NUSANTARA BIOSCIENCE
Vol. 10, No. 3, pp. 193-202
August 2018

ISSN: 2087-3948
E-ISSN: 2087-3956
DOI: 10.13057/nusbiosci/n100310

Incorporation of dietary palm date pits in all-male Nile tilapia (*Oreochromis niloticus*) diets

NEDAL MOHAMMED SIDDIG SWAR, ASAAD HASSAN WIDAA MOHAMED♥
College of Graduate Studies, Sudan University of Science and Technology. Khartoum, Sudan. ♥email: asaadwidaa2005@yahoo.com, asaadhassanwidaa@sustech.edu

Manuscript received: 4 July 2018. Revision accepted: 31 August 2018.

Abstract. *Swar NMS, Mohamed AHW. 2018. Incorporation of dietary palm date seeds in all-male Nile tilapia (*Oreochromis niloticus*) diets. Nusantara Bioscience 10: 193-202.* The study utilizes a 45-days randomized factorial design 3×2, three levels (25, 50 and 75%) of palm date seeds, three levels (non, with and without) of 3% bakery yeast (*Saccharomyces cerevisiae*) and three replicates. The observation was carried out in twenty-one plastic aquaria. All-male Nile tilapia (*Oreochromis niloticus*) fingerlings were put in each aquarium. Each aquarium was provided with well-aerated and triggered dechlorinated tap water with an average weight of 1.9±1.11 g/fish (10 fish/aquaria) and a total length of 5.18±0.69 cm/fish. Fish were given food three times/day (10 days, at 8.30,11.30, 3.30 A.M) at a rate of 12, 8 and 4% of body weight, to examine the impact of partial substitution of animal protein (fish meal) in the diet on growth achievement, carcass contexture, feed utilization, condition factor (k) and feed expense. Seven experimental diets were prepared; control diet (T0, CP 36.84) concluding 45% (fish meal) as animal protein and 0% (palm date seed meal) plant protein. Tested diets (T1, T2 and T3) concluding 25, 50, 75% with 3% bakery yeast (CP 35.71, 35.53, 34.74) and 25, 50, 75% without yeast (CP36.01, 36.27 and 35.57) respectively ; so, they substitute about 75, 50, and 25 of fish meal diet respectively. The outcomes showed that, tilapia were given food on T1, T2 and T4 diets (25, 50, and 25%) substitution with and without yeast respectively registered the greater growth achievement, feed and protein utilization than other experimental diets such as control diet, also they indicate the highest condition factor (K) grades which state that the fish are in decent health. Tilapia were given food by diet T3 (25% fish meal) T5, T6 (50 and 25% fish meal) with and without yeast respectively possessed deficient growth and diverged remarkably (p>0.05) from the other diets. Diet contexture remarkably had an impact on carcass contexture. These data prompted that Palm date seed with and without yeast *S. cerevisiae* can, to a certain extent, substitute fish meal (animal protein) in a diet for all-male Nile tilapia fingerlings at level-up to 50 and 25% with and without yeast respectively, without any unfavorable result on accretion achievement. Furthermore, fish diet, partially substituted with 3% yeast, resulted from superior accretion achievement than other diets within the present experimental circumstance. This study showed that there is an economic efficiency of confounding palm date seed (plant protein) as partial substitution of fish meal (animal protein) with and without yeast in all-male Nile tilapia, that it could decrease the expense of feeds.

