Abbassa International Journal for Aquaculture

Volume (5) Number (1), 2012

ISSN 1687-7638

Egyptian Society for Water, Aquaculture and Environment

Abbassa, Abou Hammad, Sharkia, EGYPT

ISSN 1687-7638

ABBASSA INTERNATIONAL JOURNAL FOR AQUACULTURE

Published by

Egyptian society for water, aquaculture and environment,
Central Laboratory for Aquaculture Research (CLAR),
Agricultural Research Center (ARC), Giza, Egypt

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GENERAL INFORMATION

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Abbassa Int. J. Aqua., V0l. 5 No. (1) 2012. *21 -39*

THE USE OF GINSENG IN PRACTICAL DIETS FOR NILE TILAPIA, *Oreochromis niloticus* (L.): EFFECT ON GROWTH PERFORMANCE, FEED UTILISATION, WHOLE-BODY COMPOSITION AND ENTEROPATHOGENIC *Aeromonas hydrophila*-CHALLENGE

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Received 12/ 1/ 2012 *Accepted 23/ 2/ 2012*

Abstract

This experiment was conducted to evaluate the effects of dietary ginseng herb, *Panax ginseng* supplementation on growth performance, feed utilization and enteropathogenic *Aeromonas hydrophila*-challenge of Nile tilapia, *Oreochromis niloticus* (L.). Six experimental diets were formulated to contain 0 (control), 25, 50, 75, 100 or 125 mg ginseng/kg diet. All diets are isonitrogenous (30% crude protein) and isocaloric (436 kcal/100g diet). Diets were fed to triplicate groups of Nile tilapia fry (0.71 g initial body weight) at the daily rate of 10% of fish body weight for the first four weeks then reduced to 8% for the next six weeks and further reduced to 4% for the remaining period of the study. The feed was offered twice daily; six days a week for 14 weeks. Results of fish growth indicated that final body weight, weight gain and daily gain increased significantly ($P<0.05$) with increasing ginseng level in the fish diet up to the level of 100 mg ginseng/kg diet. Increasing the level of ginseng from 100 to 125 mg ginseng/ kg diet did not exert any additional advantage to growth of fish. The lowest values were obtained at control group. Survival rate was slightly enhanced due to the inclusion of ginseng in the fish diets with insignificant differences ($P>0.05$). The highest feed intake and the best FCR were obtained at fish group maintained at 100 mg ginseng/kg diet. PER, APU and EU values were enhanced significantly ($P<0.05$) when fish fed diets containing ginseng, while the lowest values were obtained at control group. Fish body protein content increased significantly ($P<0.05$) with increasing ginseng level in the diet, while insignificant differences were observed in total lipids content among treatments (P>0.05). At the end of the experiment, fish were challenged against *Aeromonas hydrophila* for 10 days. The mortality rate decreased with the increase of ginseng level in fish diets. No mortalities were observed in fish groups maintained at diets contained at 100 and 125 mg ginseng/kg, respectively. The results of present study suggested that Nile tilapia fry fed diets containing at least 100 mg ginseng/kg had enhanced growth performance, feed utilization and enteropathogenic *Aeromonas hydrophila*-challenge.

Key words: Ginseng (*Panax ginseng*), Nile tilapia (*Oreochromis niloticus*), growth performance, feed utilization, *Aeromonas hydrophila*-challenge.

INTRODUCTION

Nowadays, herbal medicine is a growing area as an alternative medicine for human being. Many manufactured drugs derived originally from plant compounds have wide-range uses. The medicinal plants are rich in a wide variety of nutrients and they may be used as chemotherapeutics and feed additives (Chang, 2000). Herbs and spices have been added to different types of food to impart flavor as well as to improve storage stability. A wide variety of phenolic substances derived from herbs and spices possess potent antioxidant, anti-inflammatory and antimutagenic effects (Schwarz *et al*., 2001and Surh, 2002). Various medicinal herbs are now being added to livestock feed as the alternatives to antibiotics due to beneficial effects on palatability and gut functions (Jugl-Chizzola *et al*., 2006) and antimicrobial actions as well as their widespread antioxidant activity (Özer *et al*., 2007). Abdel-Tawwab *et al.* (2010) found that green tea *Camellia saneness* enhanced the growth of Nile tilapia, *Oreochromis niloticus* and significantly improved its resistance against *Aeromonas hydrophila* infection. Also, Ahmad and Abdel-Tawwab (2011) reported that caraway seed meal improved growth performance of Nile tilapia *Oreochromis niloticus*.

