

EFFECT OF MARJORAM (*Marjorana hortensis*) OR SAGE (*Salvia officinalis*) ADDITIVES ON GROWTH PERFORMANCE AND FEED UTILIZATION OF TILAPIA HYBRID (*Oreochromis niloticus* × *Oreochromis aureus*) MONOSEX FINGERLINGS.

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ABSTRACT

The response of tilapia hybrid (*Oreochromis niloticus* × *Oreochromis aureus*) to dietary herbs plants supplement with respect to growth performance and feed utilization through feeding experiments was investigated. Seven tilapia hybrid fingerlings treatments (45 fingerlings each, as average initial body weight 3.03 ± 0.01 g) were used at period 90 days in closed system. Seven dietary approximately iso-nitrogenous (30.63 ± 0.33 % crude protein) and iso-caloric (4757 ± 39 kcal GE/ kg diet) were formulated, fed to three aquaria for each treatment (diet). Medicinal herbs additives of three levels from marjoram (*Majorana hortensis*) or sage (*Salvia officinalis* L.) being 150, 300 and 600 mg/kg diet, respectively. The obtained results revealed that fish groups fed the low levels (150 mg/ Kg) of either marjoram or sage showed high response in final body weight, total weight gain, SGR (%/day) and RGR (%), followed by the moderate levels (300 mg/ Kg) and finally the high levels of the additives (600 mg/ Kg) compared to fish fed the control diet. Also, it is noted that herbal plant improve in feed utilization parameters of tilapia hybrid fingerlings, but it was declined when the level of herbal plant increased. Fish groups fed diets containing sage reflected high values of fat productive values (%) in the low level of additives and declined with increasing the level of sage in the diet. On the other hand, fish groups fed marjoram showed that declined FPV (%) with increasing the level of the marjoram used.

Therefore, it could be concluded that tilapia hybrid (*Oreochromis niloticus* × *Oreochromis aureus*) fingerlings achieve increasing by 150 and 300mg/ kg dietary addition of marjoram or sage herbs, respectively.

Keywords: Nile tilapia hybrid, medicinal herbs, marjoram, sage, growth performance, feed utilization.

INTRODUCTION

Medicinal herbs to use in human feeding are well known for thousands of years such as Egypt, India and China. Recently, there has been increasing interest in the use of medicinal plants, therefore, the plant kingdom has become a target for the search by multinational drug and biologically active lead compounds (Evans, 1996).

In aquaculture, there are many studies reporting a variety of substances including synthetic (Rao *et al.*, 2006), bacterial (Goetz *et al.*, 2004), animal and plant products (Ardo *et al.*, 2008) can be used as immunestimulants to enhance non-specific immune system of cultured fish species. Some medicinal plants are rich sources of compounds like volatile oils, saponins, phenolics, tannins, alkaloids, polysaccharides and polypeptides. These natural plant products have various activities like

antistress, appetizer, tonic, antimicrobial and immunostimulants (Citarasu *et al.*, 2002, 2003). Consequently, scores of plant extract have been tested and used under control of bacterial and viral diseases (Pachanawan *et al.*, 2008). In addition, many herbs have been used as spices and medicinal additives in fish (Lee *et al.*, 2001 and El-Dakar *et al.*, 2007) and shrimp (El-Dakar *et al.*, 2005) as growth promoters' substances.

Using medicinal herbs as growth promoters is becoming useful for fish feeding rather than classic chemical feed additives because of the accumulative effect of the chemical compounds which induced deterrent effects on human health (El-Dakar *et al.*, 2008). The most recent studies showed successful use of spices and natural herbs in fish nutrition including marjoram, basil, licorice roots, black seeds, peppermint, and fenugreek seeds (Abd El-Maksoud *et al.*, 2002; Abd El-Monem *et al.*, 2002; Sakr, 2003; Shalaby *et al.*, 2003; El-Dakar *et al.*, 2004a,b and Shalaby, 2004).

