Egyptian J. Nutrition and Feeds (2011), 14 (3): 547-556

EFFECT OF REPLACING YELLOW CORN VIA CORN BY-PRODUCT IN TILAPIA FINGERLINGS DIET.

A.M. Abdelhamid[1]; A.A.A. Soliman[2] and N.A. Maghraby[2]

[1]*Anim. Prod. Dept., Fac. of Agric., Mansoura Univ.*
[2]*Anim. Prod. Dept. National Research Center, Cairo, Egypt.*

(Received 5/10/2011, Accepted 25/11/2011)

SUMMARY

An in-door feeding trial was conducted for 16 weeks on Nile tilapia fingerlings (initial bodyweight 12.0-12.5g), in which corn was gradually replaced by corn by-product ("karataih" manufacture waste) at 0, 25, 50, 75, and 100% replacement levels. The results confirmed the superiority ($P \leq 0.05$) of the diet included 100% replacement than the control in either of final bodyweight, average bodyweight gain, average daily bodyweight gain, relative growth rate, specific growth rate, feed intake, protein intake, protein productive value, and crude protein content of the fish body.

Keywords: tilapia; corn by-product; growth performance; feed utilization; body composition.

INTRODUCTION

Artificial aqua feed is increasingly demand for the worldwide outspread fish culture. Since almost every second fish eaten comes from an aquaculture farm, i.e. nearly half of all fish eaten today is farmed, not caught (FAO, 2006). Locally also, tilapia culture in River Nile Delta governorates, particularly Kafr El-Sheikh was improved totally and positively affected from the view points of social and economic issues (Radwan, 2009). Many carbohydrates containing agro-industrial by-products were evaluated as unconventional feedstuffs for various animal species (Abdelhamid, 1988, 1992; Abdelhamid, and El-Ayoty, 1988; El-Sherif *et al.*, 2008; Omer and Tawila, 2008a & b; Tawila *et al.*, 2008; Abdelhamid *et al.*, 2009a & b; Etman *et al.*, 2010; Gabr *et al.*, 2010; and Omer *et al.*, 2010). The aim of this study was to attempt replacing yellow corn by corn by-product meal in tilapia diets.

MATERIALS AND METHODS

Feeding experiment was conducted to evaluate corn by-product instead of dietary yellow corn concerning growth performance, carcass and muscles composition and feed utilization of Nile tilapia, Oreochromis niloticus, fingerlings for 16 weeks. The experimental system consisted of 10 glass aquaria (60×35×40cm), each aquarium was continuously supplied with a compressed air from an electric compressor (Shenzehe Company BS410). Dechlorinated tap water was used to change one third of the water in each aquarium every day. Water was aerated before be used for about 24 hours to remove chlorine.

Experimental Fish:

A group of Nile tilapia O. niloticus with an average initial body weigh of (12 – 12.5 g) were obtained from the stock of earthen ponds (from a farm at AL Hamoul, Kafr El-Sheikh governorate) and transported to the aquaria located in the fish laboratory of Al Hamoul, Kafr El-Sheikh governorate. Fish were maintained in these aquaria for 2 weeks before the beginning of the experiment for acclimatization purpose. The fish were fed during the acclimatization period on a basal diet (25% crude protein) at a rate of 3% of the body weight daily, at 2 times daily. The experimental treatments were tested at two aquaria (replicates) for each. Fish were stocked at a density of 5 fish / aquarium.

Experimental Diet:

Partial or complete replacement of yellow corn (0, 25, 50, 75, and 100%) by corn by-product meal in Nile tilapia fish diets was carried out to investigate its effect on water quality parameters, growth performance, and feed and nutrients utilization. All feedstuffs used in the experimental dies (including corn by-product "karataih" manufacture waste) were purchased from Al-Iman Factory, Al-Hamoul, Kafr El-Sheikh governorate. Diets were formulated by hand mixing the ground ingredients with little water through meat mincer to pellets (3 mm), then air dried. The basal diet No.1 was considered as a control. Composition of the experimental diets is presented in Table (1). The composition of the vitamins and minerals mixture is Vitamins: A 5.714.286 IU, D3 85.714 IU, E 7.143 mg, K3 1.429 mg, B1 571 mg, B2 343 mg, B6 571 mg, B12 7.143 µg, C 857 µg, Biotin 2.857 mg, Folic acid 86 mg, Pantothenic acid 1.143 mg, Minerals: Phosphorus 28.571 mg, Manganese 68.571 mg, Zinc 51.429 mg, Iron 34.286 mg, Copper 5.714 mg, Cobalt 229 mg, Selenium 286 mg, Iodine 114 mg, Inert essential agent: Starch 57 g, Natural H. 29 g, and $CaCO_3$ up to 1000 g.

