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EFFECT OF SOME HERBAL POWDER FEED ADDITIVES ON PERFORMANCE OF MONO-SEX NILE TILAPIA (*OREOCHROMIS NILOTICUS*) FRIES REARED IN HAPAS

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ABSTRACT: The aim of this study was to investigate the effect of dietary supplementation (10 g/kg) of various herbs (such as fenugreek, rosemary, thyme, and fennel) in the formulated diets for mono-sex Nile tilapia fries. Fish with an average weight of 1.81 ± 0.1 g were randomly assigned to 5 treatments, 3 replicates per treatment, 20 fries and kept at 15 hapas (1.5 x 0.5 × 1.0 m^3) for 12 weeks. The results of the study showed that the fish that ate the thyme-containing diet had the highest body weight and followed by those which ate the fenugreek-fortified diet. Fish fed diet with rosemary had the lowest body weight. All treatments had significant differences in weight gain ($P<0.05$). In particular, fish fed on the thyme-containing diet gained more weight than fish fed on the control diet with the highest weight gain. Based on the findings, the study found that fish diets fortified with thyme powder resulted in the highest specific growth rate (%SGR) compared to other diets. There was a significant difference between the thyme added diet and all other groups ($P<0.05$). Fish fed the thyme supplement also increased their feed intake and had the best feed conversion ratio (FCR) compared to the other groups. There was a significant difference in FCR ($P<0.05$) among all other treatments. The study found no significant difference in dry matter of all treatments, except for fish fed the control diet, which recorded the lowest value ($P>0.05$). The protein content was significantly different ($P<0.05$), and fish fed diet supplemented with fennel had the lowest protein content. Fish fed diets supplemented with fenugreek and fennel had the highest lipid contents (13.95, 13.69 %, respectively), while fish fed a diet supplemented with rosemary had the lowest (11.26 %). There was no significant difference in ash content of all treatments and fish fed a diet supplemented with thyme had the highest ash content. The results showed that fish fed the diet supplemented with fennel had the highest survival rate of 100%, while fish fed the control diet had the lowest survival rate of 95%. According to the search results, all examined fish tissues did not show any histopathological changes related to their diet across all treatments. Based on the search results, it appears that adding certain herbal plants, especially thyme, to the diets for Nile tilapia fries at a rate of 10 g/kg can enhance their growth performance and feed utilization without causing any negative impacts.

Key words: Nile tilapia fries, Aquaculture, Feed additives, Performance, Histology.

INTRODUCTION

As part of the global return to nature movement, a range of feed additives are used in aquaculture to improve fish performance. Some of these additives used in feed processing use herbs and plants to replace and/or reduce the use of chemicals. The use of herbal plants is a result of increased consumer interest in biologically active ingredients of natural origins.

Using natural feed additives to increase growth performance and feed efficiency has been extensively examined in earlier scientific research (Zaki *et al*., 2012; Yılmaz *et al*., 2012).

Phytobiotic compounds include many biologically active compounds that can be derived from a variety of plant sources (Vidanarachchi *et al*., 2005), which have a variety of beneficial effects on fish, including: growth promoter, appetite increase, bile secretion and digestive enzyme activity promoter, liver protectant (Csép *et al*., 2010, Kasiri *et al*., 2011).

A strategy that has shown economic promise for enhancing the efficiency of various intensive fish production systems is nutrient supplementation in fish diets.

Thyme (*Thymus vulgaris*), an aromatic plant from the family Lamiaceae, is one of these

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alternative medicinal herbs that positively impact body gain, and which minimize feed consumption. It has gained significant attention as both a therapeutic and pharmaceutical herb. High levels of thymol (40%) and carvacrol (15%) as well as cymene, eugenol, and 4-8 allylphenol were found in thyme, which have powerful anti-bacterial and anti-oxidant properties. Thyme has inhaled steroid and anti-spasmodic properties for the bronchi (Rota *et al*., 2008).

Rosemary (*Rosmarinus officinalis*) possesses the effects of rosemary on humans and animals include anti-inflammatory, hepatoprotective, anti- thrombotic, diuretic, anti-diabetic, anti-nociceptive, anti-cancer, and anti-oxidant properties (Yousefi *et al*., 2019). Additionally, carnosic and rosmarinic acids, which have been shown to have important anti-oxidant properties, are abundant in rosemary (Erkan *et al.*, 2008).

Fenugreek is rich in flavonoids like apigenin, kaempferol, and quercetin. Saponins (such as diosgenin and yamogenin) (such as diosgenin and yamogenin) have distinctive roles include preventing oxidative damage (Kaviarasan *et al*., 2004).

Thyme, rosemary, and fenugreek in *O. mossambicus* (Ergün *et al*., 2011) increased growth performance, disease resistance, and immunity. Mostafa *et al*. (2009) found that blood sugar levels were increased, because the amino acid 4-hydroxil isoleucine found in fenugreek appears to enhance the body's production of insulin.

Since ancient times, *Foeniculum vulgare*, generally known as fennel, has been widely utilized in traditional medicine, not only in Europe but also in various other parts of the world. In fact, a number of therapeutic benefits for the digestive, endocrine, reproductive, and respiratory systems have been documented (Badgujar *et al*., 2014).

Our investigation is to study the influence of dietary feed additives of some herbal plants powder on growth performance, feed utilization, ammonia excretion rate, body composition and some histological tissues of mono-sex Nile tilapia (*Oreochromis niloticus*) fries reared in hapas.

MATERIALS AND METHODS

A total number of 300 fries averaged (1.81 ± 0.1 g) of mono-sex Nile tilapia, *Oreochromis niloticus* were brought from the local farm at Kafr El-Shaikh, Egypt and adapted for one week on the laboratory circumstances. Fries were randomly divided into 5 treatments, three replicates per treatment in 15 hapa (net enclosure of 1.5 m × 0.5 m × 1 m) that were set up in five concrete basins with dimensions of 2 m × 2 m × 1 m. The hapas were filled with aerated fresh water. All procedures and handling of animals were conducted in compliance with the guidelines of the Scientific Research Ethics and Animal Use Committee, Menoufia University, Faculty of Agriculture, Egypt, with approval No. (03-SRE & AUC-MUAGR-07-2023). All fish were counted and weighed every two weeks to assess the growth and readjust the feeding rate. The experimental fish were fed 7% of their body weight with one of the experimental diets and gradually decreased to 3% by the end of the feeding trial. Feeding was stopped for 24 h prior to weighing. All fish were fed three times a day, six days a week with the experimental diets for 84 days.

Experimental diets were similar in protein content (30.6 ± 0.04%) and ether extract (5.4 ±0.06%) (Table 1). Fenugreek (*Trigonella foenum* graecum), rosemary (*Rosmarinus officinalis*), thyme (*Thymus vulgaris*) and fennel (*Foeniculum vulgare*) were purchased from local stores, dried, ground and added at 10 g per kg feed. The treatments were defined as 0 (CTRL), (Fenugreek), (Rosemary), (Thyme) and (Fennel). The experimental diets were prepared by thoroughly blending ingredients as presented in Table (1). All ingredients are first ground to a small particle size. Water was added to the ingredients of each diet and pellets were made using a food processor. It is then dried and stored in plastic bags in the refrigerator until the end of feeding. The approximate composition of the experimental diet was determined according to AOAC (2012).