Among the effective spices, marjoram (*Majorana hortensis* Moench) commonly known as "sweet marjoram" is a classified of the family Lamiaceae (Labiatae). It is a perennial herb native to Cyprus and eastern Mediterranean countries (Egypt, Greeks and Romans) reported by (Tainter and Grenis, 1993). Marjoram is well known for its medicinal and insecticidal values. The plant is also reported to possess anticancer (Hartweel, 1969), antioxidant (El-Ghorab *et al.*, 2004) and antifungal properties (Pruthi, 1980).

The leaves of sage (*Salvia officinalis* L.) are well known for their anti-oxidative properties (Hohmann *et al.*, 1999), used in the food processing industry but applicable also to the area of human health (Pearson *et al.*, 1997). *Salvia officinalis* is reported to have a wide range of biological activities, such as anti-bacterial, fungistatic, virustatic, astringent, eupeptic and anti-hydrotic effects (Cherevatyî *et al.*, 1980 and Farag *et al.*, 1986). In addition, there are some reports concerning the hypoglycemic effects of sage, from the family Lamiaceae, in Iranian folk medicine (Omidbeygi, 1997 and Zargari, 1997).

The objectives of the present study aimed to evaluate the effects of marjoram and sage leaves as additions at different levels; 0, 150, 300, and 600 mg/Kg diet; into tilapia hybrid (*Oreochromis niloticus* × *Oreochromis aureus*) monosex fingerlings on growth performance, feed utilization and whole chemical of body composition.

MATERIALS AND METHODS

Experimental system and fish

The present investigation was carried out at Fish laboratory, Utilization of by-Products Department, Animal Production Research Institute, Ministry of Agriculture and Land Reclamation, Giza, Egypt. Monosex tilapia hybrid (*Oreochromis niloticus* × *Oreochromis aureus*) fingerlings with average weight approximately 1g. They were purchased from private hatchery in Kafer El Shaikh Governorate then transferred to the fish lab. They were acclimation and kept in plastic containers (500 l) with recirculated and aerated water at 22-24 °C for a this period to assess their disease-free health status during adaption to the experimental fishes to the ambient laboratory condition until

they reached a body weight of approximately 3g. During the acclimation period, the fingerlings were fed diet containing 30% CP. The fingerlings were randomly distributed in triplicates/treatment. The feeding trial was carried out in glass aquaria (60 l) through a warm water recirculating system. Dechlorinated tap water was recirculated through biological and mechanical filters. Water exchange rate for the system was approximately 10% of total volume per every day. Each aquarium was supplied with oxygen until saturation about 80%.

Experimental procedure and feeding experiment

Marjoram (*Marjorana hortensis*) and sage (*Salvia officinalis*) leaves were purchased from local market. They were cleaned, shadow dried at 25°C, grinding and the powders then kept separately in nylon bags in a deep freezer until prepared of experiment diets. Seven experimental diets were formulated to contain three levels of marjoram or sage additions to the control diet (H₁). Diets from H₂ to H₇ contained appropriate quantities 150, 300 and 600 mg/kg diet of either marjoram or sage, respectively. All tested diets formulated to be iso-nitrogenous (30.63 ± 0.33% crude protein) and iso-caloric (4757 ± 39 kcal GE/ kg diet). Formulation and proximate analysis of the experimental diets are presented in Table (1).

Table 1: Formulation and proximate analysis of the experimental diets (on %DM) fed to tilapia hybrid (*Oreochromis niloticus* × *O. aureus*) monosex fingerlings.

	Experimental diets						
	Control	Marjoram			Sage		
Ingredients (%)	H ₁	H ₂	H ₃	H ₄	H ₅	H ₆	H ₇
Yellow corn	46.75	46.60	46.45	46.15	46.60	46.45	46.15
Fish meal (72%)	22.75	22.75	22.75	22.75	22.75	22.75	22.75
Soybean meal (40 %)	24.00	24.00	24.00	24.00	24.00	24.00	24.00
Corn oil	3.50	3.50	3.50	3.50	3.50	3.50	3.50
Dried yeast	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Vit. & Min. mixture*	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Marjoram	-	0.15	0.30	0.60	-	-	-
Sage	-	-	-	-	0.15	0.30	0.60
Total	100	100	100	100	100	100	100
Proximate analysis (%)							
Dry matter (DM)	93.83	93.07	92.39	93.09	91.70	92.30	92.32
Crude protein (CP)	30.66	30.36	30.36	30.55	30.94	30.65	30.87
Ether extract (EE)	9.89	10.39	9.61	10.56	10.24	10.53	11.02
Crude fiber (CF)	2.45	1.67	1.24	1.51	2.09	1.21	1.37
Ash	7.71	6.95	7.24	7.62	7.09	8.38	7.86
NFE**	49.29	50.63	51.55	49.76	49.64	49.23	48.88
GE (Kcal/Kg) ***	4737	4789	4735	4714	4785	4744	4796
C/P ratio	154.50	157.74	155.96	154.30	154.65	154.78	155.36