Table (1): Composition (%) and chemical analysis (% dry matter bases) of the experimental diets.

Ingredients	Treatment (diet)No. 1	Treatment (diet) No.2	Treatment (diet) No. 3	Treatment (diet) No.4	Treatment (diet) No.5
	Corn by-product Control (0%)	Corn by-product (25%)	Corn by-product (50%)	Corn by-product (75%)	Corn by-product (100%)
Fish meal	60	60	60	60	60
Soybean meal	410	410	410	410	410
Corn by -product	0	75	150	225	300
Yellow corn	300	225	150	75	0
Wheat bran	80	80	80	80	80
Rice bran	100	100	100	100	100
Sunflower oil	30	30	30	30	30
Vitamins & minerals	20	20	20	20	20
Chemical analysis:					
Dry matter (DM)	89.25	90.01	88.96	89.86	89.79
Crude protein (CP)	25.43	25.12	24.88	25.27	25.03
Ether extract (EE)	4.18	4.25	4.63	4.56	4.82
Ash	4.96	4.46	4.65	4.81	4.66
Crude fiber (CF)	6.36	6.39	6.47	6.88	6.72
Nitrogen free extract (NFE)	59.07	59.78	95.37	58.48	58.77
Gross energy (GE)* (kcal/100 g DM)	433.01	429.46	428.22	429.46	426.69
Protein/energy (P/E) ratio (mg CP/kcal GE)	58.72	58.49	58.10	58.84	58.66
Metabolically energy (ME)** (kcal/100g)	360.75	357.79	355.28	356.76	355.47

**GE (kcal/100 g DM) = CP x 5.64 + EE x 9.44 + NFE x 4.11 calculated according to (Macdonald et al., 1973).*
***ME (kcal/100g DM) = metabolically energy was calculated by using factors 3.49, 8.1 and 4.5 kcal/g for carbohydrates, fat and protein, respectively according to Pantha (1982).*

Experimental Procedure:

During the experimental period, fish were fed the experimental diets at a rate of 3% of the live body weight daily. The diet was introduced twice daily, at 8 a.m. and 2 p.m. The amount of food was adjusted weekly based on the actual body weight changes. Light was controlled by a timer to provide a 14 hrs light: 10 hrs dark as a daily photoperiod. The experimental design was T_1:Control (0% replacement) 100% yellow corn, T_2: 25% corn by product meal 75% yellow corn,. T_3: 50% corn by product meal 50% yellow corn, T_4: 75% corn by product meal,25% yellow corn, T_5: 100% corn by product meal 0% yellow corn. respectively.

Water Quality Analysis:

Samples of water from each aquarium were taken to determine daily the water temperature (using a thermometer) and pH value (using Jenway Ltd, model 350-pH meter) and weekly for dissolved oxygen concentrations (using an oxygen meter model. d-5509) according to Abdelhamed (1996).

Chemical Analysis of the Experimental Ingredients, Diets, and Fish:

Determination of DM, CP, EE, (CF) and ash in the dietary ingredients, diets and in fish body at the start and at the end of the experiment for different groups was carried out according to the methods of A.OA.C. (1990). At the end of the experiment, three fish were derived from each group (aquarium) for drying at 60°C for 48 hours and then milled through electrical mill and kept at 4oC until analysis. Chemical analysis was carried out at Animal Production Department lab of the National Research Center, Egypt.

Growth Performance and Efficiency of Feed and Protein Utilization:

The growth performance and feed utilization parameters were calculated according to the following equations:

- Average weight gain (AWG, g/fish) = Average final weight (g)-Average initial weight (g).
- Average daily gain (ADG, g/fish) = Average final weight (g)-Average initial weight (g)/ Time (days).
- Survival rate (SR %) = Total number of fish at the end of the experiment×100/total number of fish at the start of the experiment.
- Relative growth rate (RGR) = Average weight gain (g) / Average initial weight (g).
- Specific growth rate (SGR, %/ day) = 100 [ln wt1- ln wto/T]

Where: ln: Natural log., Wto: Initial weight (g), Wt1: Final weight (g), T: Time in days.

- Feed conversion ratio (FCR) = Total feed consumption (g) /Weight gain (g).
- Protein efficiency ratio (PER) = Body weight gain (g)/protein intake (g).
- Protein productive value (PPV %) = 100 [Retained protein (g)/protein intake (g)].
- Energy retention (ER %) = 100 [Retained energy (Kcal) / Energy intake (Kcal).

Statistical Analysis:

The data were statistically analyzed by using general linear models procedure adapted by SAS (1996) for users guide. Means were separated using Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Chemical Composition of the Experimental Diets:

The experimental diets (Table 1) were isonitrogenous (25% CP) and isocaloric (430 kcal/100g and 59 mg CP/kcal GE as P/E ratio). Yet, corn by-product meal contained less (about third) crude protein (CP) and nitrogen free extract (NFE, about 20%) but very higher (ca. 60%) ash (because of its high inclusion level of $CaCO_3$ as 75% of the corn by-product meal, as given by the producer) contents than yellow corn (Table 2).

