Effects of *Zingiber officinale* powder on growth parameters, survival rate and biochemical composition of body in juvenile common carp (*Cyprinus carpio*)

Abbasi Ghadikolaei H.[1]; Kamali A.[1*]; Soltani M.[2]; Sharifian M.[3]

Received: October 2015 Accepted: December 2015

Abstract

This study was conducted with different levels (0, 0.25, 0.5,1,2 g) of *Zingiber officinale* powder per 100 g of common carp commercial diet. Feed was offered for 8 weeks by the post pelleting liquid spraying method. Results showed that there were significant differences in all growth parameters and body composition except in survival rate, Gain Weight Percent (GW%) ,SGR and NFE between treatments (p<0.05). Significant differences were also detected in GW % between control group and the last two treatments but there were no significant differences in SGR index between control group and the group fed diets containing 2 g ginger/per100g diet (p<0.05). No significant differences were observed in their length, growth, survival rate as well as NFE (p>0.05). Also, Kruskall-Wallis test found significant difference in the amount of carbohydrate and body fiber (p<0.05). The best results for growth performance, protein, lipid, and energy were found in the group fed maximum dosage of ginger powder in carp commercial diet and lowest values for these parameters were seen in the control group. Additionally, there were high amount of carbohydrate and low amount of fiber in this group. Higher level of ash was reported in the third treatment. We may therefore conclude that using *Z. officinale* at higher levels can be an efficacious medicine to improve quality and quantity of juvenile *Cyprinus carpio* growth and muscle.

Keywords: *Zingiber officinale*, *Cyprinus carpio*, Growth parameters, Body composition, Survival rate.

1- Department of Fisheries, College of Agriculture Tehran Science and Research Branch, Islamic Azad University, Tehran, Iran. P.O.Box:14515-775.

2- Department of Aquatic Animal Health, Faculty of Veterinary Medicine, University of Tehran, Tehran. Iran. P.O. Box: 14155-6453.

3-Iranian Fisheries Science Research Institute, Agriculture Research Education and Extension Organization, Tehran. Iran. P.O. Box: 14965/149.

***** Corresponding author's Email: kamali.abolghasem@gmail.com

Introduction

Medicinal plants have different activities such as antistress, growth promotion, appetite stimulation, immunostimulation, aphrodisiac and antimicrobial properties due to the active principles such as alkaloids, flavanoids pigments, phenolics, terpenoids, steroids and essential oils (Kumar Bairwa *et al*., 2012). Since many of their derivatives are known as growth stimulants and/or immunostimulant agents, the use of these compounds has increased in finfish and shellfish diet in recent decades (Banaee, 2010; Banaee *et al*., 2011; Ahmadi *et al*., 2012; Asadi *et al*., 2012). Dietary usage of 0.5g ginger /110g diet of *Orechromis mozambicus* had a significant increase in growth indices (Kumar Bairwa *et al*., 2012). Echinacea and *Allium sativum* in *O. niloticus* diet improve their gain weight and using 1% fennel (*Foeniculum vulgare*) improved fish growth performance (Abd El-Hakim *et al.*, 2010; Alay and Mohamed, 2010). Also, Similar results were observed in common carp, guppy (*Poecilia reticulate*), convict cichlid (*Cryptoheros nigrofasciatus*), red seabream (*Pagrus major)* olive flounder (*Paralichthys olivaceus*), Nile tilapia, *Oreochromis niloticus* and *O. aureus* (Pham *et al.*, 2006; Turan, 2006; Yilmaz *et al*., 2006; Cek *et al*., 2007a; Cek *et al*., 2007b; Ji *et al*., 2007; Salah *et al.*, 2008; Metwally, 2009) and *Oncorhynchus mykiss* (Nya and Austin, 2009; Bohlouli Oskoii *et al.*, 2012), zander, *Sander lucioperca* (Zakes *et al*., 2008) which were fed diets supplemented with plants. In the aquaculture sector, the use of medicinal plants (phytochemicals) has increased significantly over the past decade for different purposes such as sex reversal compound Gholipour *et al,* 2011), growth enhancer (Turan and Akyurt, 2005; Banaee, 2010; Banaee *et al*., 2011; Ahmadi *et al*., 2012; Asadi *et al.*, 2012), immunostimulant, and antipathogenic (Yılmaz *et al.*, 2013a).One of the relatively new practiced ways to improve health conditions for cultivated aquatic organisms is using a medicinal herb as an immunostimulator or growth enhancer (Citarasu, 2010). Several such herbal components as flowers, leaves, seeds and roots from different plant species have been shown to enhance growth, non-specific immune response as well as survival rates of such cultivated species as African catfish, *Clarias gariepinus* (Dada and Ikuerowo, 2009 and Soosean *et al.*, 2010), tilapia *Orechromis mossambicus* (Immanuel *et al.*, 2009) and common carp, *Cyprinus carpio* (Alishahi *et al.*, 2010; Pakravan *et al.*, 2012; Fallahpour *et al*., 2014). Ginger *Z. officinalis* is generally considered as a safe herbal medicine and perennial herbaceous plant is a part of the *Zingiberaceae* family (Weidner and Sigwart, 2000).In ginger roots a compound known as a carminative, diuretic, tonic and disinfectant contains glucosinolate, sterols and triterpenes (Al-Yahya, 1986). They are polyphenol compounds (6-gingerol, shogaols and zingerone,

alkaloids, flavonoids, polyphenols, saponin, steroids, tannin, fiber, carbohydrate, vitamins, carotenoids and minerals), which have a high antioxidant activity (Hori *et al.*, 2003; Otunola *et al*., 2010; Shirin and Prakash, 2010). Their essential oils have anti-inflammatory and oleoresin effects (Zarate and Yeoman, 1996). Ginger is among the spices with reported antiplatelet, antibacterial, antifungal, antiviral, antiworm, anti-inflammatory, and anti-oxidative activities, that have effects on gastrointestinal, cardiovascular systems, as well as antilipidemic and antihyperglycemic, anti-tumor properties and is known to be effective as an immuno-modulatory agent in human and animals, including fish (Nya and Austin, 2009; Apines-Amar *et al*., 2012; Talpur *et al*., 2013). Supplementing ginger in fish diets may enhance term growth and will signify change in magnitude and their body composition (Talpur *et al*., 2013). The variable undergoing change may be the length or other physical dimensions, including volume, weight, or mass either of the whole body of an organism or its various tissues or it may relate to lipids, protein content, or other chemical constituents of the body. Growth may also relate to the change in the number of animals in a population (Weatherly and Gill, 1987). Body composition is a good indicator of the physiological condition of a fish but it is relatively time consuming to measure. Proximate body composition is the analysis of water, fat, protein and ash contents of fish. Carbohydrates and non-protein compounds are present in negligible amounts and are usually ignored for routine analysis (Cui and Wootton, 1988).The percentage of water is a good indicator of its relative contents of energy, proteins and lipids (Weatherly and Gill, 1987).The lower percentage of water causes an increase in the lipids and protein contents and higher energy density of the fish (Dempson, *et al*., 2004). However, these values were varying considerably within and between species, size, sexual condition, feeding season and physical activity. (Toko *et al.*, 2008). Protein content, which is an important component, tends to vary little in healthy fish (Weatherly and Gills, 1987). Hence, the present study was aimed at evaluating the long-term (60 days) effects of dietary inclusion of *Z. officinale* powder on weight growth performance, survival rate and carcass quality of common carp juveniles.