* Contains per kg: vitamin A, 4.8 m. I.U; vit D3 , 0.8 m.I.U; vit E, 4.0 g; vit. K, 0.8 g; vit B1, 0.49, vit. B2, 1.6 g; vit. B6, 0.6 g; vit. B12, 4 mg; Pantothenic acid 4 g; Nicotinc acid 8 g; Folic acid, 400 mg; Biotin, 20 mg; Choline chloride, 200 mg; Copper, 4.0 g ; Iodine, 0.4g ; Iron, 12 mg ; Manganese, 22 g; Zinc 22 g and Selenium 0.04 g.

** Calculated by difference.

*** Gross energy was calculated using the factors 5.65, 9.45, 4.0 and 4.0 (Cal GE/g DM) for crude protein, ether extract, crud fiber and nitrogen free extract, respectively (Jobling, 1983).

Before starting the experiment, taken 50 fingerlings from the population as sampled for determination of initial body proximate composition. At the beginning of the experiment, fish were individually weighed thereafter, they were bulk, weighed weekly and the feed amounts were adjusted for the subsequent week.

The average body weight of hybrid tilapia (*Oreochromis niloticus* × *Oreochromis aureus*) was 3.03 g. The fish were divided into seven treatments (H₁ to H₇), each treatments contained three replicates (15 fingerlings in each replicate). During the experimental period, the fish were fed with their respective diets at a rate of 3% of their body mass per day. The daily ration was subdivided into two amounts at 0900 and 1600 hrs. A record was kept of the amount of feed consumed by the fish in each aquarium. The experimental period was 90 days. At the end, the experimental fish were sacrificed and kept at -20 °C until analyzed for body composition as whole.

Sampling and analytical procedures:

All fish were weighed at the start of trial. Whole body composition was determined in a pooled sample of 50 fish at the beginning and in pools of 8 fish per replicate at the end of the growth trial. The experimental diets and the fish carcass at the beginning and the end of the experiment were analyzed for proximate composition according to methods of A.O.A.C (2000). Gross energy (GE) contents of all samples were calculated according to Jobling (1983) using the multiplication factors of 4.0; 5.65 and 9.45 cal GE/g for carbohydrate; protein and fat, respectively. Growth indexes were calculated as follows formulations:

- Total Weight gain (WG, g)=final body weight (g)-initial body weight (g);
- Relative growth rate (RGR, %) =100×[final body weight (g)-initial body weight (g)]/ initial body weight (g);
- Specific growth rate (SGR) (% /day) =100 ×[ln final body weight (g)-ln initial body weight (g)]/ time of trial (days);
- Feed intake (FI, g/fish) = Total dry matter feed consumed;
- Feed conversion ratio (FCR) = feed intake (g)/weight gain (g);
- Protein efficiency ratio (PER) = weight gain (g)/protein intake (g);
- Protein productive value (PPV, %) = 100× [Retained protein (g) /protein intake (g)];
- Fat productive value (FPV, %) = 100× [Retained fat (g) /fat intake (g)];
- Energy utilization (EU, %) = 100× [Retained energy (g)/ energy intake (kcal)].