Physico – Chemical Parameters of Water Quality:

The ranges of the tested water criteria (Table 3) were generally within the normal ranges (25.6 – 26.4 °C, 7.10 – 7.75 pH, and 5.98 – 6.10 mg /l DO). Since, Abd El-Hakeim et *al.* (2002) cited the suitable values of water quality parameters for pisciculture as > 5 mg / l DO, and pH 6.7 – 8.6. Also, Abdelhamid (2003) cited the water quality criteria which are suitable for aquaculture in fresh water as pH 6.5 – 9.0, and DO > 5 mg / l.

Table (2): Chemical analysis of yellow corn and corn by-product meal (%dray matter basis).

Item	Yellow corn	Corn by-product meal
DM	87.4	95.22
CP	8.90	3.19
CF	2.20	2.46
EE	4.10	3.41
NFE	83.5	15.15
Ash	1.30	75.78

Table (3): Ranges of some important measured physico-chemical parameters of water quality.

Parameters	Treatments				
	Control Corn by- product (0%) (T_1)	Corn by-product (25%) (T_2)	Corn by-product (50%) (T_3)	Corn by - product (75%) (T_4)	Corn by-product (100%) (T_5)
Temperature,°C	26.1-26.4	25.6-25.7	25.6-25.7	25.6-25.6	25.6-25.7
The pH value	7.45-7.45	7.46-7.54	7.38-7.34	7.10-7.26	7.20-7.75
DO, mg/l	5.98-5.97	6.05-6.05	6.05-6.10	6.05-6.06	6.05-6.05

Fish Growth Performance:

Table 4 shows that there were non significant (P>0.05) differences among initial bodyweights (IBW) due to treatments; yet, T_5 (100% replacement) gave significantly (P≤0.05) the best final bodyweight (FBW), average bodyweight gain (AWG), and average daily bodyweight gain comparing with the control (T_1, 0% replacement). Table 5 also illustrates no significant (P>0.05) differences among survival rate (SR) of fish fed different experimental diets, although the superiority (P≤0.05) of T_5 in relative growth rate (RGR) and specific growth rate (SGR) comparing with the control.

Table (4): Effect of dietary treatments on growth performance parameters of Nile tilapia.

Treatments (No.)	IBW, g / fish	FBW, g / fish	AWG, g / fish	ADG, g / fish/day
Control, Corn by-product (0%) (T_1)	12.00 ± 0.00^{a}	25.80 ± 0.42^{ab}	13.80 ± 0.42^{ab}	0.11 ± 0.00^{ab}
Corn by- product (25%) (T_2)	12.00 ± 0.00^{a}	24.00 ± 1.55^{b}	12.00 ± 1.55^{b}	0.10 ± 0.01^{b}
Corn by- product (50%) (T_3)	12.20 ± 0.00^{a}	23.90 ± 0.21^{b}	11.70 ± 0.21^{b}	0.10±0.00b
Corn by- product (75%) (T_4)	12.00 ± 0.00^{a}	25.30 ± 0.63^{ab}	13.30 ± 0.63^{ab}	0.11 ± 0.00^{ab}
Corn by-product (100%) (T_5)	12.20 ± 0.00^{a}	29.10 ± 0.35^{a}	16.90 ± 0.35^{a}	0.14 ± 0.00^{a}

a-b: Means in the same column superscripted with different letters significantly (P≤0.05) differ.

Abou Khalifa (2009) mentioned that recycling waste is very important to provide feed for animals and fish. It is very important to provide feed, low-cost and high-value of food. Manufacturing of feed from industrial-plant waste is the key to eliminate pollution from the environment. The process of manufacturing of animal and fish feed and fertilizer from recycling waste is the most important factors for operation of unemployment reduction. So, Eleraky *et al.* (2009) revealed that milling by-products and wheat past by-products can be used as corn replacer with enzymes supplementation in fish diets.

Table (5): Effect of dietary treatments on growth rates and survival rate by Nile tilapia.

