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POSSIBLE EFFECTS OF FEEDING FISH THE DRIED-TREATED SEWAGE SLUDGE:
I-CONCERNING GROWTH PERFORMANCE, FEED UTILIZATION AND CHEMICAL COMPOSITION

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ABSTRACT

A field study was conducted to investigate the effects of feeding fish [in a polyculture system consists of four freshwater species, namely Nile tilapia (T), silver carp (Sc), common carp (Cc), and African catfish (Cf)] the sewage (S) sludge comparing with a commercial diet for fish as a control (C) for 102days. From the obtained results, the use of sewage sludge in fish feeding led to lower growth performance. Silver carp reflected better growth performance than Nile tilapia, common carp and catfish, respectively, particularly with feeding the sewage sludge. The best feed utilization was showed by silver carp and Nile tilapia, the worst values with catfish. Nile tilapia fed the sewage sludge showed the best FCR and PER. The best chemical composition of the whole fish body was found with feeding the commercial diet (control). Catfish body contained the highest ash, CP and EC and the lowest EE among all tested fish species. Control tilapia had the lowest ash and EE contents, while highest CP and EC content was found with catfish fed the sewage sludge. Silver carp muscles contained higher DM and CP and lower ash, EE and EC contents among all fish species. The best ash, EE, and CP was determined in silver carp fed the control diet. Nile tilapia showed the highest values for condition factor, dressing and fillet percentages among the tested fish species, the lowest condition factor and dressing with catfish, and the lowest fillet with common carp. Therefore, it is not recommended to use sewage sludge in fish feeding, although its use in cultured fish feeding is wide spreading in Kafr El-Sheikh governorate.

Keywords: Fish, sewage sludge,polyculture,growth performance,feed utilization,chemical composition.

INTRODUCTION

Most of the Egyptian wild (marine, brackish and fresh) water bodiesare contaminated with agricultural, industrial and urban drainage, which are responsible for their water and fish pollution with different heavy metals(Abdelhamid*et al*., 2006 and 2013a & b)at levels exceeding the Egyptians' tolerance limits(ES, 1993 and Abdelhakeem *et al.,* 2002). Heavy metals polluted water is causative for ca.thirty-two danger diseases(Abdelhamid, 2006).Fish may also respond to a stressor by altering their physiology to the point that natural resistance and immunity to disease is reduced and they become more susceptible to infectious diseases (Wedemeyer, 1997).So,many intoxications could be occurred in humans consume fish reared under polluted water conditions (Abdelhamid and El-Ayouty, 1991; Shata, 1996 andAbdelhamid*et al*., 1999) or fish fed contaminated diets(Abdelhamid, 1983 andAbdelhamid*et al*., 1996).This year (2014) will be a milestone year, where the per capita consumption of farmed fish will be greater than wild fish consumption (Koeleman, 2014). In this respect, sewage sludge (night soil or urban waste) may be used in aquaculture. However, the use of untreated night soil as a fertilizer as a source of nutrients in fish farming presents a considerable health hazard in the form of pathogens and parasites. Moreover, fish ponds receiving nutrients derived from treated night soil were less contaminated than those of untreated night soil was applied, and the fish reared in them were of superior quality (Ling *et al*., 1993).The aim of the present study was to investigate to what extend could the sewage sludgeaffectthe growth performance, feed utilization and chemical composition of some freshwater fishes in a polyculture system.

MATERIALS AND METHODS

The experimental management:

This study was conducted during the summer season 2013 in a private fish farm (of Dr. Salah Ibrahim) at Tolompat 7, Alriad, Kafr El-Sheikh governorate, Egypt, during the period from 21 / 7 / 2013 to 30/10/2013.Nile tilapia, silver carp and African catfish were purchased from a private fish farm, Kafr El-Sheikh governorate, Egypt. While, common carp were purchased from Integrated Fish Farm at Al-Manzala (General Authority for Fish Resources Development – Ministry of Agriculture), Al-Dakahlia governorate, Egypt. Fish were stocked into a netHapa for two weeks, as an adaptation period, and fed a basal diet. Fish were distributed into two experimental treatments (intwo covered-net Hapas, to prevent jumping of silver carp); in the first treatment (the control group), fish were fed the basal diet, whereas in the second treatment, fish were fed a sludge. Each Hapa (8*3*1 m) was constructed and implanted in an earthen pond. Four fish species were distributed with an average initial body weight of Nile tilapia*O. niloticus* 178 ± 3.5 g, common carp *Cyprinuscarpio*232 ± 2.75 g, silver carp *Hypophthalmichthysmolitrix*344 ± 4.3 g and African catfish *Clariasgariepinus*408 ± 3.2 g). Stocking density was 100 fish /Hapa at a rate of 1: 1: 1: 1 for Nile tilapia, common carp, silver carp and African catfish. The basal diet was purchased from Almorshedy for Trading and Development, Meet Ghamr –Al-Dakahlia – Zagazig Road, Egypt. This commercial diet contained yellow corn, soybean meal (44% CP), wheat bran, fish meal (65% CP), corn gluten (60% CP), lime stone, common salt, dicalcium phosphate, and molasses and had not less than 25% crude protein, 3% crude lipids, 3935 Kcal gross energy/Kg diet, and not more than 5.30% crude fiber, according to the manufacture's formula. The dried treatedsewage sludge was obtained from the duple stage treatment project (Sanitary Drainage Station, Kafr El-Sheikh at Al-Riad, Kafr El-Sheikh governorate, Egypt). The tested diet and sludge were offered once daily (10:00 am) at 5% of the fish biomass at each Hapa. The feed quantity was adjusted each 21 days according to the actual body weight changes.Some physical and chemical properties of water were measured, such as temperature, pH, alkalinity and dissolved oxygen in the water basin at weekly intervals.

Fish sampling and fish performance parameters:

At the end of the experiment, fish samples were collected and kept frozen until the proximate analysis of the whole fish body and thedorsal muscles.Growth performance parameters of the fish were calculated, such as average total weight gain (TWG, g), average daily gain (ADG,g/fish/day), relative growth rate (RGR, %), specific growth rate (SGR, %/day) and survival rate (SR, %). Feed conversion ratio (FCR), and protein efficiency ratio (PER) were calculated acording to **Abdelhamid (2009)**.

Also, fish samples (five fish/species/Hapa) were collcted to measure the indivedual body weight, total length and stander length to calculate condition factor (Kt) based on total length and (Ks) based on stander length. Then, fish samples were killedto remove the head and viscera, fins and scales to calculate dressing percentage from the equation: [Eviscerated-entheaded fish weight, g/whole fish body weight, g.] and to remove the bones to calcluted filled percentage from the equation:[the weight of muscles, g (removed with an sharp knife from the vertebra of the dressed fish)/ total weight, g} x100 %]**(Ali *et al*., 2013)**.

Chemical analysis of fish:

Chemical (proximate) analysis of fish (for 5 fish / species / treatment at the end of the experiment), food, and sewage samples wascarried out according to **AOAC (1995)** for dry matter, crude protein, ether extract, and ash (as well as crude fiber of food and sewage).The gross energy contents of the experimental diet and fish were calculated by using factors of 5.65, 9.45 and 4.2 Kcal/g of protein, lipid and carbohydrate, respectively **(NRC, 1993).**

Statistical analysis:

Using **SAS (2001)** and **Duncan (1955)**, numerical data collected were statistically analyzed for analysis of variance and least significant difference at propability (P) level of ≤0.05.

