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EFFECT OF DIFFERENT SOURCES AND LEVELS OF SOME DIETARY BIOLOGICAL ADDITIVES ON: I-GROWTH PERFORMANCE AND PRODUCTION ECONOMY OF NILE TILAPIA FISH

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ABSTRACT

The present study aimed to investigate the effect of dietary graded levels of Aqua Superzyme, Garlen Allicin, and Diamond V (Original XPC) on the growth performance and economic production of Nile tilapia fish (10 g initial bodyweight) for 16 weeks in indoor feeding experiment. The obtained results revealed that the best treatment was the probiotic Diamond V- Original XPC at 0.5 % of the diet which was responsible for the significantly ($P \leq 0.05$) best final bodyweight, total bodyweight gain, relative growth rate, specific growth rate, survival rate, condition factor (based on total length), return and economic efficiency among all tested materials and levels. So. It is recommended to use the feed additive Diamond V-Original XPC at 0.5% of the Nile tilapia diet for improving the growth performance, survival, and production economy.

Keywords: Prebiotic – probiotic – performance – economy - tilapia

INTRODUCTION

Probiotics (specific microbial feeds with potential benefits to the host), and prebiotics (dietary components such as complex carbohydrates able to change the colonic microenvironment fostering colonization with non-enteropathogens) are areas of current interest because they offer alternatives for the management of the growing problem of multiple antibiotic resistance and overwhelming infections in the hospitalized patient (Castillo, 2008). With increasing demand for environment friendly aquaculture, the use of probiotics in aquaculture is now widely accepted (Wang *et al*., 2008). Hence, many studies were conducted to examine the effect of probiotics on Nile tilapia *O. niloticus* growth performance (Allam, 2007 and Marzouk *et al*., 2008). Also, many studies revealed the positive effects of probiotics on different *O. niloticus* stages such fry (Abdelhamid *et al*., 2012 and Abdel-Tawwab, 2012) and fingerlings (Mehrim, 2009 and Khalafalla, 2010). Results showed that dietary supplementation of *B. subtilis* at a dose of 1.35×10^{7} cfu g^{-1} improved growth of juvenile large yellow croaker, *L. crocea* (Ai *et al*., 2011). Many products are commercially found in the local market; therefore, the present investigation aimed to compare among three different pre-and probiotics at three graded levels (besides control free of such additives) concerning their effects on growth performance and production economy of Nile tilapia fish in indoor feeding experiment for 16 weeks.

MATERIALS AND METHODS

Experimental facilities:

Thirty glass aquaria with dimensions of 60 x 75 x 50 cm (W, L, D) were used at triplicates/treatment. All male mono-six (treated with 17 α-methyl-testosterone) Nile tilapia, *Oreochromis niloticus,* fingerlings were obtained from fish hatchery of the Cent. Lab. of Aqua. Res., Abbasa, Abou-Hammad. After arrival, fish were kept under the same environmental conditions and placed in fiberglass tanks for 2 weeks as adaptation period to alleviate stresses during transportation and to be adapted to new conditions. Fish were fed the control diet containing 30 % crude protein for two weeks, during this period healthy fish of the same weight replaced the dead ones (Tables 1 and 2).

Fifteen fish/aquarium of the same initial body weight (10 g/fish) were selected and randomly distributed into ten experimental treatments (3 per- and/or probiotics x 3 levels of each + control) in triplicates. Each aquarium was supplied with compressed air via air-stones using aquarium air pumps. Settled fish wastes with one half of aquarium's water were removed daily by siphoning and water volumes were replaced by dechlarinated aerated tap water from the storage tank. Water temperature range was (26 – 28 °C). Each diet was given to fish at a rate of 3 % of live body weight twice daily at 9 am and 1 pm. The appointed quantity of diet was offered to fish 6 days a week throughout the experimental period.

Fish in each aquarium were weighed biweekly and the amounts of the required feed were readjusted according to the actual body weight. The dead fish was daily recorded and removed. At the end of study, fish were individually weighed and weights and lengths were measured.

Table 1: Scheme of the experimental conditions.

Treatment No.	**3X3**
Replication No.	3
Stocking rate, fish/aquarium	15 fish
Initial weight, g	10 g
Aquarium dimensions, cm	60 x 75x 50
Water value, L/aquarium	180
Adaptation period, d	14
Experimental period, d	112 day
Daily feeding rate, % biomass	3
Photoperiod, h	12/12

Table 2: Dietary levels of the experimented pre-and/or probiotics.

Treat.	Aqua Superzyme	Garlen Allicin	Diamond V (Original XPC)
T0	control		
T0	control		
T0	control		
T1	0.01%	0.01%	0.4%
T1	0.01%	0.01%	0.4%
T1	0.01%	0.01%	0.4%
T2	0.02%	0.02%	0.5%
T2	0.02%	0.02%	0.5%
T2	0.02%	0.02%	0.5%
T3	0.03%	0.03%	0.6%
T3	0.03%	0.03%	0.6%
T3	0.03%	0.03%	0.6%

Feed additives:

Three preparations of commercial prebiotics/probiotics were used, mainly Aqua Superzyme, Garlen Allicin, and Diamond V (Original XPC) to test the effect of their graded levels on the productive performance of Nile tilapia fingerlings. The composition of these preparations, as claimed by the manufacturers, are shown in Tables 3, 4, and 5.