Table (1). Ingredients and chemical composition of the experimental diets.

Ingredients	Dietary groups (g/kg)				
	CTRL	Fenugreek	Rosemary	Thyme	Fennel
Fish meal (65%)	100	100	100	100	100
Soybean (44%)	440	440	440	440	440
Wheat bran (10%)	130	120	120	120	120
Wheat (14%)	140	140	140	140	140
Yellow corn (7.5%)	130	130	130	130	130
Vegetable oil	20	20	20	20	20
Dicalcium phosphate	10	10	10	10	10
Premix[1]	30	30	30	30	30
Fenugreek	-	10	-	-	-
Rosemary	-	-	10	-	-
Thyme	-	-	-	10	-
Fennel	-	-	-	-	10
Chemical analysis					
Dry matter	89.81	89.71	89.51	89.52	89.52
Crude protein	30.63	30.56	30.60	30.55	30.55
Ether extract	5.33	5.43	5.55	5.35	5.35
Ash	6.34	6.44	6.55	6.64	6.64
Crude fiber	3.71	3.61	3.51	3.62	3.62
NFE[2]	53.99	53.96	53.79	53.84	53.84
GE (kcal/100g DM)[3]	451.27	451.69	452.33	450.37	450.37
ME (kcal/100g DM)[4]	369.43	369.82	370.38	368.71	368.71

[1]Premix Composition: Each 1 kg contains: vitamin A, 4,000,000 International Unit (IU); vitamin D_3, 8,00,000 IU; vitamin E, 40, 000 IU; vitamin K_3, 1,600 mg; vitamin B_1, 4,000 mg; vitamin B_2, 3,000 mg; vitamin B_6, 3,800 mg; vitamin B_{12}, 3 mg; Nicotinic acid 18000 mg; Pantothenic acid, 8000 mg; Folic acid, 800 mg; Biotin, 100 mg; Choline chloride 120,000 mg; Iron, 8000 mg; Copper, 800 mg; Manganese, 6000 mg; Zinc, 20,000 mg; Iodine, 400 mg; Selenium, 40 mg; Vitamin C (coated), 60,000 mg; Inositol, 10,000 mg; Cobalt, 150 mg; Lysine, 10,000 mg; Methionine, 10,000 mg and Antioxidant, 25,000 mg.

[2]Nitrogen Free Extract (NFE) = 100 – (% Protein + % Fat + % Fiber + % Ash).

[3]GE (kcal/100g DM) = Gross energy based on protein (5.65 kcal/g), Fat (9.45 kcal/g), and carbohydrate (4.22 kcal/g) according to (NRC, 2011).

[4]ME (kcal/100g DM) = metabolically energy was calculated by using factors 4.5, 8.1 and 3.49 kcal/g for protein, fat and carbohydrates, respectively according to Pantha (1982).

Sample collection and examination

1. Body composition

Fish samples were tested at the end of the feeding trial and analyzed for moisture, protein, lipid and ash contents using standard methods (AOAC, 2012). Six fish from each treatment were sampled for analysis. Mixed samples are stored at – 18 C and separated for biochemical analysis. Dry matter, crude protein and crude lipid were analyzed after oven drying (105 C, 6 h), Kjeldahl nitrogen determination (N × 6.25) and ether extraction with Soxhlet.

2. Growth performance parameters

2.1. Weight gain (g/fish)

Weight gain was specified as following:

Weight gain (g/fish) =
Final weight (g) - Initial weight (g).

2.1.1. Average daily gain was determined as following:

Average daily gain (g/fish/day) =
[Final weight (g) - Initial weight (g)]/n

Where, n is the experimental period (84 days).

2.2. Specific growth rate

Specific growth rate (SGR %/ day) was calculated using the equation:

SGR (%/day) = 100 × (Ln FBW−Ln IBW) /T

Where, FBW is the final fish weight at the end of the experiment; IBW is the initial fish weight at the start of the experiment; Ln is the natural log and T is the experiment period (84 days).

2.3. Survival rate

Survival rate (%) was estimated using the equation:

Survival rate (%) = 100 × (no. of survived fish at the end of the experiment ÷ no. of survived fish at the beginning of the experiment).

3. Feed utilization parameters

3.1. Feed conversion ratio (FCR)

Feed conversion ratio (FCR) was calculated according to the following equation:

FCR= Feed consumed (g) during the experimental period ÷ weight gain during the experimental period (g).

3.2. Protein efficiency ratio (PER)

Protein efficiency ratio (PER) was calculated according to the following equation:

PER = Weight gain (g) ÷ Protein intake (g)

4. Water quality parameters

Bi-weekly water test for ammonia, pH, water temperature and dissolved oxygen controlled by YSI Model 58 (APHA 1995). At the time of feeding, the water quality reached the average of ±SD: water temperature, 27.47 ± 1.35 C; dissolved oxygen, 7.90 ± 1.9 mg^{-l}; pH, 7.68 ± 0.27; ammonia, 0.036 ± 0.00 mg^{-l} and it was under normal conditions for rearing Nile tilapia.

5. Ammonia excretion rate

By the termination of the feeding period (12 weeks), the water inflow was stopped after feeding fish at 3% of their body within 30 minutes. Water samples were taken every hour for eight hours and total ammonia was measured by photometer apparatus MD100 (Germany) according to Yilmaz *et al*., (2012) as the following for formulae:

A=[(N2 - N1×V2)/B]/T2 - 1 , where A = ammonia excretion rate (mg total NH_3 - N / kg wet fish weight / hour), N1 = ammonia concentration at time 1 (mg total NH_3 - N/L), N2 = ammonia concentration at time 2 (mg NH_3 - N/L), V2 = volume of the medium at time 2 (ml), B = wet weight of the fish (g) and T2 - 1 = time interval between samplings 1 and 2 (h).

6. Histological analysis

For histological examination, two fish per hapa (n= 6 per treatment) were killed with ice slurry and stored in 10% neutral buffered formalin (Thermo Fisher, Kalamazoo, MI). The next day, the fish were washed several times with water and stored in 70% ethanol for further

processing. The head and tail of each fish were cut off and the intestine, liver, kidney and testis were separated. Tissues are usually dried in ethanol, fixed in xylene and embedded in paraffin according to histological procedures. All tissues were cut into longitudinal sections. Sections were cut at 4 µm, placed on glass slides and routinely stained with hematoxylin and eosin (H&E), then removed from xylene and coated with Permount medium.

7. Statistical analysis

Differences between test groups were tested with a one-way ANOVA test. Percentages of specific growth turned arcsine before ANOVA. Differences were considered significant when $P \leq 0.05$. Differences between means were determined by Duncan's multiple test (Duncan, 1955).

Results

Fish performance and feed utilization

Impacts of fenugreek, rosemary, thyme and fennel additives on mono-sex Nile tilapia performance were conducted in Table (2). There was a significant difference between all treatments ($P< 0.05$). The highest final weight (Fig. 1) was observed in fish fed thyme supplemented diet followed by fish fed fenugreek supplemented diet and fish fed rosemary supplemented diet gained the lowest value. In addition, each treatment group had a significant difference ($P< 0.05$) in weight gain. The highest results were observed in fish fed the thyme diet compared to fish fed the CTRL diet (Fig. 2). The mean daily gain was significantly different between all treatments ($P< 0.05$), with the highest value occurring on fish fed thyme diet followed by fish fed fenugreek diet, respectively. Fish fed the CTRL diet had the lowest results, while fish fed the rosemary and fennel- fortified diets did not differ significantly. The results of specific growth rate (SGR %) showed that fish fed thyme diet gave the best results ($P< 0.05$) (Fig.3), unlike all treatments. Fish fed the fennel supplement had the highest Survival rate (100%), and fish fed the CTRL diet had the lowest survival rate (95%), with a significant difference ($P< 0.05$) between all treatments. Fish fed the thyme-supplemented diet ate more than the other groups and exhibited the best feed conversion ratio (FCR) with a significant difference ($P< 0.05$) across all treatments (Fig. 4).