Keywords: Date palm, diet, Nile tilapia, *Oreochromis niloticus*

INTRODUCTION

Feed fabrication is the primary problem faced by aquaculture implementation. Today, dietary gives contribution of about 60-85% of the element of operating expense in NRC fish farm (1993), hence the potential utilization of low-cost uncommon autochthonous feedstuffs, such as herbs protein and their extracts has been expanding, There were many issued researches that have ensured that the supplementation of herbs or their extracts (e.g aquatic plant, cottonseed, groundnut, sesame cake, etc) in the feed holds a advantageous consequence in boosting accretion parameters and prevention from infections in aquaculture (Temesgen 2004; Shalaby 2004; Sasmal et al. 2005; Johnson and Banerji 2007; Ebrahim et al. 2007; Abd el Hakim et al. 2008; Tartiel et al. 2008; Khan et al. 2013; Labib et al. 2015). The great value of Nitrogen Free Extract (NFE) in date pits has drawn the awareness of many researchers to examine its probable usage in animals meal, with propitious outcomes. The inclusion of date pits into dietary remarkably increased the accretion of and feed utilization on sheep, calves and Sudanese desert lambs and poultry (El Hag et al. 1993; Tag El-Din and Nour 1993; Elgasim et al. 1995; El Hag and El Khanjari 2000; Yagoub and Elemam 2011; Sulaiman 2014), furthermore, for rats (Vandepopuliere et al. 1995; Hussein et al. 1998; Ali et al. 1999), and for fish such as mullet, carp and tilapia species (Yousif et al. 1996a; Belal and Al-Owafeir 2004). Wu (2003) stated that approximately, 50-70% of the accretion of tilapia in ponds is caused by natural food mesh, while the rest derives from either supplementary, completely commercial or therapeutic feed, depending on the system of aquaculture. the habit of fish in feeding can alter when there is an alteration in the environment. Yosif (2004) claimed that we can artificially alter the habits in the feeding of the fishes and take benefit of them if we can comprehend the biological, physiological characteristics of accretion and digestion of fish, the patterns of feeding and the nutritional requirement of the fishes.

The main methods of food combinations are to consider the local circumstances, to use the locally obtainable materials, to perform coalesced usage, and to do the best in thriving food founts. The selection of crude stuff for diet should be done to expand and make use of economic and sustainable crude stuff to keep comparative formula. Crude stuff granularity must be fine enough to make sure convenient digestibility and absorption. Appropriate manufacturing provision must be elected and plausible manufacturing techniques must be utilized to ensure the similarity and the quality of the diet. The granularity of crushed stuff of feed should be fine (100<40 mesh, 90<60 mesh) (Wu 2003).

Manufactured diet for fish must be in the shape of pellet, granule, crumbles or sticky paste. Fish' habitat is in water so the diet requires proper steadiness in water after being applied that it could stand for at least 20 to 30 minutes without becoming disorganized, dissolute and lost. Wu (2003) stated that the manufactured diet should not make pollution in the environment (Zero-pollution deliverance is needed). Many types of research were performed worldwide to examine palm date seeds as replacement for fish food in Nile tilapia (*Oreochromis niloticus*) diet, but none of them was done in Sudan. For that reason, this research was performed in the Fisheries Laboratory and hatchery of the Sudan University Science and Technology to appraise the accretion achievement, carcass contexture, feed utilization, condition factor (k) and feed expense of all-male Nile tilapia fingerlings, the feed with various levels of date seeds, as partial substitution of fish protein, such as 25, 50, and 75%; 75, 50, and 25% with and without bakery yeast (*Saccharomyces cerevisiae*) (with the aim of making the date seeds fiber easily absorbed by tilapia fingerlings) respectively, and also to maximize the profits from the sectional stuffs which are considered as by-products and may caused socio-economic and environmental difficulties in order to lower the expense of feeds.

The purposes of this research were (i) to inquire the impact of the coalescence of date palm seeds levels (25, 50 and 75%) with and without yeast respectively in all-male Nile tilapia feed in the accretion achievement, carcass contexture, feed utilization, condition factor (K) and feed expense. If it results well it can motivate scientists and researchers to do innovative studies; to look up for new fonts to lessen the feed expense; to enhance a new taste for cultured species; to accomplish the problems brought about by by-products; to improve fish dietary and fish farming profit in Sudan and thus it will improve food stability, (ii) to inquire the impact of coalescence of date palm seeds levels (25, 50 and 75%) with and without yeast respectively in all-male Nile tilapia dietary with the consideration on total length and water quality parameters during the experiments.

MATERIALS AND METHODS

Experimental diets

The stuff for the diets was gathered from the local market (Koko market). Seven investigational diets were formalized with different levels of fresh wet date seeds (MeshriK Wad Lagai) 0, 25, 50, and 75% for diets T0, T1, T2, T3, T4, T5 and T6 respectively in which the date seeds came from Abu Alama date packaging factory (a local factory). All diets were formulated with commonly used ingredients such as fish meal, groundnut cake, wheat bran, bread flour, starch, yeast, mineral mix and vegetable oil, and they were presented in Table 4. The experiments of this research were performed in the Freshwater Fisheries Laboratory and Hatchery, Sudan University of Science and Technology, Khartoum. It was conducted for one month and a half, from 19 August to 2 October 2015.