Table3:Minimum guaranteed analysis of Preparation No.1 (A) (Aqua Superzyme), each 1000 g prebiotic contain:

Sodium butyrate	**250 g**
Zinc methionise	250 g
Lipase	200 g
Phytase	500 FTU
Cellulase	200 U
Hylanase	10.000U
B- gluconase	2000U
Protease	1000U
Amylase	200U
Calcium carbonate	up to 1000 g

Origin: Norel- Spain & www.norelnature.com. Importer: Mediavet CO., for import & export 5 Al Kholfaa El Rashdeen St.,- Kafr El Sheikh- Egypt. www.mediaavet.com

Table 4: Analysis of preparation No. 2 (Garlen Allicin), probiotic (G).

Item	Specification	Result	Test Method
Active Ingredients			
Assay(ppm)	Allicin content (24%-26%)	25.10%	HPLC
Physical Control			
Appearance	Powder	Complies	Visual
Color	White	Complies	Visual
Sieve Analysis	100% thru 80 mesh	Complies	Mesh Screen
Chemical Control			
Heavy metals	NMT 20 ppm	Conforms	Atomic Absorption
Arsenic(As)	NMT20 ppm	Conforms	Atomic Absorption
Lead (pb)	NMT0.5ppm	Conforms	Atomic Absorption
Microbiological Control			
Total Plat Count	10,000 cfn/Max	Conforms	AOAC
Yeast & Mold	300 cfu/g Max	Conforms	AOAC
E.Coli	Negative	Negative	AOAC
Salmonella	Negative	Negative	AOAC
Staph Aureus	Negative	Negative	AOAC
Pseudomonas aeruginosa	Negative	Negative	USP

Product Name: Allicin Powder extra(Allicin 25%) bled of volatile oils 10%. Origin: Hefel Royal Eagle- China. Importer: Mediavet CO., for import & export 5 Al Kholfaa El Rashdeen St.,- Kafr El Sheikh- Egypt. www.mediaavet.com

Experimental diets:

Chemical composition of feedstuff used in this study is presented in Table 6. Ingredient composition of the experimental diets for the1st, 2nd and 3rd experiments are presented in Tables 7, 8, and 9 respectively. Fishmeal and soybean meal were used as sources of animal and plant protein sources, respectively, wheat bran and wheat milling by product were added in a constant percent for both (15% of diet) in all the experimental diets as energy sources. Wheat milling by products served as a bender agent. Fish meals were replaced by corn starch to give a different protein levels. Vitamin and mineral premixes were added with 2 % for each diet. Composition of the vitamins and minerals premix is presented in Table 10.

Table 5:Analysis of preparation No. 3 (Diamond V (Original XPC), probiotic.

Crude protein	**min. 12.0%**
Lysine	min. 0.35%
Methionine	min. 0.08%
Crude fat	min. 3.0%
Crude fiber	max. 6.5%
Ash	max. 6.5%
NFE	max. 54.5%
Manganese	min. 23mg/Kg
Phosphorus	min. 6000 mg/Kg
Potassium	min. 1.25%
Biotin	min. o.2 mg/Kg
Niacin	min. 70 mg/ Kg

Diamond V XP Yeast Culture, Diamond V Mills, Cedar Rapids, Iowa, USA). Manufactured by Diamond V(Original XP) Mills, Inc. Cedar Rapids, Iowa U.S.A. 52407. Importer: EGYVET-CARE & El-Mehala Alkobra 10 Ammar Ibn Yasser St. www. Egyvet_care@yahoo.com. Active viable microorganisms: *Saccharomyces cerevisiae* yeast and the media on which it was grown, consisting of ground yellow maize, homing feed, wheat middling, rye middling, diastatic malt and maize syrup, and cane molasses.

Table 6: Chemical composition (% dry matter basis) of feedstuff used in the experimental diets.

Ingredient	**CP**	**EE**	**CF**	**NFE**	**Ash**	**GE[1] kcal/100 g**
Fishmeal [2]	71.90	9.14	0.6	2.01	16.35	501
Soybean meal [3]	48.50	0.90	3.40	40.70	6.50	453
Wheat bran [4]	16.40	4.0	9.90	64.40	5.30	401
Wheat milling By-product [5]	17.0	4.30	8.0	66.10	4.60	414
Corn starch [6]	0.20	Trace	0.08	99.64	0.080	420

1- Calculated using factors of 5.65, 9.45 and 4.2 Kcal per g of protein, fat and carbohydrates, respectively (NRC, 1993). 2- Hearing fish meal , Revisen , Co., Denmark. 3- Kafr EL- Zayyat Extracted Oils Company, Kafr EL-Zayyat, Egypt (48%). 4-5- East Delta , Millis Co., EL-Arish, North Sinai, Egypt. 6- Egyptian company for glucose & Corn starch industry (Qrnish El-Nile-Torah-Costatica.

Table 7: Ingredients composition (g/100 g) and chemical analysis (% dry matter basis) of the experimental diets used in the 1st additive (A).