Water quality

Temperature and oxygen concentration were measured daily, while pH and the concentrations of total ammonium nitrogen (TAN =NH₄⁺ - N+NH₃-N) and nitrite-nitrogen NO₂-N were determined weekly. Water temperature was maintained at 24.1 ± 1°C. The oxygen concentration at the aquaria outflows did not drop below 4.6 mg L⁻¹ and was measured by using Oxygen meter (Jan way model 9071). The total concentrations of ammonia-nitrogen and nitrite-nitrogen at the outflow of the rearing aquaria did not exceed 0.30 mg TAN L⁻¹ or 0.02 mg NO₂-N L⁻¹, respectively. Water pH ranged from 7.9 to

8.3. The pH and water temperature values were determined by digital temperature and pH meter (Orion model 720A, S/No 13062). The previous analytical methods were done according to American Public Health Association (APHA, 1992). During the study, but averages were within acceptable limits for tilapia fish growth and health (Boyd, 1990).

Statistical analysis:

Biological data obtained from the trial were expressed as mean \pm S.E and subjected to statistical evaluation using one-way analysis of variance (ANOVA) of the general liner model (GLM) using (SAS, 2002) statistical package. Means with significantly different ($P < 0.05$) were compared with Duncan's Multiple Range test (1955).

RESULTS AND DISCUSSION

Data on the growth performance of tilapia hybrid, including initial body weight (IBW), final body weight (FBW), total weight gain (WG), relative growth rate (RGR) and specific growth rate (SGR) are shown in Table (2). These parameters in fish treatments fed diets supplemented with herbs were significantly higher than fish fed the control diet. Within the type of the herbal plants, as the level of herbal plant increased in the diets, the positive effects in treatments decreased. Meanwhile, fish fed diet contained 150 mg/Kg sage (H_5) showed higher values ($P > 0.05$) in the growth parameters compared with that contained 300 mg/Kg sage (H_6) and those fed marjoram diets or significant of diet contained 600 mg/Kg sage (H_7).

Table 2: Growth performance of tilapia hybrid (*Oreochromis niloticus* \times *O. aureus*) fingerlings fed the experimental diets (Mean \pm SE).

Item	Experimental diets						
	Control	Marjoram			Sage		
	H ₁	H ₂	H ₃	H ₄	H ₅	H ₆	H ₇
Initial body weight, IBW (g/fish)	3.03 ± 0.01	3.03 ± 0.01	3.04 ± 0.02	3.01 $0.01 \pm$	3.02 $0.01 \pm$	3.03 $0.02 \pm$	3.02 $0.02 \pm$
Final body weight, FBW (g/fish)	12.19 ^c ± 0.08	14.83 ^{ab} ± 0.48	14.19 ^{ab} ± 0.76	14.01 ^{ab} ± 0.64	15.12 ^a ± 0.70	14.64 ^{ab} ± 0.10	13.37 ^{bc} ± 0.24
Total weight gain, WG (g/fish)	9.16 ^c ± 0.08	11.80 ^{ab} ± 0.46	11.15 ^{ab} ± 0.77	11.00 ^{ab} ± 0.64	12.10 ^a ± 0.71	11.61 ^{ab} ± 0.09	10.35 ^{bc} ± 0.24
Relative growth rate, RGR (%)	302 ^c ± 2.88	389 ^{ab} ± 13.87	367 ^{ab} ± 25.54	365 ^{ab} ± 20.98	401 ^a ± 24.43	383 ^{ab} ± 2.58	343 ^{bc} ± 8.59
Specific growth rate, SGR (%/day)	1.55 ^c ± 0.01	1.77 ^{ab} ± 0.03	1.71 ^{ab} ± 0.06	1.71 ^{ab} ± 0.05	1.79 ^a ± 0.05	1.75 ^{ab} ± 0.01	1.65 ^{bc} ± 0.02

Within a raw, values with different superscripts are significantly different ($P < 0.05$).