In addition, protein efficiency ratio (PER) was higher in thyme-fed fish and significantly different between all treatments ($P< 0.05$). Fish fed the CTRL diet received the lowest rates.

Body conformation

The analysis of whole fish body is shown in Table (3). There was no significant difference in dry matter between all diet treatments, except for the fish fed the CTRL diet, which was very different and achieved the lowest value ($P> 0.05$). There was also a significant difference in the protein content of the fish ($P< 0.05$) and the protein content of the fish fed with fennel was the lowest. Fish fed fenugreek and fennel supplemented diets gained the highest value of lipid contents (13.95 and 13.69%), respectively, and fish fed a diet supplemented with rosemary exhibited the lowest rate (11.26%). There was no significant difference in ash content across all dietary treatments. The highest results were found in fish fed a diet supplemented with thyme.

Table (2). Growth performance and feed utilization of mono-sex Nile tilapia (*Oreochromis niloticus*) fed the experimental diets for 84 days (means ± SE).

Parameters	Dietary groups (g/kg) *				
	CTRL	Fenugreek	Rosemary	Thyme	Fennel
Initial body weight (IBW, g/fish)	1.82 ± 0.03	1.88±0.02	1.78±0.02	1.80±0.05	1.78±0.03
Final body weight (FBW, g/fish)	14.48±0.62^{c}	18.06±0.79^{b}	14.46±0.75^{c}	22.67±1.63^{a}	15.12±0.37^{c}
Gain (g/fish)	12.66±0.62^{c}	16.18±0.77^{b}	12.68±0.75^{c}	20.87±1.64^{a}	13.33±0.39^{bc}
Weight gain (WG %)[1]	695.60±38.59^{b}	860.64±34.19^{b}	712.36±43.55^{b}	1159.44±106.59^{a}	749.44±33.85^{b}
Average daily gain (ADG, g)	0.15±0.01^{c}	0.19±0.01^{b}	0.15±0.01^{c}	0.25±0.02^{a}	0.16±0.01^{c}
Specific growth rate (SGR, %)[2]	2.47±0.06^{b}	2.69±0.04^{b}	2.49±0.04^{b}	3.02±0.09^{a}	2.55±0.05^{b}
Survival (%)[3]	95.00±4.00^{b}	96.67±3.33^{ab}	98.33±1.69^{ab}	97.67±2.41^{ab}	100.00±00^{a}
Feed utilization					
Feed consumed (g/fish)	29.08±1.33^{bc}	30.66±0.29^{b}	26.55±0.72^{c}	37.31±1.19^{a}	26.19±0.39^{c}
Feed conversion ratio (FCR)[4]	2.30±0.15^{a}	1.89±0.09^{b}	2.09±0.09 ^{ab}	1.79±0.18^{b}	1.96±0.03^{b}
Protein efficiency ratio (PER)[5]	1.42±0.01^{b}	1.73±0.09^{ab}	1.56±0.06^{ab}	1.83±0.19^{a}	1.67±0.03^{ab}

Means in the same row with different superscript letters are significantly different ($P < 0.05$).

*CTRL= control; fenugreek, rosemary, thyme and fennel supplementation at 10 g/kg diet.

[1]WG (%) = 100 × (final body weight – initial body weight)/initial body weight

[2]SGR (%/day) = 100 × (Ln final weight – Ln initial weight)/Time (days)

[3]Survival rate (%) = [(no. of fish at the end of the experiment / no. of fish at the beginning of the experiment)] ×100.

[4]FCR = Total feed consumed (g fish^{-1})/weight gain (g fish^{-1})

[5]Protein efficiency ratio (PER) = weight gain (g fish^{-1})/protein intake (g)

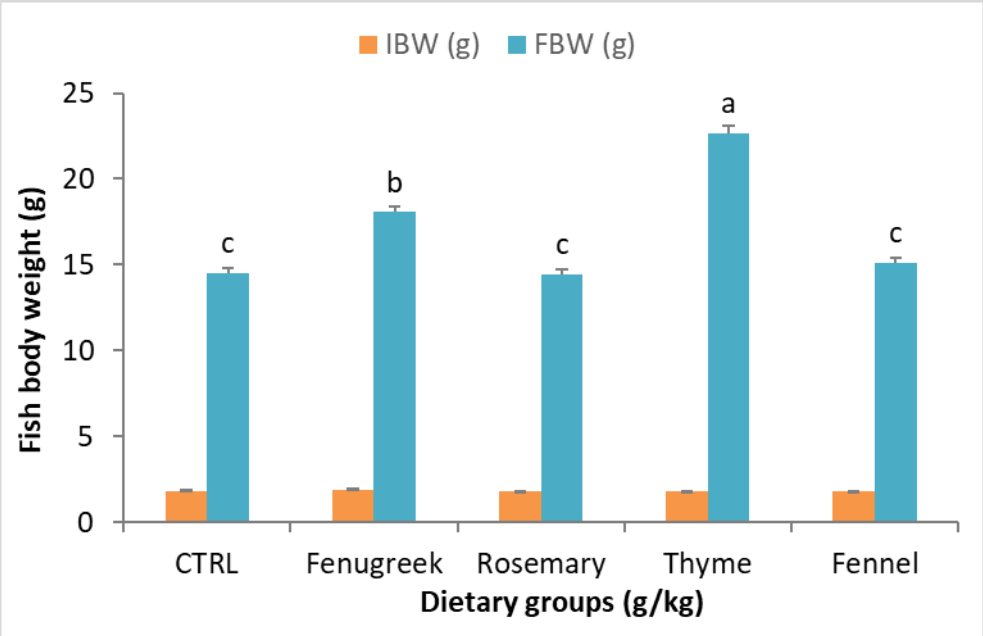

Figure (1). Final mean weight of mono-sex Nile tilapia fed different herbal additives supplemented diets for 84 days.

