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USE OF SOME NATURAL FEED SUPPLEMENTS TO IMPROVE PRODUCTIVE PERFORMANCE OF FISH

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Abstract

The present experimental study has been carried out in a closed system at Fish Production Branch, Animal Production Department, Faculty of Agriculture, Ain Shams University, Egypt. The aim was to investigate the effect of using some natural feed supplements on the productive performance of Oreochromis niloticus fish. Tilapia fingerlings with initial average body weight between 11.5 – 12.9 g/ fish were stocked in twelve plastic tanks (1 m³ water each) at a rate of 85 fish/ tank. The experiment involved three treatments each with four replicates. Two natural feed supplements (Amico-Zime® and Bio-Bud®) were tested. The first treatment was allocated as a control group, while treatment 2 was supplemented with 0.5% Bio-Bud®, and the third treatment was supplemented with 0.5% Amico-Zime®. The whole experimental fish groups were fed daily at a rate of 7% of fish biomass for fish weight between 10 - 40 g/ fish; 5% of fish biomass for fish body weight between 40-70g/ fish and 3% of fish biomass for fish weight between 70g up to the end of the experiment. The daily allowances were divided into three meals at 10.00, 13:00 and 16:00 h. for six days a week. Fish were weighing every two weeks during the experimental period. At the end of the experiment the highest weight gain (95.44 g/fish) was obtained by the third treatment, where Amico-Zime® was used. Fish groups fed bio- Bud® showed the lowest growth performance compared with other two experimental treatments. Also fish groups fed Amico-Zime® showed the highest specific growth rate (2.35%/ d) and the highest relative growth rate (844.83%). Feed utilization parameters showed that fish groups fed Amico-Zime® had better efficiency (1.48 g feed/ g gain) than

the other two treatments. Protein efficiency ratio was highest (2.215) in the third treatment (Amico-Zime®), while the lowest value (1.786) was recorded by second treatment (Bio-Bud®). The economical efficiency study showed that the total income and net return was better for group fed Amico-Zime® than the other experimental treatments. The third treatment achieved the highest total return (292.89 LE) while the lowest one (217.02 LE) was achieved by the second treatment. Net return was at highest (127.58 LE.) for the third treatment (Amico-Zime®) then the first treatment (the Control) while the lowest net return (65.11 LE.) was obtained by treatment 2 (Bio-Bud®). It could be concluded that ; by using Amico-Zime® in the present experiment superior productive values were obtained compared with the control and the other natural feed additive (Bio-Bud®).
Keywords: Tilapia, Natural Feed Supplements, Enzyme, Probiotics.
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INTRODUCTION

The Aquaculture industry has been recognized as the fastest growing food producing industry (FAO, 2002) and will play an increasingly important role in meeting the demand for fish. Egyptian aquaculture has developed rapidly in the recent years. Tilapia is one of the most widely cultured species in Egypt. Fish production increased from 140.000 MT including 19.000 MT from aquaculture, accounting for 13.5% of the total production to about than 1.4 million tons in 2011, including 983.000 MT from aquaculture, accounting for 72% of the total production. (GAFRD, 2011). Aquaculture is a fast growing industry. Successful and sustainable aquaculture depends on economically viable and environmental friendly feeds. Feed is the major operational cost involving 60 to 70% of the total cost in intensive fish farming. Fish meal has been widely used as a supplemental protein source for many years primarily for monogastric animals. It has become an expensive source of proteins and its replacement by plant protein source is very important for the development of aquaculture with lower feed costs (Carter and Hauler, 2000). One of the major problems associated with the use of plant protein

sources in fish feed is the presence of anti-nutritional factors.(Viola *et al*., 1994). Plant proteins contain insufficient amount of some essential amino acids necessary for fish growth, it has anti-nutritional factors, it has high fiber and ash content (Tacon and Jackson 1985 and FAO, 2006). Plant protein utilization could be improved by using some exogenous digestive enzymes (lipase, amylase, proteases and phytase), which can be easily found in the market (Feord, 1996). However, the use of these biotechnological resources has found some resistance in its adoption (Bomba *et al.,* 2002). Also the inclusion of live yeast in the diet improved growth performance of tilapia and carp fish improved when it is fed on a diet supplemented with active yeast (Li and Gatlin III, 2004, 2005).

