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GROWTH PERFORMANCE, FEED UTILIZATION AND CARCASS COMPOSITION COMPARISONS OF MONOSEX TILAPIA (*Oreochromis niloticus*) PRODUCED BY VARIOUS TECHNIQUES.

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ABSTRACT

The present study was conducted to compare growth, feed utilization and carcass composition *(Oreochromis niloticus)* monosex, produced through separation of sexes (male or female) and hormonal sex reversal techniques with (0,20,40,60 and 80 %) female replacements. Glass aquaria belonging to in Animal and Fish Production Department, Faculty of Agriculture, Alexandria University are use. The results indicated that: 1) the most rapidly growing fish fry or fingerlings were methyltestisterone- hormone (MTH) treated, sex reversed Nile tilapia. While normal male (NM) and normal female (NF) Nile tilapia produced by separation of sexes came second and third, respectively, however mixed sex tilapia grew at the lowest rate; 2) the higher values of condition factor and feed utilization parameters were also highest in sex reversed tilapia, and lowest in mixed sex tilapia; and 3) fat and energy contents of hormonal sex reversed tilapia carcass were highest, while the differences between sex reversed tilapia, separation of sexes and mixed sex tilapia groups for carcass crude protein and dry matter contents were insignificant.

Keywords: Growth, monosex, separation, sex reversal.

INTRODUCTION

Tilapias are a major fish protein source in most of the developing countries. Nile tilapia(*Oreochromis niloticus*)have many attributes that recommend it for culture .They show excellent growth rates on low protein diets , they tolerate wide ranges of environmental conditions, show little susceptibility to disease and are an enable to handling and captivity. Most important of all, they enjoy wide acceptance as food fish because of their high palatability and history of use from inland fisheries (Pullin and Lowe – McConnell, 1982).

In general, tilapias have high breeding rates. Their fecundity ranges from a few hundred eggs to several thousands per spawning. Under pond culture conditions, precocious breeding and stunting have been reported (Fryer and Iles, 1972; Pullin and Lowe-McConnell ,1982).

One of the basic factors of tilapia aquaculture is that male fish grow bigger and faster than the females .Also ,in order to avoid unwanted spawning in a production unit, all-male populations are preferred (Guerrero,1975).There are several methods used to skew ratios and increase the percentage of males in a population.The first method developed was simply cull through a population, discard the females and keep the males (Muir and Roberts ,1993).The use of hybrid crosses is still one of the

primary methods of producing mostly male populations .The drawback to this method is that,two separate brood lines must be maintained.The crossing must be done very carefully and meticulous records should be kept to insure that the parent species are kept pure (McAndrew and Majumdar,1989). Androgen treatment of fish has in most cases been very effective in inducing masculinization of fish (Hunter and Donaldson,1983,Donaldson and Devlin ,1996).The most commercial method used in producing monosex tilapia is the direct oral application of male hormones, most commonly 17α methyltestosterone ,although this method has some limitation (Mair and Little 1991;Vera Cruz and Mair 1994 ; Kavumpurath and Pandian,1994;Solar *et al* ., 1994;Varadaraj etal.,1994 Colombo and Grandi,1995;Gale et al ., 1995 ;Glavez *et al* ., 1996; Carvalho and Foresti,1996).Sex reversal of newly hatched tilapia generally is accomplished via oral administration of 17α methyltestosterone ,which has been incorporated into a starter fish feed at 60 mg 17α methyltestosterone, / kg feed (Popma and Green,1990).

Consequently, the present experiments were designed to compare growth performance, feed utilization and carcass composition of Nile tilapia (*O. niloticus)* monosex, produced through separation of sexes and hormonal sex reversal, with different replacing female percentage.

MATERIALS AND METHODS

The present study was conducted at the Department of Animal and Fish Production, Faculty of Agriculture, Alexandria University, and Alexandria. Ripe females and males of Nile tilapia, (*O. niloticus)* were used in the present study was introduced from Arab Fisheries Company at Barseeq ,Abo Homos ,Behera Govenorate ,Egypt. The healthy broodstock males and females were stocked separately for two weeks as adaptation period .Brood fish were randomly selected and stocked in ten experimentally glass aquaria (100×30×40cm),having a water volume of 100 liter each. Fish breeders of *O. niloticus* with an average body weight and length of 150 g and 16.5cm /fish were stocked in each aquarium at a density of 6 breeders /aquarium. The sex ratio of the fish was two females to one male glass aquaria were supplied with aerated filtered dechlorinated water and the temperature was maintained at $28\pm2\ ^{0}C$.