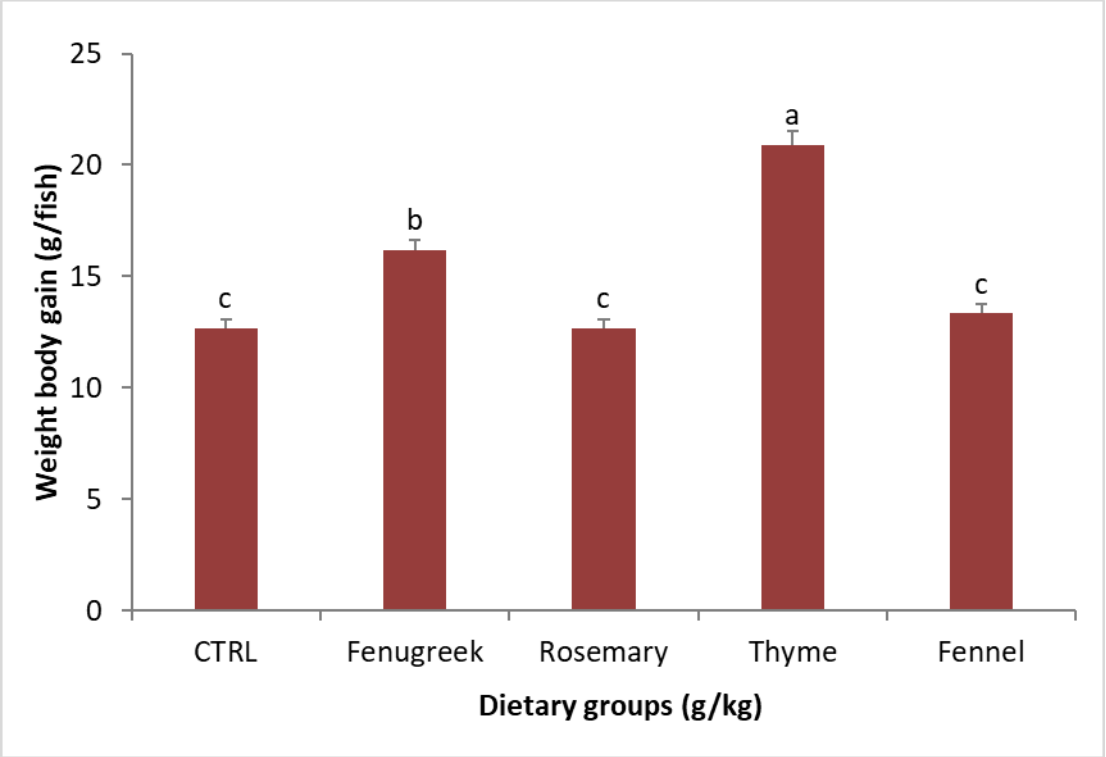

Figure (2). Weight body gain (WG, g/fish) of mono-sex Nile tilapia fed different herbal additives supplemented diets for 84 days.

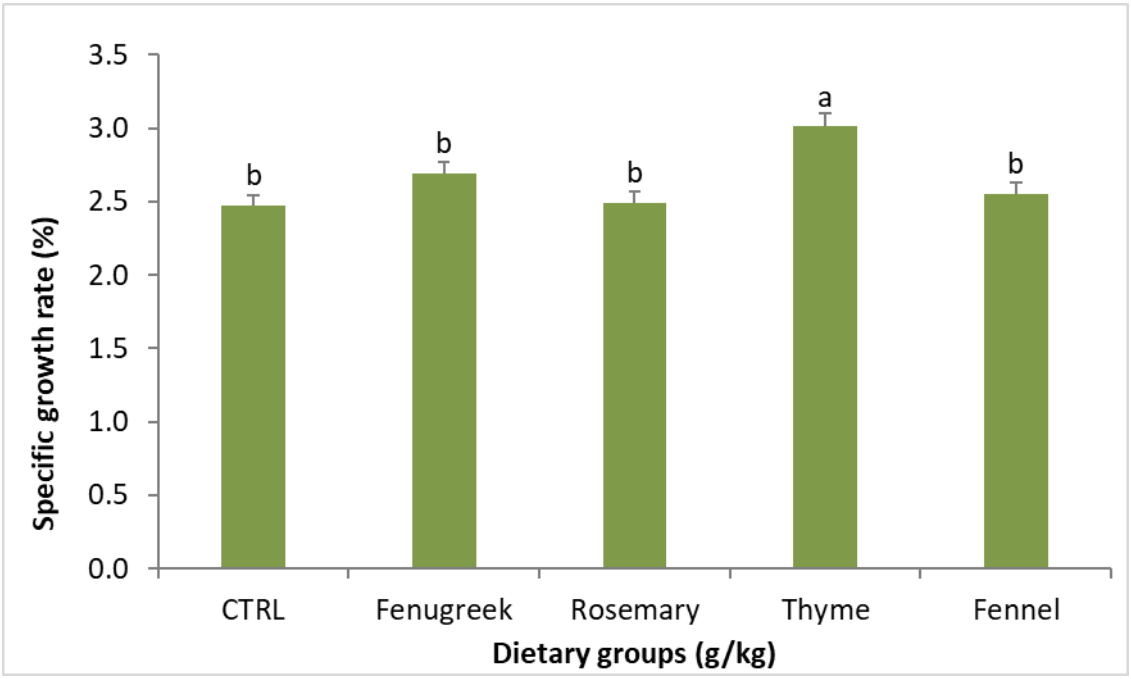

Figure (3). Specific growth rate (SGR, %) of mono-sex Nile tilapia fed different herbal additives supplemented diets for 84 days.

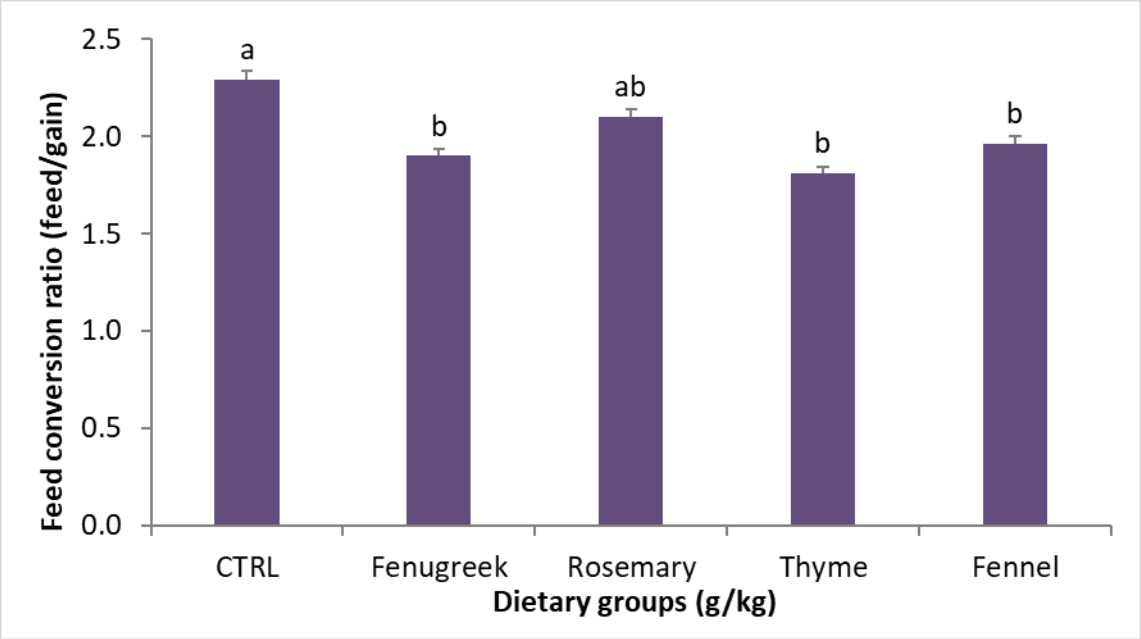

Figure (4). Feed conversion ratio (FCR) of mono-sex Nile tilapia fed different herbal additives supplemented diets for 84 days.