RESULTS AND DISCUSSION

Water quality:

The obtained values of water quality parameters in the earthen pond were 25±3 ºC for water temperature, 8.80 pH, and 2.66 ppm for dissolved oxygen (DO). This alkalinity may be attributed toproliferationof phytoplankton for the presence of sewage sludge. Also, the low level of DO may be due to increased chemical (COD) and biological oxygen demands (BOD). In this context, Edwards *et al*. (1994)fond that buffalo manure was responsible for reducing penetration of light, which may have contributed to the low phytoplankton biomass and relatively low DO. Abdel-Halim *et al*. (1998) registered also low DO and high pH vale, being 3.01-3.37 ppm and 8.32-8.63, respectively. Also, Nagdi*et al*. (1998) measured pH value and DO concentration in chicken litter treated ponds as 8.2 and 1.11 ppm, respectively. Hafez *et al*. (2002) referred to increased growth rate of Nile tilapia as a consequence of increasing of different varieties or species of phytoplankton and zooplankton and the water alkalinity with treating fish ponds with poultry litter than the control. An investigation was undertaken to study the importance of different physico-chemical parameters of water related to recycling of organic waste through aquaculture in a man-made lotic biological sewage treatment system. The levels of parameters such as water temperature, transparency, pH, dissolved oxygen, free carbon dioxide, total alkalinity, total hardness, calcium hardness, chloride ion, nitrite nitrogen, nitrate nitrogen, ammonium nitrogen, orthophosphate, biochemical oxygen demand, dissolved organic matter, and primary productivity did not indicate a pollution problem. Although higher levels of carbon dioxide and lower levels of dissolved oxygen caused asphyxiation in early hours of some days, fish mortality was not observed probably due to flowing nature of water (Manna *et al*., 2003).Abdel-Tawab and Sweilum (2004) recorded higher pH value(8.6) with using organic fertilizer (manure).A consistent increase in ammonium concentration was measured downstream of fish farm, but not the sewage effluent input. The sewage effluent input was a point source of dissolved organic nitrogen (DON) with an increase of 15 μM. Nitrate was the major component of dissolved nitrogen in this aquifer-fed chalk-bed system, with up to 10% being DON and ammonium comprising<1% (Homewood *et al.,* 2004).A study deals with the assessment of some physico-chemical and fisheries activities of a sewage fed Jannapura tank for its suitability of human consumption and fish culture have been carried out. Phosphate, nitrate, BOD and oxygen were used as indicators of possible nutrient enrichment in the tank. This water body continuously receiving sewage from the surrounding residential areas. Nitrate, phosphate and BOD values were high depicting cultural eutrophication occurring from surface runoff of nitro-phosphate fertilizers from nearby lands into the tank and the present findings revealed that the water quality of the tank is productive and eutrophic. In addition, fish diversity, species cultured, fish marketing, advantage and disadvantages of sewage fed fisheries in the present water body are discussed (**Kiran, 2014**).

Commercial diet and sewage sludge:

Table 1 presents data of proximate analysis of the control (C) diet and sewage (S) sludge on dry matter basis. The S seemed to be CP-richer than C; yet, S contained very high percentage of ash and very low percentages of EE and total carbohydrate comparing with C. However, different wastes are frequently used in fish feeding (Abdelhamid, 2014a) from plant, animal and/or variable sources such as dried blue green algae (Salama, 2003), sugar beet pulp (Magouz, 1996 andKhalafalla and Salem, 2006), corn gluten meal (El-Ebiary*et al*., 2001), tomato and potato by-products (Soltan, 2002), dried dropping dates (Srour*et al.,*2002 and Nour*et al*., 2004), fig jam by-product (El-Dakar *et al.,* 2003), coffee pulp (Rojas and Verreth, 2003), sesame hulls by-product (AbdElmonem*et al*., 2004), wastes of biscuits Manufacture Company (El-Saidy, 2004), biological treated legumes by-products (Khalafalla*et al.,*2012), medicinal plants (Ibrahim *et al*., 2012 andAbdelhamid and Soliman, 2013), palm pollen grains (Abou-Zied*et al*., 2013), duck weed and/or freshwater crayfish (Abdelhamid*et al*., 2012a&b), poultry by-product and feather meal (Gaber, 1996), poultry industry wastes (**Srour, 2003** and

Ayaad and Hassouna, 2005), fish by-product protein concentrate (Hanafy, 2008), silkworm pupae meal (Salem *et al*., 2008) and fermented fish silage (Abd El-Hakim *et al*., 2013). Moreover, plant and animal wastes are used also as organic fertilizers for fish ponds including buffalo manure (Edwards *et al*., 1994); duck droppings (Abdel – Halim *et al*., 1998 and AbouZied, 2007); duck and buffalo manures (Abdel-Hakim *et al*., 1999); poultry or cow manure (Abdel-All *et al*., 2001); poultry litter (Hafez *et al*., 2002); blue green algae and chicken manure (Bakeer*et al*., 2003); cow manure, chicken manure, sugarcane bagasse compost and rice straw compost (Hafez *et al*., 2003); poultry and cow manure (Abdel – Tawab and Sweilum, 2004); poultry manure (Hassan, 2004 and Hassanien*et al*., 2008); poultry manure (Abdel-All *et al.,* 2001 and Hassan, 2004); cow manure (Hassan *et al*., 2005); poultry drops, silkworm wastes and fresh rumen contents (Agouz and Gomha, 2011) and green fertilizers and manures (Abdelhamid, 2014b).

Table 1: Chemical composition of the tested commercial diet and sewage sludge (% on dry matter basis)

Composition %	**Control (C) diet**	**Sewage (S) sludge**
Dry matter, DM	92.75	92.12
Crude protein, CP	25.75	30.21
Ether extract, EE	3.56	0.89
Ash	6.42	41.54
Total carbohydrate	64.27	27.36

Sanitary drainage is the waste water from the human activities (municipal, domestic and industrial waste water). It consists of more than 99.99% water and less than 0.1% solids. In Egypt, man can produce daily in Egypt ca. 54g organic substances, from which 42g suspended and 12g soluble. Generally, the pollution of water resources with human-house wastes is responsible for the outspreading of colonic diseases. So, the aim of treating the waste water is to prevent outspreading of diseases and ground water pollution besides the protection of fish wealth (CTC, 2010/2011).Sewage sludge when well treated could be used for reclamation of sandy and light soils for its inclusion of fertilizer elements which are good for preserving the water by soils. It had been used as organic fertilizer for different trees (wooden forestry and fruits), forages and crops (cotton, soya bean, pees, wheat, line, field beans, maize), although it raised the plant contents of some heavy metals as Ca, Co and Pb, since sewage is containing high levels of heavy metals according to the industrial drainage which differ from time to another and from location to location (CTC, 2010/2011). Meanwhile, sewage sludge had been used in Viet Nam and India before a century in feed fish culture system. Though there are fears about the safety of the fish grown in sewage fed systems, it is the general belief that the fish grown in sewage tastes better. This has been partly attributed to the good nutrition obtained from the rich plankton growth in ponds. There is opportunity to develop systems suitable to each of the urban centers to produce fish using sewage and avoid environmental damage, being caused by the discharge of untreated sewage (Dalsgaard, 1996 and Nandeesha, 2002). However, using sewage sludge in fish farming is one of methods of overcoming the shortage in fish foods which are facing some competition between human beings and animal species because of the outspreading of aquaculture which reached nowadays more than 70% of the Egyptian total fish yield (Osman, 2012). Fish culture is a must under the present conditions of over fishing and pollution of the wild water bodies that led to disappearance of some fish species from the wild water bodies and decreased the natural catch (Shalaby, 2000).