The date seeds were washed and immersed in tap water for three days and got dried. Some were ground in the home blender, while the others were ground by professional coffee grinder in the central Khartoum market. Chemical Analysis of date seeds were shown in Table 1. The additional additive yeast was added in the experimental diets with a rate of 3 gram (by substituting 2g of starch) for diets T1, T2, T3 respectively, in dried form. The chemical analysis of the yeast was shown in Table 2. The chemical composition of fish meal was shown in Table 3.

Method of preparation

Dry stuffs were shown in Table 4 and their percentages in the mixture were shown in Table 5. After being ground, first of all, they were sifted into very fine particles, then they were weighed by using electrical balance (Model: 2003, Max: 200 g, cl: 0.001 g, AC: 220W/50HZ, S/N: 11 g, SF: 400). Based on the prearranged mixing, all dried stuff was mixed well for homogeneity and the vegetable oil, vitamins and mineral were supplemented to that mixture. Tap water was boiled and additional starch (10 g/100 g) were supplemented to make a gelatinized binder. The water was added more (depend on the ingredient) to have a preferential paste with about 10% moisture content. Pellets were produced by manual meat grinder with 0.6 mm-diameter and later were dried in the lab for 24 h and subsequently broken into crumbled form and each diet was packed in a plastic bag and kept under the ambient room temperature until the experiment started. The samples of each diet were taken for the chemical analysis and the results were shown in Table 4.

RESULTS AND DISCUSSION

Experimental fish

All-Male fingerlings of Nile tilapia were purchased from Aljwariss private farm (south Jebel Awliaa dam) with around 2 months old in average and average weight of 0.5-2.0 g (these fish were kept in a pool with high density and fed for only to keep them alive and not to gain weight until they were sold). They were about 500 fingerlings and kept in oxygenated plastic bag. They were acclimatized for half an hour in the surface of the plastic containers filled by tap water and then those fish were kept in plastic containers (aquarium) in fisheries laboratory and fed on a basal diet for 18 days (from 1-18 August) for the purpose of adaptation and once the adaptation period was finished, some initial samples were taken to the laboratory of the institution research center of animal resources (Soba) for the chemical analysis, and the result was presented in Table 6.

Experimental design

The fish (10/Aquaria) were disparted randomly to 21 of 36 L plastic containers (36×34×31 cm^3) (aquarium). The containers were filled with precipitated tap water (in the hatchery). Fish were bulk weighed, and their initial weights and total length (from the tip of the mouth till the end of the caudal fin) were recorded for random sample. Using Digital scale (electronic kitchen, auto zero, power 1.5v*2.AA battery, 5000g*1g/177oz*0.10z) and ruler respectively, the results were as follows, the average weight was1.9±1.11g, average length was 4.9± 0.77cm.

Table 1. Chemical composition of date seeds (% DM)

Type	Moisture	DM	CP%	EE%	CF%	Ash	NFE
Date seeds	1.5	98.5	6.27	2.9	3.5	2	83.83
Gross energy/kcal/100g			398.609				
Digestible energy/kcal/100g			225.11				

Note: Nitrogen-free extract (NFE) = 100- (moisture + crude protein + crude fat + crude fiber + ash). Gross energy (kcal/100g), based on 5.7 kcal/g protein, 9.5 kcal/g lipid, and 4.0 kcal/g carbohydrate. Digestible energy (kcal/100g), based on 5.0 kcal/g protein,9.0 kcal/g lipid, 2.0 kcal/g carbohydrate. DM: Dry Matter. CP: Crude Protein. EE: Either extract. CF: Crude Fiber

Table 2. Chemical composition (% DM) of yeast

Type	Name	Moisture	DM	CP	EE	CF	Ash	NFE
S. cerevisiae	Bakery-yeast	9.2	90.8	51.5	6.3	1.8	6.8	24.4

Note: DM: Dry Matter, CP: Crude Protein, EE: Either extract, CF: Crude Fiber, NFE: Nitrogen-free extract

Table 3. Chemical composition (% DM) of fish meal

Type	Moisture	DM	CP%	EE%	CF%	Ash	NFE
Fish meal	7.85	92.15	61.29	8.15	0.6	9.5	12.61