Materials and methods

Fish: A total number of 180f Juvenile *C. carpio* (27±3g and 7±2cm) were introduced in 15 aquaria (120×40×40cm) containing water at 22±4°C temperature, 7.5±0.5 pH, 8.7±0.3ppm DO, 0.3±0.01ppm, NO_2, 5±0.01ppm NO_3, 0.5±0.01ppm NH_4, 150±50ppm TH quality. Water in the aquaria was renewed daily at a rate of 20% water volume for two months from Spring 2015.

Feed preparation and feeding trial

Fresh rhizome of ginger (*Z. officinale*) was purchased from the herbalists shop and authenticated by a botanist from Institute of Medicinal Plants, Tehran University. The plant was dried in the shade. The dried rhizome was crushed into powdered form mechanically and was sieved using a household sifter (2mm), then mixed directly with EX-CG2 fish diet (Beyza Feed Mill, Shiraz, Iran) with 1% canola oil the rate of (0, 0.25 (T_1), 0.5 (T_2), 1 (T_3) and 2 (T_4) g Ginger powder/ per100 g commercial diet using the post pelleting liquid spraying method for weekly usage (Haghighi and Sharifrohani, 2013). The fish were fed the experimental diet at the rate of 3% of their body weight twice a day for two months (Table 1).

Table1: EX-CG2 fish diet Nutrition matter.

Energy (kcal)	3500
Crude Protein%	35-37
Crude Lipid%	9-11
Crude Fiber%(max)	5
Moisture%	<10
Ash%(max)	<10

At the end of the experimental period six fish from each tank were sampled and anaesthetized by using 1g clove powder in 10 liter water (100 ppm) (Alishahi *et al*., 2010). The levels of the given feeds were readjusted every 10 days. Final weight (g), Mean Weight Gain (MWG, g), Specific Growth Rate (SGR, %day-1), Average Daily Growth rate (ADG, g day-1), Growth length and final length (mm) and survival rate were estimated according to (Ronyai *et al*., 1990; Ai *et al*., 2006; Soosean *et al*., 2010) as follows:

1. MWG= (Mean final weight–Mean initial weight).
2. GW %=(Mean final weight- Mean initial weight)/ (mean initial weight)×100.
3. *SGR (% day-1) = 100×[(lnW1 – ln W0)/t]*, where *W0* and *W1* are the average initial and final body weights, respectively, and (t) time(days);
4. ADG (g day-1) = Growth/ Experimental duration,
5. GL= (final length- initial length),
6. SR = (Nf / Ni) × 100; where NF= final number of fish stock, Ni= Initial number of fish stock.

For carcass analysis, three fish from each tank were sampled 24 h after the last feeding (Nafisibahabadi *et al*., 2014) and anaesthetized using clove powder (100 ppm) (Alishahi *et al*., 2010).Then chemical compositions of whole body (moisture, protein, lipid, ash, fiber, carbohydrate, and NFE (Nitrogen Free Extraction) and Energy) of the sampled fish were determined following the Association of Official Analytical Chemists (AOAC) methods (AOAC, 2000). Moisture was determined by drying in oven (Binder, Tuttlingen, Germany), at 105˚C for 24 h (Sidhu, 2003). Crude protein was determined by using a Kjeldal system (Gerhardt, type VAP.40, Konigswinter, Germany). A conversion factor of 6.25 was used to convert total nitrogen to crude protein for all varieties of fish (Ritzmann and Daniels, 1975). Crude lipid was determined with ether

extraction in a Soxhlet extractor (Gerhardt, type SE-416) (Folch *et al.*, 1957). Ash was determined using a mu\e furnace (Nabertherm, Lilienthal, Germany), at 550˚C for 8h (Bligh and Dyer, 1959). There is no single method suitable for determining total carbohydrate in all tissues and, apart from the indirect infrared method mentioned earlier under protein, the methods are not straightforward (AOAC, 2000). For these reasons it is common to estimate carbohydrate as: C(%) =100-(P-W-F-A) (AOAC, 2000). In this formula: P: percentage of protein= (N×6.25), W: water percentage, F: fat percentage and A is Ash percentage (AOAC, 2000).For fiber percentage content in the first stage samples digested in sulfuric acid and sodium hydroxide solutions and the residue calcined (AOAC, 2000; Sidhu, 2003). The difference in weight after calcinations indicates the quantity of fiber present by (weight of crucible with dry residue (g) - weight of crucible with ash (g))/(weight of sample (g))×100 (Jafari Khorshidi, 2004). Assuming to this point all matters in filet are 100% NFE measured by: 100-(crude fiber%+ Ash%+ Moisture%+ Crude lipid%+ crude protein %) and total kcal energy calculated by 10× (5.5×amount of filet protein) + (9.1× amount of filet lipid) + (NFE×4.1) (Jafari Khorshidi, 2004).

Statistical Analysis

Statistical analysis was performed through the Shapiro-Wilk test for data normalization. Then, if data was normal one way ANOVA and Duncan Multiple Range Test was used, (DMRT) at 5% significance level to comparison tests. But, when the data was not normal Kruskal-Wallis and Man Whitney U test was conducted to compare the significant differences among the groups by SPSS Ver.18 (Duncan, 1955). Then values were presented as Mean±SD.

Results

No mortality was observed throughout the experimental period with the survival rate being the same within all the treatments (100%) (Table 2). This table showed that the factors of: final weight (80.74±33 and 48.1±16 g, respectively) and mean weight gain (16.65±5.3g and7.8±2.2g, respectively) were significantly the highest in fish in the fourth treatment compared with control group. Also, the highest GW% demonstrated in the fourth treatment (27.6±4.3 and 18.9±1.69, respectively) as compared with control group. So Mann-Whitney U test determined significant difference between the control group and T3 and T4. In ADG % and final length (mm) results showed significant difference between treatments and like other growth factors, fish in the fourth treatment had the maximum level (p<0.05; Table 1).

Table2: Growth parameters in juvenile *Cyprinus carpio*, fed ginger powder in diet for 8 weeks.

