b	30.62±1.35 a
SR3 (1000 tilapia +300 S.carp)	20	129.8±15.9 a	71.69±0.69 a	28.31±0.70 b	50.02±0.98 a	19.44±2.01 a	28.15±1.35 ab
T × SR							
T1×SR1	10	97.8±21.5 b	64.06±0.98 c	35.71±1.00 a	48.55±1.38 ab	20.29±2.85 a	29.64±1.90 bc
T1×SR2	10	66.6±21.5 b	71.32±0.98 ab	28.68±1.00 bc	51.84±1.38 a	5.90±2.85 b	35.88±1.90 a
T1×SR3	10	69.9±21.5 b	73.81±0.98 a	26.19±1.00 c	52.54±1.38 a	10.60±2.85 b	33.32±1.90 ab
T2×SR1	10	100.2±21.5 b	66.17±0.98 c	33.83±1.00 a	44.69±1.38 b	25.37±2.85 a	23.30±1.90 d
T2×SR2	10	121.7±21.5 b	70.73±0.98 b	29.27±1.00 b	47.46±1.38 b	20.55±2.85 a	25.36±1.90 dc
T2×SR3	10	189.7±21.5 a	69.58±0.98 b	30.42±1.00 b	47.49±1.38 b	28.29±2.85 a	22.98±1.90 d
Overall mean	60	107.7±8.8	69.28±0.40	30.68±0.41	48.76±0.56	18.50±1.16	28.41±0.20

\+ Means with the same letter in each column are not significantly different.

Table (38): Least-squares analysis of variance of the tested factors affecting on the composition of by-products of Nile tilapia.

Source of variation	df	F-ratios					
		body weight	Moisture %	Dry matter %	Protein %	Fat %	Ash %
Feeding treatment (T)	1	11.35***	1.30	1.45	15.35***	28.76***	34.06***
Stocking rate (SR)	2	1.62	27.02***	25.49***	3.63*	5.85**	2.41
T×SR	2	3.74*	5.19**	4.76**	0.09	2.67	0.77
Remainder df	54						
Remainder MS		4614.89	9.66	9.91	19.13	81.14	36.21

4.1.4.1.1. Effect of feeding treatment:

Table (37) shows that by-products for the fish in the first feeding treatment compared with that recorded for the second treatment had higher percentages of protein (50.97 vs. 46.55%) and ash percentage (32.95 vs. 23.88%) and lower percentages of fat (12.27 vs. 24.74%) and the differences between the two treatments were highly significant ($P<0.001$).

4.1.4.1.2. Effect of stocking rate:

As seen in table (37) the stocking rate had significant effect on the percentages of protein and fat but had insignificant effect on the percentage of ash. The by-products from fish raised under the third stocking rate (SR3) had higher percentage of protein (50.02%) and lower percentage of crude fat (19.44%).

4.1.4.1.3. Interaction between feeding treatment and stocking rate:

As described in table (38) the interaction between the two factors studied (feeding treatment and stocking rate) had insignificant effect on the percentage of protein, fat and ash percentage.

4.1.4.2. Silver carp:

The overall means of moisture, dry matter, protein, fat and ash percentages of silver carp by-products are 76.07, 23.93, 47.90, 14.92 and 31.32%, respectively (table, 39).

4.1.4.2.1. Effect of feeding treatment:

As seen in table (39), by-products for the first feeding treatment compared with by-products obtained from the second feeding treatment had higher percentages of dry matter (25.62 vs. 22.24%) and fat (19.71 vs. 10.13%) and lower percentages of protein (47.63 vs. 48.17%), and ash (29.80 vs. 32.84%)

4.1.4.2.2. Effect of stocking rate:

As shown in tables (39 and 40), stocking rate and the interaction between feeding treatment and stocking rate had insignificant effect on the percentages of moisture, dry matter, protein, fat and ash percentage of the silver carp by-products.

Table (39): Least-square means and standard error of the tested factors affecting on the composition of by-products of silver carp.