Note: DM: Dry Matter. CP: Crude Protein. EE: Either extract. CF: Crude Fiber. NFE: Nitrogen-free extract

Table 5. Nutritional Percentage: (2×3×3+3 (control) Factorial =21

Plant protein	Date seeds%+Yeast (g)			Total	N-Ex-D
D-P with (group A)	25+ 3g	50+3g	75+3g	3	3
D-P without (group B)	25	50	75	3	3
Control (non)	0	0	0	1	1
Animal protein%	75	50	25	-	-
Total	-	-	-	7	7

Note: D-P-with-Y : Date seeds with yeast. D-P-without-Y: Date seeds without yeast. N-Ex-D : Number of experiments diet

Table 6. Carcass composition (% DM) of all-male Nile tilapia

Type	DM	Moisture	CP	EE	ASH	NFE
Caracas	78	22	17.35	6.125	1.325	53.2
G/E (kcal/100 g)	369.8825					

Note: DM: Dry Matter, CP: Crude Protein, EE: Either extract, CF: Crude Fiber, NFE: Nitrogen-free extract

Table 4. The stuff and chemical composition of the experimental diets/100g

	Treatments						
Ingredient	**Control**	**With (group A)**			**Without (group B)**		
	0%	**25%**	**50%**	**75%**	**25%**	**50%**	**75%**
Fish-meal (60 cp)	45	33.75	22.5	11.25	33.75	22.5	11.25
Date-seeds (6.27 cp)	0	11.25	22.5	33.75	11.25	22.5	33.75
Groundnut cake (34.5 CP)	21	21	21	21	21	21	21
Wheat bran (15.7 CP)	10	10	10	10	10	10	10
Bread flour	10	10	10	10	10	10	10
Starch	5	2	2	2	5	5	5
Yeast	0	3	3	3	0	0	0
Mineral mix	4	4	4	4	4	4	4
Vegetable oil	5	5	5	5	5	5	5
Chemical composition (% DM)							
Moisture	6.5	8.5	6.0	12.5	7.5	6.0	6.50
DM	93.5	91.5	94.0	87.5	92.5	94.0	93.5
CP	36.84	35.71	35.53	34.74	36.01	36.27	35.57
EE	3.85	3.55	3.45	3.40	3.95	3.70	3.60
CF	3.03	2.97	2.96	2.90	2.80	2.90	2.92
Ash	15.0	13.5	8.50	12.50	9.50	7.50	9.50
NFE	34.79	35.78	43.57	33.97	40.24	43.64	41.92
G/Ekcal/100g	385.70	380.34	409.53	366.18	403.74	416.40	404.60
D/Ekcal/100g	288.42	282.025	295.805	272.23	296.08	301.90	294.10
P Energy	54.44	53.51	49.45	54.08	50.84	49.65	50.11
ERE	1.883	2.71	1.61	2.17	3.81	4.86	2.16

DM: Dry Matter, CP: Crude Protein, EE: Ether Extract, NFE: Nitrogen free Extract's\E: Gross Energy, D/E: Digestible Energy. Protein Efficiency Ratio (PER) = wet weight gain (g)/Amount of protein given (g). Protein productive value (PPV%) = (P2-PI) ×100/Protein intake (g) where: P2: Protein content in fish carcass at the end; P1: Protein content at the start. Protein-energy = (energy in protein/gross energy) X 100. Energy retention efficiency ERE (EU%) = [Final body energy (Kcal)-Initial body energy (Kcal) ÷ Dietary energy consumption (Kcal)] X 100