Growth performance:

The obtained results confirmed (regardless of fish species) that feeding fish the sewage sludge led to significantly ($P \leq 0.01$) lower values of growth performance parameters comparing with those fed the control (commercial) diet. However, regardless of dietary treatments, silver carp (Sc) performed better ($P \leq 0.01$) than tilapia (T), followed by common carp (Cc) then catfish (Cf), respectively (Table 2). The interaction analysis revealed also that Sc reflected the best ($P \leq 0.01$) values of all tested growth parameters (Table 3); among all fish species tested (the worst fish species was Cf), particularly that fed sewage sludge than that fed control diet. All fish species performed better on sewage sludge than the control diet, except Cc that performed better on commercial diet than on sewage sludge. This may be due to different feeding habits of different fish species as well as to various factors included in sewage sludge. However, silver carp reflected better growth performance although the catfish had heavier initial bodyweight. Also, tilapia was more tolerated for sludge feeding, which may be for its feeding habits. In this respect, Natarajan and Varghese (1980) tested the effects of poultry manure, digested sewage sludge cake and cow-dung on plankton production and fish growth. Both plankton production and fish growth (*Catlacatla* and *Cyprinuscarpio* var. Communis) were found to be the highest in the poultry manure treatment, followed by the sludge cake and cow-dung treatments. Compared with the cow-dung treatment, total fish production was 50.6% more in the poultry manure and 19.0% more in the sludge-cake treatment. Khourabia*et al*. (1991) also concluded the successful rearing ofNile tilapia with common carp in polyculture system at a ratio of 5:1which seems to be more desirable than tilapia alone in a monoculture. Moreover, El-Serafy*et al*. (1993) found that some fish species such as silver carp and common carp reached near the maximum carrying capacity in shorter time than that for the other fish species (bighead carp, grass carp, mullet and Nile tilapia) in the polyculture system.

Generally, Abdel-Halim *et al*. (1998) registered maximum net return of polyculture (tilapia + common carp + silver carp) with chemical fertilizers plus duck droppings than with control. Also, Nagdi*et al*. (1998) found that tilapia gave high production and was more economic in chicken manure pond than the control one. Moreover, Sweilum (1998) reported more growth performance for Nile tilapia in a polyculture system with silver carp than with common carp. Abdel-Hakim *et al.* (1999) registered lower growth and return for Nile tilapia, blue tilapia and common carpwithduck manure or buffalo manure than the control, without variations among fish species. Yet, Abdel-All *et al*. (2001) found that poultry manure resulted in the highest total yield for Nile tilapia. Additionally, Abdel-Gawade*t al.* (2003) reported that polyculture (Nile tilapia + silver carp + mullet) performed (final body weight and total production) well with artificial feeding than without artificial feeding (poultry manure+ inorganic fertilizer only).

Table 2: Effect of the experimental treatments and fish species on growth performance of fish

Treat.	**FW** (g)	**TWG** (g)	**ADG** (g)	**RGR** (%)	**SGR** (%/d)
Treatments					
Control	553.0^{a}	262.5^{a}	2.57^{a}	100.0^{a}	0.65^{a}
Sludge	522.5^{b}	232.0^{b}	2.27^{b}	85.5^{b}	0.57^{b}
± SEM	5.225	5.225	0.051	1.879	0.009
P- value	0.008	0.008	0.008	0.001	0.001
Species					
Tilapia (T)	400.50^{d}	222.50^{b}	2.180^{b}	124.98^{a}	0.7948^{a}
Silver carp (Sc)	801.00^{a}	457.00^{a}	4.480^{a}	132.85^{a}	0.8280^{a}
Common carp (Cc)	433.50^{c}	201.50^{b}	1.975^{b}	86.85^{b}	0.5876^{b}
Catfish (Cf)	516.16^{b}	108.16^{c}	1.060^{c}	26.50^{c}	0.2300^{c}
± SEM	7.389	7.389	0.072	2.657	0.013
P- value	0.0001	0.0001	0.0001	0.0001	0.0001

a-d: means superscripted with different letters in the same column,within each category, differ significantly at P≤0.05.

Table 3: Effect of the interaction between the experimental treatments and fish species on growth performance of fish

Treat.	**Control (C)**				**Sludge (S)**				**± SEM**	**P-value**
	T	**Sc**	**Cc**	**Cf**	**T**	**Sc**	**Cc**	**Cf**		
FW	392.0^{c}	784.0^{a}	528.3^{b}	507.6^{b}	409.0^{c}	818.0^{a}	338.6^{d}	524.6^{b}	10.45	0.0001
TWG	214.0^{c}	440.0^{a}	296.3^{b}	99.6^{d}	231.0^{b}	474.0^{a}	106.6^{c}	116.6^{c}	10.45	0.0001
ADG	2.100^{c}	4.313^{a}	2.906^{b}	0.976^{d}	2.260^{b}	4.646^{a}	1.043^{c}	1.143^{c}	0.102	0.0001
RGR	120.2^{a}	127.9^{a}	127.7^{a}	24.40^{b}	129.76^{a}	137.80^{a}	45.96^{b}	28.60^{c}	3.757	0.0001
SGR	0.774^{a}	0.807^{a}	0.806^{a}	0.214^{b}	0.8156^{a}	0.8490^{a}	0.3693^{b}	0.2460^{c}	0.019	0.0001

a-d: means superscripted with different letters in the same row, within each category, differ significantlyat P≤0.05.

Moreover, Hafez *et al*. (2003) recommended the use of cow or chicken manures in fertilizing fish ponds produced superior performance for Nile tilapia than common carp.However, there is an estrogenic response in the reproductive cycle of common carp andcrucian carp, in relation to a sewage treatment. This may suggest that at moderately polluted sites, biological variations of carp and genetic particularities are prevalent (Sole *et al*., 2003 and Diniza*et al*., 2005a).In addition, vitellogenin induction in males mirror carp was used as a biomarker of exposure to xenoestrogens (Diniza*et al.,* 2005b). Hassan *et al.* (2005) obtained the highest net production and return for common carp in ponds fertilized with poultry manure than for those from ponds treated with cow manure.

In addition, Abdelhamid*et al*. (2007) found that water parameters (temperature, pH, DO, salinity and phytoplankton) did not differ in integrated system (fish-cum-duck); yet, zooplankton number increased as well as growth performance (final bodyweight, body weight gain, specific growth rate, total fish production, and super and 1st class fish production) of Nile tilapia improved. Also, sewage incorporation yielded similar gross fish production as recorded from fertilizer based system, whereas net water productivity using sewage as nutrient source was found to be higher than that of a fertilizer based system (Dasgupta*et al.,* 2008). Chicken manure produced better growth performance than inorganic fertilizer (Hassanien*et al*., 2008). Additionally, Agouz and Gomha (2011) reported significantly ($P \leq 0.05$) higher final weight of Nile tilapia with poultry drops than with silkworm waste, fresh rumen content and control (feed pellets). Yet, silkworm treatment reflected the best survival rate.

Feed utilization:

Feed utilization parameters of fish fed control diet were better than for those fed sewage sludge. The Sc and T showed the best values, whereas Cf had the worst (Table 4). The interaction between fish species and dietary treatments (Table 5) showed significant ($P \leq 0.01$) effectson feed utilization parameters, where Sc fed sewage sludge consumed the highest food quantity, but T fed sewage sludge had lowest food consumption; therefore, T fed sewage sludge hadthe best FCR and PER, but control Cf had the worst FCR and PER.Moreover, the Nile tilapia, common carp and African catfish significantly improved FCR and PER ofsewage sludge compared with the control diet. This may be due to increased CP % in sewage sludge (30.21%) compared with the control diet (25.75%). Also the Africancatfishgavethe worstvaluesof FCR and PERas compared tothe otherfarmedspecies, which may be reflected in decreased growth performance parameters. Thiscould bedue to thedifferentfeeding habitsofAfricancatfish, whichclassified as carnivores or predatorsandthat needa highdietary protein.

Machiels and Henken (1985) reported 40% crude protein as an optimal requirements for *C. gariepinus* (40 – 120 g).Pantazis (1999) concluded that *Clariasgariepinus* performed best when fed diets containing 46% crude protein. Also, El-Gendy (2009) found that the best dietary crude protein and fat levels were 35.9 and 11.7%, respectively. The control diet and the sewage sludge contained 25 and 30 % CP, respectively, which were not enough for the optimal growth of African catfish.