Factors	Control	(T1)	(T2)	(T3)	(T4)
Mean Final weight$^{(ns)}$	48.1±16	52.2±17.5	63.1±22.6	69.4±25.4	80.7±33
Mean Weight Gain	7.8±2.2^{c}	9.2±3.3^{bc}	11.9±2.3^{ab}	12.9±4^{ab}	16.65±5.3^{a}
Weight Gain %	18.9±1.69	22.3±5.8	26.2±11	23.7±3.6	27.6±4.3
ADG	78.6±22.2^{c}	92.8±32.9^{bc}	118.8±23.7^{bc}	129.4±40.4^{ab}	166.5±53.4^{a}
SGR	1.8±0.19	1.96±0.49	2.2±0.82	2.15±0.3	2.43±0.35
Final length(mm)	107.7±4.5^{c}	129.4±26.5^{bc}	142.5±31.1^{ab}	161.5±30.8^{ab}	178.5±32.8^{a}
Length growth(mm)$^{(ns)}$	11.1±4.5	15.9±5.4	15.9±3	19.3±7.7	23.2±14.5
Survival rate%	100^{a}	100^{a}	100^{a}	100^{a}	100^{a}

Values are expressed as Mean±SD. Means with the different letters in the same row are significantly different (p< 0.05).ns: no significant difference.

Table 3: Amount of some nutrients in *Cyprinus carpio* body composition.

Indexes	Control group	0.25g/100g diet(T1)	0.5g/100g diet(T2)	1g/100g diet(T3)	2g/100g diet(T4)
Carbohydrate %	1.61±0.01	0.87±0.02	1.1±0.02	1.21±0.01	0.97±0.0
Fiber%	0.11±0.01	0.48±0.02	0.51±0.01	0.31±0.03	0.38±0.04
NFE%	1.5±0.05	0.39±0.01	0.6±0.2	0.57±0.41	0.59±0.04

SGR and growth length values in the control group were low. but increased in other groups with the highest values in the fourth treatment .According to Table 2, there were significant differences (p<0.05) in SGR values between this group and the control group. However, there were significant differences (p>0.05) in growth length index. All growth factors in control group were the lowest (Table 2).

As shown in Table3 there were significant differences between the control group and other treatment groups by Kruskal-Wallis (Man Whitney-U test) in the amount of carbohydrate and fiber (p<0.05). There were significant differences between (T1) and other groups in amount of carbohydrate and between T3 and T4 in amount of fiber (p<0.05). Also, these were significant differences between T2 and two groups T3 and T4 in the amount of carbohydrate and fiber. There is a significant difference between (T3) and (T4) in carbohydrate levels too (p<0.05). Furthermore, this test showed significant differences (p>0.05) in amount of NFE between treatments. The highest level of carbohydrate, and NFE and the lowest level of fiber were seen in the control group. the lowest level of carbohydrate was observed in T4 and the lowest level of fiber level was recorded in T2. Similarly the lowest level of NFE was found in T1.There were significant difference between treatments in amount of protein, lipid, ash, moisture and kcal energy (p<0.05). The best levels of protein (18.92±0.02%), lipid (2.33±0.03%) were recorded in T4 and the lowest levels belonged to the control group (Fig. 1).

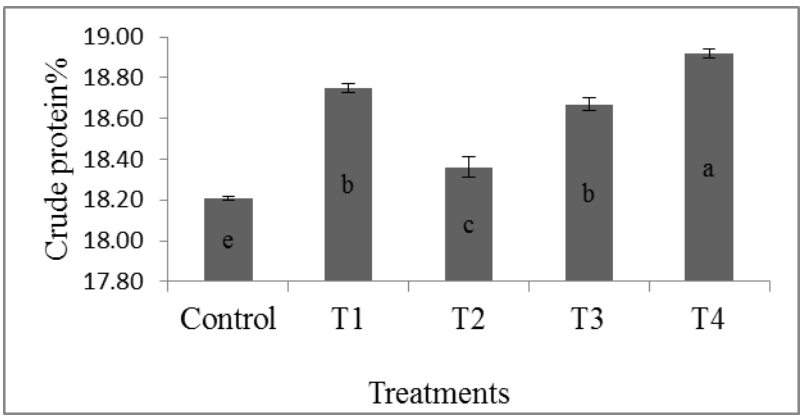

Figure1: Crude protein content (Mean±SD) in *Cyprinus carpio*.

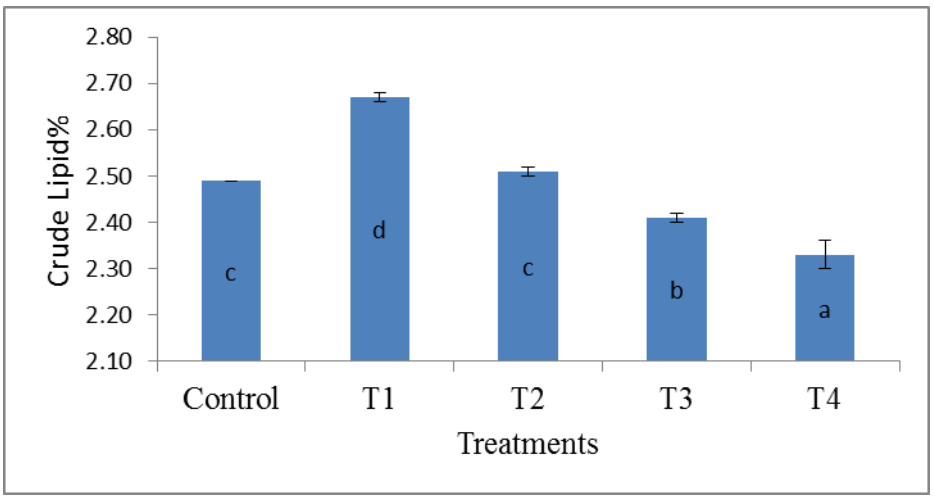

Figure 2: Crude lipid content (Mean±SD) in *Cyprinus carpio*.

Also, the highest level of energy (1064.2±4.00 Kcal) and ideal moisture level (75.13±0.03%) belonged to T4, but the lowest levels of these factors were found in the control group (Figs. 3 and 4).

As shown in Fig. 5 T_2 had the highest level of ash, while the control group showed the lowest level (2.81±0.01% and 2.36±0.01%, respectively).

Based on carp muscle nutrients *Z. officinale* powder in their commercial diets resulted in improving their body composition. It was also responsible for an increase in protein and a decrease in the lipid level in their filet consumers.

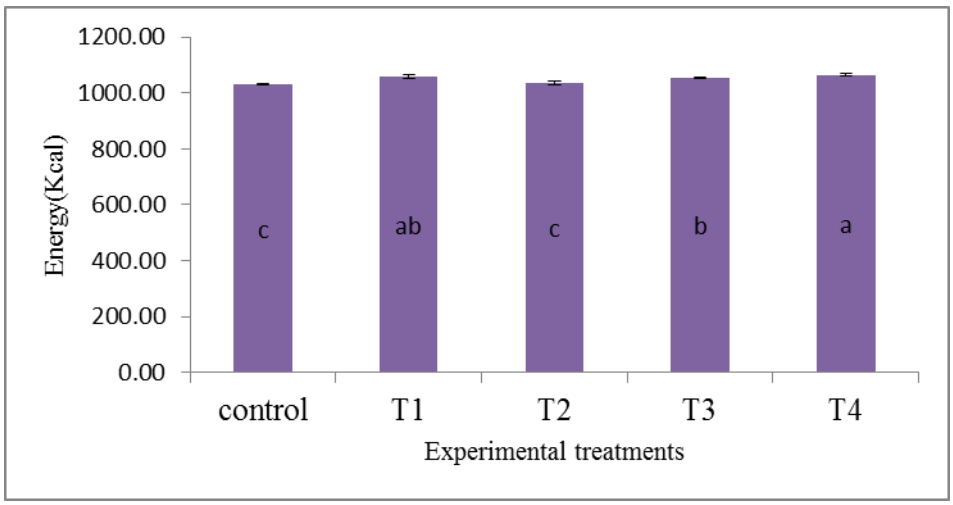

Figure 3: Kilocalorie of Energy content (Mean±SD) in *Cyprinus carpio*.