The use of medicinal plants as a natural feed additive in fish diets is becoming useful rather than classic chemicals, which may have an accumulative effect on human health. An example is ginseng, *Panax ginseng* (one of several herbs species of the *Araliaceae* family). Historically, ginseng is considered to be one of the most valuable medicinal herbs in Eastern Asian countries such as China, Korea and Japan. Most notable features of ginseng have been suggested to be the modulation of the immune system, cancer and diabetes (Vogler *et al*., 1999; Dey *et al*., 2003 and Kiefer and Pantuso, 2003). It has previously been documented that ginseng contains various bio-active components such as saponins, antioxidants, peptides, polysaccharides, alkaloids, lignans and polyacetylenes, of which saponins (ginsenoside) are considered to be the principal bioactive ingredient (Jo *et al*., 1995; Palazon *et al*., 2003) and are believed to have immune-stimulatory, anti-fatigue and hepatoprotective physiological effects (Wu and Zhong, 1999). Zhang *et al*. (2009) found that ginseng polysaccharides can enhance T and B lymphocytes proliferation *in vitro*. In addition, red ginseng may be useful for the treatment of hypertension and pulmonary vascular obstruction (Han *et al.*, 2005) and have anti-stress and antioxidant activity as well as vasorelaxing effect in several arterial vessels (Chang *et al.*, 1994 and Shin *et al*., 2000). Min *et al*. (2003) indicated that the ergogenic mechanism of red ginseng may be due to the suppressive effect of red ginseng on serotonin level during exercise. Hu *et al*. (2003) reported that *in vitro,* the extract of *Panax ginseng* root has been shown to have antimicrobial activity against *Staphylococcus aurous*, like lactose chitosan derivative against *S. aurous* CCRC 12657 (Chen and Chou, 2005).

A few fish studies have assessed the efficacy of ginseng as an immune stimulant. Work evaluating ginseng as a possible growth promoter for fish is scarce (Goda, 2008). Nile tilapia, *O. niloticus* (L.) is one of the most important species within the tilapias because of its rapid growth, good survival in high density culture, and disease tolerance (El-Sayed, 2006), that makes it a good choice for the semi-intensive and intensive grow-out strategies. Subsequently, the improving of a practical diet for Nile tilapia is necessary. Therefore, the present study was conducted to evaluate the use of ginseng supplementation as a feed additive on growth performance, feed utilization, whole body composition of Nile tilapia fry and response to challenge against pathogenic bacteria, *Aeromonas hydrophila*.

MATERIALS AND METHODS

Diet preparation and feeding regime:

A fourteen week experiment was conducted in the nutritional fish laboratory at Central Laboratory of Aquaculture Research (CLAR), Abbassa, Abu-Hammad, Sharkiya governorate. Six experimental diets (30% crude protein, 7.20% crude fat and 436 kcal/100g diet) were formulated to contain different levels of ginseng *Panax ginseng* (obtained from Pharco pharmaceuticals Co. Alexandria, Egypt, each 100 ml contains 933 mg ginseng extract ,0, 25, 50, 75, 100 and 125 mg/kg diet) in the diets. Diets formulation and proximate composition of the experimental diets are shown in Table (1). Dry ingredients of each diet were thoroughly mixed and 100 ml of water was added per kg diet. Afterwards, the mixture (ingredients and water) were blended using kitchen blender to make a paste from each diet. Pelleting of each diet was carried out by passing the blended mixture through laboratory pelleting machine with a 1mm diameter matrix. The pellets were dried in at 65 ºC a drying oven model (Fisher oven 13–261–28A) for 24 hours and stored in plastic bags which were kept in a refrigerator at 2ºC during the experimental period to avoid rancidity. Experimental diets were formulated to meet the nutritional requirement of Nile tilapia (NRC, 1993).