Daily food allowance for the tilapia groups was based on 2 % of body weight with 40 % crude protein (EL-Halawany, 2002),seven days a week for 3 times daily (Khalil *et al.*,2001) .A 7-10 days intervals, fry produced in each aquarium were collected with a dip net ,counted and divided into two groups : **First fry group** :the newly hatched fry were fed a daily portion of 12 % of their body weight /day with prepared hormone containing food as described by Guerrero ,1976 and Rothbard *et al* ., 1983).The androgen 17α-methltestosterone (ET,Sigma)was dissolved in 95% ethanol (Technical grade),60 mg in 0.7 liter and was thoroughly mixed with one kg dry food .The food was a high protein feed (40 % crude protein).Treated feed was left at room temperature for 24 hour to evaporate alcohol ,and was mixed hand 2 or 3 times to insure complete homogenization .The duration of

the treatment was 21 days. As soon as the treatment was complete, the advanced fry was accommodated in separate aquarium for 60 days rearing period.

Second fry group: the newly hatched fry were fed a daily protein of 20 % of their body weight /day with 40 % crude protein feed without hormone treatment (control) for 21 days .Then, the advanced fry was reared for 60 days.

In the second group the sexes were distinguished by visual inspection of the external primogenital papilla, since, two orifices are present in the female papillae and one in the male (Chervinski and Rothbord, 1982).

O. niloticus, (genotypic male phenotypic male), obtained through the separation (genotypic female, phenotypic female were obtained by separation of sexes.

Two duplicates of each of the three tilapia sexes groups (81 days old) were stocked into glass aquaria to study the affect of monosex Nile tilapia (*O.niloticus*) produced through separation of sexes and hormonal sex reversal techniques cultured with different inclusion rates of female Nile tilapia, on growth performance, feed utilization and carcass composition of monosex tilapia, as follows:

Group A (All males produced through methyl-testosterone hormone (MTH) treatment)

1) 100% male + 0.00 % Female
2) 80 % male + 20.0 % Female
3) 60 % male + 40.0 % Female
4) 40 % male + 60.0 % Female
5) 20 % male + 80.0 % Female

Group B (All males produced by separation of sexes (normal male (NM))

6) 100% male + 0.00 % Female
7) 80 % male + 20.0 % Female
8) 60 % male + 40.0 % Female
9) 40 % male + 60.0 % Female
10) 20 % male + 80.0 % Female

Group C (All Females produced by separation of sexes, (normal female (NF))

11) 100 % Females

This experiment was started on May 3, 2003 for 112 days. The fingerlings were fed three times daily for 6 days a week at a rate of 15%(28 days),10%(28 days),5%(28 days)and3%(28days) of their body weight with 32% crude protein artificial diet. Ingredients and nutrient composition of the artificial diet are shown in Table (1).

All fish of each population in the aquaria was sampled every two weeks to calculate growth in weight. Also, at the beginning and end of the experiment fish sampled from each population were taken for proximate chemical analysis. Proximate chemical analysis of the artificial diet and fish were determined according to AOAC (1990).

Data were subjected to analysis of variance using the software package (SPSS Version 10 program) and treatments were evaluated at the 0.05 probability.

Table 1. Ingredient and nutrient composition of the artificial diet(on dry matter basis) used in the Present study.

Item	Diet
Feed ingredient (%):	
Fish meal	22
Soybean meal	32
Yellow corn	40
Soybean oil	3
Vitamin mixture[1]	1
Mineral mixture[2]	1
Methionine	0.50
Lysine	0.50
Nnutrient composition(% on DM basis):	
Dry matter (DM %)	97.33
Crude protein (%)	32.07
Ether extract (%)	7.29
Crude fiber (%)	3.49
Ash (%)	7.47
NFE (%)[3]	49.68
Gross energy (Kcal /100 g DM)[4]	454
P : E ratio(mg protein/Kcal GE)	70.66

[1]Vitamin mix. (g / kg): Vit. A (0.012), Ergocalciferol (0.006), Tocopheral (0.40), Menadione (0.04), Biotin (0.006), L-ascorbic acid(3.0), D-calcium pantothenate (0.28), Choline chloride (8.0), Folic acid (0.015), Myo-inositol (4.0), Niacin (0.80), Pyridoxine Hcl (0.04), Riboflavin (0.20), Thiamine Hcl (0.06), BHT (0.30), Celufid (12.44).