Treatments (No.)	RGR	SGR, %/d	SR%
Control, Corn by- product (0%) (T_1)	1.15±0.03[ab]	0.68±0.01[ab]	100.00±0.00[a]
Corn by -product (25%) (T_2)	0.99±0.13[b]	0.61±0.05[b]	100.00±0.00[a]
Corn by- product (50%) (T_3)	0.95±0.01[b]	0.59±0.00[b]	100.00±0.00[a]
Corn by- product (75%) (T_4)	1.06±0.02[ab]	0.66±0.02[ab]	100.00±0.00[a]
Corn by- product (100%) (T_5)	1.38±0.02[a]	0.76±0.01[a]	100.00±0.00[a]

a-b: Means in the same column superscripted with different letters significantly ($P \leq 0.05$) differ

Tilapia zilli and *Mugil capito* fed the diet containing 45% dried restaurant food waste had the heaviest body weight, the longest standard length and the best feed conversion ratio than the other diets (Eissa *et al.*, 1985). Moreover, Magouz (1996) concluded that there were no significant differences in average weight gain, specific growth rate, feed conversion ratio, protein efficiency ratio, protein productive value, energy retention and body composition when Nile tilapia were fed diet containing 10% sugar beet pulp comparing with the control. Additionally, El-Saidy and Magdy (1999) evaluated different sources of carbohydrates (corn meal, wheat bran, starch, date palm and akalona) in tilapia diets. They found that the source of carbohydrate in the diet significantly affect the crude protein, fat and energy digestibility coefficients. They suggested that wheat bran or corn meal at the 28.5% level of the diet can efficiently be utilized as energy source in ration for Nile tilapia diets, wheat bran being the best. Also, Soltan (2002) used potato by-product as non-conventional ingredient in Nile tilapia diets and reported that it could replace yellow corn by potato by-product up to 40% without adverse effects but even reduces feed costs by 7.53%.

Feed and Nutrients Utilizations:

Table 6 shows that there were non significant ($P>0.05$) differences among treatments in feed conversion ratio (FCR) nor in protein efficiency ratio (PER). Yet, there were significant ($P \leq 0.05$) differences among treatments in feed intake (FI), protein intake (PI), and protein productive value (PPV) in favor of T5 comparing with the control.

Table (6): Means ± standard errors of feed intake, feed conversion ratio, protein intake, protein productive value, and protein efficiency ratio of the tested Nile tilapia fingerlings as affected by dietary treatments.

Treatments (No.)	Feed Intake, g/fish	FCR	Protein Intake, g/fish	PPV, %	PER
Control Corn by- product (0%) (T_1)	46.64±1.54[ab]	3.37 ± 0.01[a]	11.85 ± 0.39[ab]	11.84 ± 0.00[ab]	1.16 ± 0.00[a]
Corn by- product (25%) (T_2)	44.35 ± 1.57[b]	3.78 ± 0.35[a]	11.14 ± 0.39[ab]	10.92 ± 1.03[b]	1.06 ± 0.10[a]
Corn by- product (50%) (T_3)	43.90 ± 0.11[b]	3.75 ± 0.05[a]	10.92 ± 0.02[b]	10.89 ± 0.16[b]	1.06 ± 0.01[a]
Corn by- product (75%) (T_4)	44.89 ± 0.73[ab]	3.38 ± 0.10[a]	11.34 ± 0.18[ab]	11.93 ± 0.39[ab]	1.16 ± 0.03[a]
Corn by- product (100%) (T_5)	50.03 ± 0.27[a]	2.95 ± 0.04[a]	12.52 ± 0.07[a]	13.73 ± 0.20[a]	1.32 ± 0.03[a]

a-b: Means in the same column superscripted with different letters significantly ($P \leq 0.05$) differ

Srour *et al.* (2002) came to the conclusion that the inclusion of 25% dried dropping dates meal instead of yellow corn meal in diets of tilapia and catfish did not negatively affect fish growth performance nor feed and nutrients utilization as compared with the control, but even reduces the cost of feed required for production of one kg fish gain. El-Komy (2006) recommended the usage of either potato processing by-product (PPB) or broken rice meal (BRM) as unconventional feedstuffs in tilapia diets up to 40 and 60%, respectively as sources of energy instead of yellow corn. He found BRM was superior than PPB as alternative energy source.

These unconventional feed resources can play an important role in reducing feed costs in intensive fish culture, particularly under conditions of fluctuations present in prices of feedstuffs in the local and world markets, especially after using various organic matters including foods and feeding stuffs for producing bio-fuel worldwide. Khalafalla and Salem (2006) replaced up to 20% of yellow corn energy by olive cake without harmful effect on the tilapia growth performance and feed utilization.

Chemical Analysis of Nile Tilapia Fingerlings:

At the start, on fresh weight basis, DM was 79.06, CP 11.86, fat 4.56, ash 3.53, and NFE 0.99 %. But at the end of the experiment, DM was generally lower and CP higher. There were no significant ($P>0.05$) differences among treatments in DM and energy contents, but there were significant ($P\leq0.05$) differences among treatments in CP, fat, and ash percentages. Where all treatments were significantly higher in CP but T5 was lower in fat and ash percentages (Table 7).