Fish and culture technique:

Nile tilapia fry, *Oreochromis niloticus* (L) with an average initial body weight of 0.71 g/ fish were obtained from the fish hatchery ponds, Central Laboratory for Aquaculture Research (CLAR). Fish were kept in indoor tank for 2 weeks as an acclimation period to the laboratory conditions. Fish were divided into 6 groups (3 replicates per treatment), each containing 20 fish/aquarium. Each subgroup of fish was transferred at random into a 100 L glass aquarium. De-chlorinated tap water was used throughout the study. In order to avoid accumulation of the metabolites, a one half water of the aquarium was changed daily. Each aquarium was also supplied with air produced by a small electric compressor unionized. The photoperiod was set on a 12 hour light-dark cycle using fluorescent tubes as the light source. During the course of the experiment, all fish from each aquarium were collected every two weeks and collectively weighed The feeding rate was 10% of fish body weight for the first four weeks then reduced to 8% for the next six weeks and further reduced to 4% for the remaining period of the study. Fish feeding was carried out 6 days/week, two times/ day and the rations were adjusted each time the fish were weighed.

Chemical analysis of diets and fish:

The tested diets and fish from each treatment were analyzed according to the standard methods of AOAC (1990) for moisture, protein, fat and ash. Moisture content was estimated by heating samples in an oven at 85ºC until constant weight and calculating weight loss. Nitrogen content was measured using a micro kjeldahl apparatus and crude protein was estimated by multiplying nitrogen content by 6.25. Total lipids content was determined by ether extraction and ash was determined by combusting samples in a muffle furnace at 550ºC for 6 hours. Crude fiber was estimated according to Goering & Van Soest (1970). Gross energy was calculated according to NRC (1993).

Table 1: Formulation (feed ingredients) and proximate chemical composition (% on dry matter basis) of the experimental diets.

Ingredients	Ginseng levels (mg/kg)					
	0.0	**25**	**50**	**75**	**100**	**125**
Herring Fish meal[1]	12.50	12.50	12.50	12.50	12.50	12.50
Soybean meal	38.50	38.50	38.50	38.50	38.50	38.50
Corn meal	28.50	28.50	28.50	28.50	28.50	28.50
Wheat bran	13.00	13.00	13.00	13.00	13.00	13.00
Corn oil	00.36	00.36	00.36	00.36	00.36	00.36
Cod liver oil	1.50	1.50	1.50	1.50	1.50	1.50
Starch	2.64	2.61	2.59	2.56	2.54	2.51
Vitamins premix[3]	1.00	1.00	1.00	1.00	1.00	1.00
Minerals premix[4]	2.00	2.00	2.00	2.00	2.00	2.00
Ginseng	0.00	0.025	0.050	0.075	0.100	0.125
Total	100	100	100	100	100	100
Chemical analyses:						
Dry matter	91.37	91.45	91.38	91.40	91.40	91.38
Crude protein	30.20	30.22	30.23	30.21	30.22	30.20
Total lipids	7.21	7.19	7.19	7.21	7.18	7.21
Ash	9.34	9.32	9.33	9.33	9.32	9.33
Crude fiber	5.10	5.11	5.09	5.11	5.10	5.09
NFE [5]	48.15	48.16	48.16	48.14	48.18	48.17
GE (kcal/100g) [6]	436.66	436.63	436.68	436.68	436.61	436.74

1- Danish fish meal 71.3% protein, 14.2% crude fat, and 11.0% ash obtained from Triple Nine Fish Protein, DK-6700 Esbjerg, Denmark.

2- Egyptian soybean flour 45.6% protein, 6.3% crude fat, and 7.9% obtained from National Oil Co., Giza, Egypt.