On the other hand,Khourabia*et al*. (1991) calculated FCRfor Nile tilapia in a polyculture system as 1.58-2.82.Magouz (1996) calculated FCR for Nile tilapia fed at 40% sugar beet pulp as 5.67. Also, Sweilum (2001) reported better growth rate, yield and food conversion of Nile tilapia using polyculture combination with catfish than with *Sarotherodongalilaeus.* Moreover, Kheir*et al*. (2002) obtained similar growth performance among fish or prawn reared alone or in polyculture. This result may indicate that growth of both species was not affected by the presence of the other species. The FCR was better in the polyculture than in the monoculture indicating that the polycultured species consumed less feed and utilize the fed more efficiently than the monocultured ones.Srour*et al*. (2002) obtained FCR of 5.47, 7.11

and 6.95 by feeding dried dropping date for Nile tilapia at 50, 75 and 100% of the diet. Yet, Kheir and Saad (2004) gave better growth, production and FCR for Nile tilapia with catfish (which was used as police fish to control recruitment of Nile tilapia) in polyculture.

Additionally, Abdelhamid (2011) revealed that monoculture of all males mono-sex Nile tilapia was more better than polyculture (Nile tilapia plus silver carp) concerning their superiority in final bodyweight, bodyweight gain, specific growth rate, feed conversion ratio, feed cost/kg bodyweight gain, economic efficiency, and return. Yet, Brummett and Alon (1994) reported that tilapia growth and feed conversion were adversely affected by the presence of crayfish. Abdel-Tawab and Sweilum (2004) recorded slightly lower feed conversion with organic fertilizer (manure) than with artificial feeding of Nile tilapia. Yet, AbouZied (2007) mentioned that Nile tilapia reared in the integrated ponds with Peking ducks exhibited better body weight, fish yield, food conversion, and return than those of the non-integrated ponds.

Table 4: Effect of the experimental treatments and fish species on feed utilization by fish

Treat.	FI (g)	FCR	PER
Treatments			
Control	1087.9^{a}	5.53^{a}	0.97^{a}
Sludge	1010.3^{b}	5.78^{a}	0.88^{b}
± SEM	15.16	0.239	0.022
P- value	0.002	0.473	0.020
Species			
Tilapia (T)	706.8^{d}	3.18^{c}	1.236^{a}
Silver carp (Sc)	1455.6^{a}	3.19^{c}	1.235^{a}
Common carp (Cc)	855.8^{c}	5.18^{b}	0.883^{b}
Catfish (Cf)	1178.3^{b}	11.08^{a}	0.360^{c}
± SEM	21.44	0.33	0.032
P- value	0.0001	0.0001	0.0001

a-d: means superscripted with different letters in the same column, with each category, differ significantlyat P≤0.05.

Table 5: Effect of the interaction between the experimental treatments and fish species on feed utilization by fish

Treat.	Control (C)				Sludge (S)				± SEM	P-value
	T	Sc	Cc	Cf	T	Sc	Cc	Cf		
FI (g)	721.4^{d}	1447.9^{a}	975.0^{c}	1207.3^{b}	692.1^{c}	1463.2^{a}	736.5^{c}	1149.3^{b}	30.33	0.003
FCR	3.37^{b}	3.30^{b}	3.30^{b}	12.18^{a}	2.99^{c}	3.09^{c}	7.06^{a}	9.99^{a}	0.479	0.0001
PER	.163a	1.196a	.196a	0.323b	.310a	1.273a	.570b	0.396c	0.045	0.0001

a-d: means superscripted with different letters in the same row, within each category, differ significantlyat P≤0.05.

Chemical composition:

Chemical composition of the whole fish body (regardless of fish species) was significantly better (lower ash and higher CP percentages) with feeding control diet than with feeding sewage sludge (Table 6). The Cf contained the highest ash and CP percentages and the highest EC but the lowest EE percent among all tested fish species. However, the interaction effect was significant , since the highest DM % was found with T fed sewage sludge, the lowest ash % was determined in control fed T, the lowest EE % and the highest CP % and EC were estimated and calculated with CF fed sewage sludge (Table 7). Concerning proximate analysis of fish muscles, regardless of fish species, there were slight (although significant) differences between both dietary treatments (Table 8). Regardless of dietary treatments, Sc contained highest (P≤0.01) DM and CP percentages and lower ash EE and EC among all tested fish species. The interaction (fish species X dietary treatments) effects were significant, since the best DM was found with feeding Sc the sewage sludge, ash, EE and CP with control Sc (Table 9). In this respect, Yip and Wong (1977) raised carp in a sewage effluent and different concentrations of digested sludge. The highest growth rate of carp occurred in the 0.2% sludge, followed by the sewage effluent and 0, 0.4, 0.6 and 0.8% media. Similar results were obtained from measurements of the dry weights and protein contents of the carp at the end of the experiment.

Additionally, Saini and Sharma (1999) tried sewage sludge - a common urban refuse as supplementary feed for the fish (*Cyprinuscarpio* L) at 0, 50, 75 and 100%. The fish was raised on the experimental diet for 60 days. Common carp fed 100% sewage sludge failed to indicate appreciable growth. However, partial replacement (50%) was favorable and resulted in high growth. Fish reared at 50% sewage sludge supplemented diet also attained high protein level as compared to control and other treatments. Yet, Abdel-Tawab and Sweilum (2004) recorded lowest CP and highest DM and ash in Nile tilapia whole body with using manure as fertilizer than with artificial feeding. However, Hassan (2004) registered gradual increases in final weights, net yield, profitable regime and DM and CP contents of the whole tilapia body with increasing poultry manure levels as pond fertilizer.

Table 6: Effect of the experimental treatments and fish species on chemical composition of fish body

Treat.	**DM (%)**	**On dry matter basis (%)**			
		Ash	**EE**	**CP**	**EC** (Kcal/100 g)
Treatments					
Control	25.45[b]	16.61[b]	13.13[a]	70.24[a]	418.7[a]
Sludge	26.33[a]	21.02[a]	12.14[b]	66.82[b]	398.5[b]
± SEM	0.143	0.115	0.079	0.127	0.685
P- value	0.0005	0.0001	0.0001	0.0001	0.0001
Species					
Tilapia (T)	27.97[a]	16.83[d]	17.06[a]	66.09[b]	399.2[c]
Silver carp (Sc)	27.69[a]	17.57[c]	16.44[b]	65.98[b]	398.0[c]
Common carp (Cc)	22.15[c]	18.36[b]	12.71[c]	68.91[b]	410.8[b]
Catfish (Cf)	25.75[b]	22.48[a]	6.48[d]	73.16[a]	473.4[a]
± SEM	0.202	0.163	0.112	0.179	0.969
P- value	0.0001	0.0001	0.0001	0.0001	0.0001

a-d: means superscripted with different letters in the same column, within each category, differ significantlyat P≤0.05.

In relation to the chemical composition of the whole fish body, fishes fed sludge resulted in increasing of EE in common carp, and ash in Nile tilapia and silver carp, also to decrease the content of CP in the same species (Table 7).Regarding the chemical composition in muscles, feeding fishes (Nile tilapia, common carp and silver carp) thesewage sludge increased the EE % and decreasing the CP %(Table 9) compared with the control diet, which reflected inreduction in the quality of meat produced from these fishes.