Ingredients	Aqua Superzyme (A) levels			
	0	A1	A2	A3
Fish meal	10	10	10	10
Soybean meal	44	44	44	44
Wheat milling by product	15	15	15	15
Yellow corn	21.38	21.38	21.38	21.38
Corn starch	2.0	1.99	1.98	1.97
O il mixture [1]	4.62	4.62	4.62	4.62
Vitamin premix [2]	1.0	1.0	1.0	1.0
Mineral premix [3]	2.0	2.0	2.0	2.0
Aqua Superzyme	0.0	0.01	0.02	0.03
Total	100	100	100	100
Chemical analysis				
Dry matter	92.55	92.55	92.56	92.94
Crude protein	30.0	30.02	30.16	29.9
Ether extract	6.65	6.71	6.47	6.72
Crude fiber	2.15	2.37	2.20	2.28
Ash	4.95	3.29	5.25	4.87
Carbohydrate	55.73	57.60	55.90	56.21
Calculated energy value				
Gross energy [4] (Kcal / Kg)	479.51	486.14	476.83	479.35
Digestible energy (Kcal / Kg)	4040	4100	4020	4040
Metabolize energy (Kcal /Kg)	2610	2620	2590	2600
Protein to energy ratio P /E ratio mg CP / Kcal	75.38	73.10	74.91	73.89
CHO / CP ratio [5]	1.85	1.92	1.85	1.88

1- Sunflower oil : cod liver oil with ratio of 1:1.

2-3- Minerals and vitamins premix composition is presented in Table 10.

4- Calculated by using factors of 5.65, 9.4 and 4.2 Kcal per gram of protein, fat and nitrogen free extract, respectively (NRC, 1993).

5- CHO/CP ratio. Means carbohydrate to protein ratio.

Table 8:Ingredients composition (g/100 g) and chemical analysis (% dry matter basis) of the experimental diets used in the 2nd additive (G).

Ingredients	Garlen Allicin (G) levels			
	0	G1	G2	G3
Fish meal	10	10	10	10
Soybean meal	44	44	44	44
Wheat milling by product	15	15	15	15
Yellow corn	21.38	21.38	21.38	21.38
Corn starch	2.0	1.99	1.98	1.97
Oil mixture [1]	4.62	4.62	4.62	4.62
Vitamin premix [2]	1.0	1.0	1.0	1.0
Mineral premix [3]	2.0	2.0	2.0	2.0
Garlen Allicin 25%	0.0	0.01	0.02	0.03
Total	100	100	100	100
Chemical analysis				
Dry matter	92.55	92.82	93.06	94.15
Crude protein	30.0	29.97	30.03	29.86
Ether extract	6.65	6.72	6.61	6.54
Crude fiber	2.15	2.37	2.20	2.28
Ash	4.95	5.33	4.26	5.5
Carbohydrate	55.73	55.59	56.89	55.82
Calculated energy value				
Gross energy [4] (Kcal / Kg)	479.51	477.54	481.52	475.69
Digestible energy (Kcal / Kg)	4040	4020	4070	4010
Metabolezable energy (Kcal /Kg)	2610	2590	2610	2800
Protein to energy ratio P /E ratio mg CP / Kcal	75.38	73.11	73.80	74.40
CHO / CP ratio [5]	1.85	1.85	1.89	1.87

1- Sunflower oil : cod liver oil with ratio of 1:1.

2-3- Minerals and vitamins premix composition is presented in Table 10.

4- Calculated by using factors of 5.65, 9.4 and 4.2 Kcal per gram of protein, fat and nitrogen free extract, respectively (NRC, 1993).

5- CHO/CP ratio. Means carbohydrate to protein ratio.

Table 9: Ingredients composition (g/100 g) and chemical analysis (% dry matter basis) of the experimental diets used in the 3rd additive (XPC).

Ingredients	Diamond V (XPC) levels			
	0	XPC1	XPC2	XPC3
Fish meal	10	10	10	10
Soybean meal	44	44	44	44
Wheat milling by product	15	15	15	15
Yellow corn	21.38	21.38	21.38	21.38
Corn starch	2.0	1.6	1.5	1.4
Oil mixture [1]	4.62	4.62	4.62	4.62
Vitamin premix [2]	1.0	1.0	1.0	1.0
Mineral premix [3]	2.0	2.0	2.0	2.0
XPC	0.0	0.4	0.5	0.6
Total	100	100	100	100
Chemical analysis				
Dry matter	92.55	93.37	92.90	93.27
Crude protein	30.0	30.18	30.5	29.91
Ether extract	6.65	6.33	6.40	6.56
Crude fiber	2.15	2.37	2.20	2.28
Ash	4.95	4.96	4.76	5.71
Carbohydrate	55.73	56.15	56.11	55.53
Calculated energy value				
Gross energy [4] (Kcal / Kg)	479.51	477.36	488.22	475.01
Digestible energy (Kcal / Kg)	4040	4020	4040	4000
Metabolezable energy (Kcal /Kg)	2610	2580	2600	2580
Protein to energy ratio P /E ratio mg CP / Kcal	75.38	74.95	75.50	74.65
CHO / CP ratio [5]	1.85	1.86	1.84	1.85

1- Sunflower oil : cod liver oil with ratio of 1:1.
2-3- Mineral and Vitamin premix composition is presented in Table 10.
4- Calculated by using factors of 5.65, 9.4 and 4.2 Kcal per gram of protein, fat and nitrogen free extract, respectively (NRC, 1993).
5- CHO/CP ratio. Means carbohydrate to protein ratio.

Table 10: Composition (/kg) of vitamins and minerals premix* used in the experimental diets.