Independent variable	No.	body weight Mean±SE	moisture % Mean±SE	dry matter% Mean±SE	protein % Mean±SE	fat % Mean±SE	ash % Mean±SE
Feeding treatment (T)							
T1 (poultry litter)	15	470.0±15.4 a	74.38±0.50 b	25.62±0.50 a	47.63±1.28 a	19.71±0.77 a	29.80±0.81 b
T2 (artificial feed)	15	383.8±15.4 b	77.76±0.50 a	22.24±0.50 b	48.17±1.28 a	10.13±0.77 b	32.84±0.81 a
Stocking rate (SR)							
SR1 (1000 tilapia +100 S.carp)	10	466.1±18.9 a	75.72±0.61 a	24.28±0.61 a	46.51±1.57 a	15.10±0.95 a	32.26±0.99 a
SR2 (1000 tilapia +200 S.carp)	10	416.8±18.9 ab	75.92±0.61 a	24.08±0.61 a	47.67±1.57 a	15.51±0.95 a	31.80±0.99 a
SR3 (1000 tilapia +300 S.carp)	10	398.3±18.9 b	76.57±0.61 a	23.43±0.61 a	49.52±1.57 a	14.14±0.95 a	29.90±0.99 a
T × SR							
T1×SR1	5	525.8±26.7 a	74.52±0.87 bc	25.48±0.87 ab	44.90±2.21 a	20.65±1.34 a	29.92±1.40 b
T1×SR2	5	454.8±26.7 ab	73.73±0.87 c	26.27±0.87 a	49.10±2.21 a	20.71±1.34 a	30.80±1.40 ab
T1×SR3	5	430.4±26.7 bc	74.88±0.87 bc	25.12±0.87 ab	48.89±2.21 a	17.75±1.34 a	28.68±1.40 b
T2×SR1	5	406.4±26.7 bc	76.91±0.87 ab	23.09±0.87 bc	48.13±2.21 a	9.55±1.34 b	34.60±1.40 a
T2×SR2	5	378.8±26.7 bc	78.10±0.87 a	21.90±0.87 c	46.23±2.21 a	10.30±1.34 b	32.80±1.40 ab
T2×SR3	5	366.2±26.7 c	78.26±0.87 a	21.74±0.87 c	50.15±2.21 a	10.54±1.34 b	31.12±1.40 ab
Overall mean	30	427.1±10.9	76.07±0.87	23.93±0.35	47.90±0.91	14.92±0.55	31.32±0.57

\+ Means with the same letter in each column are not significantly different.

Table (40): Least-square analysis of variance of the tested factors affecting on the composition of by-productsf of silver carp.

Source of variation	df	F-ratios					
		body weight	Moisture %	Dry matter %	Protein %	Fat %	Ash %
Feeding treatment (T)	1	15.72***	22.74***	22.74***	0.09	76.92***	7.07**
Stocking rate (SR)	2	3.44*	0.53	0.53	0.94	0.55	1.60
T×SR	2	0.59	0.65	0.65	0.99	1.20	0.53
Remainder df	24						
Remainder MS		3573.48	3.76	3.76	24.57	8.94	9.80

4.1.4.3. Correlation coefficients between body measurements and chemical composition of by-products:

As described in table 41, body weight is positively correlated with fat percentage of tilapia and silver carp by-products and this means that increasing body weight was followed by storing crude fat in non-edible parts of the fish and this state was particularly clear in silver carp.

Table (41): Correlation coefficients between body measurements and chemical composition of by-products of Nile tilapia and silver carp.

Nile tilapia							
	BW	BL	BD	Moisture%	Dry matter %	Protein %	Fat %
Moisture %	-0.10	-0.04	-0.15				
Dry matter %	0.10	0.04	0.16	-1.00			
Protein %	-0.38**	-0.38*	-0.41***	0.46***	-0.47***		
fat %	0.29*	0.28*	0.44***	-0.53***	0.54***	-0.73***	
Ash %	-0.19	-0.20	-0.34**	0.41***	-0.42***	0.57***	-0.92***
Silver carp							
	BW	BL	BD	Moisture%	Dry matter %	Protein %	Fat %
Moisture %	-0.78***	-0.56***	-0.80***				
Dry matter %	0.78***	0.56***	0.80***	-1.00			
Protein %	-0.36*	-0.52**	-0.03	0.09	-0.09		
fat %	0.60***	0.32	0.49**	-0.67***	0.67***	-0.02	
Ash %	-0.36*	-0.24	-0.29	0.61***	-0.60***	0.19	-0.46**

Body weight is negatively correlated with the percentages of moisture, protein and ash and this means that, increasing in body weight was mainly on the costs of the increase in these components in the flesh.