The aim of the present study was to evaluate the effect of two feed additive products; enzymatic (Amico Zime®) and active yeast (Bio-Bud®) on the utilization of plant protein used in fish feeds in order to increase growth rate, feed utilization and economical efficiency.

MATERIALS AND METHODS

This study was conducted in the closed system at Fish production Branch - Faculty of Agriculture, Ain Shams University, Egypt.

Experimental system:

Twelve plastics tanks (1m³ each) were connected into a closed system provided by mechanical filter to remove the fish fecal solids from the water also a sump pond 3 m³. Water pump (1.5 hp) was used to circulate the water in the closed system. Biological filter with total volume of 1200 L. contains plastic corrugated media and gravels to convert the toxic ammonia into nontoxic nitrate. Air blower (3.5 hp) was used to provide tanks with needful air through plastic hose and air stones in each plastic tank.

Closed System Unit Used in the Experiment

Before starting the experiment, tanks were drained completely and were exposed to sun radiation for two days. The experimental tanks were distributed randomly on the 3 treatments (4 tanks each). The experiment lasted 105 days. One thousand and twenty Nile tilapia fingerlings (11.5-12.9 g/ each) were distributed randomly on fish tanks, with stocking rate of 85 fish/ tank (i.e. 85 fish/ m^3 of water).

Fish sampling:-

Fish of each tank were weighed every two weeks during the whole experimental period and daily feed allowances were readjusted according to the new fish weight. Fish groups were fed daily at a rate of 7% of fish biomass for fish weight between 10-40g/ fish, 5% of fish biomass between for fish weight between 40-70g/ fish and 3% of fish biomass for fish weight between 70g up to the end of the experiment. The daily allowances were divided into three meals at 10.00, 13:00 and 16:00 h. for six days a week.

Growth parameters:

According to the data of body weight, the following parameters were calculated:

1. Average Daily Gain (ADG)

ADG = (Wt 2-wt 1)/ t

Where:

wt 1 = first fish weight in grams.

wt 2 = following fish weight in grams.

t = period in days.

2. Specific Growth Rate (SGR)

Specific growth rate was calculated according to Jauncey and Rose (1982).

SGR = (Ln wt2- Ln wt1) x100/t.

Where:

Ln = (log l0x) 3.303

3. Relative Growth Rate (RGR)

RGR= (wt.2-wt.1) x100/wt.1

4. Food Conversion Ratio (FCR)

The food conversion ratio was calculated according the following equation :

$$FCR = \frac{\text{Feed intake (g)}}{\text{Final body weight (g)} - \text{Initial body weight (g)}}$$

5. Protein Efficiency Ratio (PER)

The protein efficiency ratio was calculated according to the following equation:

$$PER = \frac{\text{Final body weight (g)} - \text{Initial body weight (g)}}{\text{Protein intake (g)}}$$

Experimental Diets:

Experimental diets were prepared by using the local available raw material in market (Table1), where treatment 1 represent the control diet, diet 2 and 3 represent Bio-Bud® diets and, Amico-Zime® respectively.

Table 1. Formulation and chemical composition of the experimental diets.

Ingredient	Tret.1	Tret.2	Tret.3
Yellow corn	15	15	15
Rice bran	13.5	9	9
Soybean meal (44% CP)	30	39.5	39.5
Meat & bone meal	25	25	25
Fish meal (72% CP)	5	0	0
Vegetable oil	3	3	3
Salt	0.5	0.5	0.5
$CaCO_3$	4.425	4.425	4.425
Mono CaP	0.7	0.7	0.7
Binder (Bintonite)®	2.55	2.5	2.5
Anti oxidant & Anti toxic	0.025	0.025	0.025
Vitamin premix(1)	0.3	0.3	0.3
Amico-Zime®	-	-	0.05
Bio Bud®.	-	0.05	-
Chemical composition			
Protein content (%)	30.92	30.93	30.93
Gross Energy (kcal / kg)	3646.1	3640.9	3640.9
Fiber content (%)	4.4	4.5	4.5
Fat content (%)	9.8	8.9	8.9
Ash content (%)	12.5	12	12
Price / LE. in Dec-2012	3885.1	3598.8	3618.8

1) Vitamin and mineral mixture is presented in Table 2

Table 2. Vitamins and minerals of the mixture used in the experimental diets (/kg).