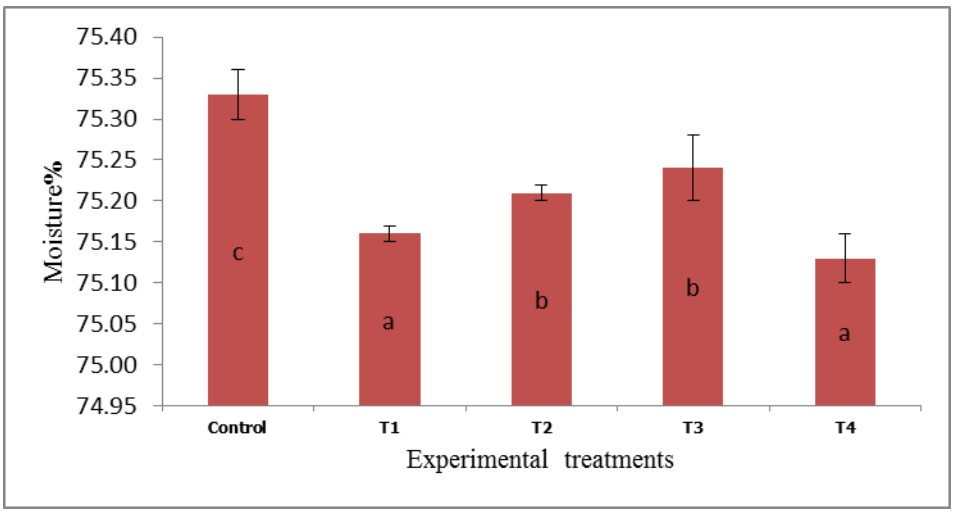

Figure 4: Moisture content (Mean±SD) in *Cyprinus carpio*.

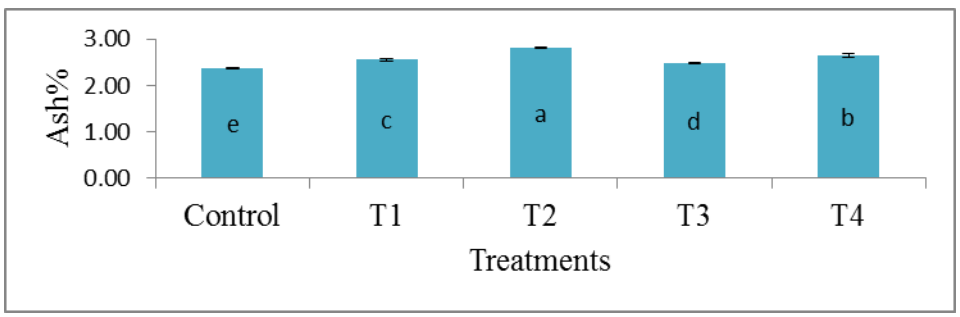

Figure 5: Ash content (Mean±SD) in *Cyprinus carpio*.

Discussion

The use and application of phytochemical agents (herbal components) in aquaculture has been increasing rapidly for such different purposes as prevention of diseases and reduction in the application of hazardous antibiotics (Sakai, 1999). Despite the importance of Ginger as a traditional medicine (Al-Yahya, 1986), to the best of our knowledge, the present study was the first experiment conducted to evaluate the effectiveness of Ginger in aquaculture in Iran. The results of this study showed positive effects of dietary ginger on growth performance and biochemical body composition. Xie *et al*. (2008) and Soosean *et al*. (2010) demonstrated that the highest final weight and weight gain in fishresulted from the highest level of *Rheum officinale* extract in common carp and *Garcinia mangostana* in African catfish, *Clarias gariepinus* diets. Bahrami Babaheydari *et al.* (2014) used higher levels of *Wood Betony* (8%) in the diets of common carp and reported similar results as the present study for all growth parameters after 10 weeks. Similar results were obtained using saponin and its derivates showing positive effects on fish growth by increasing RNA transcription, amino acids and protein production rates (Francis *et al*., 2005). Increase in body weight of carp fed with diets supplemented with a mixture of Astragalus root (*Radix astragalin*) and Chinese angelica root (*R. angelicae sinensis*) were reported by Jian and Wu (2004) which are in agreement with the results of our study. In contrast, no significant changes were observed in body weight of tilapia fed diets supplemented with 0.5 and 1% garlic for 4 weeks (Ndong and Fall, 2007). However, Pierce *et al.* (2008) reported decrease in WG in rainbow trout fed diets with plant meal. It has been previously reported that different plant additives can enhance growth rates in some fish species such as African catfish, *Clarias gariepinus* brood stock (Dada and Ikuerowo, 2009) *C. gariepinus* fingerlings (Soosean *et al.*, 2010), red sea bream, *Pagrus major* (Ji *et al.*, 2007a) and tilapia *Oreochromis mossambicus* (Immanuel *et al.*, 2009). In contrast with these reports, the dietary inclusion of some plant extracts did not have much improving effects on growth rates as indicated for juvenile pikeperch, *Sander lucioperca* fed on two medicinal herbs *Astragalus radix* and *Lonicera japonica* (Zakes *et al.*, 2008) as well as for common carp receiving willow herb, *Epilobium hirsutum* (Pakravan *et al.*, 2011). Such differences could be explained by variation in plants species, the route of administration, extraction, the species specific characteristics of different aquatic species and even culturing conditions (Alishahi *et al.*, 2010). Another factor which may impact the effectiveness of the herbal adjuvant as a growth promoter is the duration through which the diet is applied, for example while the immunostimulatory effects of herbal extracts on the diet become apparent after 2-4 weeks after the