The percentage of dry matter, of the by-products, is negatively correlated with protein percentage (-0.47) and ash percentage (-0.42) for tilapia and the same trend was observed for silver carp, but positive correlation was observed between dry matter and fat percentages for tilapia (0.54) and silver carp (0.67) by-products.

The correlation coefficients between protein and fat percentages are negative for tilapia (-0.73) and slightly negative for silver carp (-0.02) by-products. Also the negative correlation observed between fat and ash percentage. These correlations are relatively in agreement with that obtained in this experiment for the flesh of Nile tilapia and silver carp.

4.2. Second experiment:

4.2.1. Fry production:

Survival rate of triploids up to the first feeding of stage was significantly lower than that of the unshocked control (38.41% vs. 65.71%, experimental observation) and the differences between diploids and triploids in this trait are highly significant (P<0.001). These results agreed with that reviewed by Mair, (1993) with tilapia fish, Withler at al., (1995) with coho salmon *(Oncorhynchus kisutch)* and McGeachy et al., (1995) with Atlantic salmon *(Salmo salar)* and the reduction in viability during embryonic development for triploid embryo may be due to the thermal shock itself used for the induction of triploidy.

4.2.2. Body measurements:

Triploidzation was confirmed as a tool to prevent stunting effects in extensive pond culture of *O. niloticus*. Table (42) outline the means and standard errors of body weight, body length, condition factor and body depth belonging to successive age groups of triploid and diploid *O. niloticus.*

The results of body weight indicated that triploid fish were heavier than diploids at all ages studied (3-7 months) but these differences in weights were not significant. The insignificant differences among diploids and triploids *O. niloticus* perhaps attributed to carrying out the experiment in aquaria which relatively prevent uncontrolled reproduction. These results agreed with studies on triploid *O. niloticus* carried out by (Brämick et al., 1995 and Hussain et al., 1995), channel catfish (Wolters et al., 1982), tench *Tinca tinca* (Flajshans et al., 1993), common carp (Cherfas et al., 1994), Sydney rock oysters (Nell et al., 1995) and Atlantic salmon (Galbreath and Thorgaard, 1995). It seems that breeding activities of fish were responsible for decreasing the growth in diploid compared with triploid *O. niloticus*. On the other hand Puckhaber and Hörstgen-Schwark (1996) indicated that triploids *O. niloticus* showed poorer growth performance than diploids

Table (42) also show that triploid *O. niloticus* had the longest bodies compared with diploids with significant differences between the two groups in some studied ages of this experiment and this trend was also observed for condition factor and body depth. Hussian et al., (1996) reported insignificant length differences between triploids and diploids of *O. niloticus*.

Cassani and Caton (1986) explained that diploids grass carp had significantly higher condition factor where they were grown together with triploid grass carp but when diploid and triploid grass carp were grown in separate pools there was no significant differences in condition factors. Galbreath and Thorgaard, (1995) stated also, condition factor was greater for diploid Atlantic salmon than triploid. On the other hand, Hussain et al., (1995) found that condition factor (K) of triploid *O. niloticus* female was higher compared with diploid females. Also Johnson et al., (1986) found that there was no significant differences between triploid and diploid coho salmon in body length, body weight and condition factor.

4.2.3. Growth traits:

Sterile fish may convert a greater part of the nutrients absorbed on body weight gain and therefore may attain a higher growth rate and more efficient feed conversion compared with the diploid ones.