Item	*/kg mixture	Item	*/kg mixture
Vitamin A	4.8 m.I.u.	Folic acid	400 mg
Vitamin D3	0.8 m.I.u.	Biotin	20 mg
Vitamin E	4.0 gm	Choline chloride	200mg
Vitamin K	0.8 gm	Copper	4.0 mg
Vitamin B1	0.4 gm	Iodine	0.4 mg
Vitamin B2	1.6 gm	Iron	12.0 mg
Vitamin B6	0.6 gm	Manganese	22.0 mg
Vitamin B12	4.0 gm	Zinc	22.0 mg
Pantothenic acid	4.0 gm	Selenium	0.04 mg
Nicotinic acid	8.0 gm		

* Broiler premix was obtained from Pfizer , Egypt

Water quality parameters

Average system temperature was (27.9 ± 0.8 C), dissolved oxygen (6.1 + 0.4 mg/L), and pH (7.91 ± 0.1) were monitored once daily. Nitrite-nitrogen (0.4 ± 0.01 mg/L) was monitored weekly using a model PLN code test kit from LaMotte (Chestertown, Maryland, USA). Total ammonia-nitrogen (0.04 ± 0.003 mg/L) was monitored once weekly using the method described by Boyd and Lichkoppler (1979).

Economical study

Economical analysis was done at the end of the study. The total return (value of fish harvested), total costs (value of fingerlings, artificial diets, and water exchange cost), and net return (total return- total costs) were calculated according to Green *et al*. (1995).

Statistical analysis

The statistical analysis was applied according to Steel and Torrie (1980) on the collected data using Two-way analysis of variance (ANOVA).

Differences between means were tested for significance according to Duncan's multiple rang test (Duncan, 1955).

The following repeated measurement statistical model for analyzing fish weight, food conversion ratio and specific growth rate at different treatment and time was utilized:

$$Yijkm = \mu + Ti + Kij + Mk + TMik + eijkm,$$

where, **Yijkm** is the mth fish weight, food conversion ratio and specific growth rate;

μ is the overall mean;

Ti is the i th treatment effect, i=1 for control, 2 for Bio-buds and 3 for Amico-Zime;

Kij is the j th tank effect within the i th treatment, j = 1-12 and considered as the error term for testing the treatment effect;

Mk = the kth time effect, k = 1-8;

TMik is the interaction between treatment and time and

eijkm is the m th random effect of the residual that $\sim N(0, I\sigma e 2)$.

The last term was used for testing the tank within treatment, time and interaction by time by treatment effects.

RESULTS AND DISCUTION

Growth parameters:

Growth performance of fish fed the experimental diets are presented in Table 3, where the best significant growth performance (P>0.05) was achieved by fish group fed the Amico-Zime®. Treatment 3

showed higher significant weight gain (95.44 g/ fish) than treatments 2 and 1, where fish group fed the Bio-Bud® showed the lowest value (85.40 g/ fish). Also specific growth rate and relative growth rate showed the same trend. The total weight gain / m3 of fish group fed the Amico-Zime® can be calculated as 8.1 kg/m3 compared with 8kg/ m3 for the control group and 7.3 kg fish/ m3 for Bio-Bud® group.

Table 3: Growth performance of tilapia fish fed the experimental diets.