The fish in each aquarium were fed on the experimental diets according to the feeding control, three times/day (at 8.30-11.30-3.30 o'clock). On first 20 days the fish were fed with a ratio of 12% of body weight, and then it was reduced to 8% in third 10 days and into 4% in the last 10 days. The daily nourishing quota was adjusted every 10 days and also the bulk fish weighing was done every 10 days with a sampling method. At the end of the diet experiment, each fish were weighed individually with an electrical balance. The total length was measured on some sample randomly, and some fish were taken as a sample from each treatment and kept in the freezer for the chemical analysis. All the dirt found inside plastic containers were siphoned twice daily before feeding time to prevent accumulation of fecal matter and waste (since accessories and personal hygienic were taken good care of, no disease appeared during the experiment), also the containers were brushed and cleaned weekly based on their cleanliness conditions. Approximately 10% (2-3 litter at one time) of fresh water was added to restore the water volume and also the containers were drained at each sampling and refilled again with completely new water. On the day of sampling, no feed was provided for fish. At this time, all plastic containers were equipped with aerations nets using an air blower. Water quality parameters such as oxygen, temperature, total ammonia, nitrites and nitrates, and pH were measured by using a dissolved oxygen meter (Model: DO-5509), manual thermometer, kits, Eco Tester PH1 (Range 0.0-14.0, power 4*1.5"VA76" micro alkaline batteries) respectively (water sample was stored in freezer till the end of the trial). Each sampling was measured.

Growth performance parameters

Weight gain (WG%) = W_2/W_{1x100}

Average daily gain (ADG) (g/fish day-1) = total gain/ duration period (days).

Average daily feed intake (ADF/IN) = Total feed intake/duration period. 4-Specific growth rate (SGR)% day-1) = 100 × (Ln W2-Ln WI)/n.

Where:

Ln: Natural logarithms, n: is the duration period

Relative weight gain (RWG%) = Weight gain/initial weight ×100

Survival Rate (%) = 100× (Final number of fish/initial number of fish) 7-condition factor (K)= $100 \times W/L^3$

Where:

W = Weight of the fish in gram

L = Total length of fish in centimeter.

Feeds efficiency

Feed conversion ratio (FCR) = dry matter intake (g)/total gain (%)

Protein efficiency ratio (PER) = total gain (g)/protein intake (g)

Protein productive value (PPV%) = (P2-PI) ×100/ protein intake (g)

Where:

P2 = Protein content in fish carcass at the end;

PI = Protein content at the start.

Energy retention efficiency

ERE (EU%) = (E2-EI) ×100/Energy intake (kcal)

Where:

ET = Energy in fish carcass (kcal) at the end

EI = Energy in fish carcass (kcal) at the start

Energy retention efficiency (%) = [final body energy (Kcal)-initial body energy (Kcal)/dietary energy consumption (Kcal)] X 100

Statistical analysis

Feedstuff, experimental feeds and carcasses were examined for proximate composition following the guidance of AOAC (2003). Statistical analyses of data were done by SPSS (version 15) 2007 (general model multivariate). To evaluate specific differences between treatment means at (p>0.05), Duncan's multiple range tests were applied. To describe the data in figures, the excel sheet was used.

RESULTS AND DISCUSSION

Growth performance

Results in Table 7 indicated that the overall mean ± SD of the final weight, (WG%), (WG g/fish), (DWG g/fish), (RWG) and (SGR) of all-male Nile tilapia fed on diets with partially substituted by palm date seeds with and without yeast escalated remarkably (p>0.05) with escalating of date palm seeds percentages (with yeast) in T1 and T2, and also escalated remarkably (p>0.05) with increasing of date palm seeds substitution in T4 (without yeast). However, the greatest values of final weight (36.15±5.22), WG% (193.60±25.26), WG (g/fish (17.48±4.2), WG (g) (0.39±0.11), RWG% (93.60±25.26) and SGR% (1.45± 0.30) were achieved by fish fed on T2, and the greatest values of final body weight (g) (34.76± 6.52), PWG% (181.42±22.76), PWG (g) (15.76± 4.86), DWG (g) (0.35± 0.13), RWG% (81.42± 22.76) and SGR (1.31 ± 0.29) were achieved by fish fed on T4.

The increment weight

Results in Table 8 indicated that the result of mean ± SD of increased weight of All-Male Nile tilapia fed on the experimental diet control, T1, T2%, T3%, and T4%,T5%, T6%/days increase in control (18.76±1.28 to 39.03± 1.79), in diets contain palm date seeds with T1 (16.67± 1.28 to 33.17±2.5), T2 (18.67± 1.74 to 36.15± 5.2) and T4 (19.00± 1.67 to 34.76± 6.52) without yeast, but this result decrease in T3 (19.67± 0.97 to 23.41± 13.42), T5 (22.33± 0.48 to 27.92± 13.24) and T6 (21.33± 1.74 to 18.02± 4.66).