[2] Mineral mix. (g/kg):$Ca(H_2PO_4)_2$,H_2O(0.40), Ca- lactate (1.0), Fe Citrate (0.10), $MgSO_4.7H_2O$ (0.40), K_2HPO_4(0.70). NaH_2PO_4, H_2O (0.25), $AlCl_3$, $6H_2O$ (0.02). $ZnSO_4$, $7H_2O$ (0.126).$CuSO_4$, $5H_2O$ (0.03), $MnSO_4$, H2O (0.015), KI (0.02).

[3]NFE = Nitrogen free extract.

[4]Gross energy, calculated on the basis of 5.65, 9.5 and 4.2 Kcal GE /100 g protein, lipid,, and NFE, respectively.

RESULTS AND DISCUSSION

Growth performance:

A comparison of mean net gains, average daily weight gain (ADG g/fish/day) and specific growth rate (SGR %/day) among three monosex populations of Nile tilapia, *O. niloticus*, are shown in Table (2).The results revealed that the most rapidly growing fish in aquaria were methyl-testosterone-treated ,sex reversed tilapia (genotypic male and female, phenotypic male).Genotype had an important role in determining growth of sex- reversed phenotypic males (Hanson *et al* ., 1983). Thereby, growth increased when there were genotypic males in the populations of Hormonal sex reversed tilapia.Methyl testosterone hormone treatment (MTH) and normal male Nile tilapia (NM) produced by separation of sexes grew faster

than normal females Nile tilapia (NF) produced by separation of sexes, and the differences are significant (P≤ 0.05). Lovshin,.and Da Silva (1975) they found that *O.niloticus* females grew slower than normal males. Hanson *et al.*, (1983) reported all- male *O. niloticus* obtained by hybridization grew 30 % faster than mixed sex fingerlings of *O. niloticus*. The results of the present study indicate also that all- male Nile tilapia produced through hormonal sex reversal or separation of sexes grew faster than mixed- sex tilapia (MST), fingerlings by 69% and 126%, respectively (Table 2). It is apparent in the studies that the net weight gains of all–male Nile tilapia declined as the replacing females percentage increased in aquaria (Table 2).The drop in weight gain was greater than 40%. These findings also corroborate those of ADG g/fish/day (Table 2). ADG and SGR were higher in all–males, produced by methyl testosterone treatment or the separation of sexes, than those in 100% females or in mixed- sex tilapia fingerlings.

Table 2: Effect of mono and mixed sexing of Nile tilapia (*O. niloticus*) fry on growth performance, parameters and condition factor (K) grown in aquaria for 112 days.

Item*	Treat-ment	Average fish weight(g/fish)		Average fish length (g/fish)		Gain (g/ fish)	Average daily gain (g/ fish/ day)	Specific growth rate (%)	Condition Factor (%)
		Initial	Final	Initial	Final				
Group A	1	5.60^{a}	89.57^{a}	8.54^{a}	16.00^{a}	83.97^{a}	0.75^{a}	2.48^{a}	2.05^{a}
	2	5.74^{a}	76.60^{d}	8.43^{a}	18.00^{a}	70.86^{d}	0.55^{d}	2.20^{d}	1.22^{d}
	3	5.63^{a}	61.72^{f}	8.48^{a}	17.40^{b}	56.09^{f}	0.49^{f}	1.99^{f}	1.06^{f}
	4	5.68^{a}	47.83^{g}	8.46^{a}	17.00^{c}	42.15^{g}	0.38^{g}	1.90^{g}	0.86^{g}
	5	5.60^{a}	34.85^{i}	8.40^{a}	15.60^{f}	29.25^{i}	0.26^{i}	1.63^{i}	0.74^{i}
Group B	6	5.67^{a}	85.95^{b}	8.47^{a}	17.00^{c}	80.28^{b}	0.72^{b}	2.43^{b}	1.63^{b}
	7	5.58^{a}	64.95^{e}	8.38^{a}	17.50^{b}	59.37^{e}	0.53^{e}	2.19^{e}	1.11^{e}
	8	5.49^{a}	45.46^{h}	8.29^{a}	16.80^{d}	39.97^{h}	0.36^{h}	1.89^{h}	0.83^{h}
	9	5.50^{a}	32.33^{j}	8.30^{a}	15.50^{g}	26.83^{j}	0.24^{j}	1.58^{j}	0.72^{j}
	10	5.50^{a}	21.29^{k}	8.40^{a}	14.10^{h}	15.69^{k}	0.14^{k}	1.19^{k}	0.56^{k}
Group C	11	5.57^{a}	80.32^{c}	8.37^{a}	18.00^{a}	74.75^{c}	0.66^{c}	2.38^{c}	1.28^{c}

*Means in the same column with different superscripts are significant different (P≤0.05).

