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GINGER AS A FEED SUPPLEMENT FOR NILE TILAPIA REARED IN EARTHEN PONDS.

BY

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ABSTRACT

A feeding trial, 115 days, was conducted to evaluate Ginger (*Zingiber officinale*) as growth stimulant. Monosex Nile tilapia (*Oreochromis niloticus* L.) fingerlings with an average of initial fresh body weight 42.85±0.11gm/fish, were obtained from a private farm, in El-Rayan, at El-Fayoum Governorate, ARE. They were acclimated in ¼ Faddan (fdn.) pond for 2 wk. Acclimated fingerlings were allotted to 3 treatments. Each treatment was represented in two hapas, 30 fingerlings/each. Hapas were fixed in an earthen pond, (3 fdn. area × 2m depth), with water column of 1.5m. One third of the water level was replaced daily.

Three diets of similar crude protein and gross energy were arranged to contain Ginger (obtained from the local market) at levels of 0.0, 0.5 and 1.0 % respectively. Diets were fed at a rate of 3% from fish fresh body weight /day, twice daily. Fish were weighed every 15 days, then feeding rate was corrected according to the new biomass. Throughout the experimental period water quality was monitored. Growth performance, survival rates %, body chemical composition and feed utilization parameters were obtained. Also a simple economic evaluation was considered.

Results revealed that the diet contained 0.5 % ginger had better positive response on the studied parameters compared to the other diets (1.0 % ginger diet and the control). However slight positive effect was observed with 1.0% ginger diet compared to the control.

Key words: Feed additives, medicinal plants, ginger, Nile tilapia fish, growth performance, body composition, economics.

INTRODUCTION

To day the use of medicinal plants as feed supplements is accepted in agriculture animals especially mono-gastric ones. This is due to the improvement in animals' performance without health hazards for humans. Ginger is one of the medicinal plants that belongs to the family *Zingiberaceae* and *Zingiber* genus (Huseen, 1981). It has anti-microbial activity (both gram – positive and negative pathogenic bacteria, Srinivasan *et al.*, 2001), reduce blood glucose (in rabbits,

Mascolo *et al.*, 1989), reduce serum and hepatic cholesterol levels and possesses potential cardio tonic activity (Johri and Zutshi, 1992 & Shoji *et al.*, 1982). reduce gastrointestinal problems (Grontved and Henter, 1986 & Yoshikawa *et al.*, 1992), has antioxidant effect (Ahmed *et al.*, 2000), had anti-cancer effect (Yoshikawa *et al.*, 1993, Mahady *et al.*, 2003, Leal *et al.*, 2003) and antiparasitic effect (Adewunmi *et al.*, 1990). The active ingredients in ginger are thought to reside in its volatile oils, which comprise approximately 1 – 3 % of its weight. The concentrations of active ingredients vary with growing conditions. Gingerols oil have analgesic, sedative, antipyretic and antibacterial effects (Connell and Sutherland, 1969, Ding *et al.*, 1991) . About six compounds appear to be important in ginger, especially shogao, which provides the anti-emetic activity (kobayashi *et al.*, 1988). Ginger contains curcumin (like lurmeric) in addition to the phenolic compounds, gingerols and diarylheptanoids, which are high in antioxidants (Watson, 2001).

The present study aimed to investigate the effect of ginger supplements on mono-sex Nile tilapia (*Oreochromis niloticus* L.) growth performance, survival rate, body chemical composition and feed utilization . Also a simple economic evaluation was made.

MATERIALS AND METHODS

The experimental work was carried out in a commercial fish farm at El-Rayan Valley, El-Fayoum Governorate, ARE. The laboratory work was carried out at Animal Production Department, Faculty of Agriculture, El-Fayoum University, El-Fayoum Governorate, ARE.

A feeding trial, 115 days, started on 2/7/2004 was conducted to evaluate Ginger as growth stimulant. Monosex Nile tilapia (*Oreochromis niloticus* L.) fingerlings with an average of initial fresh body weight 42.85±0.11gm/fish, were obtained from a private farm, in El-Rayan, at El-Fayoum Governorate, ARE. They were acclimated in ¼ Faddan (fd.) pond for 2 wk. Acclimated fingerlings were allotted to 3 treatments. Each treatment was represented in two net enclosures (hapas), 30 fingerlings/each. Each hapa, (net enclosure), was of 2m length x 2m width x 1.5m height. Hapas were fixed in an earthen pond, (3 fdn. Area × 2m depth), with water level of 1.5m. The distance between each two hapas was not less than 10m. In such pond, one third of the water level was replaced daily.