Table 7: Effect of the interaction between the experimental treatments and fish species on chemical composition of fish body

Treat.	Control (C)				Sludge (S)				± SEM	P-value
	T	Sc	Cc	Cf	T	Sc	Cc	Cf		
DM (%)	26.05^a	25.91^a	23.53^b	26.29^a	29.89^a	29.46^a	20.78^c	25.20^b	0.286	0.0001
Ash (%)	13.49^d	18.48^b	14.96^c	19.51^a	20.18^c	16.67^d	21.77^b	20.47^a	0.231	0.0001
EE (%)	18.88^a	13.42^b	12.52^c	7.72^d	15.25^b	19.45^a	12.91^c	5.97^d	0.159	0.0001
CP (%)	67.62^b	68.09^b	72.51^a	72.76^a	64.57^c	63.86^c	65.32^b	73.56^a	0.254	0.0001
EC (Kcal/100 g)	409.7^b	406.9^b	430.9^a	427.5^a	388.8^b	389.1^b	390.7^b	471.2^a	1.37	0.0001

a-d: means superscripted with different letters in the same row, within each category, differ significantlyat P≤0.05.

Table 8: Effect of the experimental treatments and fish species on chemical composition of fish muscles

Treat.	DM (%)	On dry matter basis (%)			
		Ash	EE	CP	EC (Kcal/100 g)
Treatments					
Control	19.165^a	4.91^b	3.625^a	91.463^a	550.08^a
Sludge	18.388^b	5.25^a	3.033^b	91.714^a	545.88^b
± SEM	0.053	0.040	0.190	0.195	0.757
P- value	0.0001	0.0001	0.043	0.378	0.001
Species					
Tilapia (T)	18.85^b	4.76^b	2.97^b	92.25^b	548.43^b
Silver carp (Sc)	20.23^a	4.82^b	2.05^c	93.11^a	544.55^c
Common carp (Cc)	18.38^c	5.28^a	2.57^{bc}	92.13^b	543.96^c
Catfish (Cf)	17.62^d	5.44^a	5.70^a	88.85^c	554.98^a
± SEM	0.076	0.056	0.269	0.276	1.071
P- value	0.0001	0.0001	0.0001	0.0001	0.0001

a-d: means superscripted with different letters in the same column, within each category, differ significantlyat P≤0.05.

Table 9: Effect of the interaction between the experimental treatments and fish species on chemical composition of fish muscles

Treat.	Control (C)				Sludge (S)				± SEM
	T	Sc	Cc	Cf	T	Sc	Cc	Cf	
DM (%)	18.77^b	20.14^a	18.91^b	18.82^b	18.93^b	20.33^a	17.86^c	16.42^d	0.107
Ash (%)	4.93^a	4.54^b	5.16^a	4.99^a	4.60^d	5.11^c	5.40^b	5.88^a	0.08
EE (%)	2.42^b	1.48^c	2.19^{bc}	8.39^a	3.53	2.61	2.96	3.01	0.381
CP (%)	92.64^b	93.96^a	92.63^b	86.60^c	91.86	92.26	91.63	91.09	0.39
EC (Kcal/100 g)	545.4^b	544.0^b	543.2^b	567.7^a	551.4^a	545.1^b	544.7^b	542.2^b	1.514

a-d: means superscripted with different letters in the same row, within each category, differ significantly at P≤0.05.

Condition factor, dressing and boneless(fillet):

Condition factor, dressing and fillet percentages were not affected significantly (P≥0.05) by dietary treatments, regardless of fish species (Table 10); while all parameters were affected by fish speciesat P≤0.01 (regardless of dietary treatments), being the highest for T and the lowest Kt, Ks and dressing were calculated for Cf and the lowest fillet was calculated for Cc.The interaction effect between fish species and dietary treatments was not significant (P≥0.05) for Kt and Ks values, where the highest values were in T and the lowest ones in Cf compared with other species fed control diet or sewage sludge. Also, T showedsignificantly the highestdressing percentage whether fed control diet or sewage sludge as compared to the other species(Table 11). In this respect,Abdel-All *et al*. (2001) found that Nile tilapia reared in earthen ponds fertilized with poultry manure (400 kg/Feddan) resulted in the highest significant (P≤0.05) dressing (66.9%), flesh (54.4%) and return than those reared in ponds fertilized with 200 kg/Feddan poultry manure with or without artificial food (1.5%) or cow manure or inorganic fertilizer. The controversial effects among literature and the present results may be attributed to differences in fish rearing systems (monoculture, polyculture, semi-intensive, intensive, cages, earthen ponds, source and quality of rearing water, stocking density, feeding or not, and what about feed composition?), the fish (species, age, health status, and the ratio between species) and the organic fertilizer (source, composition, and rate).

Table 10: Effect of the experimental treatments and fish species on condition factor, dressing and boneless of fish

Treat.	Kt	Ks	Dressing* %	Fillet** %
Treatments				
Control	1.06	1.76	65.21	51.15
Sludge	1.07	1.78	65.53	49.08
± SEM	0.022	0.037	0.749	0.732
P- value	0.800	0.730	0.764	0.054
Species				
Tilapia (T)	1.49^{a}	2.47^{a}	70.675^{a}	51.49^{a}
Silver carp (Sc)	1.01^{c}	1.73^{c}	65.674^{b}	52.05^{a}
Common carp (Cc)	1.27^{b}	2.17^{b}	62.972^{bc}	47.11^{b}
Catfish (Cf)	0.50^{d}	0.70^{d}	62.175^{c}	49.82^{ab}
± SEM	0.031	0.053	1.059	1.035
P- value	0.0001	0.0001	0.0001	0.008

Kt: Condition factor based on the total length.
Ks: Condition factor based on the standard length.
***: Eviscerated-entheadedfish weight, g/whole fish body weight, g.**
****: Fish muscles' weight, g/ Eviscerated-entheadedfish weight, g.**
a-d: means superscripted with different letters in the same column, within each category, differ significantlyat P≤0.05.

Table 11: Effect of the interaction between the experimental treatments and fish species on condition factor, dressing and boneless of fish

Treat.	Control (C)				Sludge (S)				± SEM	P-value
	T	Sc	Cc	Cf	T	Sc	Cc	Cf		
Kt	1.46[a]	0.99[c]	1.29[b]	0.52[d]	1.52[a]	1.03[c]	1.26[b]	0.48[d]	0.044	0.051
Ks	2.44[a]	1.65[c]	2.24[b]	0.71[d]	2.51[a]	1.81[c]	2.11[b]	0.69[d]	0.075	0.026
Dressing* %	69.82[a]	64.78[b]	62.32[b]	63.92[b]	71.52[a]	66.56[ab]	63.61[bc]	60.43[c]	1.498	0.024
Fillet** %	51.96[ab]	51.18[ab]	48.93[b]	52.53[a]	51.02[ab]	52.91[a]	45.29[c]	47.1b[c]	1.464	0.047

C: control S: sewage sludge
T: tilapia Sc: silver carp
Cc: common carp Cf: catfish
Kt: Condition factor based on the total length.
Ks: Condition factor based on the standard length.
***: Eviscerated-entheadedfish weight, g/whole fish body weight, g.**
****: Fish muscles' weight, g/ Eviscerated-entheadedfish weight, g.**
a-d: means superscripted with different letters in the same row, within each category, differ significantly (*P≤0.0001).

CONCLUSIONS

From the above mentioned results in the present study, feeding fish species (Nile tilapia, common carp and African catfish) with sewage sludge improved growth performance and feed utilization, but it led to decreased content of CP and increasing content of EE and ash in the whole fish body and muscles, which reflected in reduction of meat quality for these species. So, it is not recommended to use sewage sludge in fish feeding, although its use in cultured fish feeding is wide spreading in Kafr El-Sheikh governorate.

REFERENCES

Abd El-Hakim, N.F.; Bakeer, M.N. and Soltan, M.A. (1999).Integrated fish culture with farm animals. Annals of Agric. Sc., Moshtohor, 37 (2): 1001-1015.