Table (3). Body composition of mono-sex Nile tilapia (*Oreochromis niloticus*) fed different herbal additives supplemented diets for 84 days (means ± SE).

Items (%)	*Dietary groups (g/kg)				
	CTRL	**Fenugreek**	**Rosemary**	**Thyme**	**Fennel**
Dry matter	24.42±0.58^{b}	26.11±0.17^{a}	26.66±0.31^{a}	27.11±0.27^{a}	26.70±0.34^{a}
Protein	57.86±0.40^{ab}	58.46±0.76^{ab}	60.07±0.91^{a}	60.13±0.51^{a}	56.96±0.71^{b}
Lipids	12.08±0.40^{b}	13.95±0.24^{a}	11.26±0.33^{b}	11.49±0.44^{b}	13.69±0.38^{a}
Ash	11.83±1.58	11.47±0.61	11.88±0.10	12.96±0.31	12.80±0.69

Means in the same row with different superscript letters are significantly different ($P < 0.05$). *CTRL= control; fenugreek, rosemary, thyme and fennel supplemented diets with 10 (g/kg diet).

Ammonia excretion rate

The effects of herbal supplementation on the ammonia excretion of mono-sex Nile tilapia fries (*Oreochromis niloticus*) fed the experimental diets are performed in Fig. (5). Ammonia excretion rate showed significant differences during the period of 8 h amongst all treatments. The highest value of water ammonia excretion rate was in fish fed rosemary followed by thyme supplemented diets after 1 h with significant differences (P< 0.05). Significant decreasing trend was observed until the period of the testing period (8 h). After 7 h, ammonia excretion rate was under detection amongst all treatments except fish fed fenugreek supplemented diet. It was showed that ammonia excretion rate in the water for fish fed rosemary and fenugreek supplemented diets were the lowest after 8 h with significant differences amongst all treatments (Fig.5).

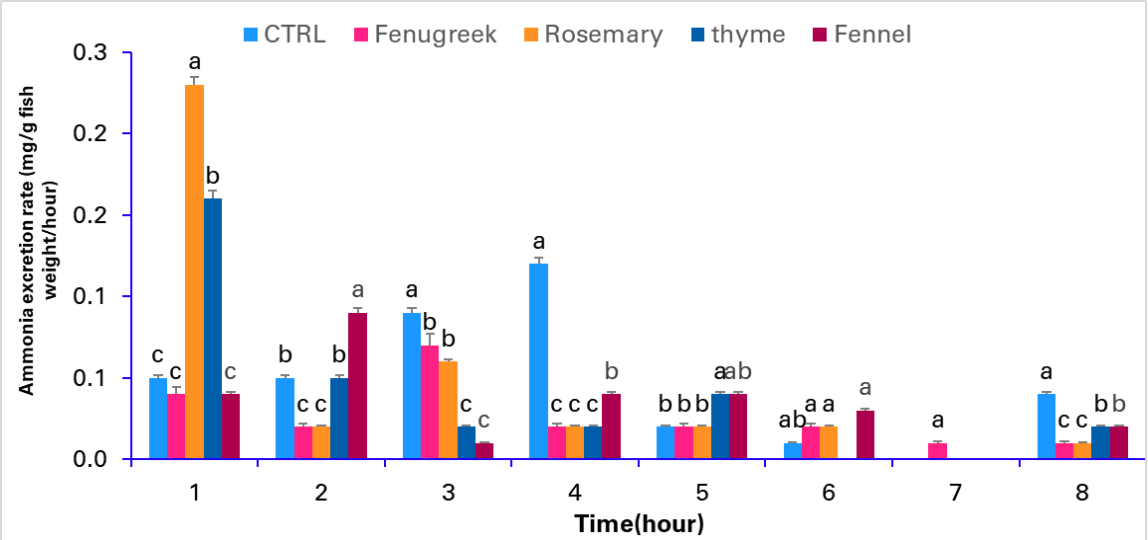

Figure (5). Ammonia excretion rate after 8 hours of Nile tilapia fed different herbal additives supplemented diets. CTRL, Fenugreek, Rosemary, Thyme and Fennel at 10 g/kg diet. Values mean ± SEM (n=3).

Histological examination

Control mono-sex Nile tilapia and groups fed diet supplemented with fenugreek, rosemary, thyme and fennel (10 g/ kg diet) showing normal hepatopancreatic tissues including hepatocytes, sinusoids and pancreatic tissue (Fig. 6 a, b, c, d and e); respectively. Moreover, normal renal tissues including gromeruli (Gr), tubules and interstitium was observed in fish kidney of all treatments (Fig. 7). The examination of fish intestine showed normality in the control group (Fig. 8a). Increasing in the goblet cells number was observed in fish fed diets with herbal supplementation at 10 g/kg diet (Fig. 8 c and e). Moreover, the normality of fish testis was found in all treatments with normal testicular tissues including seminiferous tubules and spermatozoa filled lumens. (Fig. 9 a, b, c, d and e). Diet-related histopathological changes were not observed in all fish tissues from all treatments.