Three diets of similar crude protein, CP (%) and gross energy, GE (Kcal/g) were arranged to contain Ginger (*Zingiber officinale*) at levels of 0.0, 0.5 and 1.0 % respectively. Diets composition and chemical analysis are shown in (Table 1). Such medicinal plant was obtained from local market.

Ingredients per each diet were ground and mixed with vitamins and minerals mixture. Line seed oil and molasses were sprayed on the mixture. Water was added to each diet until stiff dough resulted and this was pressed through 2mm die by meat mincer. The resulting materials were dried in oven at 40°C over night and then stored at - 4°C.

During adaptation and experimental period, fish were fed the tested diets at a rate of 3% from their fresh body weight /day, twice daily in two equal portions at 9 a.m. and 2 p.m. Representative fish samples/each hapa were weighed every 15 days, then feeding rate was corrected according to the new biomass.

Throughout the experimental period, growth, survival rate % and feed utilization parameters were obtained. Also, water temperature, pH, dissolved oxygen, ammonia-N and Nitrite were measured (Table 2).

Table (1): Diets ingredients and calculated chemical composition.

Items	Control	Ginger level, %	
		0.5	1.0
Ingredients,%			
Herring fish meal	8.98	8.98	8.98
Soybean meal	19.50	19.50	19.50
Gluten meal	19.20	19.20	19.50
Rice bran	17.50	15.00	15.00
Wheat bran	17.52	19.52	18.72
Yellow corn	10.00	10.00	10.00
Ginger	0.00	0.50	1.00
Molasses	2.00	2.00	2.00
Linseed oil	2.00	2.00	2.00
Dried yeast	2.00	2.00	2.00
Dicalcium phosphate	1.00	1.00	1.00
Vit. & Min. premix[1]	0.30	0.30	0.30
Total	*100*	*100*	*100*
Determined nutrients composition			
DM, %	91.03	90.72	91.75
DM basis			
CP,%	30.28	30.05	29.98
EE,%	6.88	6.76	6.92
CF,%	5.87	6.00	6.03
NFE,%	49.35	49.14	49.10
Ash, %	7.62	8.05	7.97
GE, k cal/g DM[2]	4.63	4.60	4.61
GE, k cal/g DM[3]	4.39	4.35	4.36
CP/GE, mg/kcal[2]	65.44	65.34	65.03
CP/GE, mg/kcal[3]	69.04	69.04	68.73

[1] Each kg contains 2000000 IU vit. A, 400000 IU vit. D_3, 4000 mg vit. E, 300 mg vit K_3, 200mg vit B_1, 800mg vit B_2, 4000mg nicotinic acid, 2.0 mg B_{12}, 2000mg pantothenic acid, 300 mg vit. B_6, 200 mg folic acid, 10mg biotin, 100 mg choline chloride, 1600mg Cu, 156 mg I, 6421 mg Fe, 12800mg Mn, 9000 mg Zn, 32 mg Se, 53mg cobalt and 1400mg ethoxyquine.

Energy values were 5.64, 9.44 & 4.11 k cal / g for protein, lipid &carbohydrates respectively (NRC, 1993)

[2] including CF energy.

[3] excluding CF energy.

Fish samples were taken at the start and at the end of the experiment, weighed, minced, mixed well and kept at –20°C for chemical analysis.

Chemical analysis of the experimental diets and whole body of the experimental fish were conducted according to AOAC (1984) methods.

Total weight gain (TG), average daily gain (ADG), specific growth rate (SGR), feed conversion ratio (FCR), protein efficiency ratio (PER), protein productive value (PPV), energy efficiency ratio (EER), energy utilization (EU) and survival rate (SR) were calculated according to the following equations:

1. TG, g = W2-W1, where,W2 is the final weight of fish in g and W1 is the initial weight of fish in g .
2. ADG, g = Average weight gain, g / Experimental period, day.
3. SGR, % = 100(ln W2-ln W1)/T, where, W2 is the final weight of fish in g, W1 is the initial weight of fish in g, ln is the natural log and T is the time in days.
4. FCR = Feed intake, g / Weight gain, g.
5. PER = Weight gain, g / Protein intake, g.
6. PPV, % = 100 (Retained protein, g / Protein intake, g).
7. EER = Weight gain, g / Energy intake, Kcal.
8. EU = 100 (Retained energy, Kcal / Energy intake, Kcal).
9. SR, % = 100 (Number of fish at end / Number of fish at start)

Economical efficiency was expressed as net returns/fdn and net returns/total costs, %. The analysis of variance and LSD range test were used to compare treatment means where data were analyzed using statistical package for social science (SPSS, 1997), Level of significant was 0.05.