Abd El-Hakim, N.F.; Elgarhy, M.A. and Sayed, S.H. (2013).Studies of the use of fermented fish silsge in diets for all male Nile tilapia (*Oreochromis niloticus* Lin.). Egyptian J. Nutrition and Feeds, 16 (2): 501 (Summary).

AbdElmonem, A.I.; Shalaby, S.M.M., El-Dakar, A.Y. and Sadrak, O.W. (2004). Nutritional evaluation of sesame hulls by-product as a non-conventional feedstuff in diets of red tilapia, *Oreochromisniloticus X Oreochromismosambicus.* Alex. J. Agric. Res., 49 (2): 1-13.

Abdel-All, M.M.; El-Hindawy, M.M., Hafez, F.A., Hassona, M.A. and Ismail, A.A. (2001).Effect of different fertilizers and artificial feeding systems on fish pond productivity. J. Egypt. Acad. Soc. Environ. Develop., (A-Aquaculture), 1 (2): 61-75.

Abdel-Gawad, A.S.; Ibrahim, E.M., Salem, M.I. and Shfie, M.M. (2003). Biological studies of fish reared under polyculture system: relationship between growth performance and feeding regime. Proc. Conf. Fish Wealth and Food Safety in Arab and Islamic Countries.Azhar Univ., 22-24 Oct., 18p.

Abdelhakeem, N.F., Bakeer, M.N. and Soltan, M.A. (2002). Aquatic Environment for Fish Culture. Deposit No. 4774/2002.

Abdel-Halim, A.M.; El-Nady, M.A., El-Shafie, M.M. and Ibrahim, E.M. (1998). Evaluation of certain chemical fertilizers alone or combined with organic partners for extensive aquaculture in Egypt. Bull. Fac. Agric., Univ. Cairo, 49: 1-14.

Abdelhamid, A. M. (1983). Mykotoxin-Nachweis in Lebens-und Futtermitteln des subtropischenKlimas. In: Kurzfassungen der Vorträgezur 37. Tag.Ges.Ernährungsphysiol.Haustiere, Gőttingen, 5. Z. Tierphysiol., Tierernährug u Futtermittelkde., 50: 4-5.

Abdelhamid, A. M. (2006). Heavy metals pollution of the Egyptian aquatic media.The 2nd Inter. Sci. Con. For Environment "Recent Environmental Problems and Social Sharement", 28-30 March, South Valley University. Pp. 127 – 153.

Abdelhamid, A.M. (2009). Fundamentals of Fish Production and Culture.New Universal Office, Alexandria, Deposit No. 24400/ 2008, I.S.B.N. 977–438–052–5, 393 pp.

Abdelhamid, A. M. (2011). Intensive rearing of mono-sex Nile tilapia and silver carp under mono-or polyculture systems at different stocking densities in floating net cages. engormix.com, Aquaculture Technical Article, 9p.(J. Animal and Poultry Production, Mansoura University, 2: 277- 289).

Abdelhamid, A.M. (2014a). Fish Nutrition.An Arabic Textbook, Al-Mansoura Univ., 415p.

Abdelhamid, A.M. (2014b). The Blue Revolution (Pesciculture).An Arabic Textbook, Al-Mansoura Univ., 674p.

Abdelhamid, A.M. and El-Ayoty, S.A. (1991). Effect of catfish (*Clariaslazera*) composition of ingestion rearing water contaminated with lead or aluminum compounds. Arch. Anim. Nutr., Berlin, 41: 757 – 763.

Abdelhamid, A.M. and Soliman, A.A.A. (2013).Comparative evaluation for dietary inclusion of some medical plants by common carp fish. Egyptian J. Nutrition and Feeds, 16 (2): 485-499.

Abdelhamid, A.M.; El-Barbary, M.I. and Mabrouk, E.M.E. (2013a).Some heavy metals status in Ashtoum El-Gamil Protected Area. Journal of the Arabian Aquaculture Society, 8 (1): 69-86.

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

Abdelhamid, A. M.; El-Mansoury, A. M.; Osman, A. I. and El-Azab, S. M. (1999). Mycotoxins as causative for human food poisoning under Egyptian conditions. J. Agric. Sci., Mansoura Univ., 24: 2751 – 2757.

Abdelhamid, A. M.; Gawish, M. M. M. and Soryal, K. A. (2006). Comparative study between desert cultivated and natural fisheries of mullet fish in Egypt, I- concerning heavy metals. J. Agric. Sci. Mansoura Univ., 31: 5665 – 5680.

Abdelhamid, A. M.; Gomaa, A. H.and El-Sayed, H. G. M. (2013b). Studies on some heavy metals in the River Nile water and fish at Helwan area, Egypt. Egypt. J. Aquat. Biol. & Fish., 17 (2): 105 – 126.

Abdelhamid, A. M.; Khalil, F. F.andRagab, M. A. (1996). Survey of aflatoxin and ochratoxin occurrence in some local feeds and foods. Proceeding of conference on Food Borne Contamination and Egyptian's Health, Mansoura Univ., Nov. 26-27, pp: 43-50

Abdelhamid, A.M.; Maghraby, N.A, Mehrim, A.I. and Soliman, A.A.A. (2012a).Impact of non conventional feedstuffs on growth performance and nutrients utilization of Nile tilapia fish. Egyptian J. Nutrition and Feeds, 15 (1 Special Issue): 349-357.

Abdelhamid, A.M.; Maghraby, N.A, Mehrim, A.I. and Soliman, A.A.A. (2012b). Physiological, biochemical and microbiological assessment for non-conventional feedstuffs by Nile tilapia fish. Egyptian J. Nutrition and Feeds, 15 (1 Special Issue): 359-366.

Abdel-Tawab, A.A. and Sweilum, M.A. (2004). Improvement of fish production and water quality in tilapia cultured ponds by using different types of artificial diets and organic fertilizers. Vet. Med. J., Giza, 52 (1): 19-28.

Abou-Zied, R.M. (2007). Effect of integrated duck-fish farming on growth performance and economic efficiency of Nile tilapia (*Oreochromis niloticus* L.).Fayoum J. Agric. Res. & Dev., 21 (2): 156-164.

Abou-Zied, R.M.; Hassouna, M.M.E., Mohamed, R.A. and Abdl-Aziz, M.F.E. (2013).Effect of some environmental conditions and addition of palm pollen grains on the reproductive performance of red hybrid tilapia (*Oreochromis* sp.). Egyptian J. Nutrition and Feeds, 16 (2): 463-468.

Agouz, H.M. and Gomha, A.A. (2011).Evaluation study for the impact of poultry drops, silkworm wastes and fresh rumen contents in the Nile tilapia culture. Journal of the Arabian Aquaculture Society, 6 (1): 33-48.

Ali, M. Y.; Shams, F. I.; Al-Imran; Khanom, M. and Sarower, M.G. (2013). Fillet yield, dress-out percentage and phenotypic relationship between different traits of grey Mullet (*Liza parsia,* Hamilton 1822). International Journal of Engineering and Applied Sciences, Vol. 4, No. 1: 49-58.

AOAC, Association of Official Analytical Chemists (1995). Official methods of analysis of AOAC International, 16th ed. AOAC International, Arlington, VA.

Ayaad, E.A. and Hassouna, M.E. (2005). Effect of partial replacement of fishmeal by poultry industry wastes in diets on growth performance of seabass, *Dicentrarchuslabrax,* reared in earthen ponds. J. Egypt. Acad. Soc. Environ. Develop., (D- Environmental Studies), 6 (2): 257-266.

Bakeer, M.N.; Abdel-Gawad, A.S., Salama, A. and Nossier, M.I. (2003). Biological and economic investigations of silver carp (*Hypophthalmichthysmolitrix*) cultured in cages at different stocking densities and manuring treatments. Inter. Conf. on Fish Wealth and Food Security in Arab and Islamic Countries, Al-Azhar Univ., 19p.