As described in table (43) triploid *O. niloticus* had higher daily gain, specific growth rate compared with diploids at most studied ages and these results are not in agreement with that obtained by Hussain et al., (1995), who found that there were non significant differences between diploids and triploids of *O. niloticus* in regard to growth rate. Also Brämick et al., (1995) found that the non significant differences between diploid and triploid *O. niloticus* could be observed at the age of maturation. Galbreath and Thorgaard (1995) had the same results with Atlantic salmon, they found that specific growth rates do not differed significantly between diploid and triploids Atlantic salmon. On the other hand, Puckhaber and Hörstgen-Schwark (1996) reported that triploid *O. niloticus* showed poor growth performance compared to diploids, also McCarthy et al., (1996) found that specific growth rate of triploid Atlantic salmon was lower than that of diploids.

4.2.4. Feed conversion ratio:

Table (43) shows that feed conversion ratio had no clear trend for diploids and triploids *O. niloticus*. Feed conversion ratio was better for triploids at some studied ages, while diploids had better feed conversion ratio at the other ages. Cassani and Caton (1986) stated insignificant differences between triploids and diploids grass carp in regard to feed conversion ratio. Also Henken at al., (1987) found that diploids and triploids of African catfish, *Clarias gariepinus* converted their feed with similar efficiency.

Table (42): Least square means and standard errors for body measurements of diploid and triploid *O.niloticus*

Age	Body weight (gm)		Body length (cm)		Condition factor (K)		Body depth (cm)	
(month)	Diploid	Triploid	Diploid	Triploid	Diploid	Triploid	Diploid	Triploid
3	15.9±1.0	16.5±1.0	9.1±0.2	9.4±0.2	1.98±0.04	1.91±0.04	2.9±0.07 a	3.1±0.07 b
3.5	19.9±1.1	21.6±1.1	9.9±0.2	10.0±0.2	2.04±0.02	2.06±0.02	2.9±0.06	3.0±0.07
4	23.9±0.7	24.2±0.7	10.2±0.1	10.2±0.1	2.21±0.04	2.27±0.04	3.3±0.05	3.3±0.06
4.5	36.5±1.7	40.2±1.7	12.1±0.2	12.2±0.2	2.06±0.04	2.14±0.04	3.7±0.07	3.8±0.07
5	50.9±2.3	55.4±2.3	13.2±0.2	13.1±0.2	2.16±0.04 b	2.44±0.04 a	4.3±0.09	4.5±0.09
5.5	64.0±2.8	70.4±2.8	14.1±0.2 b	15.1±0.2 a	2.26±0.07 a	2.06±0.07 b	4.2±0.12 b	4.6±0.12 a
6	84.1±4.9	91.5±4.9	15.8±0.3	15.8±0.3	2.04±0.03 b	2.25±0.03 a	4.8±0.11 b	5.3±0.11 a
6.5	102.6±0.7	118.5±0.7	16.4±0.3 b	17.4±0.3 a	2.26±0.03 a	2.08±0.03 b	5.5±0.13	5.6±0.13
7	121.2±7.2	138.1±7.2	17.7±0.3	18.5±0.3	2.07±0.03	2.10±0.03	5.6±0.14	5.9±0.14

\+ Means in the same row followed by different letters are significantly different ($P<0.05$).

Table (43): Growth traits of diploid and triploid *O. niloticus.*

Age	Daily gain (gm)		Specific growth rate (SGR)		Feed conversion ratio (FCR)	
(month)	diploid	triploid	diploid	triploid	diploid	triploid
3 - 3.5	0.27	0.34	1.50	1.80	1.75	1.45
3.5 - 4	0.27	0.17	1.22	0.76	2.22	3.85
4 - 4.5	0.84	1.07	2.82	3.38	0.85	0.68
4.5 - 5	0.96	1.01	2.22	2.14	1.37	1.19
5 -5.5	0.87	1.00	1.53	1.60	1.75	1.67
5.5 - 6	1.34	1.41	1.82	1.75	1.43	1.49
6 - 6-5	1.23	1.80	1.33	1.72	2.04	1.52
6.5 - 7	1.24	1.31	1.11	1.02	2.50	2.70

4.2.5. Gonadal development:

Gonadal development in triploid *O. niloticus* at the end of the experiment was retarted compared to diploid. In triploids of both sexes average gonads (expressed as GSI) were smaller than diploids with significant differences between the two ploidy groups (Table 44).