The results of the present study investigated that some medicinal herbs can be effective immunostimulators (e.g. *Artemisia capillaries*, *Astragalus radix*, *Massa medicata fermentata*, *Scutellaria radix*). Their effectiveness has been demonstrated in the rearing of aquatic animals such as shrimps and fish (Dügenci *et al.* 2003; Jian and Wu 2004 and Yin *et al.*, 2006). Moreover, some studies have confirmed that the application of a diet

with herbal adjuncts has a positive impact on the health and resistance of the fish, and also improves their conditions and growth rate (Lee *et al.*, 2001; Jian and Wu 2004 and Sivaram *et al.*, 2004). Abd El-Maksoud *et al.* (1999) observed that the highest weight gain of Nile tilapia (*Oreochromis niloticus*) fingerlings was obtained when fed with 3% marjoram leaves of the total diet. This also resulted in the best protein and energy utilizations apart from having a significant effect on body composition. On the contrary, results obtained by Abd El-Maksoud *et al.* (2002) demonstrated that Nile tilapia (*Oreochromis niloticus*) fingerlings fed diets contained 0.5-1% of chamomile flowers, Nigel seed or marjoram leaves alone showed lower performance than the control group. The differentiation between the mentioned experiment before and the present study may contribute to fish species and the levels of herbal plants tested.

Results of Table (3) showed in general significant effects ($P < 0.05$) on feed utilization of tilapia hybrid fingerlings when herbal plants were added to the control diet. Fish groups fed herbal plants additives showed higher feed intake, except group fed diet H₇, than the control diet. The improvements in feed intake were indicated significantly ($P < 0.05$) in fish treatments fed diets supplemented at level of 150 mg/Kg of both marjoram or sage (H₂ & H₅), respectively compared to the control group fed diet without herbal plants additives. It is noted that within the type of herbal plant, the improvement was declined when the level of herbal plant increased. In this respect, according to Mabey (1988) marjoram contains tonic and astringent bitter principles, which rouse the appetite and hence it is helpful for invalids. Sage herb when used in large amounts causes nervous irritation, convulsions and death. Hence its use is prohibited in known epileptic conditions. However, some reports suggest the toxicity and carcinogenicity of herbal reactive metabolites and/or intermediates that arise through internal metabolism.

Table 3: Feed utilization of tilapia hybrid (*Oreochromis niloticus* × *O. aureus*) fingerlings fed the experimental diets (Mean ± SE).

Item	Experimental diets						
	Control	Marjoram			Sage		
	H ₁	H ₂	H ₃	H ₄	H ₅	H ₆	H ₇
Feed intake, FI (g/fish)	15.22 ^{bc} ±0.12	16.30 ^a ±0.03	16.11 ^{ab} ±0.46	15.77 ^{ab} ±0.31	16.27 ^a ±0.45	15.73 ^{ab} ±0.19	14.78 ^c ±0.19
Feed conversion ratio (FCR)	1.66 ^b ±0.00	1.38 ^a ±0.05	1.45 ^a ±0.06	1.43 ^a ±0.05	1.35 ^a ±0.04	1.36 ^a ±0.01	1.43 ^a ±0.01
Protein efficiency ratio (PER)	1.96 ^b ±0.00	2.38 ^a ±0.09	2.28 ^a ±0.09	2.28 ^a ±0.09	2.41 ^a ±0.08	2.41 ^a ±0.01	2.27 ^a ±0.02
Protein productive value (PPV %)	19.70 ^b ±0.02	29.90 ^a ±0.86	28.63 ^a ±2.40	30.29 ^a ±1.43	32.01 ^a ±0.87	30.50 ^a ±0.29	29.83 ^a ±0.26
Fat productive value (FPV %)	21.59 ^d ±0.02	36.57 ^c ±0.85	37.42 ^{bc} ±1.36	40.60 ^{ab} ±1.39	44.73 ^a ±1.09	36.15 ^{bc} ±0.53	35.95 ^c ±3.55
Energy utilization (EU %)	11.50 ^c ±0.01	18.48 ^b ±0.50	17.94 ^b ±1.15	19.83 ^{ab} ±0.82	20.88 ^a ±0.55	19.22 ^{ab} ±0.22	20.35 ^a ±0.87

Within a row, values with different superscripts are significantly different ($P < 0.05$).