	Initial weight (g/ fish)	**Final weight (g/ fish)**	**Weight gain (g/ fish)**	**Total gain (kg/m^3)**	**Average daily Gain (g/d)**	**SGR (%/d)**	**RGR (%)**
Treatment 1	12.94	107.19^a	94.25^a	8.01^a	0.90	2.18^a	732.65
Treatment 2	12.79	98.19^a	85.40^b	7.26^b	0.81	2.18^a	667.32
Treatment 3	11.53	106.97^a	95.44^a	8.11^a	0.91	2.35^a	844.83

Deguara *et al*. (1999). Reported that exogenous digestive enzymes were used to enhance fish growth by improving the digestibility of the nutrients, remove the anti-nutritional factors, improve the non-starch polysaccharides, spare the utilization of the amino acids in enzyme synthesis and minimizing the environmental pollutants caused by minimizing the fish wastes. These results are in agreement with those of several authors like Khalafalla *et al.*(2010) who indicated that all mentioned growth parameters increased significantly ($P<0.05$) for fish groups fed diets containing Amico-Zime® compared to those fed diets without Amico-Zime®. On the other hand, the groups of fish fed diet without Amico-Zime® and fish meal recorded the lowest growth values. Moreover, groups fed diets containing 15% fish meal and 0.5 or 1% Amico-Zime® had significantly ($P<0.05$) higher values than other different treatments. Jackson *et al*. (1996) found that the utilization of external feed enzymes has not only improved fish performance but also it

has reduced the feed coast to produce one unit of gain and reduced fish excretion into the environment. Feord *et al*. (1996) came to the same results and found an improvement in growth performance of fish when he added exogenous enzymes to fish diets.

Feed utilization parameters

Feed utilization parameters (Table 4) in the form of feed in grams used to produce one gram gain (FCR) and protein efficiency ratio (PER) in the form of unit body weight gain per unite protein fed. Better feed conversion ratio (FCR) was observed by fish group fed diet No. 3 where the (Amico-Zime®) was included in the diet than the other experimental groups. The worst FCR was observed by fish groups fed the (Bio Bud®).

The same trend was achieved for the protein efficiency ratio (PER), where the treatment 3 (Amico-Zime®) showed the highest significant ($P<0.05$) protein efficiency ratio (2.21), while the lowest significant one ($P<0.05$) was recorded by treatment 1 (the control).

Table 4: Feed utilization parameters of tilapia fingerlings fed the experimental diets.

	Feed amount (g/ fish)	**FCR (g feed/ g gain)**	**PER**
Treatment 1	168.07	1.78^{b}	1.48^{c}
Treatment 2	157.94	1.87^{a}	1.79^{b}
Treatment 3	142.14	1.48^{c}	2.21^{a}

These results of feed utilization parameter were in agreement with several authors like (Yildirim and Turan, 2010) who reported that the best specific growth rate was observed at the group receiving enzyme complex group. Also, feed conversion ratio, protein efficiency ratio and apparent net protein utilization were significantly higher in all enzyme complex groups than that with control ($p<0.01$). The highest value of protein

content (21.75%) was observed at 0.75 g kg-1 enzyme complex group. The results suggested that enzyme supplementation can significantly improve growth performance and feed utilization in African catfish. Feord *et al*. (1996) who estimated that the aims of the addition of enzyme were to equals soy bean meal (plant protein) to that of fishmeal (animal protein); to maximize digestibility of dietary components, to improve weight gain, FCR and energy utilization, also reduce diet cost with high productive performance. As in the present experiment, exogenous digestive enzymes were used to enhance fish growth by improving the digestibility of the nutrients, remove the anti-nutritional factors, improve the non-starch polysaccharides, spare the utilization of the amino acids in enzyme synthesis and minimizing the environmental pollutants caused by minimizing the fish wastes (Yigit and Olmez, 2010). These results are in agreement with Khalafalla *et al*. (2010) who reported that growth parameters increased significantly ($P<0.05$) for fish groups fed diets containing Amico-Zime® compared to those fed diets without Amico-Zime®. On the other hand, the groups of fish fed diet without Amico-Zime® and fishmeal recorded the lowest values of AWG, ADG and SGR. Jackson *et al*. (1996) found that the utilization of external feed enzymes has not only improved fish performance but also it has reduced the feed coast to produce one growth unit and reduce fish excretion into the environment. These results were in agreement with those of Yildirim and Turan (2010) who reported that the best specific growth rate was observed at the group receiving enzyme complex group. Also, feed conversion ratio, protein efficiency ratio and apparent net protein utilization were significantly higher in all enzyme complex groups than that with control ($p<0.01$). The results suggested that enzyme supplementation can significantly improve growth performance and feed utilization of African catfish.