3- Vitamins premix (per kg of premix): thiamine, 2.5 g; riboflavin, 2.5 g; pyridoxine, 2.0 g; inositol, 100.0 g; biotin, 0.3 g; pantothenic acid, 100.0 g; folic acid, 0.75 g; para-aminobenzoic acid, 2.5 g; choline, 200.0 g; nicotinic acid, 10.0 g; cyanocobalamine, 0.005 g; α-tocopherol acetate, 20.1 g; menadione, 2.0 g; retinol palmitate, 100,000 IU; cholecalciferol, 500,000 IU.

4- Minerals premix (g/kg of premix): $CaHPO_4.2H_2O$, 727.2; $MgCO_4.7H_2O$, 127.5; KCl 50.0; NaCl, 60.0; $FeC_6H_5O_7.3H_2O$, 25.0; $ZnCO_3$, 5.5; $MnCl_2.4H_2O$, 2.5; $Cu(OAc)_2.H_2O$, 0.785; $CoCl_3..6H_2O$, 0.477; $CaIO_3.6H_2O$, 0.295; $CrCl_3.6H_2O$, 0.128; $AlCl_3.6H_2O$, 0.54; Na_2SeO_3, 0.03.

5- Nitrogen-Free Extract (calculated by difference) = 100 – (protein + lipid + ash + fiber).

6- Gross energy (GE) was calculated according to NRC (1993) as 5.65, 9.45, and 4.11 kcal/g of protein, lipid, and carbohydrates, respectively.

Water quality analysis

Water samples were collected biweekly from each aquarium. Water temperature and dissolved oxygen were measured on site with an YSI model 58 oxygen meter (Yellow Spring Instrument Co., Yellow Spring, Ohio, USA). While the pH degree was measured using a pH–meter (Digital Mini-pH Meter, model 55, Fisher Scientific, USA). Unionized ammonia was measured using DREL/2 HACH kits (HACH Co., Loveland, Colorado, USA).

Growth parameters:

Weight gain (WG) = W_2- W_1

Daily gain (DG) = W_2 - W_1 / T;

Where W_2 = average final body weight (g), W_1 = average initial body weight (g) and T = the experimental period (days).

Feed utilization parameters:

Feed conversion ratio (FCR) = feed intake (g)/body weight gain (g);

Protein efficiency ratio (PER) = gain in weight (g)/protein intake in feed (g);

Apparent protein utilization (APU %) = 100 [protein gain in fish (g)/protein intake in feed (g)].

Energy utilization (EU%) = [energy gain in fish/energy intake in feed] x 100.

Challenge test:

At the end of the feeding trial, fish of each treatment were divided into two subgroups. The first subgroup was challenged with pathogenic *Aeromonas hydrophila.* A 0.2 ml dose of 24-h broth from virulent bacterial pathogen of *A. hydrophila* ($5x10^5$ CFU/ml) was given by interperitoneal injection (I.P) (Schaperclaus *et al.*, 1992). The second subgroup was I.P injected by 0.2 ml of saline solution as a control. Both subgroups were kept under observation for 10 days to record any abnormal clinical signs and the daily mortality rate.

Statistical analysis:

The obtained data were subjected to one-way ANOVA. Differences between means were tested at the 5% probability level using Duncan test. The statistical analysis was done using SPSS program version 10 (SPSS, Richmond, USA) as described by Dytham (1999).

Economical evaluation:

The cost of feed required to produce a unit of fish biomass was estimated using a simple economic analysis. The estimation was based on local retail sale market price of all the dietary ingredients at the time of the study. These prices (in LE/kg) were as follows: herring fish meal, 12; soybean meal, 3.0; corn meal, 2.50; starch 3.0, wheat bran 1.50; fish oil, 7.0; corn oil, 5.0; vitamins premix, 7.0; minerals mixture, 3.0 and 2.50 LE/g (1000 mg) ginseng.