Table (2): Water quality parameters during the experimental period.

Items	[1]Temperature, °C		[2]Dissolved oxygen, mg / L		[3]PH	
	5-8 a.m.	1-3 p.m.	5-8 a.m.	1-3 p.m.	5-8 a.m.	1-3 p.m.
Range	20-29.4	22-31.2	2.9-4.9	6.2-8.9	8.6-8.8	8.5-8.9
Average	27	28.8	3.9	7.7	8.7	8.7
SE	1.3	0.7	0.4	0.3	0.03	0.03
Relative %	100	107	100	197	100	100

Ammonia-N was nil and Nitrite was nil (Sera kits, 5138 Heinsberg, Germany). [1]measured by centigrade thermometer. [2] measured by oxygen meter, Cole Parmer model 5946. [3] measured by Orion digital pH meter model 201. SE is the standard error.

RESULTS

Table 3 shows the effect of ginger level on Nile tilapia growth performance and survival rate. As evident the diet contained 0.5% ginger enhanced ($P \leq 0.05$) final body weight, total gain, daily gain and SGR than the other diets. Increasing ginger level to 1.0% lowered such parameters to be nearly similar to the control. Also such increase (1.0% ginger) was associated with lower survival rate for the tested fish.

Table (3): Effect of ginger level on growth performance and survival rate on Nile tilapia.

Items	Ginger level % in the diet.			SED
	0.0	0.5	1.0	
Initial weight, g /fish.	42.80	42.76	43.00	0.11
Final weight, g/fish.	109.44^{b}	128.92^{a}	106.00^{b}	1.84
Total gain, g/fish.	66.64^{b}	86.16^{a}	63.00^{b}	1.83
Daily gain, g/fish.	0.58^{b}	0.75^{a}	0.55^{b}	0.02
SGR, %.	0.82^{b}	0.96^{a}	0.78^{b}	0.02
Survival rate, %.	100	100	95	2.72

Averages in the same row having different superscripts differ significantly ($P \leq 0.05$).

Table 4 illustrates the effect of ginger level in the diet on body chemical and energy composition of Nile tilapia. Insignificant differences were obtained regarding body DM, CP, EE, Ash and GE.

Table (4): Effect of ginger level in the diet on body chemical composition of Nile tilapia.

Items	Start	Ginger level			SED
		0.0	0.5	1.0	
DM, %	28.36	29.19	31.33	29.23	0.94
Composition on DM basis					
CP, %	56.61	57.56	53.95	53.38	2.18
EE, %	27.48	26.49	30.52	29.75	2.84
Ash	15.91	15.95	15.53	16.87	0.91
GE, kcal / g.	5.989	5.747	5.924	5.819	0.156

Insignificant differences were obtained.

The effect of ginger level in the diet on feed utilization of Nile tilapia is presented in Table 5. The diet contained 0.5% ginger enhanced ($P \leq 0.05$) feed intake, FCR, PPV, EER and EU more than the control. The 1.0 % ginger diet lied in between such diets.

Table (5): Effect of ginger level in the diet on feed utilization of Nile tilapia.

Items	Ginger level,%			SED
	0.0	0.5	1.0	
Feed intake,g/fish/period	239.95	246.56	215.13	15.66
FCR	3.28^{a}	2.6^{b}	3.13^{ab}	0.21
Protein utilization,				
PER	1.01^{b}	1.28^{a}	1.64^{ab}	0.22
PPV, %	17.41	22.21	16.28	2.38
Energy utilization.				
EER	0.087^{b}	0.142^{a}	0.083^{ab}	0.004
EU, %.	8.57^{b}	13.84^{a}	9.11^{ab}	1.15

Averages in the same row having different superscripts differ significantly ($P \leq 0.05$).

Table 6 illustrates the effect of ginger level in the diet on production economics for Nile tilapia. The 0.5% ginger diet increased feeding costs and consequently total production costs than the control and the 1.0% ginger diet respectively. Also it improved fish production and its selling prices, net returns and % net returns / total costs as well as feed cost /kg fish than the control and the 1.0% ginger diet respectively.

Table (6): Effect of ginger level in the diet on production economics for Nile tilapia.