Group A (All males produced through methyl-testosterone hormone treatment, MTH)

1) 100% male + 0.00 % Female 2) 80 % male + 20.0 % Female
3) 60 % male + 40.0 % Female 4)40 % male + 60.0 % Female
5) 20 % male + 80.0 % Female

Group B (All males produced by separation of sexes, NM)

6) 100% male + 0.00 % Female 7)80 % male + 20.0 % Female
8) 60 % male + 40.0 % Female 9)40 % male + 60.0 %Female
10) 20 % male + 80.0 % Female

Group C (All Females produced by separation of sexes, FM)

11) 100 % Females

Specific growth rate (SGR) = $100 (\ln_{Fw} - \ln_{Iw}) / T$

Where: $_{Fw}$: mean weight at the end of the experiment

$_{Iw}$: mean length at the beginning of the experiment

T: time in days

Condition factor = Weight (gm)/length^{3} (cm).

Condition factor (K):

In the present study, it may be of interest to note that the condition factor (K) was generally higher in methyl testosterone treated group, sex reversed, Nile tilapia (2.05) than all-male Nile tilapia produced by separation of sexes (1.63) or mixed–sex tilapia (MST) fingerlings (0.89±0.08) or100%

tilapia females (1.28) and the differences were significant (P≤0.05) (Table 2). Lagler (1956) and Huet, (1970) claimed that the higher values of condition factor indicated the suitability of the environmental condition to species and the good health of fish.

Feed and nutrient utilization:

Table (3) shows the values of feed and nutrient utilization of the three tested monosex populations of Nile tilapia , *O. niloticus* ,stocked in glass aquaria under different rearing conditions .There was a significantly (P≤0.05) higher intake by all-male tilapia produced through hormonal sex reversal compared to other tilapia group. Also, MTH group utilized feed better than NM, NF and MST groups, and the differences are significant (P≤0.05). It should be pointed out that the efficiency of feed utilization, protein efficiency were greatly improved by decreasing the replacing females percentage in all-male tilapia culture from 80 to zero % (Table 3).

Table 3: Effect of mono and mixed sexing of Nile tilapia (*O. niloticus*) fry on feed utilization parameters grown in aquaria for 112 days

Items*	Treatments	Feed utilization		Protein utilization		Energy utilization (%)
		FI (g)	FCR	PER	PPV %	
Group A	1	176.88^{a}	2.11^{k}	1.48^{a}	25.47^{a}	15.88^{a}
	2	161.81^{d}	2.62^{h}	1.91^{d}	20.57^{d}	12.69^{d}
	3	133.81^{f}	2.43^{f}	1.28^{f}	22.19^{f}	13.54^{f}
	4	106.69^{g}	2.53^{e}	1.23^{g}	21.31^{g}	12.85^{g}
	5	76.05^{i}	2.60^{c}	1.25^{i}	2171^{i}	12.84^{i}
Group B	6	174.21^{b}	2.17^{j}	1.44^{b}	24.77^{b}	14.43^{b}
	7	139.52^{e}	2.35^{g}	1.33^{e}	24.91^{e}	13.36^{e}
	8	102.32^{h}	2.56^{d}	1.22^{h}	21.12^{h}	12.35^{h}
	9	72.98^{j}	2.72^{b}	1.15^{j}	20.00^{j}	11.73^{j}
	10	46.29^{k}	2.85^{a}	1.06^{k}	18.65^{k}	10.96^{k}
Group C	11	166.69^{c}	2.23^{i}	1.40^{c}	24.02^{c}	14.07^{c}

*Means in the same column with different superscripts are significant different (P≤0.05).