Ingredient	Concentration
Vitamin A	15000 Iu
Vitamin D_3	15000 Iu
Vitamin E	2 mg
Vitamin K_3	2 mg
Vitamin B_1	2 mg
Vitamin B_2	2.5 mg
Nicotine amide	10 mg
Vitamin B_6	3 mg
Vitamin B_{12}	5 mcg
Folic acid	2 mg
Ca – d –Pantothenate	5.5 mg
Calcium	200 g
Phosphate	90 g
Sodium	40 g
Cupper	2.5 g
Magnesium	48 g
Manganese	3.6 g
Zinc	23.5 g
Iron	8 g
Cobalt	450 mg
Iodine	200 mg
Selenium	20 mg

***Super Vit , Arab Veterinary Industrial Co. (Avico), Jordan.**

***Eco Vit , Egyptian veterinary produced and feed a additives Co., Damiatta, Egypt**.

Experimental conditions:

Fish were reared in fresh water. Temperature, pH, dissolved oxygen and photoperiod values were 28±2 ˚C , 8.5±0.2 , 7 ppm and 12/12 hours light/darkness, respectively. Water exchange rate was 30 % daily of the total volume of rearing water.

Chemical analysis of diets:

The tested diets were analyzed in triplicates. Chemical analysis was carried out according to the methods described by A.O.A.C. (1990) for dry matter, crude protein, ether extract, crude fiber and ash. Nitrogen free extract (carbohydrate) content was calculated by subtraction the total percentages of CP, EE, CF and ash from 100. The gross energy contents of the experimental diets and fish samples were calculated by using factors of 5.65, 9.45 and 4.2 Kcal/g of protein, lipid and carbohydrate, respectively (NRC, 1993). Digestible energy content was calculated from standard physiological fuel values as 4, 4 and 9 Kcal/g of protein, carbohydrate and lipid, respectively (Garling and Wilson, 1976).

Measurements and calculations:

Gain, average daily gain (ADG), percentage average daily gain (ADG %), and specific growth rate (SGR %) were calculated according to the following equations:

Gain =final fish weith (g) – initial fish weith (g).

Gain % = Gain of fish (g) / initial weith of fish (g) X 100.

ADG = Gain (g) / time (day).

ADG % = {ADG / Initial weight of fish (g)}X 100.

SGR = 100 X{(In W_2 – In W_1) / T}

Where..... W_2 is the final weight of fish (G).

Where..... W_1 is the initial weight of fish (G).

In: is natural log.

T: is the period (day).

Condition factor (K) = {(Final weight) / (Final Length) ^{3} } X 100

Cost – benefit analysis:

Cost – benefit analysis was used to express the economic analysis due to the cost of feed and their profitability according to New (1987).

Incident cost (IC):

Incident cost is expressing the cost of feed consumed to produce one kilogram fresh fish. IC = cost of feed consumed / kg fish produced.

Profit index (PI):

Profit index (PI) is expressed as the value of fish produced divided cost of feed.

PI = Price of fish produced / price of feed consumed.

The prices in LE/Kg (year 2012) for fish 7.000, control diet 4.087, Aqua 0.01% diet 4.096, Aqua 0.02% diet 4.0105, Aqua 0.03% diet 4.114, Garlen 0.01% diet 4.099, Garlen 0.02% diet 4.112, Garlen 0.03% diet 4.124, XPC 0.4 % diet 4.147, XPC 0.5% diet 4.162, and XPC 0.6% diet 4.177.

Statistical analysis:

Data obtained were analyzed using one-way analysis of variance. All statistical analysis were performed according to **SAS (2006)**. Differences were subjected to **Duncan's (1955).** Multiple Range – test.

RESULTS AND DISCUSSION

Growth performance:

Gain and survival:

The next tables present the mean values of growth performance parameters of the experimented tilapia fish fed the Aqua Superzyme containing experimental diets (Table 11), the Garlen Allicin probiotic containing experimental diets (Table 12), and the Diamond V (Original XPC) probiotic containing experimental diets (Table 13), concerning initial bodyweight (IW), final bodyweight (FW), total weifgt gain (TWG), average daily gain (ADG), relative growth rate (RGR), specific growth rate (SGR), and survival rate (SR).

The data cleared that all of the pre- and probiotics used in the present study led to significant ($P \leq 0.05$**)** improvements in all tested criteria

comparing with their controls (without additives); although, there were no significant ($P \geq 0.05$) differences among the initial body weights. A_1, G_1, and XPC_2 were the best treatments, comparing with their other levels (Tables 11, 12, and 13, respectively).

Table 11:Growth performance of Nile tilapia (*O. niloticus*) fish fed the Aqua Superzyme containing experimental diets.

Treat.	IW (g)	FW(g)	TWG (g)	ADG (mg)	RGR (%)	SGR (%/d)	SR(%)
Cont.	10.90	39.86^{c}	28.96^{c}	258.57^{c}	266.16^{c}	1.15^{c}	85.49^{b}
A_1	10.79	52.81^{a}	42.02^{a}	375.18^{a}	389.20^{a}	1.41^{a}	95.95^{a}
A_2	10.95	46.81^{b}	35.85^{b}	320.15^{b}	327.33^{b}	1.29^{b}	94.33^{a}
A_3	10.45	45.39^{b}	34.94^{b}	312.02^{b}	334.40^{b}	1.31^{b}	89.16^{ab}
P > F	0.106	0.0001	0.0002	0.0002	0.0005	0.0006	0.021
± SE	0.135	1.01	1.04	9.31	11.38	0.025	2.0

a-c: means in the same column having different letters are significantly ($P \leq 0.05$) different.

Table 12:Growth performance of Nile tilapia (*O. niloticus*) fed the Garlen Allicin probiotic containing experimental diets.