Table (44): Reproduction traits, carcass traits and chemical analysis of diploid and triploid *O. niloticus*.

	Diploids		Triploids		
Variable	N	Mean ±SE	N	Mean ±SE	P
GSI (male)	20	0.84±0.06	20	0.59±0.06	0.005
GSI (female)	20	4.64±0.21	20	1.03±0.21	0.001
HSI (male)	20	2.03±0.19	20	3.02±0.19	0.001
HSI (Female)	20	2.70±0.11	20	2.51±0.11	0.234
Carcass traits:					
Dressing %	20	51.68±0.79	20	53.01±0.79	0.239
Flesh %	20	35.94±0.62	20	34.12±0.62	0.045
Viscera %	20	7.08±0.37	20	7.36±0.37	0.607
By-products %	20	61.46±0.90	20	62.36±0.90	0.472
Chemical analysis					
Flesh					
Moisture%	20	77.10±0.43	20	75.42±0.43	0.009
Protein%	20	63.62±1.03	20	64.96±1.03	0.366
Fat%	20	10.62±0.52	20	11.16±0.52	0.468
Ash%	20	6.85±0.53	20	7.14±0.53	0.700
By-products					
Moisture%	20	66.67±1.11	20	63.09±1.11	0.028
Protein%	20	37.17±1.23	20	35.45±1.23	0.329
Fat%	20	31.23±0.94	20	32.27±0.94	0.438
Ash%	20	21.55±0.38	20	21.83±0.38	0.610

GSI of triploid males is 0.59 compared to 0.84 for diploid males and 1.03 compared to 4.64 for triploid and diploid females, respectively. The large values in females may be due to the large weight of ovaries compared to spermatic system of males. Similar findings have been reported for tilapia by Brämik et al., (1995), Hussian et al., (1995) Hussian et al., (1996) and Puckhaber and Hörstgen-Schwark (1996) and for other fish species, Cyprinid loach, *Misgurnus anguillicaudatus* (Suzuki et al., 1985), Coho salmon, *Oncorhynchus kisutch* (Johson et al., 1986), African catfish, *Clarias gariepinus* (Henken et al., 1987), white crappies, *Pomoxis annularis* (Parsons, 1993), tench, *Tinca tinca* (Flajshans et al., 1993) and Atlantic salmon (Galbreath and Thorgaard, 1995) and McCarthy et al., (1996).

The results of 6 different crosses between triploid males and normal diploid females show that triploid spermatozoa were unable to fertilize the eggs obtained from diploids females and the same result also obtained when the eggs from triploids female were used to be fertilized by spermatozoa normal diploid males. Therefore, this experiment had confirmed that both female and male triploid *O. niloticus* were functionally and reproductively sterile. Such reproductive sterility in mixed-sex culture of Oreochromis species would improve production by preventing precocious sexual maturation, particularly in ponds. The use of sterile triploid fish could also be a way to avoid the risk of gene introgression from farmed stocks into native wild stocks.

4.2.6. Hepatosomatic index (HSI):

HSI of triploid males were larger than that of diploids (3.02 vs. 2.03) with significant differences between the two groups (Table 48) but the HSI of triploid females were smaller than that of diploids (2.51 vs. 2.70) but the differences were not significant (table 48). Similar findings have been reported for coho salmon, *Oncorhynchus kisutch* (Johnson et al., 1986) but for *O. niloticus*, Hussian et al., (1995) found insignificant differences between triploids and diploids males and females *O. niloticus* for HSI.