Economical Evaluation:

In the present study the total return (the sale price of the harvested fish) were 292.89, 217.02 and 273.35 L.E and total return per kg live fish for treatments 3, 2, and 1 were found to be 7.65, 7.45, 7.56 L.E, respectively. These results indicated that the highest return was achieved by treatment 3 and the lowest price was in treatment 2. The coast per (Kg) was found to be 3.33, 4.21 and 4.01 L.E. for treatments 3, 2 and 1, respectively. Tilapias were marketed according to its size. These results indicated that the highest value was in treatment 3 and the lowest with treatment 2. The cost of management tank operation (Worker-Electricity- Ice) estimated to be 1.00 L.E per Kg. and calculated this paid out with the total coast. Net return per (kg) was found to be 3.32, 2.24 and 2.55 L.E. for treatments 3, 2 and 1, respectively. Net return was highest for treatment 3 then treatment 1 while the lowest net return was obtained by treatment 2. All data about the economic statistics are listed in Table (5).

Table 5: Economical Evaluation of the Experiment.

Item	Treatment 1		Treatment 2		Treatment 3	
	Quantity Kg	Value L.E./tank	Quantity Kg	Value L.E./tank	Quantity Kg	Value L.E/tank
Total return	36.15	273.35	29.15	217.02	38.27	292.89
Feed	64.53	145.19	54.56	122.76	56.46	127.03
Management cost	1	36.15	1	29.15	1	38.27
Net return		92.007		65.11		127.58

CONCLUSION

In general, the results of this study indicated that the use of digestive enzymes e.g. Amico-Zime® as feed supplements enhanced growth performance, feed utilization and increase economical return.

REFERENCES

Boyd, C. E. and F. Lichkoppler 1979. Water quality management in pond fish culture. Auburn Univ. agric. Exp. Station. Research and Development series. No. 22, pp 30.

Bomba, A., R. Nemcová; D. Mudrona and P. Guba 2002. The possibilities of potentiating the efficiency of probiotics. Trends in Food Science and Technology, 13: 121-126.

Carter, C.G. and R.C. Hauler 2000. Fish meal replacement by plant meals in extruded feeds for Atlantic salmon, Salmo salar L. Aquaculture, 185: 299-311.

Deguara. S., K. Jauncey; J. Feord, and J. Lopez 1999. Growth and feed utilization of gillhead sea bream. Sparus aurata. Fed diets with supplementary enzymes. In Brufau J. (ed.), Tacon A. (Ed.). Feed manufacturing in the Mediterranean region: Recent advances in research and technology. Zaragoza: CIHEAM-IAMZ. Reus. Pain. 195-215.

Duncan, D.B. 1955. Multiple range and multiple F-tests. Biomet. 11: 1-15.

FAO 2002 Status of the world fisheries and aquaculture 2002. FAO. Rome. 150 pp.

FAO 2006 Prospective analysis of the future aquaculture development: the role of COFI Sub-Committee on Aquaculture. A working document prepared for the third session of the Committee on Fisheries Sub-Committee on Aquaculture. FAO. Rome.

Feord, J. C. 1996. Exogenous enzymes improve performance of carp and tilapia when fed diets containing high levels of soya bean meal. Vll International Symposium on Nutrition and Feeding of fish.

GAFRD 2011. Statistical book for General Authority For Fish Resource Development (2011), 9: 1- 106 .

Green, B. W., Z. El-Nagdy, H. Hebicha, I. Shaker; D. Kenawy and A.R. EI-Gamal 1995. Evaluation of Nile tilapia production systems in

Egypt. Research Reports. Pond Dynamics/Aquaculture Collaborative Research Program.

Jackson, L.S., M.H. Li and E.H. Robinson 1996. Use of microbial phytase in channel catfish lctalurus punctatus diets to improve utilization of phytate phosphorus. Journal of the world Aquaculture Society. 27: 309 – 313.

Jauncey, K and B. Rose 1982. A Guide to Tilapia Feeds and Feeding, Institute of Aquaculture, University of Sterling, Scotland. 27: 43-54.