Treat.	IW (g)	FW(g)	TWG (g)	ADG (mg)	RGR (%)	SGR (%/d)	SR(%)
Cont.	10.90	39.86^{d}	28.96^{d}	258.57^{d}	266.16^{d}	1.15^{d}	85.49^{b}
G_1	10.86	62.43^{a}	51.56^{a}	460.41^{a}	474.66^{a}	1.56^{a}	97.77^{a}
G_2	11.05	52.27^{b}	41.21^{b}	368.00^{b}	372.83^{b}	1.39^{b}	95.83^{ab}
G_3	11.08	47.25^{c}	36.16^{c}	322.89^{c}	326.30^{c}	1.29^{c}	93.59^{ab}
P > F	0.733	0.0001	0.0001	0.0001	0.0001	0.0001	0.124
± SE	0.166	0.91	0.89	8.01	9.24	0.02	3.34

a-d: means in the same column having different letters are significantly ($P \leq 0.05$) different.

Table 13:Growth performance of Nile tilapia (*O. niloticus*) fed the Diamond V (Original XPC) probiotic, containing experimental diets.

Treat.	IW (g)	FW(g)	TWG (g)	ADG (mg)	RGR (%)	SGR (%/d)	SR(%)
Cont.	10.90	39.86^{d}	28.96^{c}	258.57^{c}	266.16^{c}	1.15^{c}	85.49^{b}
XPC_1	10.79	67.21^{b}	56.42^{b}	503.75^{b}	522.93^{b}	1.63^{b}	93.75^{a}
XPC_2	10.95	75.35^{a}	64.39^{a}	574.97^{a}	587.86^{a}	1.72^{a}	100^{a}
XPC_3	10.45	63.13^{c}	52.68^{b}	470.41^{b}	504.23^{b}	1.60^{b}	97.77^{a}
P > F	0.106	0.0001	0.0001	0.0001	0.0001	0.0001	0.016
± SE	0.13	1.17	1.25	11.18	15.21	0.025	2.52

a-c: means in the same column having different letters are significantly ($P \leq 0.05$) different.

Table 14 presentes the comparison effect of the three treatments (additives) and three addition levels (besides the control). The best FW (75.35 g), TWG (64.39 g), RGR (587.86 %), SGR (1.72 %/d), and SR (100 %) was 3*2 (XPC_2 , the probiotic Diamond V- Original XPC at 0.5 % of the diet).

Table 14: Comparison (treatment, T * level, L) of growth performance of Nile tilapia fish (*O. niloticus*) fed the Aqua Superzyme, Garlen Allicin, and Diamond V (Original XPC) containing experimental diets.

T *L	IW (g)	FW(g)	TWG (g)	ADG (mg)	RGR (%)	SGR (%/d)	SR(%)
Cont.	10.90	39.86^{f}	28.96^{f}	258.57^{f}	266.16^{f}	1.15^{f}	85.49^{c}
1*1	10.79	52.81^{d}	42.02^{d}	375.18^{d}	389.20^{d}	1.41^{d}	95.95^{ab}
1*2	10.95	46.81^{e}	35.85^{e}	320.15^{e}	327.33^{e}	1.29^{e}	94.33^{ab}
1*3	10.45	45.39^{e}	34.94^{e}	312.02^{e}	334.40^{e}	1.31^{e}	89.16^{bc}
2*1	10.86	62.43^{c}	51.56^{c}	460.41^{c}	476.66^{c}	1.56^{c}	97.77^{ab}
2*2	11.05	52.27^{d}	41.21^{d}	368.0^{d}	372.83^{d}	1.39^{d}	95.83^{ab}
2*3	11.08	47.52^{e}	36.16^{e}	322.89^{e}	326.30^{e}	1.29^{e}	93.59^{abc}
3*1	10.79	67.21^{b}	56.42^{b}	503.75^{b}	522.93^{b}	1.63^{b}	93.75^{abc}
3*2	10.95	75.35^{a}	64.39^{a}	574.97^{a}	587.86^{a}	1.72^{a}	100^{a}
3*3	10.45	63.13^{c}	52.68^{c}	470.41^{c}	504.23^{bc}	1.60^{bc}	97.77^{ab}
P > F	0.0082	0.0001	0.0001	0.0001	0.0001	0.0001	0.0362
± SE	0.117	1.07	1.089	9.731	11.724	0.0214	2.668

a-f: means in the same column having different letters are significantly (P ≤ 0.05) different.

Amer (2012) concluded that *Diamond V XP* (inactive yeast a commercial product containing 100% dried *Saccharomyces Cerevisae* distributed by *DIAMOND V mils*, Cidar Rapids, IOWA, and USA) could be used successfully as feed additive for feeding Nile tilapia *Oreochromis niloticus* without any adverse effects on their productive performance. Generally, it improves growth performance than control diet. Also, results obtained showed that using *Diamond V XP* at level (1.5g) had the best results on productive with levels of protein (30 %). Moreover, it could be suggested that dietary supplement with Diamond *V XP* (1.5g) is useful in the intensive production system of fish.

Hassan (2013) obtained results concerning the effects of the probiotic Hydroyeast Aquaculture® on adult male *O. niloticus* showed that the 15 g/kg diet realized best significantly (P ≤ 0.05) values for final body weight, average weight gain, average daily gain, relative growth rate, and specific growth rate. However, about adult females' *O. niloticus,* the 10 g probiotic/kg diet was the best treatment concerning the significantly (P ≤ 0.05) improvement of the growth performance parameters (final body weight, AWG, RGR, ADG and SGR). So, based on the obtained results, the optimum level of the tested probiotic Hydroyeast Aquaculture® was depinding on fish sex.