Brummett, R.E. and Alon, N.C. (1994).Polyculture of Nile tilapia (*Oreochromis niloticus*) and Australian red claw (*Cheraxquadricarinatus*) in earthen pons. Aquaculture, 122: 47-54.

Cairo Training Center (CTC) (2010/2011). Trainer Guide – Novel methods program for treating sewage sludge and solid wastes and environmental protection. CTC, Giza.

Dalsgaard, A. (1996). Wastewater-fed aquaculture in Viet Nam. Mekong Fisheries Network Newsletter - Mekong Fish Catch and Culture, 1 (4): 1-3.

Dasgupta, S.; Pandey, B.K., Sarangi, N. and Mukhopadhyay, P.K. (2008). Evaluation of water productivity and fish yield in sewage-fed *vis-a`-vis* fertilized based carp culture. Bioresource Technology, 99: 3499–3506.

Diniza, M.S.; Peresa, I., Magalha˜ es-Antoineb, I., Fallab, J. and Pihanc, J.C. (2005a). Estrogenic effects in crucian carp (*Carassiuscarassius*) exposed to treated sewage effluent. Ecotoxicology and Environmental Safety, 62: 427–435.

Diniza, M.S.; Peresa, T. I. and Pihanb, J.C. (2005b). Comparative study of the estrogenic responses of mirror carp (*Cyprinuscarpio*) exposed to treated municipal sewage effluent (Lisbon) during two periods in different seasons. Science of the Total Environment, 349: 129– 139.

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

Edwards, P.; Pacharaprakiti, C. and Yomjinda, M. (1994).An assessment of the role of buffalo manure for pond culture of tilapia. I. On-station experiment. Aquaculture, 126: 83-95.

El-Dakar, A.Y.; AbdElmonem, A. and Shalaby, S.M.M. (2003). Utilization of fig jam by-product as an unconventional energy source in red tilapia diet. Conf. Fish. Cul.In Des. Reg., 1-9.

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

El-Gendy, E.H.I., 2009.Effect of protein and oil levels on growth performance of catfish (*Clariasgariepinus*). M.Sc. Thesis, Faculty of Agriculture, Suez Canal University, Ismailia, Egypt. (ISSN 1687 – 1049).

El-Saidy, D.M.S.D. (2004). Growth, production and economic profitability of Nile tilapia and mullets in semi-intensive polyculture system under Egyptian fish farm conditions. 1st Inter. Conf. of Export Trends for Egyptian Fishes, pp: 156-169.

El-Serafy, S.S.; El-Gamal, A.A., Al-Zahaby, A.S. and Abdel-Nasser, G. (1993).Polyculture of six fish species under different management systems in Egypt. Bull. Nat. Indt. Ocn.&Fish., A.R.E., 19: 363-377.

ES, Egyptian standards 2360 (1993). Maximum levels for heavy metal contaminants in food. EOFS, ES: 2360 – 1993.

Gaber, M.M.A. (1996). Partial and complete replacement of fish meal by poultry by-product and feather meal in diets of Nile tilapia (*Oreochromis niloticus*). Annals of Agric. Sc., Moshtohor, 34 (1): 203-214.

Hafez, F.A.; Arafa, S.A., Abdul-Aziz, G.M., Hassan, A.A. and Abd El-Aal, M.M. (2003).Effect of commercial diets, manure and some agriculture by-products on performance of Nile tilapia in polyculture system.Egyptian Soc. Anim. Reprod.Fert.Fifteenth Annual Cong., Quena and Luxor, 26-30 Jan., 195-208.

Hafez, F.A.; Hindawy, M.M., Hassona, E.M. Abdel-Aal, M.M. and Hassan, A.A. (2002).Effect of fertilizations and artificial feeding on water parameters in tilapia earthen ponds. Vet. Med. J., Giza, 50 (2): 221-237.

Hanafy, M.A. (2008). Fish by-product protein concentrate as a replacer dietary fish meal for Nile tilapia (*Oreochromis niloticus* L.) fingerlings. Egyptian Journal of Aquatic Research, 34 (3): 338-350.

Hassan, A.A. (2004). Effect of poultry manure levels on Nile tilapia fingerlings (*Oreochromisniloticus*) performance in rice fields.Proc.The 1st Intern. Conf. Vet. Res. Div., NRC, Cairo, Egypt, Feb 15-17th, pp:419-429.

Hassan A.A.; Abdel-Aal, M.M. and Sayed, S.H. (2005).Effect of organic manures or chemical fertilizers on water parameters and growth performance of common carp (*Cyprinuscarpio*) in rice fields. J. Agric. Sci. Mansoura Univ., 30 (9): 5071-5079.

Hassanien, H.A.; Elnady, M.A., Salem, M.A.I. and Samir, M.H. (2008).Effect of some fertilization sources on growth and water quality of Nile tilapia (*Oreochromis niloticus*). Egypt. J. of Appl. Sci., 23 (7): 44-53.

Homewood, J. M.; Purdie, D. A. and Shaw, P. J. (2004). Influence of sewage input and fish farm effluents on dissolved nitrogen species in a Chalk River. Water, Air, and Soil Pollution: Focus, 4: 117–125.

Ibrahim, M.A; Khalafalla, M.M., Zaki, M.A. and AbdEl Hamid, H.M. (2012). Physiological and nutritional studies on improving growth of Nile tilapia (*Oreochromis niloticus*) fingerlings using ginger root meal as a feed additive. Egyptian J. Nutrition and Feeds, 15 (1 Special Issue): 377-389.

Khalafalla, M.M. and Salem, M.F.E. (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.

Khalafalla, M.M.; Mohsen, M.K, Eweeda, N.M., Belal, E.B. and Abozaid, S.A. (2012). Nutritional evaluation of some legumes by-products (biological treated) as a non-conventional feedstuffs in diets of Nile tilapia (*Oreochromis niloticus*) fingerlings. Egyptian J. Nutrition and Feeds, 15 (1 Special Issue): 337-347.

Kheir, M.T. and Saad, A.S. (2004). Recruitment control of *Oreochromis niloticus* (Linnaeus, 1757) with *Clariasgariepinus* (Burchell, 1822) in a polyculture system. J. Egypt. Ger. Soc. Zool., 45B: Vetrinary Anatomy &Embriology: 53-65.

Kheir, M.T.; Habashy, M.M. and Saad, A.S. (2002).Observations on growth and survival of silver carp *Hypophthalmichthysmolitrix*and juveniles of freshwater prawn *Macrobrachiumrosenbergii*in monoculture and polyculture systems.J.Egypt. Acad. Soc. Environ. Develop., 2 (1): 17-27.

Khourabia, H.M.; El-Sherif, M.S. and Danasoury, M.A.K. (1991).Enhanced fish production through polyculture system of Nile tilapia (*Tilapia nilotica*) with common carp (*Cyprinuscarpio*) in floating cages. Zagazig Vet. J., 19 (4): 854-864.