Generally, there is a negative relationship between crude proteins and crude fats in chemical composition of Nile tilapia fish on one hand (Abdelhamid *et al.*, 1995a&b, 1997, 1998a&b, 2002a & b, 2007b & c and El-Ebiary and Zaki, 2003) and a positive correlation between crude protein and crude ash contents of Nile tilapia fish, on the other hand (Abdelhamid *et al.*, 1995a&b, 1997, 1998a&b and 2007a). A negative relationship was noticed between CP and EE contents of fish body but a position relationship between CP and ash contents was recorded too (Abdelhamid *et al* ., 1995a&b; 1999; 2000; and El-Saidy and Gaber, 2002). Eid (1995), Kobeisy and Hussein (1995), Gaber (1996), El-Saidy and Gaber (1998 & 2002) and El-Saidy *et al.* (1999) found that there was a positive correlation between crude protein and fat contents of the fish, but Abdelhamid *et al.* (1995b, 1998a&b, 1999, 2001, 2002a&b, 2004 and 2005a&b), Goda (2002), Magouz *et al.* (2002-a & b) and El-Ebiary and Zaki (2003) found a negative correlation between protein and fat contents of the fish. However, El-Ebiary *et al.* (2001) suggested that up to 40% of fish meal protein can be replaced with corn gluten meal in diet of sea bass fry without adverse effects on whole body composition.

Table (7): Means (±SE) of chemical composition (% fresh matter bases) of Nile tilapia carcass as affected by the dietary treatments.

Treatment (No.)	DM	CP	Fat	Ash	EC, kcal /100g
Control Corn by- product (0%) (T_1)	78.80±0.05^{a}	12.96±0.03^{b}	4.66±0.01^{a}	3.63±0.05^{a}	117.00±0.00^{a}
Corn by- product (25%) (T_2)	78.56±0.13^{a}	14.33±0.05^{a}	4.63±0.07^{a}	3.23±0.05^{ab}	125.00±0.00^{a}
Corn by- product (50%) (T_3)	78.43±0.^{13a}	14.16±0.10^{a}	4.60±0.03^{a}	3.40±0.12^{ab}	124.00±0.00^{a}
Corn by-product (75%) (T_4)	78.63±0.07^{a}	14.30±0.20^{a}	4.36±0.09^{ab}	4.73±0.15^{a}	127.50±3.18^{a}
Corn by- product (100%) (T_5)	78.86±0.08^{a}	14.76±0.05^{a}	4.13±0.01^{b}	3.06±0.01^{b}	127.50±3.18^{a}

a-b: Means (in the same column) superscripted with different letters significantly ($P\leq0.05$) differ.

REFERENCES

Abd El- Hakim, N. F., Bakeer M.N. and Soltan M.A. (2002). Water Environment for Fish Culture. Deposition No.: 4774, ISBN: 977-298-228-5.

Abdelhamid, A.M. (1988). Utilization From Agro-industrial By-products in Ruminant's Feeding. 1st Nat. Conf. On the Role of the Sci. Res. in Raising Animal Wealth. 2nd Forum: Developing Ruminant's Feed Resources. 25-29 Sept., pp: 119-130. Acad. Sci. Res. Technol., Cairo.

Abdelhamid. A. M. (1992). Feeding value of dried sugar beet pulp from Egyptian production. Arch. Anim. Nutr., 42: 365-370.

Abdelhamid, A.M. (1996). Field and Laboratorial Analysis in Animal Production. Dar Annashr for Universities, Cairo, Deposit No. 11318/1996, ISBN: 977- 5526-04-1, 680 p.

Abdelhamid, A.M. (2003). Scientific Fundamentals for Fish Production and Management, 2nd Rev. Ed., Deposit No. 15733/2003, Mansoura Univ. Press.

Abdelhamid, A.M. and S.A. El-Ayoty (1988). Feeding sheep on pea by-products produced during preparation for freez-preservation. Archiv für Tierernährung, 38: 789-797.

Abdelhamid, A.M., A.I. Mehrim and F. F. Khalil (2004). Detoxification of aflatoxin-contaminated diet of tilapia fish using dietary supplementation with egg shell, Betafin®, clay or silica. J. Agric. Sci. Mansoura Univ., 29: 3163 – 3173.

Abdelhamid, A.M., F.F. Khalil, and A. M. El-Zareef (2000). Studies on iron in Egyptian freshwater fishes, 2- Effect of vitamin C and/or vitamin A supplementation on iron utilization by tilapia (*Oreochromis niloticus*) and catfish (*Clarias lazera*). J. Agric. Sci., Mansoura Univ., 25(1): 113 – 131.

Abdelhamid, A.M., F.F. Khalil and M.I. El-Barbary (1997). Effect of different dietary crude protein levels supplemented with graded levels of flavomycin on growth performance of Nile tilapia fry and their utilization of different nutrients. Egypt. J. Aquat. Biol. & Fish., 1(2): 93 – 108.