Condition factor:

Data of the condition factor (K) for the experimented fish fed the Aqua Superzyme containing experimental diets (Table 15), the Garlen Allicin probiotic containing experimental diets (Table 16), and the Diamond V (Original XPC) probiotic containing experimental diets (Table 17) were calculated on the bases of standard and total lengths, respectively, It revealed that the significantly ($P \leq 0.05$) highest level among the tested levels of each additive was of A_1, G_1, and XPC_1 for both K_1 and K_2. However, all additives used raised the condition factor comparing with their controls, but Diamond V (Original XPC) was responsible for the highest k-factors comparing with the other additives.

Table 15:Condition factor of Nile tilapia (*O. niloticus*) fed the Aqua Superzyme prebiotic of the experimental diets.

Treat	K_1 (standard length basis)	K_2 (total length basis)
Control	5.40 ^{b}	2.91 ^{b}
A_1	8.13 ^{a}	4.39 ^{a}
A_2	6.94 ^{ab}	3.89 ^{a}
A_3	6.60 ^{ab}	3.52 ^{ab}
P > F	0.0723	0.0297
±SE	0.605	0.277

a-b: means in the same column having different letters are significantly ($P \leq 0.05$) different.

Table 16:Condition factor of Nile tilapia (*O. niloticus*) fed the Garlen Allicin probiotic of the experimental diets.

Treat	K_1 (standard length basis)	K_2 (total length basis)
Control	**5.40 ^{b}**	**2.91 ^{b}**
G_1	**8.09^{a}**	**4.47 ^{a}**
G_2	**6.58 ^{ab}**	**3.69 ^{ab}**
G_3	**6.27 ^{ab}**	**3.65 ^{ab}**
P > F	**0.0488**	**0.0588**
±SE	**0.553**	**0.326**

a-b: means in the same column having different letters are significantly ($P \leq 0.05$) different.

Table 17: Condition factor of Nile tilapia (*O. niloticus*) fed the Diamond V (Original XPC) probiotic of the experimental diets.

Treat	K_1 (standard length basis)	K_2 (total length basis)
Control	5.40 ^{b}	2.91 ^{b}
XPC_1	10.08^{a}	5.29 ^{a}
XPC_2	9.74 ^{a}	5.33 ^{a}
XPC_3	8.82 ^{a}	4.75 ^{a}
P > F	0.0009	0.0003
±SE	0.528	0.326

a-c: means in the same column having different letters are significantly ($P \leq 0.05$) different.

Table 18 illustrates the comparison data of K-factor, it showes that the highest K-factor based on total lengths was caculated with the treatment * level 3 * 2 **(**XPC_2, Diamond V, Original at inclusion level 0.5 % of the diet).

Table 18: Comparison among the three additives and their inclusion levels (3 plus control) for condition factor of Nile tilapia (*O. niloticus*) fed the Aqua Superzyme, Garlen Allicin, and Diamond V (Original XPC) including experimental diets.

Treat	K_1 (Standard length)	K_2 (Total length)
control	5.40^{e}	2.91^{d}
1*1	8.13^{bcd}	4.39^{abc}
1*2	6.94^{cde}	3.89^{bc}
1*3	6.60^{de}	3.52^{cd}
2*1	8.09^{bcd}	4.47^{abc}
2*2	6.58^{de}	3.69^{cd}
2*3	6.27^{de}	3.65^{cd}
3*1	10.08^{a}	5.29^{a}
3*2	9.74^{ab}	5.33^{a}
3*3	8.82^{abc}	4.75^{ab}
P > F	0.0002	0.0001
±SE	0.589	0.294

a-e: means in the same column having different letters are significantly (P ≤ 0.05) different.

Lara-Flores *et al*. (2003) evaluated the effects of probiotics on growth performance in Nile tilapia under two stress factors. These stressors were dietary protein level and stocking density. The probiotics used based either upon *Streptococcus faecium* and *Lactobacillus acidophilus* or *Saccharomyces cerevisiae*. Results indicated that the fry fed diets with a probiotics supplement exhibited greater growth than those led the control diet without probiotic. Of all probiotic treatments, yeast was an appropriate growth stimulating additive in tilapia cultivation. The authors stated that the increased growth rate as a positive response to added probiotics could be attributed to increased efficiency of existing digestive processes or by promoting the digestion of previously indigestible substances. In addition, probiotics may have a protein sparing effect.

Two strains of *Saccharomyces cerevisiae* were tested as probiotics for rainbow trout fry, during the first month of feeding. Each strain was introduced into separate diets, at the rate of 10^6 CFU g^{-1} and their effects were compared with those of a control diet. In all groups, the counts of bacteria associated with trout intestine were maximum 10 days post start feeding (dpsf; 10^7 CFU g^{-1}). An autochthonous yeast, *Debaryomyces hansenii*, was also retrieved associated to the intestine of the control group in high numbers after 240 degree days of experiment (10^4–10^5 CFU g^{-1}), while the colonization level was significantly less in trout fed the probiotic diets. The effect of the dietary yeast was observed by assaying the activity of three enzymes in the brush border membrane of the enterocytes: alkaline

phosphatase (AP), γ-glutamyl-transpeptidase (GGT), and leucine-amino-peptidase N (LAP). Both *S. boulardii* and *D. hansenii* seemed to stimulate digestive maturation in fish, but the natural colonization by *D. hansenii* was likely too late for trout reared at optimal temperature. The supplementation of trout starter diet with *S. boulardii* may be particularly useful in fast growing conditions (Waché *et al.,* 2006).