Feed conversion ratio (FCR) and protein efficiency ratio (PER) were affected, in the same trend, by the herbal additives. Best FCR and highest

PER were observed ($P>0.05$) for fish groups fed 150, 300 mg/Kg sage (H_5 & H_6) and 150 mg/Kg marjoram (H_2), respectively. Protein productive values (PPV%) were also affected by the feed additives, where H_5 and H_6 followed by H_4 revealed the highest figures compared with the control diet. Highest results of fat productive value (FPV%) were obtained in fish groups fed diet H_5 (sage) followed by those fed H_4 (marjoram). However, fish groups fed all levels of sage and the highest level of marjoram (H_4) showed the best improvement in energy utilization, EU ($P>0.05$) compared to fish group fed (H_1). It has been suggested that the herbal plants can improve the metabolism of fats and their utilization parameters (Jeong *et al.*, 2007 and Takaoka *et al.*, 2007). High antioxidant activity was also recognized in medicinal plants which contain polyphenols that protect and reduce cellular damage by various radicals. It is also reasonable that antioxidants in herbs contribute to the activation of immune functions for various pathogens in fish. Immunostimulating activities of herbs has been reported in other fish, such as tiger shrimp, Japanese flounder (Jeong *et al.*, 2007), yellow croaker *Pseudoscianena crocea* (Jian and Wu, 2003) and greasy grouper (Sivaram *et al.*, 2004).

Another factor that may impact the effectiveness of the herbal adjuvant as a growth stimulant might also be the period in which the supplemented diet is applied (Dügenci *et al.*, 2003; Jian and Wu 2004 and Yin *et al.*, 2006). With carp weighed 100g the improvement in growth rate was confirmed after 30 days of the herbal supplemented diet.

The results of proximate analysis of whole body of tilapia hybrid for dry matter, protein, ether extract, ash and gross energy at the end of the study are shown in Table (4). Dry matter content was increased significantly in marjoram or sage diets than control diet, while ash content was decreased ($P<0.05$). The protein contents in fish body were affected negatively by additive levels of herbal plants compared with control group.

Table 4: Whole body composition (%DM) of tilapia hybrid (*Oreochromis niloticus* × *O. aureus*) fingerlings at the end of experiment (Mean ± SE).

Item	Experimental diets						
	Control	Marjoram			Sage		
	H ₁	H ₂	H ₃	H ₄	H ₅	H ₆	H ₇
Dry matter (DM%)	17.87 ^d ±0.01	22.18 ^c ±0.08	22.34 ^{bc} ±0.58	24.41 ^a ±0.16	23.97 ^a ±0.25	23.01 ^b ±0.07	22.91 ^{bc} ±0.03
Crude protein (CP%)	52.11 ^a ±0.01	51.51 ^{abc} ±0.44	51.26 ^{abc} ±0.91	49.06 ^d ±0.29	50.41 ^{bcd} ±0.61	50.01 ^{cd} ±0.48	51.74 ^{ab} ±0.03
Ether extract (EE%)	18.46 ^d ±0.01	21.10 ^{abc} ±0.23	20.87 ^{abc} ±0.48	22.05 ^{ab} ±0.09	22.73 ^a ±0.25	20.10 ^{bcd} ±0.29	19.70 ^{cd} ±1.73
Ash (%)	27.31 ^a ±0.01	24.30 ^e ±0.29	24.55 ^{de} ±0.09	25.65 ^{bc} ±0.03	24.85 ^{de} ±0.14	25.83 ^b ±0.34	25.10 ^{cd} ±0.12
Gross energy (Kcal GE/kg)	4774 ^b ±1.20	5028 ^{ab} ±31.32	5001 ^{ab} ±7.65	4985 ^{ab} ±1.11	5076 ^a ±17.65	4887 ^b ±25.29	4923 ^{ab} ±89.21

Within a raw, values with different superscripts are significantly different ($P < 0.05$).

* Fish analysis before beginning the experiment were: DM, 13.97%; CP, 52.03%; EE, 18.11%; A

Fish group fed diet H₄ showed the lowest protein content in its whole body composition. On the other hand, ether extract and GE contents in whole fish body at the end of the experiment were significantly increased in diets contained the tested herbal plants.