Khalafalla, M. M., M. I. Bassiouni; N. M. Eweedah and H. M. Elmezyne 2010. Performance of Nile tilapia (Oreochromis niloticus L.) fingerlings fed diets containing different levels of Amico-Zime®. J. Agric. Res. Kafer El-Shiekh Univ., 36: 111- 122.

Klaenhammer. T.D. and M.J. Kullen 1999. Selection and design of probiotics. International Journal of Food Microbiology 50: 45-57.

Lara-Flores, M., M.A. Olvera-Novoa; B.E. Guzma´n-Me´ndez and W. Lo´pez-Madrid 2003. Use of the bacteria Streptococcus faecium and Lactobacillus acidophilus, and the yeast Saccharomyces cerevisiae as growth promoters in Nile tilapia (Oreochromis niloticus). Aquaculture, 216: 193-201.

Li, P. and D.M. Gatlin III 2004. Dietary brewers yeast and the prebiotic Grobiotic TM AE influence growth performance, immune response and resistance of hydride striped bass (Morone chrysops X M. saxatilis) to Streptococus iniae infection. Aquaculture, 231: 445-456.

Li, P. and D.M. Gatlin III 2005. Evaluation of the prebiotics GroBiotic R-A and brewers yeast as dietary supplements for sub-adult hydride striped bass (Morone chrysops X M. saxatilis) challenged in situ with Mycobacterium marinum. Aquaculture, 248: 197-205 .

NRC 1993. Nutrient requirements of fish. National Academy Press,Washington D.C.

Steel, R.G.D. and J.A. Torrie 1980. Principles and procedures of statistics. 2nd ed., USA McGraw Hill pp. 183 – 193.

Tacon, A. G. J. and A. J. Jackson 1985. Utilization of conventional and unconventional protein sources in practical fish feeds. Pages 119–145 in C. B.Cowey, A. M.Mackie, and J. G.Bell, editors. Nutrition and feeding in fish. Academic Press, London, UK.

Viola, S., H. Angeoni and E. Lahav 1994. Present limits of protein sparing by amino acid supplementation of practical carp and tilapia feeds. Bamidgeh, 46: 212 – 222.

Yigit, N.O. and M. Olmez 2009. Canola meal as an alternative protein source in diets for fry of tilapia (Oreochromis niloticus). Bamidgeh, 61: 35-41.

Yigit, N.O. and M. Olmez 2010. Effects of cellulase addition to canola meal in tilapia (Oreochromis niloticus L.) diets. 305: 102-108

Yildirim, Y. B. and F. Turan 2010. Effects of Exogenous Enzyme Supplementation in Diets on Growth and Feed Utilization in African Catfish (Clarias gariepinus). Journal of animal and veterinary advances year. (9): 327-331.

تأثيـراسـتخدام بعض الإضـافات الغذائيـة الطبيعيـة لتحسيـن الأداء الإنتـاجى فـى الأسـماك

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الملخص العربـى

تم إجراء هذه الدراسة في نظام مغلق في شعبة إنتاج الأسماك ، قسم الإنتاج الحيواني ، كلية الزراعة ، جامعة عين شمس ، جمهورية مصر العربية. كان الهدف من هذه التجربة دراسة تأثير استخدام بعض الإضافات الغذائية على الأداء الإنتاجي لإصبعيات البلطي النيلي (١١.٥ – ١٢.٩ جم/ سمكة) و التي تم تخزينها في خزانات بلاستيكية (١ متر مكعب مياه لكل منهما) بمعدل ٨٥ سمكة / خزان. تضمنت التجربة على ٣ معاملات وتم تخصيص ٤ أحواض لكل معاملة . تم اختبار استخدام إضافات طبيعية فى معاملتين منهم وكانت هذه الإضافات عبارة عن (مجموعة إنزيمات تعرف بالأميكو زايم – مجموعة خمائر حية تعرف بالبيو بودز). تم تخصيص أول معاملة كمجموعة مقارنة بين الثلاث معاملات بينما كانت المعاملة الثانية كانت عبارة عن إضافة ٠.٠٥ % خمائر حية تعرف تجارياً (بيو بودز) إلى مكونات العليقة والمعاملة الثالثة هى إضافة ٠.٠٥ % مجموعة إنزيمات تعرف تجارياً (أميكوزايم) إلى مكونات العليقة.