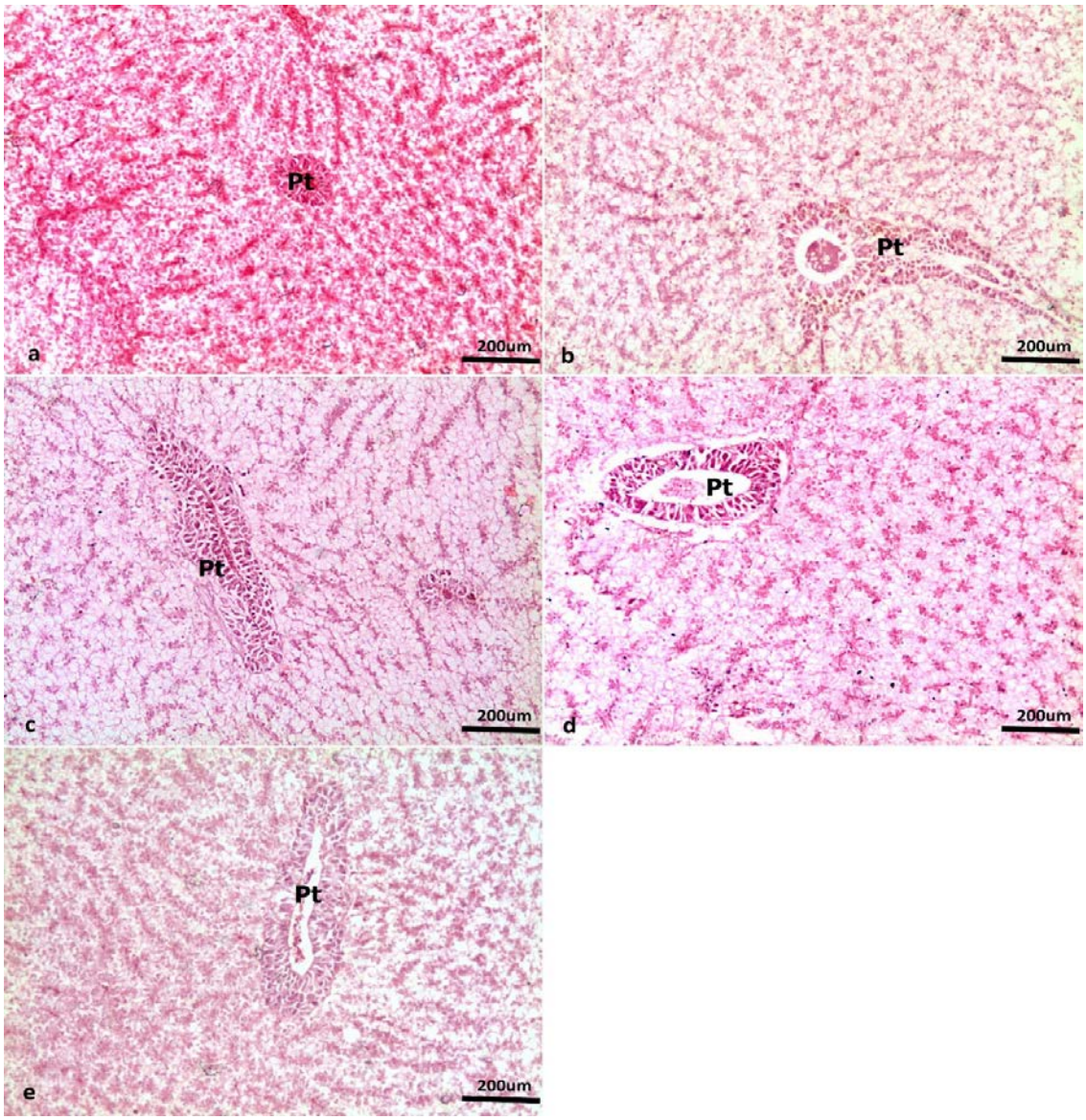

Figure (6). Liver of Nile tilapia fed different herbal additives supplemented diets.

(a) control group, (b) fenugreek, (c) rosemary, (d) thyme and (e) fennel supplemented diets. H&E X10.

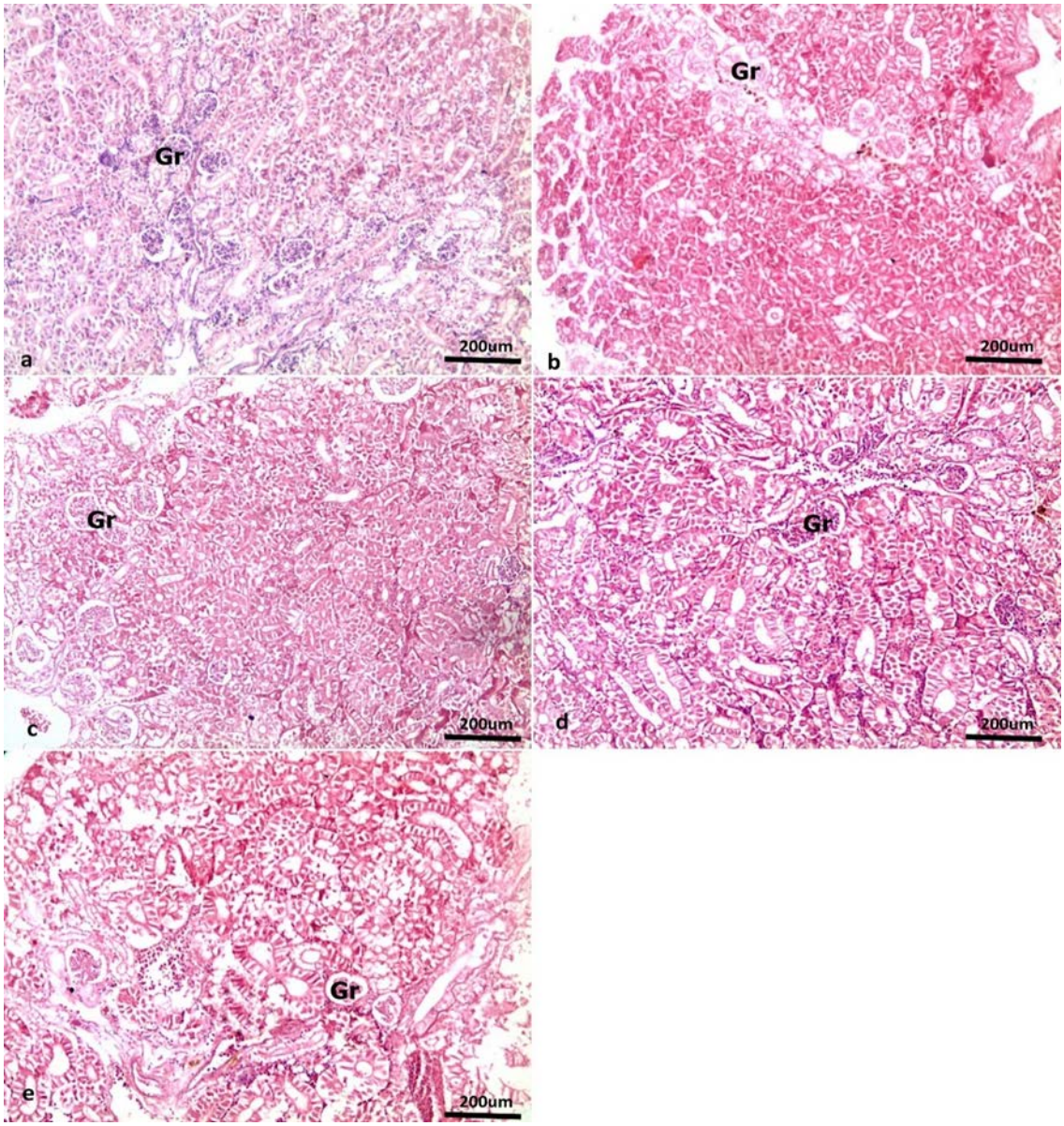

Figure (7). Kidney of Nile tilapia fed diets supplemented with different herbal additives supplemented diets.

(a) control group, (b) fenugreek (c) rosemary, (d) thyme and (e) fennel supplemented diets, showed normal renal tissues including gromeruli (Gr), tubules and interstitium. H&E X10.