RESULTS AND DISCUSSION

Water temperature ranged between 27 and 29◦C, dissolved oxygen ranged between 4.8 and 5.7 mg/L, pH ranged between 7.6 and 7.9 and the unionized ammonia concentration range was 0.11–0.19 mg/L. All the previous water quality parameters are within the acceptable ranges for normal growth of Nile tilapia (Boyd, 1984).

In this study, fish growth was enhanced significantly ($P<0.05$) with ginseng supplementation as compared to the control diet (Table 2). Fish fed the diet containing 100 mg ginseng/kg diet showed the highest in growth performance (final body weight, weight gain and growth rate) in comparison to other diets. Lowest values were observed in fish fed control diet (Table 2). In addition, the differences in growth performance between fish fed diet contained 100 or 125 mg ginseng /kg were insignificant. Fish survival ranged between 97 and 100% without any significant differences among treatments (P>0.05) as shown from (Table 2). These results agreed with those found by Ahmad *et al* (2011) with Nile tilapia fingerlings. They stated that fish fed on 1% cinnamon level in the diet gave higher body weight and weight gain significantly than fish fed on other cinnamon levels. Similarly, Abdel-Tawwab *et al.* (2010) observed a growth-promoting influence of green tea on Nile tilapia and they reported that the optimum growth and feed utilization were obtained at the level of 0.5 g green tea/kg diet. Abd El Hakim *et al.* (2010) conducted an experiment with Nile tilapia fingerlings fed a basal diet containing 0, 1.0, 2.0, and 3.0% fennel, *Foeniculum vulgare* for 14 weeks. They found that use of 1.0% fennel in the diet produced the maximum fish performance.

The enhanced growth in the ginseng-supplemented diet may be because ginseng enhanced the nutrient digestibility leading to improved nutrient utilization, which in turn could also explain the better growth. Platel *et al*. (2002) reported that spices are desirable for stimulating digestion, and had a high stimulatory influence particularly on bile secretion and pancreatic enzyme activity. Also, Dey *et al*. (2003) and Kiefer and Pantuso (2003) reported that ginseng may improve psychological function, immunity and conditions associated with diabetes. It has previously been documented that ginseng contains various bio-active components such as saponins, antioxidants, peptides, polysaccharides, alkaloids, lignans and polyacetylenes, of which saponins (ginsenoside) are considered to be the principal bioactive ingredient.

Table 2: Growth performance (means ± SE) of Nile tilapia, *O. niloticus* fed diets containing different levels of ginseng.

Items	Ginseng levels (mg/kg)					
	0.0	**25**	**50**	**75**	**100**	**125**
Initial weight (g)	0.71 [a] ±0.0	0.72 [a] ±0.01	0.72 [a] ±0.01	0.71 [a] ±0.01	0.72 [a] ±0.01	0.71 [a] ±0.0
Final weight (g)	16.13 [d] ±0.09	20.17 [c] ±0.20	22.30 [c] ±0.26	25.90 [b] ±0.34	35.47 [a] ±1.11	36.87 [a] ±1.43
Weight gain (g)	15.42 [d] ±0.09	19.45 [c] ±0.20	21.57 [b] ±0.27	25.18[b] ±0.35	34.75 [a] ±1.10	36.15 [a] ±1.44
Growth rate (g/day)	0.16 [d] ±0.01	0.20 [c] ±0.01	0.22 [c] ±0.02	0.26 [b] ±0.01	0.35 [a] ±0.01	0.37 [a] ±0.01
Survival rate (%)	97 [a] ±0.58	97 [a] ±1.00	99 [a] ±0.58	99 [a] ±1.00	100 [a] ±0.0	100 [a] ±0.0

Means with different superscripts in the same row are significantly different (P>0.05).

In the present study, feed intake (FI) increased significantly (P<0.05) while FCR decreased significantly in diets supplemented with different levels of ginseng (Table 3). Moreover, FER, PER, APU, and EU values increased significantly with diets supplemented by ginseng levels (100 or 125 mg/kg diet). The best value of FCR and highest values of FI, FER, PER, APU, and EU were obtained for fish fed diet contained 100 or 125 mg ginseng/kg diet. Elevated FI may be a result of a high demand for nutrients stimulated by the higher growth rate and/or improved appetite related to sensory stimulation by the presence of ginseng in the diet.