Abdelhamid, A. M.; F. F. Khalil and M. I. El-Barbary (1998a). Effect of using graded levels of gibberellic acid in diets differing in the crude protein levels on performance and chemical composition of Nile tilapia fingerlings. Egypt. J. Aquat. Biol. & Fish., 2 (4): 221-233.

Abdelhamid, A.M., F.F.M Khalil, M.I. El-Barbary, V.H. Zaki and H.S. Husien (2002a). Feeding Nile tilapia on Biogen® to detoxify aflatoxic diets. Proc. 1st Ann. Sc. Conf. Anim. & Fish Prod., Mansoura Fac. Agric., 24 & 25 Sep., pp: 207 – 230.

Abdelhamid, A.M., F.F. Khalil, and M.R. Essa (1999). Effect of graded levels of vitamins C and/or E in diets of Nile tilapia brood stock fishes (*Oreochromis niloticus*) on: 1- Growth performance, chemical composition and feed utilization. Egypt. J. Nutr. & Feeds, 2: 823 – 838.

Abdelhamid, A.M., F.F. Khalil, and M.A. Ragab (1998b). Problem of mycotoxins in fish production. Egypt. J. Nutr. and Feeds, 1: 63–71.

Abdelhamid, A.M., F.F. Khalil, V.H. Zaki, A.F. El-Shaieb, and A.M.M. El-Mezaien (2001). Effect of feeding systems on performance of caged gilthead seabream (*Sparus aurata*) under Egyptian conditions. Egypt. J. Nutr. and Feeds, 4: 139 – 152.

Abdelhamid, A.M., F.I. Magouz, M.F.E. Salem, A.A. Mohamed, and M.K. Mohsen (2002b). Effect of dietary graded levels of aflatoxin B_1 on growth performance and biochemical, chromosomal and histological behavior of Nile tilapia, *Oreochromis niloticus*. Proc. 1st Ann. Sc. Conf. Anim. & Fish Prod. Mansoura, 24 & 25 Sep., pp: 231 – 250.

Abdelhamid, A.M., G.H.A. Ghanem, A.M. Aiad and R.I.M. Matari (2009a). Evaluating the possibility of recycling banana waste as a feed for ruminants. I- chemical composition, rumen-liquor parameters, digestibility coefficients, and feeing values by lambs. J. Agric. Sci. Mansoura Univ., 34: 10451 – 10467.

Abdelhamid, A. M.; G. H. A.Ghanem, A. M. Aiad and R. I. M. Matari (2009b). Evaluating the possibility of recycling banana waste as a feed for ruminants. II- growth performance, blood picture, and feeding economics by lambs. J. Agric. Sci. Mansoura Univ., 34: 10469 – 10479.

Abdelhamid, A. M., H. A. El-Fadaly and S. M. Ibrahim (2007a). Studies on integrated fish/duck production system: 1- On water quality and fish production. J. Agric. Sci. Mansoura Univ., 32: 5225 – 5244.

Abdelhamid, A.M., H.A. El-Fadaly and S.M. Ibrahim (2007b). Integrated aquaculture by bearing ducks on earthen fish ponds. Engormix. Com. Aquaculture Technical Articles.

Abdelhamid, A.M., H.H. El-Sadaney, M.M. El-Shinnawy and T.M. Dorra (1995a). Effects of dietary graded levels of ascorbic acid on performance and chemical composition of tilapia fingerlings. J. Agric. Sci. Mansoura Univ., 20: 2731 – 2742.

Abdelhamid, A. M., H. H. El-Sadaney, M. M. El-Shinnawy and T. M. Dorra (1995b). Effects of dietary levels of crude protein, crude fat. and ascorbic acid on Nile tilapia (*Oreochromis niloticus*) fingerlings performance. J. Agric. Sci. Mansoura Univ., 20: 2743 – 2766.

Abdelhamid, A. M., M. F. I. Salem, and A. E. Tolan (2005a). Evaluation of linseed meal as feed ingredient in diets of growing Nile tilapia (*Oreochromis niloticus*). J. Agric. Res. Tanta Univ., 31 (3): 385–402.

Abdelhamid, A.M., M.F.I. Salem, and A.E. Tolan (2005b). Utilization of black seed meal (*Nigella sativa*) in Nile tilapia (*Oreochromis niloticus*) diets. J. Agric. Res. Tanta Univ., 31(3): 403-419.

Abdelhamid, A.M., M.A. Ibrahim, N.A. Naghraby and A.A.A. Soliman (2007c). Effect of dietary supplementation of betaine and/or stocking density on performance of Nile tilapia. J. Agric. Sci. Mansoura Univ., 32: 167 - 177.