treatment, the positive impact on the growth rates was noted 8- 12 weeks after in red sea bream, *Pagrusmajor* and Japanese flounder, *Paralichthys olivaceus* (Ji *et al.*, 2007a; 2007b, Zakes *et al.*, 2008). So, it should be examined to what extent an aquatic species is in a specific relation with the herbal additive, or if the aquatic body weight influences the final findings. The positive effects of *Wood botany* on growth performance of common carp would be primarily related to the chemical composition of the plants (Francis *et al*., 2005; Bahrami Babaheydari *et al.*, 2014). Some plant extracts improve SGR (Ji *et al.*, 2007; Yu *et al*., 2008; Dada and Ikuerowo, 2009; Nya and Austin, 2009) similar to the present research. Also increase in SGR was reported in fishes after feeding with prickly chaff-flower (Rao *et al.*, 2006), mango kernel (Sahu *et al.*, 2007) and alfalfa (Olvera-Novoa *et al.*, 1990.This is in contrast to the results obtained using dietary willow herb and marshmallow in common carp diet (Fallahpour *et al.*, 2004; Pakravan *et al.*, 2011). These differences refer to different phytochemical substances like polyphenols, steroids, tannin, fiber and their dosage used (Otunola *et al*., 2010; Shirin and Prakash, 2010). Dietary marshmallow (*Althaea Officinalis* L.) extract (0,025, 0.5, 1% per kg food) increased growth factors like MFW, GW% and SGR of common carp that were similar to the findings of the present study it,. However significant differences were detected between the results of the two studies (p<0.05) (Fallahpour *et al*., 2014).Their results demonstrated that marshmallow extract (0.25%) significantly improved weight gain in fish, whereas weight of fish fed marshmallow (1%) significantly decreased when compared with that of the control group, which was not in agreement with the results of the present study (Table 2); This has been attributed to the different amounts of bioflavonoid in extracts of marshmallow and ginger powder which affect the fish's food finding ability by stimulating their sense of smell and encouraging them to eat more than normal (Adams, 2005). Moreover, Platel *et al*. (2002) stated the favorable effects of medicinal plants on digestion and a stimulating effect on bile secretion and the activity of pancreatic enzymes.

In the present study survival of the fish was not significantly affected by the experimental diets. The results of this study are in line with the studies of Cho *et al.* (2007), Ji *et al.* (2007a), (Bilen andMugeBilen,2012)and Pakravan *et al*. (2011) who reported no significant adverse changes in the survival rates of olive or Japanese flounder, *Paralichthys olivaceus* and common carp. So, it could be concluded that adding *Z. officinale* powder (up to 2g/100g) to the commercial diets of common carp exerted no adverse effects on survival rates. Limited scientific research has been carried out to evaluate the effects of medicinal plant powder on carcass quality in aquatics and most of them mention protein and lipid content in fish

muscles. Investigation of chemical properties of fresh water fishes is very important, because it provides useful information to experts related to food resources with low fat, and high protein content and being easily accessible (Tocher *et al.*, 2004). The best body content of protein, lipid, and moisture in this study was found in T3 and lowest levels were in the control group. Though, on comparison different levels of *Stachys lavandulifolia* extract in common carp diets showed approximately similar levels of moisture, however protein and lipid levels were lower than those reported in the present study. These differences are due to the effects of alkaloids, tannin and polysaccharides of wood botany extract on *C. carpio* diet (Bahrami Babaheydari *et al.*, 2014). Pakravan *et al.* (2011) used dietary willow herb, (*Epilobium hirsutum)* extract on common carp body composition and also demonstrated these differences in amounts of moisture, protein and lipid. Similar to the aforementioned survey the moisture level was higher, while protein and lipid levels were lower than the findings of the present research. This is due to the amounts of flavonoids (in particular guaiaverin, quercetin-3-0-beta-D-glucuronide, and quercitrin), steroids (in particular beta-sitosterol and its ester, including among other beta-sitosterol caproate) and tannins than those contained in ginger (p<0.05) between the two studies. Fallahpour *et al.* (2014) showed slight changes in body composition in fish (*C. carpio*) fed a diet supplemented with marshmallow (*Althaea officinalis* L.) extract (0.25%, 0.50 and 1%, and with normal diet as controls) compared with controls and Glencross *et al.* (2004) found an increase in crude protein levels in rainbow trout fed with 12.5% yellow lupine meal. Increased body composition of tilapia was observed after feeding them diets enriched with 5 and 10% alfalfa meal; (15 and 20%), soybean meal (30 and 60%) and cottonseed meal (30 and 60%) (Ali *et al.*, 2003; Toko *et al.*, 2008) which is similar to the present research. On the other hand, proximate body composition including the levels of moisture, crude protein, crude lipid and ash as % of wet weight were not affected by inclusion of the plant extract in the diets of Nile tilapia, *Oreochromis niloticus* (Abdel *et al.*, 2009), and red sea bream (Ji *et al.*, 2007a) which is in disagreement with our results. Several such factors as species specific characteristics, medicinal plant composition as well as the duration of the experiments can affect the response (Citarasu, 2010). In addition, composition of *Cyprinus carpio* in the present study were compared with that of Hoseini *et al.* (2013) which showed high differences in all amounts of body composition parameters; protein (15.69±1.54%), fat (14.45%), Ash (1.2±1.3%) and moisture (66.57 ±12.2%) and others that were demonstrated in this survey (p≤0.05); all of them were higher than those in our study and these differences were because of different climate, age, weight of samples, time and place of

being examined, the role of ginger in carp diet to reduce the level of this factors, and the extruded diet consumed instead of the manual feeds in carps polyculture system (Citarasu, 2010; Ali *et al;* 2003). Also, common carp collected from two sites of the Indus River at Shehbaz khel (SK=upstream) and Chashma (CH=downstream) showed that in carp samples collected at CH moisture, fat, crude protein, ash, total carbohydrate content and energy value were 78.30 %, 10.08 %, 45.53%, 7.14%, 37.25, 421.84 kcal, respectively, and in samples collected at CK moisture content, fat, crude protein, ash, total carbohydrate, and energy value were 79.08 %, 13.99%, 53.59, 7.91, 24.51, and 438.3 kcal, respectively (Jabeen and Chahudry, 2011). When compared to results obtained in the present study, significant differences (p<0.05) were detected in carcass analysis of carp with the use of *Z. officinale* powder in the carp commercial diet. These differences were probably due to variations in geography, study season, fish age, type of diet and method of sampling (Hoseini *et al*., 2013).The chemical content of this fish for crude protein was 15.99±0.29%, 2.71±2.01% for crude lipid, 0.93±0% for ash and 79.53±0.71% for moisture (Ojagh *et al.*, 2009) which were significantly different (p<0.05) when compared with the two studies in all carp muscle nutrients. Body composition in common carp fed a pellet diet had 74.01% moisture, 15.7% crude protein, 2.04% lipid and 5.2% ash which when compared to the present study demonstrated lower amounts of moisture, lipid and protein content and higher amount of ash, that was significantly different (p<0.05). Generally these differences refer to distinction in environmental factors such as temperature (Cordier *et al* 2002; Tocher *et al* 2004), pH and salinity are known to influence the composition of lipids in fish (De Torrengo and Brenner, 1976). These differences originated with differences between complement addition, initial weight of common carp in tests and differences between environmental conditions (Ali *et al.*, 2003).