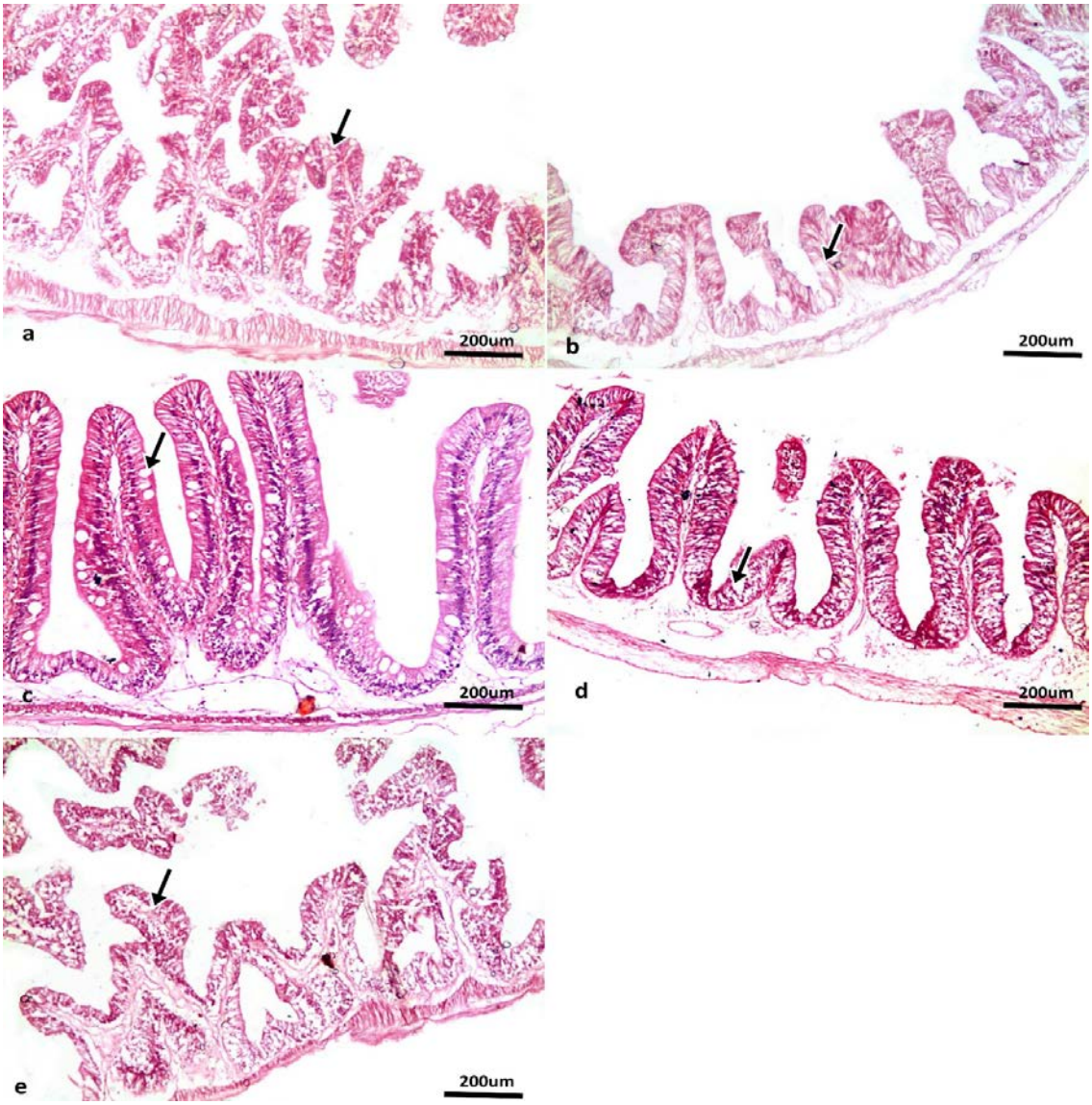

Figure (8). Intestine of Nile tilapia fed different herbal additives supplemented diets.

(a) control group, (b) fenugreek, (c) rosemary, (d) thyme and (e) fennel supplemented diets. H&E X10.

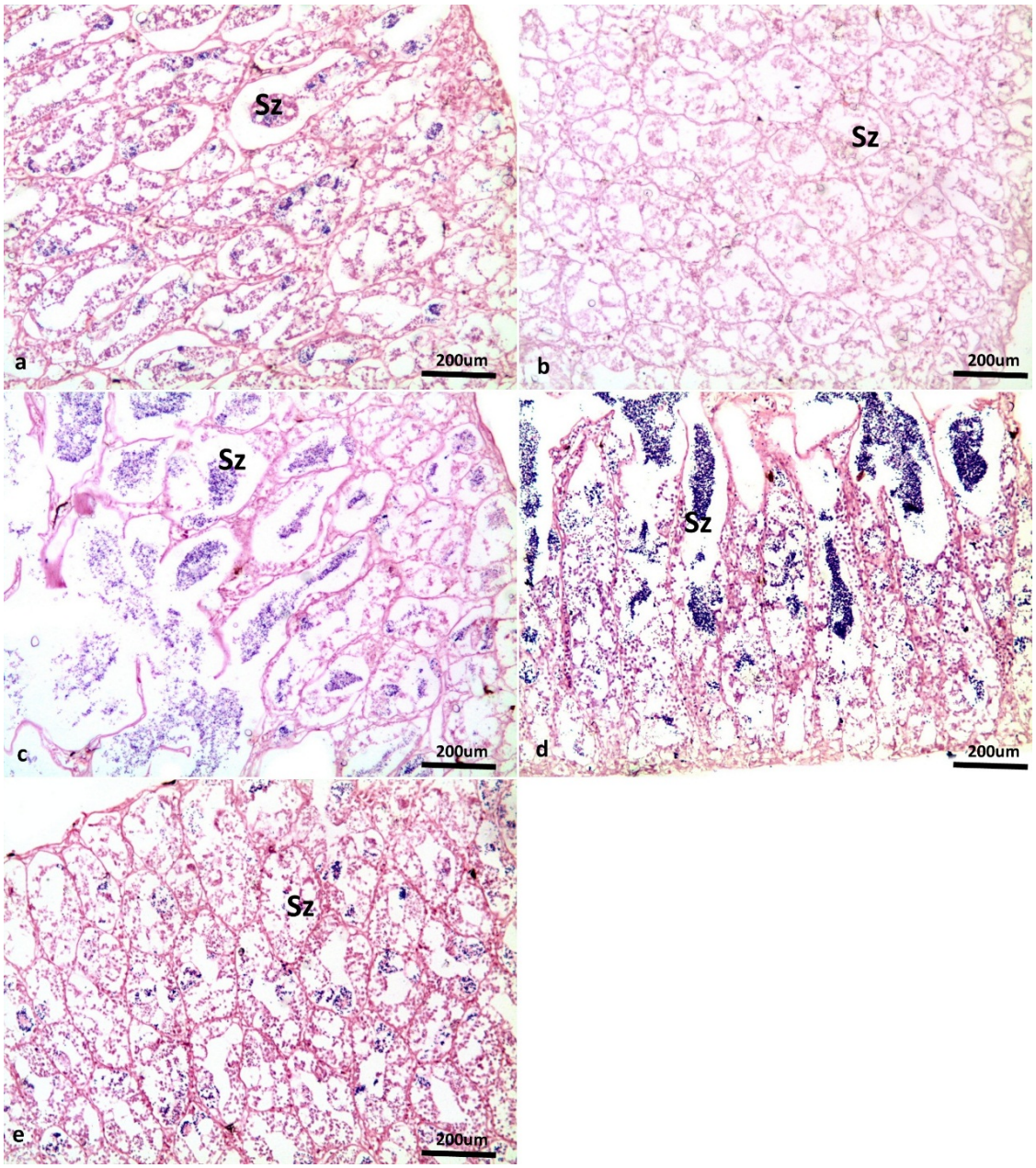

Figure (9). Testis of Nile tilapia fed different herbal additives supplemented diets.

(a) control group, (b) fenugreek, (c) rosemary, (d) thyme and (e) fennel supplemented diets showed normal testicular tissues including seminiferous tubules and spermatozoa filled lumens. H&E X10.

Discussion

The use of herbal plants and spices in fish culture has been shown to have benefits such as enhancing growth (Shalaby *et al.*, 2006), reducing stress (Citarasu, 2010), stimulating appetite (Dorucu *et al.*, 2009), improving immune response (Ergün *et al.*, 2011), enhancing skin coloration (Yılmaz and Ergün, 2011), improving hematological and biochemical status (Yılmaz and Ergün, 2012) and increasing disease resistance (Yılmaz *et al.*, 2012; Yılmaz *et al.*, 2013). Differences in active components in the herbs may have influences on these outcomes. To investigate this, a study was conducted over a

feeding trial of 12 weeks to determine the impact of fenugreek, rosemary, thyme and fennel supplementation in the diets for mono-sex Nile tilapia fries reared in haps on the performance, body composition, ammonia excretion rate and histology.