Abou Khalifa, A.A.B. (2009). Mubarak international project, for waste recycling. Global Fisheries & Aquaculture Research Conference, 24-26 October, Cairo, p: 5.

A.O.A.C. Association of Official Agricultural Chemists (1990). Official methods of analysis. 15th Ed. Published by the A.O.A.C., Benjamin Francklin Station, Washington. D.C., USA.

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

Eid, A. (1995). Evaluation of fish oil, corn oil, palm oil, olive oil and beef tallow singly and in combination as supplemental dietary lipid source for fingerling Nile tilapia diets. Zagazig J. Agric. Res., 22(4): 1015 – 1022.

Eissa, M. A., M.A. Abaza, M.N. Shehata and H. El-Ebiary (1985). Effect of feeding restaurant waste on growth and feed conversion of tilapia and mullet in different culture methods. Alex. J. Agric. Res., 30 (2): 717-728.

El-Ebiary, E.H. and M.A. Zaki (2003). Effect of supplementing active yeast to the diets on growth performance, nutrient utilization, whole body composition and blood constituents of mono-sex tilapia (Oreochromis niloticus). Egypt. J. Aquat. Biol. & Fish., 7 (1): 127 – 139.

El-Ebiary. E.H., M.A. Zaki and H.A. Mabrook (2001). The use of corn gluten meal as a partial replacement for fish meal in diets of sea bass (Dicentrarchus labrax) fry. Bull. Nat. Inst. of Oceanog. & Fish, A.R.E., 27: 373-386.

Eleraky, W., A.G. El-Nobi, M. U. Dief and M. Elkohly (2009). Influence of multienzymes supplementation in unconventional diets on growth performance, health condition and protein utilization of Oreochromis niloticus. Global Fisheries & Aquaculture Research Conference, 24-26 October, Cairo, p: 51.

El-Komy, H.M.A.I. (2006). Utilization of some non-conventional feedstuffs and food processing by-products in the diet of Nile tilapia. Ph. D. Thesis, Fac. of Agric., Kafr El-Sheikh Univ.

El-Saidy, D.M.S.D and M.A. Magdy (1999). Effect of using different sources of carbohydrate in practical diets on the performance of Nile tilapia, Oreochromis niloticus (L) fingerlings. Egypt. J. Aquat. Biol. & Fish., 3 (3): 195-216.

El-Saidy, D.M.S.D. and M.M.A. Gaber (1998). Effects of using ascorbate polyphosphate in practical diets on Nile tilapia (Oreochromis niloticus) fry performances. Menofiya J. Agric. Res., 23(2): 363 – 378.

El-Saidy. D.M.S.D. and M.M.A. Gaber (2002). Optimal dietary lipid levels for growth of Nile tilapia (Oreochromis niloticus L.) fry. Annals of Agric. Sci., Moshtohor, 40 (3): 1461– 1473.

El-Saidy, D.M.S.D., M.M.A. Gaber, and F.I. Magouz (1999). Effect of dietary energy level on growth, feed conversion, body composition, digestibility coefficients and energy budget of Nile tilapia (Oreochromis niloticus). Egypt. J. Aquat. Biol. & Fish., 3 (3): 159–178.

El-Sherif. Kh., T.H. Tag El-Din, E.H. Abo-Egla and H. Abd-El-Khalik (2008). Performance of growing male rabbits fed diets containing banana leaves and yeast culture. Egypt. J. of Rabbits Sci., 18 (2): 83-98.

Etman, K.E.I., A.M.M. Zeid and T.I. El-Monayer (2010). Utilization from new nutritional resources in ruminants feeding: 1- Effect of using dried distillers grains with solubles (DDGS) in rations for fattening Friesian calves. J. Animal and Poultry Prod., Mansoura Univ., 1 (12): 659-668.

FAO (2006). In: anon. (2006). Nearly half of all fish eaten today farmed, not caught. Aquaculture. Feed Tech, 10 (9): 31.

Gaber, M.M.A. (1996). Effect of oil sources on growth, feed conversion and body composition of Nile tilapia (Oreochromis niloticus). Annals of Agric. Sci., Moshtohor, 34 (4): 1549 – 1562.

Gabr. A.A.. M.M. El-Shinnawy. E.H. Makled and N.T.H. Tag El-Din (2010). Effect of including dried distillers grains with soluble in growing lambs diet on digestibility. some rumen parameters. blood constituents and performance. J. Animal and Poultry Prod.. Mansoura Univ.. 1 (6): 251-264.

Goda. A.M.A.S. (2002). The influences of n6/n3 dietary fatty acid ratio on growth performance and body fatty acid composition of Nile tilapia (Oreochromis niloticus). Vet. Med. J. Giza. 50(1): 33 – 45.