Generally, various studies of dietary herbal supplements in different fish species demonstrated their growth performance but there was lack of data on their body composition. Results showed that the choice of herbs, their dose and time of application was very important for obtaining higher efficiency (Citarasu, 2010). Ginger has its natural antioxidants as gingerols, shogaols and zingerone (Hori *et al.*, 2003); essential oils have potent anti-inflammatory effects and oleoresin (Zarate and Yeoman, 1996), exerts direct and indirect intense effects on growth, reproductive axis and body composition in different species including fish (Kocour *et al*., 2005). Hence, the use 2g dietary ginger powder in juvenile common carp diet is recommended.

References

Abdel, A., Mostafa, Z.M., Ahmad, M.H., Mousallamy, A. and Samir, A., 2009. Effect of using dried fenugreek seeds as natural feed additives on growth performance, feed utilization, whole-body composition and entropathogenic *aeromonas hydrophila*-challenge of monosex Nile tilapia *O. niloticus* (L) fingerlings. *Australian Journal of Basic and Applied Sciences*, **3**, 1234-1245.

Abd El Hakim, N.F., Ahmad, M.H., Azab, E.S., Lashien, M.S. and E.S. Baghdady., 2010. Response of Nile tilapia, *Oreochromis niloticus* to diets supplemented with different levels of fennel seeds meal (*Foeniculum vulgare*). *Abbassa International Journal for Aquaculture*, 3, 215–230.

Adams, C., 2005. Nutrition-based health. *Feed International*, 2, 25-28.

Ahmadi, K., Banaee, M., Vosoghei, A.R., Mirvaghefei, A.R. and Ataeimehr, B., 2012. Evaluation of the immunomodulatory effects of silymarin extract (*Silybum marianum*) on some immune parameters of rainbow trout, *Oncorhynchus mykiss* (Actinopterygii: Salmoniformes: Salmonidae). *Acta Ichthyologica Et Piscatoria*, 42 (**2**), 113–120.

Ai, Q.H., K.S., Mai, B.P., Tan, W., Xu, Zhang, W., Ma, H. and Liufu, Z., 2006. Effects of dietary vitamin C on survival, growth, and immunity of large yellow croaker, *Pseudosciaena crocea*. *Aquaculture*, 261, 327-336.

Ali, A., Al-Asgahn, N.A., Al-Ogaily, M.S. and Ali, S., 2003. Effect of feeding different levels of Alfalfa meal on the growth performance and body composition of Nile tilapia (*Oreochromis niloticus*) Fingerlings. *Asian Fisheries Science*, 16, 59-67.

Alishahi, M., Ranjbar, M.M., Ghorbanpour, M., Peyghan, R., Mesbah, M. and Razi Jalali, M., 2010. Effects of dietary *Aloe vera* on some specific and nonspecific immunity in the common carp (*Cyprinus carpio*). *International Journal of Veterinary Research*, 3, 189-195.

Alay, S.M., Mohamed, M.F., 2010. *Echinacea purpurea* and *Allium sativum* as immunostimulants in fish culture using Nile tilapia (*Oreochromis niloticus*). *Journal of Animal Physiology and Animal Nutrition*, 2010, 94, e31-39.

Al-Yahya, M. A., 1986. Phytochemical studies of the plants used in traditional medicine of Saudi Arabia. Fitoterapia, 57, 179-182.

Apines Amar M.J.S., Amar E.C., Faisan Jr.J.P., Pakingking, Jr.R.V. and Satoh S., 2012. Dietary onion and ginger enhance growth, hemato-immunological responses, and disease resistance in brown-marbled grouper, *Epinephelus fuscoguttatus*. AACL Bioflux, 5(**4**), 231-239.

Association of Official Analytical Chemists (AOAC), 2000. Official methods of analysis of the association of official analytical

chemists. 16th Edition, Arlington, VA, USA.

Asadi, M.S., Mirvaghefei, A.R., Nematollahi, M.A., Banaee, M. and Ahmadi, K., 2012. Effects of watercress (*Nasturtium nasturtium*) extract on some immunological parameters of rainbow trout (*Oncorhynchus mykiss*). *Open Veterinary Journal*, 2(**1**), 32-39.

Bahrami Babahydari, S., Dorafshan, S., Paykan Heyrati, F., Mahboobi Soofiani, N. and Vahabi, M.R., 2014. The physiological changes, growth performance and whole body composition of common carp, *Cyprinus carpio* fed on diet containing wood betony, *Stachys lavandulifolia* extract. *Journal of Agriculture Science Technology*. Vol. 16, 1565-1574.

Banaee, M., 2010. Influence of silymarin in decline of sublethal diazinon-induced oxidative stress in rainbow trout (*Oncorhynchus mykiss*). Ph.D. Thesis, Aquaculture and Environmental Department, Natural Resource Faculty, Natural 2459 Resource and Agriculture Collage, Tehran University, Iran, 149P.

Banaee, M., Sureda, A., Mirvaghefi, A.R. and Rafei, G.R., 2011. Effects of long-term silymarin oral supplementation on the blood biochemical profile of rainbow trout (*Oncorhynchus mykiss*). *Fish Physiology and Biochemistry*, 37, 887-896.

Bilen S.Muge Bline A.2013.Effectsof different protein source on growth performance and food consumption of goldfish (*Carasius auratus*) *Iranian journal of fisheries science*12(3) 717-722.

Bligh E.G. and Dyer W.J., 1959. A rapid method of total lipid extraction and purification. *Canadian Journal of Biochemical Physiology*, 37, 911-917.

Bohlouli Oskoii, S., Tahmasebi Kohyani, A., Salati, A.P., Parseh, A. and Sadeghi, E., 2012. Effects of dietary administration of *Echinacea purpurea* on growth indices and biochemical and hematological indices in rainbow trout (*Oncorhynchus mykiss*) fingerlings. *Journal of Fish Physiology and Biochemistry*, 38, 1029–1034.

Cek, S., Turan, F. and Atik, E., 2007a. The effects of gokshura, (*Tribulus terrestris)*, on sex differentiation of guppy, *Poecilia reticulata*. *Pakistan. Journal of Biology Sciences*, 10, 718–725.

Cek, S., Turan, F. and Atik, E., 2007b. Masculinization of convict cichlid (*Chichlasoma nigrofasciatum*) by immersion in (*Tribulus terrestris*) extract. *Aquaculture International*, 15(**2**), 109–119.

Cho, Y.S., Schiller, N.L., Kahng, H.Y., and Oh, K.H., 2007. Cellular responses and proteomic analysis of *Escherichia coli* exposed to green tea polyphenols. *Current microbiology*, 55, 501–506.

Citarasu, T., 2010. Herbal biomedicine: A new opportunity for

aquaculture industry. *Aquaculture International.,* 18, 403-414.

Cordier M., Brichon G., Weber J.M., Zwingelstein G., 2002. Changes in the fatty acid composition of phospholipids in tissues of farmed sea bass (*Dicentrarchus labrax*) during an annual cycle. Roles of environmental temperature and salinity. *Comparative Biochemical Physiology*, 133, 281–288.