Items	Ginger level, %		
	0.0	0.5	1.0
Offered feed /fdn, kg.	7558.43	7766.67	6437.77
Fish production/fdn, kg	3447.36	4060.98	3172.05
Feed cost/ fdn, LE[1]	15116.85	15610.95	13004.29
Fish cost at the start/ fdn, LE[2]	5355	5355	5355
Other production costs/ fdn[3]	1000	1000	1000
Total production costs/ fdn, LE.	21471.85	21965.95	19359.29
Fish selling price / fed, LE.[4]	24131.52	28426.86	22204.35
Net returns / fdn.			
LE	2659.67	6460.90	2845.06
Relative %	100	442.92	106.97
Net returns / total costs, %.	12.39	29.41	14.70
Feed cost / kg fish, LE.	6.56	5.23	6.32

[1] LE 2.00 for 0% ginger diet, LE 2.01 for 0.5% ginger diet, LE 2.02 for 1.0% ginger diet.
[2] LE 170 / 1000 fingerling.
[3] Labor, equipment, fuel, depreciation, ... etc.
[4] LE 7 / kg fresh fish.

DISCUSSION

In the present study water quality was within the acceptable ranges however the low oxygen at 5 – 8 a.m. (Table 2). Such low level is due to the depletion of oxygen that began after sunset and continued to sunrise.

Ginger is a universal agent that used in folk medicine. It has anti-microbial activity (both gram – positive and negative pathogenic bacteria, Srinivasan *et al.*, 2001), reduce blood glucose (in rabbits, Mascolo *et al.*, 1989), reduce serum and hepatic cholesterol levels and possesses potential cardiotonic activity (Johri and Zutshi, 1992 & Shoji *et al.*, 1982), reduce gastrointestinal problems (Grontved and Henter, 1986 & Yoshikawa *et al.*, 1992), has antioxidant effect (Ahmed *et al.*, 2000), has anti-cancer effect (Yoshikawa *et al.*, 1993, Mahady *et al.*, 2003, Leal *et al.*, 2003) and antiparasitic effect (Adewunmi *et al.*, 1990).

On the other hand Wilkinson (2000) pointed out to ginger's potential harmful effect. He cleared that the rate of spontaneous loss of fetuses was doubled. Miller (1998) and Argento *et al.*, (2000) reported that ginger enhance the anticoagulant effect, leading to an increased risk of bleeding. IG C(2000) cleared that ginger is not very palatable.

Fish that fed the diet contained 0.5% ginger improved fish growth performance (Table 3) and feed utilization (Table 5) more than the other two diets. Consequently it resulted in more production, lower feed cost /kg fish, more net returns and % net returns/total costs, however the higher feed offered (Table 6). Such results and that of above authors suggest that the 0.5% ginger in the diet is adequate and that of 1.0% resulted in sort of unacceptability of the host animal tissues so that it reduced feed intake, feed utilization and growth performance along with an increase in mortality rate.

In conclusion it seams that 0.5% ginger is acceptable as a supplement in Nile tilapia diets to improve its growth performance, feed utilization and profit.

REFERENCES

Adewunmi, C.O.; Oguntimein, B.O. and Furu, P. (1990): Molluscicidal and antischistosomal activities of zingiber officinal. Planta. Med. 56: 374 – 376.

Ahmed, R.S.; Seth, V. and Banerjee, B.D. (2000): Influence of dietary ginger (*Zingiber officinales* Rosc.) on antioxidant defense system in rat: comparison with ascorbic acid. Indian J. Exp. Biol., 38: 604 – 606.

AOAC (1984): Official methods of analysis. S. Williams ed. Association of Official analytical chemists, Inc. Arlington, Virg.,USA.

Argento, A.; Tiraferri, E. and Marzaloni, M. (2000): Oral anticoagulants and medicinal plants. An emerging interaction. Ann. Ital. Med. Int. 15: 139-143.

Connell, D. and Sutherland, M. (1969): A re-examination of gingerol, shogaol and zingerone, the pungent principles of ginger (*Zingiber officinale* Roscoe). Aust. J. chem., 22: 1033 – 1043.

Ding, G.H.; Naora, K.; Hayashibara, M.; Katagin, Y.; Kano, Y. and Iwamoto, K. (1991): Pharmacokinetics of 6-gingerol after intravenous administration in rats. Chem. Pharm. Bull (Tokyo), 39: 1612 – 1614.

Grontved, A. and Hentzer, E. (1986): Vertigo-reducing effect of ginger root. A controlled clinical study. Orl. J. Otorhinolaryngol. Relat. Spec., 48: 282 – 286.

Huseen, F.T.K. (1981): Medicinal plants " Its culture and composition" Dar Elmarrich, Alread, Saudi-Arebia (Arabic text book).

IGC (2000): Ginger . Indian Gyan. Com Pvt Ltd

Johri, R.K. and Zutshi, U. (1992): Ayurvedic formulation 'Trikatu' and its constituents. J. Ethnopharmacol.,37: 85 – 91.