In an in door experiment, the prebiotic Avian Plus was evaluated by adding it at graded levels into isonitrogenous-isocaloric-diets of tilapia fish for 112 days. The obtained results revealed the superiority of the Avian Plus containing diets, particularly at level of 25 mg/kg feed which led to significantly ($P \leq 0.05$) best final bodyweight, average bodyweight gain, average daily bodyweight gain, relative growth rate, and specific growth rate comparing with the control (Abdelhamid *et al*., 2011).

Two experiments were carried out. In both experiments, Nile tilapia fry (0.1 g initial bodyweight) were stocked into glass aquaria at 100 fry / aquarium in duplicate aquaria / treatment. The experimental diets were offered daily at a feeding rate of 10 % of the fish biomass for 21 days (hormone-treated diets as commercially done for sex reverse) followed by 8 or 12 weeks as experimental periods in the 1st and the 2nd experiments, respectively. Bio-Mos® and T-Protphyt 2000 were added to the 1st and the 2nd experiments, respectively at graded levels. The results obtained revealed no significant ($P \geq 0.05$) differences among treatments in both experiments concerning growth performance. However, the diet containing testosterone alone in the 1st experiment (T4) and that containing T-Protphyt 2000 at 4 g / Kg diet in the 2nd experiment reflected the best growth performance. The dietary inclusion of Bio-Mos® was not beneficial, whereas the dietary inclusion of T-Protphyt 2000 at 4 g / Kg diet was positively effective in increasing the growth performance of the tilapia fry (Abdelhamid *et al*., 2012).

Amer (2012) concluded that *Diamond V XP* (inactive yeast a commercial product containing 100% dried *Saccharomyces cerevisae* distributed by *DIAMOND V mils*, Cidar Rapids, IOWA, and USA) could be used successfully as feed additive for feeding Nile tilapia *Oreochromis niloticus* without any adverse effects on their productive performance. Generally, it improves feed utilization than control diet. Also, results obtained showed that using *Diamond V XP* at level (1.5g) had the best results on productive with levels of protein (30 %). Moreover, it could be suggested that dietary supplement with Diamond *V XP* (1.5g) is useful in the intensive production system of fish.

Hassan (2013) obtained results concerning the effects of the probiotic Hydroyeast Aquaculture® on adult male *O. niloticus* showed that the 15 g/kg diet realized best significantly ($P \leq 0.05$) values for growth performance.

Economics:

Economically, A1, G1 and XPC2 (Tables 19, 20, and 21, respectively) were the best levels among the tested concentrations for the different substances examined in the present study. The interaction (T*L)

effect on the economic efficiency of feeding Nile tilapia fish the experimental diets included Aqua Superzyme, Garlen Allicin, and Diamond V-Original (T) with their different levels (L) is given in Table 22. From which it is clear that the best economic diets are 3*2 (Diamond V-Original at 0.5 % of the diet).

Table 19: Effect of Nile tilapia (*O. niloticus*) fed the Aqua Superzyme prebiptic supplementation on the economic efficiency of the experimental diets.

Treat	Total [1] output[1]	In put[2]	Net return[3]	Economic efficiency[4] %	Relative economic efficiency[5]
Control	0.87 [c]	0.25 [c]	0.62 [c]	248.10 [c]	100.0 [b]
A_1	1.26 [a]	0.31 [a]	0.95 [a]	307.86 [a]	124.40 [a]
A_2	1.07 [b]	0.28 [b]	0.78 [b]	275.80 [b]	111.33 [b]
A_3	1.05[b]	0.28 [b]	0.76 [b]	265.10 [bc]	107.0 [b]
P > F	0.002	0.0001	0.0002	0.004	0.010
±SE	0.031	0.004	0.028	7.76	3.76

a-c: means in the same column having different letters are significantly (P ≤ 0.05) different.
Total feed costs per treatment (LE/kg diet) = Feed costs per one kg diet x feed intake
1-Total outputs per treatment (LE/kg) = fish price x total fish production
2- Total fish production per treatment = final number of fish x fish weight gain
3- Net return per treatment (LE) = total outputs – total feed costs
4- Economic efficiency per treatment(%) = (net return / total feed costs) x 100
5- Relative economic efficiency relative to the control (100).

Table 20: Effect of Nile tilapia (*O. niloticus*) fed the Garlen Allicin probiptic supplementation on the economic efficiency of the experimental diets.

Treat	Total output	In put	Net return	Economic Efficiency, %	Relative economic efficiency
Control	0.87 [d]	0.25 [c]	0.62 [d]	248.10 [c]	100.0 [c]
G_1	1.54 [a]	0.33 [a]	1.21 [a]	359.11 [a]	144.66 [a]
G_2	1.23 [b]	0.32[b]	0.91 [b]	284.25 [b]	114.66 [b]
G_3	1.085[c]	0.31 [b]	0.77 [c]	247.72 [c]	100 [c]
P > F	0.0001	0.0001	0.0001	0.0001	0.0001
±SE	0.026	0.004	0.026	9.486	2.09

a-d: means in the same column having different letters are significantly (P ≤ 0.05) different.

Table 21:Effect of Nile tilapia (*O. niloticus*) fed the Diamond V (Original XPC) probiotic supplementation on the economic efficiency of the experimental diets.