تم تغذية التجربة بالكامل (ال٣ معاملات) يوميا بمعدل ٧% من الكتلة الحية للأسماك على وزن من ١٠-٤٠ جم ، ومعدل ٥% من الكتلة الحية على وزن من ٤٠-٧٠ جم ، وبمعدل ٣% من الكتلة الحية على وزن ٧٠ جم وحتى نهاية التجربة ، كانت الوجبات تقسم يوميا على ٣ وجبات خلال اليوم ، الأولى في تمام الساعة ١٠ ص ، والثانية في الواحدة ظهرا ، والثالثة في تمام الساعة الرابعة عصرا لمدة ٦ أيام فى الأسبوع . وكانت تؤخذ عينات من الأسماك كل أسبوعين طوال التجربة لتقدير الأوزان وإعادة تقدير كميات العلف.

فى نهاية التجربة تبين أن أعلى صافى وزن للأسماك تم الحصول عليه (الفرق بين الوزن النهائى والوزن الإبتدائى) من المعاملة الثالثة والتى تعرف بالأميكوزايم (٩٥.٤٤ جم/سمكه)، وفى المعاملة الثانية والمعروفة باسم (البيوبودز) لوحظ أقل معدلات نمو مقارنة بالمعاملتين الأخرتين. أيضا لوحظ أن مجموعة الأسماك التى تم تغذيتها بمعاملة الآميكوزايم أعطت أعلى معدل نمو نسبى يومى (٢.٣٥%) وأعلى نسبة نمو (٨٤٤.٨٣%).

طبقا لمعايير إستخدام الآعلاف لوحظ أن مجموعة الأسماك التى تم تغذيتها بإضافة الأميكوزايم (المعاملة الثالثة) كانت أفضل معاملة فى استهلاك كميات العلف التى تم توفيرها وبالتالى أظهرت أحسن معامل تحويل بين المعاملات حوالى (١.٤٨ :١) أى أن كل ١.٤٨كجم علف ينتج عنه ١كجم لحم أسماك مقارنة بالمعاملات الأخرى، كذلك سجلت معدلات كفاءة أداء البروتين والاستفادة منه أعلى قيمة (٢.٢١٥) كانت فى المعاملة الثالثة (الأميكوزايم) بينما كانت أقل قيمة (١.٧٨٦) فى المعاملة الثانية (البيوبودز).

دراسات العائدات الاقتصادية أثبتت أن الإيرادات الكلية والربح الصافى كانت أعلى فى المعاملة الثالثة (الأميكوزايم) مقارنة بباقى المعاملات.المعاملة الثالثة حققت أعلى عائد (٢٩٢.٨٩ جنيه مصرى) بينما حققت المعاملة الثانية أقل عائد (٢١٧.٠٢ جنيه مصرى) كذلك كان صافى الأرباح فى المعاملة الثالثة (الآميكوزايم) أعلى قيمة (١٢٧.٥٨ جنيه مصرى) وكانت أقلهم المعاملة الثانية (البيو بودز) فى الآرباح بقيمة (٦٥.١١ جنيه مصرى).

يمكن أن نخلص إلى أنه باستخدام مجموعة أنزيمات الأميكو- زايم ® في التجربة الحالية تم الحصول على قيم إنتاجية متفوقة مقارنة مع الأعلاف بدون إضافات (الكونترول) أو المجموعة التى تم إضافة خمائر البيوبدز عليها.

أعطت هذه الدراسة حلول لبعض المشاكل مثل (أرتفاع أسعارأعلاف الأسماك – نقص المواد العلفية الخام – أحتياج الأسماك للبروتين المرتفع في علائقها - أحتياج الأسماك للبروتين الحيوانى المرتفع السعر وأستبدالة بالبروتين النباتى - هضم الكربوهيدرات بالنسبة للأسماك – المواد المثبطة للنمو الموجودة فى بعض الخامات العلفية) وذلك بأستخدام الأميكو زايم .