Kobayashi, M.; Ishida, Y.; Shoji, N. and Ohizumi, Y. (1988): Cardiotonic action of 8- gingerol, an activator of the Ca++ pumping adenosine triphosphatase of sarcoplasmic reticulum, in guinea pig atrial muscle. J. pharmacol. Exp. Ther.,246: 667 – 673.

Leal, P.F.; Braga, M. E.; Sato D.N.; Carvalho, J.E.; Marques, M.O.. and Meireles, M.A. (2003): Functional properties of spice extracts obtained via supercritical fluid extraction. J. Agric. Food Chem. 51: 2520 – 2525.

Mahady, G.B.; Pendland, S.L.; Yun, G.S.; Lu, Z.Z. and Stoia, A. (2003): Ginger (*Zingiber officinale* Roscoe) and gingerols inhibit the growth of Cag A + strains of Helicobacter pylori. Anticancer Res.,23:3699 – 3702.

Mascolo, N.; Jain, R. and Capasso, F.(1989) Ethnopharmacologic investigation of ginger (*Zingibar officinale*). J. Ethnopharmacol.,27: 129 - 140

Miller, L.G. (1998): Herbal medicinal: selected clinical considerations focusing on known or potential drug-herb interaction. Arch. Intern. Med. 158 2200-2211.

NRC (1993): Nutrient requirements of fish. National Research Council, National Academy Press, Washington, DC, USA.

Shoji, N.; Iwasa, A.; Takemoto, T.; Ishida, Y. and Ohizumi, Y. (1982): Cardiotonic principles of ginger (*Zingiber officinale* Roscoe). J. Pharm. Sci., 71: 1174 – 1175.

Srinivasan, D.; Nathan, S.; Suresh, T. and Perumalsamy. P.L .(2001): Antimicrobial activity of certain Indian medicinal plants used in folkloric medicine. J. Ethnopharmacol., 74: 217 – 220.

Watson, R.R.. (2001): Vegetables, fruits and herbs in health promotion. CRC Press, Chapter 12, 180p.

Wilkinson, J.M. (2000): What do we know about herbal morning sickness treatments? A literature survey. Midwifery, 16: 224 – 228.

Yoshikawa. M.; Hatakeyama, S.; Chatani, N.; Nishino, Y. and Yamahara, J .(1993): Qualitative and quantitative analysis of bioactive principlesin zingiberis rhizoma by means of high performance liquid chromatography and gas liquid chromatography. On the evaluation of zingiberis rhizoma and chemical change of constituents during zingiberis rhizoma processing. Yakugaku Zasshi, 113: 307 – 315.

Yoshikawa. M.; Hatakeyama, S.; Taniguchi, K.; Matuda, H.; Yamahara, J. (1992): 6-Gingesulfonic acid, a new anti-ulcer principle, and ginger glycolipids A, B, and C, three new monoacyldigalactosylglycerole, from zingiberis rhizoma originating in Taiwan. Cem. Pharm. Bull., Tokyo, 40: 2239 – 2241.

الزنجبيل كمضاف غذائي في علائق البلطي النيلي المربى في الأحواض الأرضية

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أجريت تجربة تغذية (١١٥ يوم) لتقييم الزنجبيل; كمنشط نمو للبلطي النيلي أحادي الجنس (٤٢,٨٥ جم وزن ابتدائي للسمكة) ، والذي تحصل عليه من مزرعة خاصة بوادي الريان ، بمحافظة الفيوم، ج م ع .واقلمت في حوض ¼ فدان لمدة أسبوعين . وزعت الأسماك المؤقلمة على٣ مجاميع حيث مثلت كل منها في حاويتين شبكيتين (هابتان)، بكل منها ٣٠ إصبعية. ووضعت الهابات في حوض أرضي (المساحة ٣فدان مع ٢ م عمق مع ١,٥م عمود مياه). وتم تغيير ثلث منسوب المياه يوميا.

كونت ثلاثة علائق متماثلة البروتين والطاقة تحتوى الزنجبيل بمستويات صفر، ٠,٥ ، ١,٠ %. وغذيت العلائق بنسبة ٣ % من وزن الجسم/اليوم . وتم وزن السمك كل ١٥ يوم مع تصحيح معدل التغذية تبعا لذلك. وخلال التجربة تم مراقبة نوعية المياه . وأخذت بيانات النمو والإعاشة ومكونات الجسم، والانتفاع بالغذاء. واجري أيضا تقييم اقتصادي بسيط.

أوضحت النتائج الفضلية العليقة التي احتوت ٠,٥ % زنجبيل بالمقارنة ببالقي العلائق (١,٠% زنجبيل و الكنترول).