The present results are in accordance with the experiments conducted by (Zakęś *et al.*, 2001 and 2004). They obtained that, the addition of herbal supplements to commercial feed could potentially be advantageous especially in species that are less effective at assimilating high-caloric commercial feeds and that store energy as fat, especially in the viscera, such as pikeperch (*Sander lucioperca*, L.). On the other hand, in studies suggesting a growth-promoting effect of herbal adjuvant no differences were noted in the proximate composition of the fish bodies (Jeong *et al.*, 2007 and Takaoka *et al.*, 2007). Although results of Zakęś *et al.* (2008) did not suggest that the herbal adjuvants (*Astragalus radix* and *Lonicera japonica*) had a significant impact on the growth rate of juvenile pikeperch (*Sander lucioperca* L.) fish, the protein content of the fish from the dietary group fed both of the herbs was significantly higher than in the treatments fed diets supplemented with just one herb or the control group. Also, they obtained that, the herbs did not have a significant impact on the fat content in the whole fish body, such an effect was noted in the proximate composition of the viscera. On the same trend, feeding fish diets with herbal adjuvants can improve the lipid metabolism (Jeong *et al.*, 2007) as fat is more effectively utilized as a source of energy, which means that protein ingested with the diets can be used more effectively for somatic growth.

Conclusion

According to the results obtained from the present study, it could be concluded that tilapia hybrid (*Oreochromis niloticus* × *Oreochromis aureus*) monosex fingerlings achieve increased weight gain, feed efficiency, and protein content in whole body composition by 150 and 300 mg/ kg dietary additives of marjoram or sage herbs

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تأثير إضافة البردقوش أو المرمرية على أداء النمو و الإستفادة الغذائية على إصبعيات هجين البلطي (بلطي نيلي x بلطي أورلي) وحيد الجنس. خالد فهمي الخولي

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اجريت تجربة تغذية لتوضيح إستجابة أصبعيات هجين البلطي (البلطي النيلي x البلطي الأورلي) وحيدة الجنس لإضافة بعض النباتات الطبية باستخدام قياسات النمو وكفاءة الإستفادة الغذائية. استخدم سبع مجاميع من أصبعيات هجين البلطي (45 أصبعية لكل مجموعة، بوزن بداية $3,03 \pm 0,01$ جرام) فى تجربة استمرت 90 يوم تحت النظام المغلق. تم تركيب سبعة علائق متشابهة تقريبا فى محتواها من النيتروجين (30% بروتين خام) والطاقة (39 ± 4757 كيلو كالورى طاقة كلية/كجم عليقة) وغذيت عليها المعاملات (ثلاثة مكررات لكل معاملة). أضيفت أوراق البردقوش أو المرمرية الجافة الى العليقة المقارنة بمستويات (150 و 300 و 600 ملجم/كجم عليقة).

أظهرت النتائج أن مجموعات الاسماك المغذاة على مستويات منخفضة (150 ملجم/كجم) من كل من البردقوش أو المرمرية سجلت استجابة عالية في وزن الجسم النهائي، الزيادة الكلية فى الوزن، معدل النمو النسبى ومعامل النمو النسبى تليها المستويات المتوسطة (300 ملجم/كجم) وأخيرا المستويات العالية (600 ملجم/كجم) من النباتات الطبية المضافة مقارنة بمجموعة الاسماك التى تغذت على العليقة المقارنة.

من الملاحظ أن الإستفادة من الغذاء لإصبعيات البلطي الهجين تقل بزيادة مستوى الإضافة داخل مستويات كل نبات، كما أظهرت مجموعات الاسماك التى تغذت على مستويات منخفضة من المرمرية استجابة عالية فى القيم الإنتاجية للدهون وتقل الإستجابة تدريجيا مع زيادة مستوى الإضافة. على الجانب الأخر أظهرت الاسماك المغذاة على عليقة تحتوى على مستويات مرتفعة من البردقوش انخفاض فى القيم الإنتاجية للدهون.

لذا يوصى بإضافة 150 أو 300 ملجم / كجم من اوراق البردقوش أو المرمرية إلى علائق
إصبعيات هجين البلطي (بلطي نيلي x بلطي أورلي) وحيد الجنس.

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