4.2.7. Carcass traits:

Analysis of fish carcass traits at the end of this experiment (table 48) showed that triploids *O. niloticus* had higher percentages of dressing, viscera and by-products and lower percentage of flesh as compared with that obtained from the diploid fish. These results are not in agreement with that obtained by Galbreath and Thorgaard (1995), they reported that the dress-out percentage of diploids Atlantic salmon were significantly did not differ from

GSI of triploid males is 0.59 compared to 0.84 for diploid males and 1.03 compared to 4.64 for triploid and diploid females, respectively. The large values in females may be due to the large weight of ovaries compared to spermatic system of males. Similar findings have been reported for tilapia by Brämik et al., (1995), Hussian et al., (1995) Hussian et al., (1996) and Puckhaber and Hörstgen-Schwark (1996) and for other fish species, Cyprinid loach, *Misgurnus anguillicaudatus* (Suzuki et al., 1985), Coho salmon, *Oncorhynchus kisutch* (Johson et al., 1986), African catfish, *Clarias gariepinus* (Henken et al., 1987), white crappies, *Pomoxis annularis* (Parsons, 1993), tench, *Tinca tinca* (Flajshans et al., 1993) and Atlantic salmon (Galbreath and Thorgaard, 1995) and McCarthy et al., (1996).

The results of 6 different crosses between triploid males and normal diploid females show that triploid spermatozoa were unable to fertilize the eggs obtained from diploids females and the same result also obtained when the eggs from triploids female were used to be fertilized by spermatozoa normal diploid males. Therefore, this experiment had confirmed that both female and male triploid *O. niloticus* were functionally and reproductively sterile. Such reproductive sterility in mixed-sex culture of Oreochromis species would improve production by preventing precocious sexual maturation, particularly in ponds. The use of sterile triploid fish could also be a way to avoid the risk of gene introgression from farmed stocks into native wild stocks.

4.2.6. Hepatosomatic index (HSI):

HSI of triploid males were larger than that of diploids (3.02 vs. 2.03) with significant differences between the two groups (Table 48) but the HSI of triploid females were smaller than that of diploids (2.51 vs. 2.70) but the differences were not significant (table 48). Similar findings have been reported for coho salmon, *Oncorhynchus kisutch* (Johnson et al., 1986) but for *O. niloticus*, Hussian et al., (1995) found insignificant differences between triploids and diploids males and females *O. niloticus* for HSI.

4.2.7. Carcass traits:

Analysis of fish carcass traits at the end of this experiment (table 48) showed that triploids *O. niloticus* had higher percentages of dressing, viscera and by-products and lower percentage of flesh as compared with that obtained from the diploid fish. These results are not in agreement with that obtained by Galbreath and Thorgaard (1995), they reported that the dress-out percentage of diploids Atlantic salmon were significantly did not differ from that obtained from triploid fish. Also Hussian et al., (1996) reported insignificant differences between diploids and triploids *O. niloticus* in the percentage of dress-out and gut weight. On the other hand Henken et al, (1987) found that triploid African catfish *Clarias gariepinus* had higher gutted weight compared with diploids fish.

Percentages of viscera and by-products were higher in bodies of triploids compared with diploids. Higher percentages were caused by accumulation of more fat around viscera of sterile triploids. Due to fish sterility, fat had not been mobilized for egg and spermatozoa production. A similar findings was observed by Hussian et al., (1995) in *O. niloticus*. This suggests that lower energy diets may well be more appropriate for these fish to avoid the build-up of this wasted lipid.

4.2.8. Chemical analysis:

Chemical analysis of flesh (table 48) indicated that protein, fat and ash percentages, in flesh of triploids, were higher than in flesh of diploids and the differences between the two ploidy groups were insignificant for protein, fat and ash percentages, but diploids had the higher percentage (77.1%) of moisture compared with (75.42%) for triploid fish and the differences were highly significant (table 44). These results agreed with that obtained by Hussain et al., (1995) with *O. niloticus.*

Chemical analysis of fish by-products (table 44) show that protein and moisture percentages, in by-products of triploids, were higher than in by-products of diploids, while fat and ash percentages show the opposite trend.

This experiment has shown that the use of triploid tilapia may have important benefits for aquaculture and would help to avoid many of the problems associated with the precocious maturity and excessive reproduction display by tilapia in pond conditions. The problems lie with finding economic methods of producing large numbers of triploid tilapia fry particularly as the direct production of triploids using tetraploid females and diploid males, respectively which dappears to impossible in *O. niloticus* at the present time (Myers, 1986 and Belay, 1995).