Goda (2008) reported that Nile tilapia fingerlings fed diets containing at least 200 mg/kg ginseng herb (Ginsana® G115) for 17 wk had enhanced growth performance, diet utilization efficiency. Adams *et al*. (1988) stated that olfactory feed ingredients enhanced *Tilapia zillii* growth through enhancing fish capability to eat more feed than normal. Zhang *et al*. (2009) found that ginseng polysaccharides can enhance T and B lymphocyte proliferation *in vitro*. Therefore, it is evident that dietary ginseng can increase lymphocytes proliferation in animals. Various medicinal herbs are now being added to livestock feed as the alternatives to antibiotics due to beneficial effects on palatability and gut functions and antimicrobial actions (Jugl-Chizzola *et al.*, 2006). Also, these results are similar to the previous studies with Nile tilapia when fed 0.5 g green tea/kg diet (Abdel-Tawwab *et al.*, 2010), fed on a 1.0% fennel seed meal/kg diet (Abd El Hakim *et al.*, 2010), or fed on a 1.0% cinnamon/kg diet (Ahmad *et al.*, 2011).

Table 3: Feed intake, feed conversion ratio (FCR), feed efficiency ratio (FER) protein efficiency ratio (PER), apparent protein utilization (APU) and energy utilization (EU) of Nile tilapia, *O. niloticus* fed diets containing different levels of ginseng.

Items	Ginseng levels (mg/kg)					
	0.0	25	50	75	100	125
Feed intake (g feed/fish)	28.38 [f] ±0.20	31.23 [e] ±0.28	33.64 [d] ±0.39	37.98 [c] ±0.55	46.62 [b] ±0.92	49.62 [a] ±0.26
FCR	1.84 [a] ±0.02	1.61 [b] ±0.02	1.56 [b] ±0.02	1.51 [b] ±0.01	1.34 [c] ±0.02	1.38 [c] ±0.06
FER	0.54 [c] ±0.01	0.62 [b] ±0.01	0.64 [b] ±0.01	0.66 [b] ±0.01	0.75 [a] ±0.02	0.73 [a] ±0.03
PER	1.97 [c] ±0.02	2.25 [b] ±0.03	2.32 [b] ±0.03	2.40 [b] ±0.02	2.70 [a] ±0.05	2.64 [a] ±0.12
APU (%)	34.13 [c] ±1.03	38.98 [bc] ±1.74	40.67 [b] ±1.40	43.71 [b] ±0.86	56.65 [a] ±1.43	55.22 [a] ±2.62
EU (%)	18.95 [c] ±0.48	21.91 [b] ±1.18	23.00 [b] ±0.46	24.36 [b] ±0.24	31.69 [a] ±0.91	30.22 [a] ±1.27

Means with the same letter in the same row are not significantly different at $P > 0.05$.

The present study indicated that, dry mater and protein content increased significantly ($P<0.05$) with increasing ginseng level in the diets, while total lipids not affected by increasing ginseng levels. On the other side, body ash content decreased significantly with increasing ginseng level in the diets (Table 4). These results are in agreement with the results obtained by Sakr (2003). Who found indicated that body composition of hybrid tilapia, *Oreochromis niloticus* × *Oreochromis aureus* strongly affected by adding of graded levels of dried marjoram leaves (DML) where protein content increased as the level of DML and dried basil leaves (DBL) increased in the experimental diets. However, deposit of lipid and ash contents decreased with increasing DML and DBL levels in the diets of hybrid tilapia fingerlings. El-Dakar *et al.* (2004) found that deposit of lipid decreased when hybrid tilapia fed graded levels (0, 0.5, 1 and 2 %) of dried marjoram leaves. Furthermore, they showed that shrimp fed 2% marjoram leaves resulted in low lipid deposit in the whole body with increasing protein content and decreased markedly lipid and ash contents. Contrarily, Shalaby (2004) showed that no significant difference (P>0.05) was detected in moisture, crude protein, ether extract, ash, and energy contents of Nile tilapia when fed diets containing various levels of fenugreek seeds. Also, Abd El Hakim *et al.* (2010) and Ahmad *et al.* (2011) found no significant differences in the chemical body composition of Nile tilapia fed diets containing fennel or cinnamon, respectively.