Group A (All males produced through methyl-testosterone hormone treatment, MTH)

1) 100% male + 0.00 % Female 2) 80 % male + 20.0 % Female
3) 60 % male + 40.0 % Female 4) 40 % male + 60.0 % Female
5) 20 % male + 80.0 % Female

Group B (All males produced by separation of sexes, NM)

6) 100% male + 0.00 % Female 7)80 % male + 20.0 % Female
8) 60 % male + 40.0 % Female 9)40 % male + 60.0 %Female
10) 20 % male + 80.0 % Female

Group C (All Females produced by separation of sexes, FM)

11) 100 % Females

FI =Feed intake (g)
FCR = dry feed (g) / live body gain (g)
PER = live body gain (g) / protein intake (g).
PPV% = 100* protein gain (g) / protein intake (g)
EU% =100* Energy gain (Kcal) / energy intake (Kcal)

The methyltesterone hormone treated tilapia group apparently utilized food more efficiently than untreated fish in this experiment .This might be due to the combination of androgen and genetic effects .Similar results concerning

methyl testosterone treatment and growth were obtained with salmon (Fagerlund *et al* .,1983)and Nile tilapia (EL-Halawany,2002).

Carcass composition:

Comparing the chemical composition at the start and end of the experiment (Table 4and 5) indicated that, as the fish grew, their dry matter, crude protein, ether extract and energy content increased, but there was a decrease in their ash content. Similar results were obtained for common carp, *Cyprinus carpio* (Nour *et al.*,1989) and Florida red tilapia (EL-Ebiary and Essa ,2002).The results in Table (5) showed that fat, and energy contents of hormonal sex reversal tilapia group were higher than that of un-treated tilapia ,males or females, as well as mixed sex tilapia groups. These results were inagreement with the results of Khalil *et al.*, (2001) and EL-Sagheer, (2001).However, in case of dry matter and crude protein the differences between experimental fish groups were insignificant. It is obvious also that the ash content of treated Nile tilapia ,*O.niloticus* ,fingerlings was less than that of un-treated tilapia as well as mixed sex tilapia fingerlings groups.

Table 4: Effect of mono and mixed sexing of Nile tilapia (*O. niloticus*) fry on carcass composition at the beginning of the present study grown in aquaria for 112 days.

Item*	Treatments	Dry matter (%)	% on dry matter basis			energy content (Kcal/g)
			Crude protein	Ether extract	ASH	
Group A	1	24.47^{a}	62..60^{h}	18.68^{a}	18.72^{h}	529.40^{a}
	2	24.45^{a}	62.65^{g}	18.64^{a}	18.71^{h}	529.31^{b}
	3	24.42^{a}	62.70^{f}	17.94^{b}	19.36^{g}	523.62^{c}
	4	24.39^{a}	62.79^{e}	17.56^{c}	19.70^{f}	519.62^{d}
	5	24.36^{a}	62.79^{e}	17.20^{d}	20.01^{d}	516.50^{e}
Group B	6	24.38^{a}	63.11^{a}	16.76^{h}	20.13^{c}	514.15^{g}
	7	24.37^{a}	63.06^{b}	17.11^{g}	19.83^{e}	517.18^{f}
	8	24.37^{a}	63.01^{b}	16.79^{f}	20.20^{b}	513.87^{h}
	9	24.35^{a}	62.94^{c}	16.79^{f}	20.27^{b}	513.48^{i}
	10	24.35^{a}	62.89^{d}	16.81^{e}	20.30^{a}	513.39^{g}
Group C	11	24.34^{a}	62.84^{d}	16.83^{e}	20.33^{a}	513.30^{k}

*Means in the same column with different superscripts are significant different (P≤0.05).

Group A (All males produced through methyl-testosterone hormone treatment, MTH)

1) 100% male + 0.00 % Female 2)80 % male + 20.0 % Female

3) 60 % male + 40.0 % Female 4)40 % male + 60.0 % Female

5) 20 % male + 80.0 % Female

Group B (All males produced by separation of sexes, NM)

6) 100% male + 0.00 % Female 7)80 % male + 20.0 % Female

8) 60 % male + 40.0 % Female 9)40 % male + 60.0 %Female

10) 20 % male + 80.0 % Female

Group C (All Females produced by separation of sexes, FM)

11) 100 % Females

Finaly it could be concluded that hormone treatement of tilapia fry significantly improved growth performance ,feed utilization and carcass

composition ,however Osman (2004) showed disadvantages of this treatment as following :

a) during mixing of the hormone with fish feed ,it is sprayed after dissolving into alcohol.The worker gets to inhale the evaporated hormone,which had bad influence on him.Therefore,he has to wear a mask in a very well ventilated environment ,2) the hormone, while getting sprayed, containments the surrounding water.Therefore,the treatment has to be done in isolated cement tanks taking into consideration that direct sun breaks down the homone within 24 hours, 3)the American Food Organization has banned the production of hormone treated monosex fish using by17α methyltestosterone to protect the worker who could misuse the hrmone during preparing treated fry feed ,4) the production of the treated feed with 17α methyltestosterone should be done in a very careful condition in fish feed plant, and not in each hatchery, under the control of Ministry of Health and Ministry of Environment and 5)the treated feed should be used directly in fry feeding only in the first 28 days of fish life and not to be used after that.