Treat	Total output	In put	Net return	Economic Efficiency, %	Relative economic efficiency
Control	0.87 ^{c}	0.25^{d}	0.62 ^{c}	248.10^{b}	100.0 ^{b}
XPC_1	1.69^{b}	0.37 ^{b}	1.32 ^{b}	355.74 ^{a}	143.66 ^{a}
XPC_2	1.93 ^{a}	0.41^{a}	1.52 ^{a}	368.05 ^{a}	148.66 ^{a}
XPC_3	1.58^{b}	0.34 ^{c}	1.23 ^{b}	356.0 ^{a}	143.66 ^{a}
P > F	0.0001	0.0001	0.0001	0.0001	0.0004
±SE	0.037	0.005	0.033	7.41	5.01

a-d: means in the same column having different letters are significantly (P ≤ 0.05) different.

Table 22:Comparison effect of feeding Aqua Superzyme, Garlen Allicin, and Diamond V-Original supplementations (T) with their different levels (L) on the economic efficiency of the experimental diets fet to Nile tilapia (*O. niloticus*).

T*L	Total output	In put	Net return	Economic Efficiency, %	Relative economic efficiency
Control	0.868^{f}	0.249^{f}	0.619^{f}	248.10^{d}	100.0^{d}
1*1	1.26^{d}	0.309^{d}	0.951^{d}	307.86^{b}	124.40^{b}
1*2	1.075^{e}	0.286^{e}	0.789^{e}	275.80^{c}	111.33^{cd}
1*3	1.048^{e}	0.287^{e}	0.761^{e}	265.10^{cd}	107.0^{cd}
2*1	1.547^{c}	0.337^{c}	1.209^{c}	359.11^{a}	144.66^{a}
2*2	1.236^{d}	0322^{d}	0.915^{d}	284.25^{bc}	114.66^{bc}
2*3	1.085^{e}	0.312^{d}	0.773^{e}	247.72^{d}	100.0^{d}
3*1	1.692^{b}	0.371^{b}	1.321^{b}	355.74^{a}	143.66^{a}
3*2	1.932^{a}	0.413^{a}	1.519^{a}	368.05^{a}	148.66^{a}
3*3	1.580^{c}	0.346^{c}	1.234^{bc}	356.0^{a}	143.66^{a}
P > F	0.0001	0.0001	0.0001	0.0001	0.0001
±SE	0.0326	0.0049	0.030	8.3418	4.1791

a-f: means in the same column having different letters are significantly (P ≤ 0.05) different.

El-Haroun *et al.* (2006) and El-Haroun (2007) reported that the diets containig probiotic Biogen® realised significantly (P≤0.01) the highest net return and the lowest total cost by Nile tilapia and African catfish, respectively comparing with the control diets. Mohamed *et al.* (2007) also reported that dietary inclusion of Biogen® improved the economic evaluation for Nile tilapia production.

Egyptian populations of African catfish *Clarias gariepinus* (24.34±1.38 g) were fed a formulated diet containing approximately 31% (analyzed value) crude protein and cultured for 214 days. Four levels of dried brewer's yeast, *Saccharomyces cerevisiae*, (DY) were used as feed additives at levels of 0.0, 1.0, 1.5 and 2.0% in diets. Results showed that, adding high

level of DY, 2%, recorded highest final body weight (913.26 g), growth rate (4.72 g/fish/day), total production (47.5 kg/m3) and profit per cage (52.21%) after 186 days. The study demonstrates that DY inclusion in the feeds of hybrid cat fish was significant. However, finding the optimal inclusion level of DY still needs more investigation of higher DY levels than 2% (Essa *et al*., 2011).

Amer (2012) concluded that *Diamond V XP* (inactive yeast a commercial product containing 100% dried *Saccharomyces cerevisae* distributed by *DIAMOND V mils*, Cidar Rapids, IOWA, and USA) could be used successfully as feed additive for feeding Nile tilapia *Oreochromis niloticus* without any adverse effects on their productive performance. Generally, it improves economic efficiency than control diet. Also, results obtained showed that using *Diamond V XP* at level (1.5g) had the best results on productive with levels of protein (30 %). Moreover, it could be suggested that dietary supplement with Diamond *V XP* (1.5g) is useful in the intensive production system of Nile tilapia fish.

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تـأثير اخـتلاف مصـدر ومسـتوى بعـض الإضـافات الحيويـة العلفيـة علـى : 1- أداء النمـو واقتصاديات إنتاج أسماك البلطي النيلى

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فـي تجربـة تغذيـة معمليـة لمـدة سـتة عشـر أسـبوعا لدراسـة تـأثير ثلاثـة إضـافات علفيـة (Aqua Superzyme, Garlen Allicin, and Diamond V-Original XPC) بثلاثـة مستويات من كل منها (خلافا للمقارنة الخالية من الإضافات) على أسماك البلطي النيلى (وزن أولى 10 جم)، تم الوصـول إلى أن أفضل المعاملات إحصائيا ($P \leq 0.05$) كانت المعاملـة المحتويـة علـى Diamond V-Original XPC بمستوى 0.5% من العليقة، والتي حققت أفضـل وزن جسم نهـائي، زيـادة كليـة فـي وزن الجسم، معدلات نمو نسبية ونوعية، معدل إعاشة، معامل حالة (على أساس طول الجسم الكلى)، عائد، وكفاءة اقتصادية، من بين كل الإضـافات والمستويات المختبـرة. وعليـه يوصـى باسـتخدام Diamond V-Original XPC كإضـافة علفيـة لعلائق أسماك البلطي النيلى بتركيز 0.5% من العليقة لتحسين أداء النمو والحياتية واقتصاديات الإنتاج.

قام بتحكيم البحث

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