The results of the bacterial challenge test are presented in Table (5). Fish mortality after *A. hydrophila* infection ranged from 0.0% to 30% in ginseng treated groups which were much lower as compared to the control group (90%). Most notable features of ginseng have been suggested to be the modulation of the immune system (Vogler *et al*., 1999 and Dey *et al*., 2003). Palazon *et al*. (2003) reported that ginseng is believed to have immune-stimulatory, anti-fatigue and hepatoprotective physiological effects. Ginseng had an antibacterial activity antagonistic to pathogenic *A. hydrophila* (George Mateljan Foundation, 2007). Similarly, Abdel Wahab *et al.* (2007) found that adding 0.5% cinnamon level in the diet is enough to eliminate harmful microbes in the gut, improve food absorption, and control blood sugar to a certain extent.

Table 4: Proximate composition (%; on dry weight basis) of whole body of Nile tilapia, *O. niloticus* fry fed diets containing different levels of ginseng.

Items	Ginseng levels (mg/kg)					
	0.0	**25**	**50**	**75**	**100**	**125**
Dry matter	26.05 [b] ±0.97	26.92 [b] ±0.72	26.83 [b] ±0.24	26.68 [b] ±0.55	28.86 [a] ±0.57	28.65 [a] ±1.39
Crude protein	67.72 [c] ±0.34	67.968[c] ±0.2	68.12 [bc] ±0.90	68.60 [b] ±0.53	69.76 [a] ±0.40	69.09 [a] ±0.26
Ether extract	16.50 [a] ±0.34	16.17 [a] ±0.62	16.90 [a] ±0.66	17.22 [a] ±0.52	17.97 [a] ±0.44	17.89 [a] ±0.39
Ash	15.78 [a] ±0.58	15.87 [a] ±0.88	14.98 [b] ±0.44	14.18 [b] ±0.57	12.27 [c] ±0.06	13.02 [c] ±0.65

Means with the same letter in the same row are not significantly different at P> 0.05.

Table 5: Mortality rate (%) of Nile tilapia, *O. niloticus* fry fed diets containing different levels of ginseng for 14 weeks and challenged by *A. hydrophila* for 10 days.

Items	Ginseng levels (mg/kg)					
	0.0	**25**	**50**	**75**	**100**	**125**
No. injected fish	10	10	10	10	10	10
Bacterial dose (5x 15 CFU/ml)	0.3 ml	0.3 ml	0.3 ml	0.3 ml	0.3 ml	0.3 ml
Injection route	I / P	I / P	I / P	I / P	I / P	I / P
Mortality rate (%) after 10 days of injection	90	30	20	10	0	0

Economic evaluation of the experimental diets is shown in Table (6). There was a reduction in feed cost to produce 1 kg of fish weight gain by 22.27% for the diet containing 100 mg ginseng/kg diet compared to the control diet. Previous studies showed that the use of spices at small amounts reduced cost and increased profit in feeds of other fish species (Abd El Hakim *et al.*, 2010 and Ahmad *et al.*, 2011). In conclusion, supplementation of Nile tilapia diets with 100 mg ginseng/kg diet can enhance growth performance and feed utilization and improve the health of Nile tilapia fry against bacterial infection.

Table 6: Economic efficiency for production of one kg gain of Nile tilapia, *O. niloticus* fry fed diets containing different levels of ginseng.