Khalafalla. M. M. E. and M. F. E. Salem (2006). Use of (olive cake, sugar beet pulp and molasses) as non-conventional energy feed sources in Nile tilapia (Oreochromis niloticus) diets. Egypt. J. Agric. Res., 84 (1B): 295-309.

Kobeisy, M.A. and Hussein, S.Y. (1995). Influence of dietary live yeast on growth performance and some blood constituents in Oreochromis niloticus. Proc. 5th Sci. Conf. Anim. Nut., Ismailia, 12 – 13 Dece., pp: 417 – 425.

Macdonald, P., Edwards, R.A. and Greenhalgh, J.F.D. (1973). Animal Nutrition, 2nd Ed., Longman, London.

Magouz, F. I. (1996). Effect of including sugar beet pulp in the diet on growth performance, efficiency of feed utilization and body composition of Nile tilapia (Oreochromis niloticus). J. Agric. Sci. Mansoura Univ., 21 (1): 187-193.

Magouz, F.I., M.K. Mohsen, and A. H. Gooda (2002a). Effect of including some biological feed additives in the diet on growth performance and feed efficiency of Nile tilapia (Oreochromis niloticus). Proc. 2nd Conf. Food borne Contamination and Egyptians' Health, April 23–24. El-Mansoura Univ., pp: 329 – 339.

Magouz. F.I.. M.K. Mohsen. and N.M. Abd El-Moniem (2002b). Utilization of different sources and levels of lipids in the diet of Nile tilapia (Oreochromis niloticus). Proc. 2nd Conf. Foodborne Contamination and Egyptians' Health. 23–24 April. El-Mansoura. Egypt, pp: 357–370.

Omer, H.A.A. and M.A. Tawila (2008a). Growth performance of growing Baladi goats fed diets containing different levels of sun dried peel potato waste. Egypt. J. Nutr. And Feeds, 11 (3): 453-468.

Omer, H.A.A. and M.A. Tawila (2008b). Response of Baladi goats to diets containing different levels of citrus by-product. Egypt. J. Nutr. And Feeds, 12 (1): 75-88.

Omer, H.A.A., S.S. Abdel-Magid, S.M. Ahmed, M.I. Mohamed and I.M. Awadalla (2010). Response to partial replacement of yellow corn with potato processing waste as non-conventional source of energy on the productive performance of Ossimi lambs. Tropical Animal Health and Production (accepted for publication Mar. 11, 2010).

Pantha, B. (1982). The use of soybean in practical feeds for Tilapia niloticus. M. Sc. Thesis. Univ. of Stirling.

Radwan. I. (2009). Tilapia fish culture in River Nile Delta from 1990 to 2008. Asmak, Egyptian Fish Council, April. No.8, pp: 12-13.

SAS (1996). SAS/STAT Guide for personal computer. SAS Inst. Cary, N. C.

Soltan. M. A. (2002). Using of tomato and potato by-products as non-conventional ingredients in Nile tilapia. Oreochromis niloticus diets. Annals of Agric. Sc., Moshtohor. 40 (4): 2081-2096.

Srour. T. M.A., M.A. Zaki and A.A. Nour (2002). Dried dropping dates (DDD) as a dietary source for Nile tilapia (Oreochromis niloticus) and African catfish (Clarias gariepinus). Proc. 1st Ann. Sc. Conf. Anim. & Fish Prod. Mansoura. 24 & 25 Sep.. pp: 183-192.

Tawila M. A., H.A.A. Omar and S.M. Gad (2008). Partial replacing of concentrate feed mixture by potato processing waste in sheep ration. American-Eurasian J. Agric. & Environ. Sci., 4 (2): 156-164.

تأثير إحلال مخلف الذرة محل الذرة فى عليقة اصباعيات البلطى.

عبد الحميد محمد عبد الحميد[1] ، على على على سليمان[2] ، نجوى عبد المنعم مغربى[2]

[1]قسم إنتاج الحيوان- كلية الزراعة - جامعة المنصورة - المنصورة - مصر.
[2]قسم الإنتاج الحيوانى - المركز القومى للبحوث - الدقى - الجيزة - مصر.

في تجربة تغذية معملية، تم اختبار إمكانية إحلال (بنسب صفر، 25، 50، 75، و100%) مخلفات مصانع الكاراتيه (مخلفات ذرة) محل الذرة في علائق اصباعيات أسماك البلطي النيلي (وزن أولى 12.0-12.5جم) لمدة 16 أسبوعا. أظهرت النتائج تفوق العليقة الخامسة (نسبة إحلال 100%) معنويا في كل من وزن الأسماك النهائي، الزيادة في وزن الجسم، الزيادة اليومية في وزن الجسم، معدلي النمو النوعي والنسبي، استهلاك العلف والبروتين، القيمة الإنتاجية للبروتين، وكذا بروتين جسم الأسماك مقارنة بالكونترول.