Therefore, further studies should be conducted in this are a select in order to the safe and optimum monosexing tilapia method for culture .

Table (5): Effect of mono and mixed sexing of Nile tilapia (*O. niloticus*) fry on carcass composition at the ending of the present study the grown in aquaria for 112 days.

Item*	Treatment	Dry matter (%)	% on dry matter basis			energy content (Kcal/g)
			Crude protein	Ether extract	ASH	
Group A	1	25.58^{a}	66.80^{k}	22.13^{a}	11.07^{f}	585.60^{a}
	2	25.57^{a}	66.83^{j}	21.49^{b}	11.68^{e}	579.79^{b}
	3	25.54^{a}	66.86^{i}	20.83^{c}	12.31^{d}	573.73^{c}
	4	25.51^{a}	66.89^{h}	20.17^{d}	12.94^{c}	567.66^{d}
	5	25.48^{a}	66.92^{g}	19.51^{e}	13.57^{b}	561.60^{e}
Group B	6	25.49^{a}	67.15^{a}	18.65^{k}	14.20^{a}	554.78^{k}
	7	25.49^{a}	67.11^{b}	18.69^{g}	14.20^{a}	554.93^{j}
	8	25.48^{a}	67.07^{c}	18.73^{i}	14.20^{a}	555.09^{i}
	9	25.47^{a}	67.03^{d}	18.77^{h}	14.20^{a}	555.24^{h}
	10	25.46^{a}	66.99^{e}	18.81^{ga}	14.20^{a}	555.39^{g}
Group C	11	25.47^{a}	66.95^{f}	18.84^{f}	14.21^{a}	555.45^{f}

***Means in the same column with different superscripts are significant different (P≤0.05).**

Group A (All males produced through methyl-testosterone hormone treatment, MTH)

1) 100% male + 0.00 % Female 2)80 % male + 20.0 % Female

3) 60 % male + 40.0 % Female 4)40 % male + 60.0 % Female

5) 20 % male + 80.0 % Female

Group B (All males produced by separation of sexes, NM)

6) 100% male + 0.00 % Female 7)80 % male + 20.0 % Female

8) 60 % male + 40.0 % Female 9)40 % male + 60.0 %Female

10) 20 % male + 80.0 % Female

Group C (All Females produced by separation of sexes, FM)

11) 100 % Females

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مقارنة كفاءة النمو والاستفادة والاستفادة من الغذاء والتركيب الكيماوى لآسماك البلطى وحيد الجنس بنظم مختلفة

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أجريت هذه الدراسة فى معمل تغذية الأسماك بقسم الإنتاج الحيوانى والسمكى – كلية الزراعة – جامعة الإسكندرية فى أحواض زجاجية من أجل مقارنة كفاءة النمو وكفاءة الإستفادة من الغذاء والتركيب الكيماوى لآسماك البلطى وحيد الجنس المنتج من خلال فرز الذكور عن الإناث أو من المعاملة الهرمونية بهرمون ١٧ ألفا ميثيل تيستستيرون مع أدخال نسب أحلال للإناث (٠،٢٠،٤٠،٦٠،٨٠) لكل من الذكور المعاملة وغير المعاملة.

وأوضحت النتائج الاتى :

١) أكثر معدلات النمو كانت لتلك الاسماك التى عوملت بهرمون ١٧ ألفا ميثيل تيستستيرون ، بينما الأسماك التى لم تعامل بالهرمون (ذكور وإناث) والتى انتخبت بواسطة فرز الأجناس جاءت فى المرتبة الثانية والثالثة على التوالى بينما اسماك البلطى مختلطة الأجناس قد أعطت معدلات أقل .

٢) القيم المرتفعة لمعامل الحالة ومعاير الإستفادة من الغذاء كانت مرتفعة فى الاسماك المعاملة بالهرمون بينما كانت منخفضة لآسماك البلطى مختلطة الجنس .

٣) محتوى جسم أسماك البلطى وحيد الجنس المعامل بالهرمون من الدهون والطاقة كانت مرتفعة، بينما كان هناك إختلافات معنوية بين مجموعة الذكور المعاملة بالهرمون والغير معاملة ومختلطة الجنس فى محتوى البروتين والمادة الجافة بدرجة معنوية.