Kiran, B.R. (2014). Water quality status and fisheries of sewage fed tank in Bhadravathi Taluk of Karnataka, India. International Science Congress Association. Res. J. Animal, Veterinary and Fishery Sci., 2 (9): 6-12.
Koeleman, E. (2014). Aquaculture takes over wild fisheries. AllAboutFeed, 22 (7): 18-20.
Ling, B.; Den, T.X., Lu, Z.P., Min, L.W., Wang, Z.X.andYuan, A,X. (1993). Use of night soil in agriculture and fish farming.World Health Forum, 14 (1): 67-70.
Machiels, M.A.M. and A.M. Henken, 1985. Growth rate, feed utilization and energy metabolism of the African catfish, *Clariasgariepinus* (Burchell, 1822), as affected by dietary protein and energy content. Aquaculture, 44 (4): 271 – 284. (ISSN:0044-8486).
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.
Manna, N.K.; Banerjee, S. and Bhowmik, M. L. (2003). Hydrobiology of Wastewater-fed Man-made Lotic Fish Culture Ponds in Relation to Pollution Physico-Chemical Characteristics Philippine Journal of Science, 132 (1): 47-58.
Nagdi, Z.A.; El-Nady, M.A., El-Shafie, M.M. and Abdel Megid, S.A. (1998).The effects of heavy fertilizer-feed input on the ecology and production of Nile tilapia. Bull. Fac. Agric., Univ. Cairo, 49: 15-28.
Nandeesha, M.C. (2002). Sewage fed aquaculture systems of Kolkata. Aquaculture Asia-Farmers as Scientists, VII (2): 28-32.
Natarajan, M. and Varghese, T.J. (1980).Studies on the effects of poultry manure, digested sewage sludge cake and cow-dung on the growth rate of *Catlacatla* (Hamilton) and *Cyprinuscarpio* var. communis (Linneaus). Agricultural Wastes, 2 (4): 261-271.
National Research Council, (NRC) (1993).Nutrient Requirements of fish.National academy press. Washington. DC.
Nour, A.A.; Srour, T.M. and Nour, O. (2004). Utilization of inedible dried dropping dates as a dietary energy source for blue tilapia (*Oreochromisaureus*) reared in enclosure nets. J. Agric. Sci. Mansoura Univ., 29 (1): 73-82.
Osman.M.F. (2012).Development of Fish Wealth in Egypt. 13th Sci. Conf. for Animal Nutrition, 14-17 Feb., Sharm El-Shekh, 9p.
Pantazis, P.A. (1999). Nutritional studies in the African catfish, *Clariasgariepinus* (Burchell, 1822). Ph. D. Thesis, University of Stirling, Scotland. 192p.
Rojas, J.B.U. and Verreth, J.A.J. (2003). Growth of *Oreochromisaureus*fed with diets containing graded levels of coffee pulp and reared in two culture systems. Aquaculture, 217: 275-283.
Saini, V.P. and Sharma, L.L. (1999). Use of sewage sludge as supplementary diet for the carp, *Cyprinuscarpio* (L). Indian J. Fish., 46 (3): 295-300.

Salama, A.A.(2003). Economic evaluation of Nile tilapia (*Oreochromisniloticus*) culture in rice fields receiving varying feeding inputs. Conf. of Fish Wealth and Food Security in Arab and Islamic Countries, Azhar Univ., 22-24 Oct., pp: 20-35.

Salem, M.F.I.; Khalafalla, M.M.E., Saad, I.A.I. and El-Hais, A.M.A. (2008).Replacement of fish meal by silkworm, *Bombyxmori*pupae meal, in Nile tilapia, *Oreochromis niloticus* diets. Egyptian J. Nutrition and Feeds, 11 (3): 611-624.

SAS (2001). SAS/STAT Guide for personal computer. SAS Inst. Cary, N.C.

Shalaby, F.S.E. (2000). An economical study for the impact of environmental pollution on the biodiversity in the Nile fisheries. Proc. Forum “Fish Wealth Development-Principles and Limitations”, Mansoura Univ., May 9, pp: 249-327.

Shata, Hanaa A. (1996). Pollution in El-Manzala Lake, possible contribution to incidence of chronic renal failure in Dakahlia. Proc. Foodborne Contamination & Egyptian's Health, Univ. of Mansoura, Nov. 26-27, pp: 197-200.

Sole, M.; Raldua, D., Barcelo, D. and Porte, C. (2003). Long-term exposure effects in vitellogenin, sex hormones, and biotransformation enzymes in female carp in relation to a sewage treatment works. Ecotoxicology and Environmental Safety, 56: 373–380.

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. (2003). Utilization of poultry viscera meal (PVM) protein in Nile tilapia (*Oreochromis niloticus*) and African catfish (*Clariasgariepinus*) diets. J. Adv. Agric. Res., 8 (3): 473-485.

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

Sweilum, M.A. (1998). Comparison of silver carp and common carp usefulness as additional fish in tilapia rearing ponds. Bull. Fac. Sci., Zagazig Univ., 20 (2): 288-299.

Sweilum, M.A. (2001). Growth performance and production of *Oreochromis niloticus* using polyculture systems and fertilizers. Egypt. J. Aquat. Biol. & Fish., 5 (2): 105-119.

Wedemeyer, B.A. (1997). Effectsrearingconditionsonthehealth and physiologicalquality of fish in intensive culture. In: Fish Stress and Health in Aquaculture. G.K. Iwama , A .D. Pickering, J.P. Sumpter and C.B. Schbridge, Univ.

Yip, S.W. and Wong, M.H. (1977).*The effects of sewage sludge on the growth rate of carp, Cyprinuscarpio* L. Environmental Pollution, 14 (2): 127-132.

التأثيرات المحتملة لتغذية الأسماك على الحمأة الجافة المُعالجة: ١- بالنسبة لأداء النمو والاستفادة الغذائية والتركيب الكيماوى

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تم إجراء تجربة تغذية حقلية فى هابتين وضعتا فى حوض ترابى وذلك لدراسة تأثيرات تغذية الأسماك [فى نظام متعدد الأنواع مكون من البلطى النيلى والمبروك الفضى والمبروك العادى والقرموط الأفريقى] على الحمأة مقارنة بعلف أسماك تجارى كمقارنة، وذلك لمدة ١٠٢ يوما. واستخلص من هذه الدراسة أن التغذية على الحمأة خفّضت معنويا من قيم مقاييس أداء النمو. وأن أداء النمو فى المبروك الفضى كان أفضل من البلطى ثم المبروك العادى وأخيرا القراميط. وتفوق المبروك الفضى على باقى الأنواع الثلاثة بالنسبة لمقاييس أداء النمو (بينما كانت القراميط هى الأسوأ) خاصة بالتغذية على الحمأة. وقد كانت مقاييس الاستفادة الغذائية أسوأ للأسماك المغذاة على الحمأة. وكانت أفضل استفادة غذائية مع المبروك الفضى والبلطى، والأسوأ مع القراميط. أظهر البلطى المُغذى على الحمأة أفضل تحويل غذائى ونسبة كفاءة بروتين (بينما القراميط سجلت أسوأ قيم). أظهر تحليل الجسم تحسنا معنويا بالتغذية على العليقة عكس ما أظهرته الحمأة. وأظهرت القراميط أعلى رماد وبروتين خام وطاقة مع انخفاض المستخلص الإيثيرى بين كل الأنواع السمكية. كانت أعلى مادة جافة مع البلطى المغذى على الحمأة، وأقل رماد فى البلطى المغذى على العليقة التجارية، وأقل مستخلص إيثيرى وأعلى بروتين خام وطاقة فى القراميط المغذاة على الحمأة. إن عضلات المبروك الفضى قد احتوت مادة جافة وبروتين خام أعلى معنويا مع انخفاض كل من الرماد والمستخلص الإيثيرى والطاقة مقارنة بكل الأنواع الثلاثة الأخرى. كانت أفضل مادة جافة فى المبروك الفضى المُغذى على الحمأة، وأفضل رماد ومستخلص إيثيرى وبروتين خام فى المبروك الفضى المُغذى على العليقة المقارنة. حقق البلطى أعلى قيم لمعمل الحالة والتصافى والتشافى بين الأنواع السمكية محل الدراسة، وكانت أقل معاملات حالة وتصافى للقراميط، وأقل تشافى للمبروك العادى. وعليه فلا يُنصح بتغذية الأسماك على الحمأة المعالجة، رغم انتشار استخدامها لتغذية الأسماك بين مربى الأسماك فى محافظة كفر الشيخ.