Items	Ginseng levels (mg/kg)					
	0.0	**25**	**50**	**75**	**100**	**125**
Price/ kg feed (L.E)	4.04	4.11	4.17	4.23	4.29	4.36
FCR (kg feed/kg gain)	1.84	1.61	1.56	1.51	1.34	1.38
Feed cost / kg gain(L.E)	7.44	6.61	6.50	6.39	5.75	6.01
Reduction in feed cost/ kg gain (%comparing with the control)	0.0	11.16	12,63	7.26	22.72	19.22

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استخدام الجنسنج فى علائق البلطى النيلى التجارية وتأثير ذلك على معدلات النمو والاستفادة من الغذاء وتركيب الجسم ومقاومة بكتيريا أيروموناس هيدروفيلا

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أجريت هذه التجربة لدراسة تأثير إضافة الجنسنج إلى العلائق الغذائية على أداء الأسماك وكفاءة الاستفادة من الغذاء ومناعة أسماك البلطى النيلى ضد البكتريا الممرضة أيروموناس هيدروفيلا .تم تغذية أسماك البلطى النيلى (٠.٧١ جم) على ستة علائق غذائية تحتوى كلاً منها على٣٠ % بروتين خام و ٤٣٦ كيلوكالورى/١٠٠جم عليقة. تم إضافة الجنسنج بمعدل صفر ،٢٥ ،٥٠ ،٧٥ ،١٠٠ و١٢٥ مجم/كجم علف. تم تغذية كل مجموعة من الأسماك على واحدة من هذه العلائق لمدة ١٤ أسبوع فى ثلاث مكررات بمعدل ١٠% من وزن الجسم لمدة ستة أسابيع ثم بمعدل ٨ % الأربعة أسابيع التالية ثم بمعدل ٤ % حتى نهاية التجربة. أظهرت النتائج وجود زيادة معنوية فى نمو الأسماك مع زيادة مستوى الجنسنج فى العليقة حيث كانت أعلى قيمة مع نسبة ١٠٠مجم جنسنج/كجم علف مقارنة بالكنترول .كذلك تحققت أعلى استفادة من العلف المقدم فى المجموعة التى تتغذى على عليقة تحتوى على ١٠٠مجم جنسنج/كجم عليقة، أيضاً ارتفعت كمية الغذاء المأكول وانخفض معامل التحويل الغذائى وزادت نسبة كفاءة البروتين والقيمة الإنتاجية للبروتين والاستفادة من الطاقة معنوياً مع زيادة مستوى الجنسنج فى العليقة حتى ١٠٠مجم جنسنج/كجم عليقة مقارنة بالكنترول. أظهر التحليل الكيماوى لجسم الأسماك ارتفاعاً معنوياً فى نسبة المادة الجافة وكذلك نسبة البروتين مع زيادة نسبة الجنسنج فى العلف، على العكس انخفضت نسبة الرماد معنوياً فى جسم الأسماك مع زيادة نسبة الجنسنج فى العلف، ولم يكن هناك اختلافات معنوية فى نسبة الدهن بين المعاملات المختلفة. فى نهاية التجربة قسمت أسماك كل معاملة إلى قسمين: فى القسم الأول تم حقن الأسماك بمحلول ملحى فى التجويف البطنى للأسماك وفى القسم الثانى تم حقن الأسماك ببكتريا أيروموناس هيدروفيلا الممرضة فى التجويف البطنى للأسماك وتم متابعة نسبة الوفيات يومياً لمدة ١٠ أيام وقد لوحظ قلة نسبة الوفيات مع ارتفاع مستوى الجنسنج فى العلف، ولم تلاحظ أى وفيات فى المجموعات التى تغذت على علائق تحتوى على ١٠٠ ،١٢٥ مجم جنسنج/كجم علف على التوالى. توصى هذه الدراسة باستخدام الجنسنج فى علائق أسماك البلطى النيلى بمعدل ١٠٠مجم جنسنج/كجم علف لتحقيق أكبر استفادة من العلف وزيادة معدل نمو الأسماك و رفع قدرتها على مقاومة البكتريا الممرضة التى قد تتواجد فى البيئة المائية.