Cui, Y. and Wootton, R.J., 1988. Effects of ration, temperature and body size on the body composition, energy content and condition of the minnow (Phoxinus phoxinus L.). *Journal of Fish Biology*, 32, 749–764.

Dada, A.A. and Ikuerowo, M., 2009. Effects of ethanolic extracts of *Garcinia kola* seeds on growth and haematology of Catfish (*Clarias gariepinus*) brood stock. *African Journal Agriculture Research*, 4, 344-347.

Dempson I.B., Schwarz C.J., Shears M. and Furey G., 2004. Comparative proximate body composition of Atlantic salmon with emphasis on parr from fluvial and lacustrine habitats, *Journal of Fish Biology*, 64, 1257-1271.

De Torrengo M.P., Brenner, R., 1976. Influence of environmental temperature on the fatty acid de saturation and elongation activity of fish (*Pimelodus maculatus*) liver microsomes. *Biochimica et Biophysica Acta*, 424, 36–44.

Duncan, D.B., 1955. Multiple ranges and multiple (F) test. *Biometrics*, 11, 1- 42.

Fallahpour, F., Banaee,M., Javadzade, N., 2014. Effects of dietary marshmallow (*Althaea Officinalis* L.) extract on growth performance and body composition of common carp (*Cyprinus carpio*). *International Journal of Advance Biological and Biomedical Research*, 2 (**8**), 2453-2460.

Folch J., Lees M. and Sloane-Stanley G.H., 1957. A simple methods for the isolation and purification of total lipids from animal tissues. *Journal of Biological Chemistry*, 226, 497-509

Francis, G., Harinder, P. Makkar, S. and Becker, K., 2005. *Quillaja* saponins - a natural growth promoter for fish. *Animal feed science and technology*, 121, 147-157.

Gholipour, K.H., Mirzargar, S.S,, Soltani, M., Ahmadi, M., Abrishamifar, A., Bahonar, A. and Yousefi, P., 2011. Anesthetic effect of tricaine methanesulfonate, colve oil and electroanesthesia on lysozyme activity of *Oncorhynchus mykiss*. *Iranian Journal of Fisheries Science*s, 10(**3**), 393–402.

Glencross, B., Evans, D., Hawkins, W. and Jones, B., 2004. Evaluation of dietary inclusion of yellow lupin (*Lupinus luteus*) kernel meal on the growth, feed utilization and tissue histology of rainbow trout (*Oncorhynchus mykiss*). *Aquaculture*, 235, 411-422.

Haghighi, M.and Sharifrohani, M., 2013. The effects of powdered ginger rhizome (*Zingiber officinale*) on haematological and immunological parameters of rainbow trout *Oncorhynchus mykiss*. *Asian Journal of Marine Science*s, 1, 7-11.

Hori Y., Miura T., Hirai Y., Fukumura, M., Nemoto, Y., Toriizuka, K. and Ida, Y., 2003. Pharmacognostic studies on ginger and related drugs – part 1: five sulfonated compounds from Zingiberis rhizome (Shokyo). *Phytochemical*, 62, 613-617.

Hoseini, M.J., Baboli, M. and Sary, A., 2013. Chemical composition and fatty acids profile of chainness carps in (Dashte Azadegan farm) Khouzestan Province. MSC. thesis. IAU Ahvaz Branch. 105P.

Immanuel, G., Uma, P.R., Iyapparaj, P., Citarasu, T., Punitha Peter, S.M., Michael Babu, M. and Palavesam, A., 2009. Dietary medicinal plant extracts improve growth, immune activity and survival of tilapia (*Oreochromis mossambicus*). *Journal of Fish Biology*, 74, 1462-1475.

Jabeen F. and Chaudhry, S.A., 2011. Chemical compositions and fatty acid profiles of three freshwater fish species. *Food Chemistry*, 125, 991–996

Jafari khorshidie, K., 2004. Aquatic animal feedings manual note. 60P.

Ji, S.C., Jeong, G.S., Im, G.S., Lee, S.W., Yoo, J.H. and Takii, K., 2007a. Dietary medicinal herbs improve growth and some non-specific immunity of red sea bream, *Pagrus major*. *Fisheries Sciences*, 73, 70-76.

Ji, S., Jronh, G., IM, G., Lee, S., Yoo, J. and Takii, K., 2007b. Dietary medicinal herbs improve growth performance, fatty acid utilization, and stress recovery of Japanese flounder. *Fisheries Sciences*, 73, 70-76

Jian, J. and Wu, Z., 2004. Influence of traditional Chinese medicine on non-specific immunity of Jian arp (*Cyprinus carpio* var. Jian). *Fish Shellfish Immunology*, 16, 185-191.

Kocour, M., Lynhard, O., Gela, D. and Rodina, M., 2005. Growth performance of all female and mixed sex common carp, *Cyprinus carpio* L. population in central European climatic conditions. *Journal of the Word Aquaculture Society*, 36, 103–113.

Kumar Bairwa, M., Kumar Jakhar, J., Satyanarayana,Y., and Devivaraprasad Reddy,A., 2012. Animal and plant originated immunostimulants used in aquaculture. *Journal of Natural Products Plant Resources*, 2(**3**), 397-400.

Metwally, M.A.A., 2009. Effect of garlic (*Allium sativum*) on some antioxidant activities in tilapia nilotica (*Oreochromis niloticus*). *World Journal of Fish Marine Sciences*, 1, 56-64.

Nafisi bahabadi, M., Banaee, M., Taghiyan, M. and Nematdoust Haghi, B., 2014. Effects of dietary

administration of yarrow extract on growth performance and blood biochemical parameters of rainbow trout (*Oncorhynchus mykiss*). *International Journal of Aquatic Biology*, 2(**5**), 275-285

Ndong, D. and Fall, J., 2007. The effect of garlic (*Allium sativum*) on growth and immune responses of hybrid tilapia (*Oreochromis niloticus* x *Oreochromis aureus*), Document Scientific que du CRODT, pp. 1–22.

Nya, E.J. and Austin, B., 2009. Use of garlic, *Allium sativum*, to control *Aeromonas hydrophila* infection in rainbow trout, *Oncorhynchus mykiss* (Walbaum). *Journal of Fish Diseases*, 32, 963-970. http://dx.doi.org/10.1111/j. 1365-2761.2009.01100.x

Ojagh M., Rezaei M. and Khoramgah M., 2009. Survey chemical compositions and muscles fatty acids in common carp and Grass carp. *Iranian Food Industries Journal*, 6(**1**), 77-83.

Olvera-Novoa, M.A., Campos, S.G., Sabido, M.G. and Martinez-Palacios, C.A., 1990. The use of alfalfa leaf protein concentrates as a protein source in diets for tilapia (*Oreochromis mosssambicus*). *Aquaculture*, 90, 291-302.

Otunola, G.A., Oloyede, O.B., Oladiji A.T. and Afolayan, A.J., 2010. Comparative analysis of the chemical composition of three spices *Allium sativum* L., *Zingiber officinale* Rosc., and *Capsicum frutescens* L. commonly consumed in Nigeria. *African Journal of Biotechnology*, 9, 6927–6931.