Previous research has examined the impact of using herbal plants in fish and shrimp diets on their performance (Yilmaz *et al*., 2012 and Ayoub *et al.*, 2019). The obtained results showed significant differences in growth performance when comparing the different dietary treatments (Table 2). Based on the findings, fish that were fed a diet supplemented with 10g thyme powder per kg of diet had the increased values of final weight, weight gain, weight gain percentage, average daily gain, and specific growth rate. In another study, Al-Safah and Al-Faragi (2017) found the highest growth rate in Common carp fingerlings that were fed a diet containing 1.5% thyme. However, the results of Tonsy *et al*. (2011) showed that Nile tilapia fingerlings had the best performance when fed diets containing 1-2% fenugreek sprouts. These variations in results can be attributed to the changes of fish species, life stages, levels, and types of herbal plants used.

In a study conducted by Hussein *et al*. (2022), significant differences in growth were observed in common carp (*Cyprinus carpio*) fries fed a diet containing varying concentrations of marjoram leaves for 12 weeks. The increased values were found in fish fed diet with 2.5 g/kg of marjoram leaves, while a decreasing trend in growth performance was observed by increasing the marjoram leaves level in the diets. In our research, fish fed thyme-supplemented diets showed a higher feed intake and better feed conversion ratio (FCR) than other groups.

Survival rate was differed significantly between all dietary groups (Table 2), with the fish fed fennel-supplemented diets gaining the highest value. The study also observed that the experimental diets were acceptable by fish, and fish fed fennel-supplemented diet gained the highest value (Table 2). In reference to Yilmaz *et al*. (2012), the results showed that when feeding sea bass with the same herbal plants at 1%.

Regarding, dry matter of whole body composition, there was no significant difference between all treatments (Table 3). However, there was a significant difference in the protein content of fish bodies, with thyme-fed fish and rosemary-fortified diets achieving the highest results.

These results contradict the findings of El-Kholy (2012), who added different levels (150, 300 and 600 mg/ kg) of supplemented sage and/or marjoram to the diets for hybrid tilapia (*Oreochromis niloticus* × *O. aureus*) fingerlings and recorded a passive effect on ash and protein contents. Lipid content increased significantly by adding herbal plants to the diets. In our research, the highest lipid contents were observed in fish fed fenugreek and fennel-supplemented diets, respectively. Previous studies did not notice differences in whole-body composition with herbal plants supplementation as growth enhancer in the diets (Jeong *et al*., 2007 and Takaoka *et al*., 2007). Figure 4 shows the effects of herbal supplementation on ammonia excretion in mono-sex Nile tilapia, *Oreochromis niloticus*, fed experimental diets. The results indicate that after 8 hours, the ammonia excretion rate in the rearing water differed significantly between all groups and fish fed rosemary and fenugreek-supplemented diets exhibited the decreased values. Comparable results were reported by Yilmaz *et al*. (2012), who observed slightly lower ($P > 0.05$) amounts of ammonia excretion in the rearing water for sea bass when fed diets with the inclusion of thyme, rosemary, and fenugreek at 1%.

As shown by Ip *et al*. (2001), the main source of ammonia in fish is from protein catabolism. The low ammonia excretion rate indicates that the high protein diet is used for growth rather than energy according to Yigit *et al*. (2003). Similar findings were reported in studies conducted by El-Saidy and Gaber (2004) and Reyes and Chien (2009), who found that Yucca schidigera-supplemented diets for Nile tilapia resulted in a decreased ammonia excretion rate.

The liver, kidney, intestine, and testis of the mono-sex Nile tilapia fries/juveniles were subjected to histological examination to determine the safety of supplementation of

fenugreek, rosemary, thyme, and fennel (10 g/kg diet). Results revealed that the supplementation did not have any opposing effects on the wellbeing of the tested fish.

The results of the study also show that adding 10 g/kg of phytonutrients, particularly thyme, to Nile tilapia fries feed improves performance and feed efficiency. In addition, the normality of all fish tissues shows that the use of medicinal plants in the fish diet is safe. However, more research is needed to examine the effects of fish hematology, immune system and fish gut microbiota to improve fish health and increase the use of green medicine as growth promoters in fish feeds. Such studies could contribute to improving the quality of feeds and increasing fish production.

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تأثير إضافة مسحوق بعض الأعشاب النباتية على أداء زريعة أسماك البلطي النيلي وحيد الجنس المرباه بالهابات

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الملخص العربي

تم دراسة تأثير إضافة مسحوق بعض الأعشاب النباتية مثل الحلبة، الروزماري، الزعتر أو الشمر بمعدل ١٠ جم/ كجم عليقة لزريعة أسماك البلطي النيلي وحيد الجنس المرباه في الهابات.

كان متوسط الوزن الابتدائي للأسماك ١.٨١ جم تم توزيعها عشوائياً على خمس معاملات بكل منها ثلاث مكررات بكثافة ٢٠ زريعة بكل هابه وتم تربيتها لمدة ١٢ أسبوع. تم تغذية الزريعة على واحدة من خمسة علائق تجريبية ثلاث مرات يومياً (٩ ص – ١١ ص – ١ ظ). ارتفع معدل النمو فى الأسماك التي تغذت على عليقة مضاف إليها مسحوق الزعتر وكانت الأعلى قيمة في زيادة الوزن النهائي, وكذلك الأعلى قيمة في معدل النمو النوعي واختلفت معنوياً عن باقي المجموعات. وكانت أقلهم نمواً المجموعة التي تغذت على عليقة تحتوي مسحوق الروزماري. سجلت مجموعة الأسماك التي تغذت على عليقة تحتوي على مسحوق الشمر أعلى معدل حيوية بينما سجلت المجموعة التي تغذت على العليقة الكنترول أقل معدل حيوية.

ارتفع معدل استهلاك العلف فى مجموعة الأسماك التي تغذت على عليقة مضاف إليها مسحوق الزعتر مقارنة بالمجموعات الأخرى وحققت معنويا أفضل معدل تحول غذائي مقارنة بباقي المجموعات. لم تظهر الإضافات الغذائية أي اختلافات معنوية في محتوي الجسم من المادة الجافة ماعدا مجموعة الكنترول اختلفت معنويا وكانت أقل فى محتوى المادة الجافة. ظهرت اختلافات معنوية في محتوي الجسم من البروتين والمستخلص الايثيري وسجلت المجموعة التي تغذت على العليقة التي تحتوي على مسحوق الشمر أقل قيمة.

ظهرت اختلافات معنوية بين كل المجموعات في معدل استخراج الأمونيا وكان أقل معدل بعد ٨ ساعات في مجموعتي الأسماك التي تغذت على العلائق التي تحتوي على مسحوق الروزماري ومسحوق الحلبة.

ولم تظهر العلائق التجريبية أي تغييرات هستولوجية في أنسجة جسم الأسماك المختبرة بين كل المعاملات مما يؤكد على أمان استخدام الأعشاب والنباتات الطبية خصوصاً الزعتر في تغذية يرقات البلطي النيلي بدون أي تأثيرات سلبية.

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