Pakravan, S., Hajimoradloo, A. and Ghorbani, R., 2011. Effect of dietary willow herb *Epilobium hirsutum* extract on growth performance, body composition, haematological parameters and *Aeromonas hydrophila* challenge on common carp, *Cyprinus carpio*. *Aquaculture Research*, 43, 861- 869.

Pham, M.A., Lee, K.J., Lee, B.J., Lim, S.J., Kim, S.S., Lee, Y.D., Heo, M.S. and Lee, K.W., 2006. Effects of dietary *Hizikia fusiformis* on growth and immune responses in juvenile olive flounder (*Paralichthys olivaceus*). *Asian-Australasian Journal of Animal Sciences*, 19, 1769-1775.

Pierce, L., Palti, Y., Silverstein, J., Barrows, F., Hallerman, E. and Parsons, J., 2008. Family growth response to fishmeal and plant-based diets shows genotype×diet interaction in rainbow trout (*Oncorhynchus mykiss*). *Aquaculture*, 278, 37–42.

Platel, K., Rao, A., Saraswahi, G. and Srinivasan, K., 2002. Digestive stimulant action of three Indian spices mixes in experimental rats. Nahrung, 46(**6**), 394-398.

Rao, Y.V., Das, B.K., Jyotyrmayee, P. and Chakrabarti, R., 2006. Effect of *Achyranthes aspera* on the immunity and survival of *Labeo rohita* infected with *Aeromonas hydrophila*. *Fish and Shellfish Immunology*, 20, 263 – 273.

Ritzmann S.E., Daniels J.C., 1975. Serum protein abnormalities. Little Brown, Boston.

Ronyai, A., peteri, A., Radics, F., 1990. Cross breeding of starlet and lena river sturgeon. *Aquaculture Hungrica szarwas*, 6, 13-18.

Sahu, S., Das, B.K., Mishra, B.K., Pradhan, J. and Sarangi, N., 2007. Effect of *Allium sativum* on the immunity andsurvival of *Labeo rohita* infected with *Aeromonas hydrophila*. *Journal of Applied Ichthyology*, 23, 80-86.

Sakai, M., 1999. Current research status of fish immunostimulants. *Aquaculture*, 172, 63-92.

Salah, M.A, Nashwa, M.A.T. and Mohamed, F.T., 2008. Proceedings of 8th international symposium on tilapia in aquaculture, Cairo, Egypt, 12-14, October, 2008, 277-296.

Sidhu K.S., 2003. Health benefits and potential risks related to consumption of fish or fish oil. *Regulatory Toxicology and Pharmacology*, 38(**3**), 336-344.

Shirin, P.R. and J. Prakash, 2010. Chemical composition and antioxidant properties of ginger root (*Zingiber officinale*). *Journal of Medicinal Plants Research*, 4, 2674–2679.

Soosean, C., Marimuthu, K., Sudhakaran, S. and Xavier, R., 2010. Effects of mangosteen (*Garcinia mangostana* L.) extracts as a feed additive on growth and haematological parameters of African catfish (*Clarias gariepinus*) fingerlings. *European Review of Medicine Pharmacy Sciences*, 14, 605-611.

Talpur, A.D., Ikhwanuddin M. and Abol-Munafi, A.B., 2013. Nutritional effects of ginger (*Zingiber officinale* Roscoe) on immune response of Asian sea bass, *Lates calcarifer* (Bloch) and disease resistance against *Vibrio harveyi*. *Aquaculture*, 400–401, 46–52.

Tocher, D.R., Fonseca-Madrigal, J., Dick, J.R., Ng, W.K., Bell, J.G. and Campbell P.J., 2004. Effects of water temperature and diets containing palm oil on fatty acid desaturation and oxidation in hepatocytes and intestinal enterocytes of rainbow trout (*Oncorhynchus mykiss*). *Comparative Biochemistry and Physiology B-Biochemistry and Molecular Biology*, 137(**1**), 49–63.

Toko, I.I., Fiogbe, E.D. and Kestemont, P., 2008. Growth, feed efficiency and body mineral composition of juvenile vundu catfish (*Heterobranchus longifilis*, Valenciennes 1840) in relation to various dietary levels of soybean or cottonseed meals. *Aquaculture Nutrition*, 14(**3**), 193–203.

Turan, F. and Akyurt, I., 2005. Effects of red clover extract on growth performance and body composition of African catfish (*Clarias gariepinus*). *Fisheries Sciences*, 78, 618- 620.

Turan, F., 2006. Improvement of growth performance in tilapia (*Oreochromis aureus*, Linnaeus) by supplementation of red clover

(*Trifolium pratense*) in diets. Bamidgeh, *Israeli Journal of Aquaculture*, 58(**1**), 34-38.

Weatherly, A.H. and Gill, H.S., 1987. The biology of fish growth, London, Academic Press. 433-443

Weidner, M.S. and Sigwart, K., 2000. The safety of a ginger extract in the rat. *Journal of Ethnopharmacology*, 73 (**3**), 513–520.

Xie, J., Liu, B., Zhou, Q., Su, Y., He, Y., Pan, L., Ge, X. and Xu, P., 2008. Effects of anthraquione extract from rhubarb *Rheum officinale* Bail on crowding stress response and growth of common carp *Cyprinus carpio* var. *Jian*. *Aquaculture*, 281, 5-11.

Yılmaz, S., Ergün, S. and Soytas, N. , 2013a. Dietary supplementation of cumin (*Cuminum cyminum*) preventing streptococcal disease during first-feeding of mozambique tilapia (*Oreochromis mossambicus*). *Journal of BioScience and Biotechnology*, 2, 117- 124.

Yilmaz, E., Genc, M.A., Cek, S., Mazlum, Y. and Genc, E. 2006. Effects of orally administered *Ferula coskunii* (Apiaceae) on growth, body composition and histology of common carp, *Cyprinus carpio*. *Journal of Animal and Veterinary Advances*, 5(**12**), 1236–1238.

Yu, M.C., Li, Z.J., Lin, H.Z., Wen, G.L. and Ma, S., 2008. Effects of dietary bacillus and medicinal herbs on the growth, digestive enzyme activity, and serum biochemical parameters of the shrimp *Litopenaeus vannamei*. *Aquaculture International*, 16, 471-480.

Zakes, Z., Kowalska, A., Demska Zak, K., Jeney, G. and Jeney, Z., 2008. Effect of two medicinal herbs (*Astragalus radix* and *Lonicera japonica*) on the growth performance and body composition of juvenile pikeperch [*Sander lucioperca* (L.)]. *Aquaculture Research*, 39, 1149-1160.

Zarate, R. and Yeoman, M.M., 1996. Change in the amounts of gingerol and derivatives during a culture cycle of ginger, *Zingiber officinale*. *Plant Science*, 121(**1**), 115-122.