Particular accretion rate (%)

Results in Table 9 indicated that the mean ± SD of particular accretion rate (%) of all-male Nile tilapia fed on the experimental diet control, T1, T2%, T3%, and T4%, T5%, T6%/days escalate with no coalesced palm date seeds in the diet, with and without yeast in the control (2.78±19.41 to 3.61±8.10), T1 (2.80±4.35 to 3.49±15.07) , T2 (2.79±13.71 to 3.16±75.52) with yeast and T4 (2.67±13.57 to 3.14±49.41), T5 (2.67±8.59 to 3.31±19.02) and T6 (2.74±4.92 to3.33±51.10) without yeast, but this result was lessened in T3 (2.93±18.08 to 2.90±108.75), but overall there is no remarkable discrepancy (p>0.05). This means that all-male Nile tilapia grow normally when various levels of palm date seeds coalesced in the diets.

The weight of group/individual (g)

Result in Table 10 showed that the mean ± SD of final weight \ individual (g/fish) of All-Male Nile tilapia groups control (Non) (4.17±1.61), group A (3.82±1.57) and group B (4.03±1.76) are not remarkably dissimilar (p>0.05) and the mean weight/fish for 45 days was 4.00 g. These result showed that the nutritive value of date seed and their hormone-accretion content are more appropriate for fish nourishment.

Feed efficiency

Results in Table 11 showed that the mean ± SD of meal intake, feed efficiency, food conversion ratio, protein efficiency ratio, protein productive value, condition factor (K%) and survival rate. The smaller remarkable rate of meal intake (the death fish did not lower the mortality rate, so it was excluded) was 84.27± 7.9 and 81.10± 10.8 which was obtained by fish fed on diet T1 (which gave low FCR) and T6 (which gave high FCR). The mean rates of PER increased in T0, T1, T5 and T6 significantly (p>0.05) as the increase of palm date seed substitution.

Table 7. Growth performance of all-male Nile tilapia fingerlings fed on the experimental diets (g/fish)

Items	Treatments							Sig
	Non	**With**			**Without**			
	T0 (0.0%)	**T1 (25%)**	**T2 (50%)**	**T3 (75%)**	**T4 (25%)**	**T5 (50%)**	**T6 (75%)**	
Initial weight				19.00±1.11				0.23
Final weight**	39.03± 1.79	33.17±2.5	36.15± 5.22	23.41± 13.42	34.76± 6.52	27.92± 13.24	18.02± 4.66	0.00
WG (%)	209.45±6.98a	199.12±6.82b	193.60±25.26b	122.30±85.92e	181.42±22.76c	149.70 ±68.78d	113. 88± 22.72e	0.01
WG (g/fish)	20.37±0.69a	16.51±1.43b	17.48± 4.20b	3.74± 14.37e	15.76± 4.86c	5.59± 12.91d	3.32± 4.09e	0.00
DWG (g)	0.45± 0.02a	0.37± 0.04b	0.39± 0.11b	0.08±0.38d	0.35± 0.13b	0. 25± 0.34c	0.07± 0.11d	0.22
RWG (%)	109.45± 7.07a	99.12± 6.82b	93.60± 25.26b	22.30± 85.92d	81.42± 22.76c	24.24± 68.78d	15.92±22.72e	0.01
SGR	1.64± 0.07a	1.53± 0.08a	1.45± 0.30b	0.24± 2.46d	1.31 ± 0.29b	0.87 ± 1.62c	0.28± 0.57d	0.05

Note: Data are represented as mean of three samples replicates ± standard error. Means in the same row with the same letter are not remarkably different (P>0.05)

Table 8. The increment weight of all-male Nile tilapia (g/fish) as affected with date pit incorporation in diets/days

Diets	Weight of fish (g) at different times					
	0 time	**11 days**	**21 days**	**31 days**	**41days**	**Increment (g)**
T_o (0.0%)	18.67±1.28d	24.00±2.21c	32.00±1.45b	39.00±3.02a	39.03±1.79a	20.36±1.95
T1 (25%)	16.67±1.28d	24.00±0.84c	28.00±6.32b	32.67±4.61a	33.17±2.5a	16.50±3.11
T2 (50%)	18.67±1.74d	24.33±0.48c	28.67±1.28b	33.67±3.95a	36.15±5.22a	17.48±2.53
T3 (75%)	19.67±0.97c	28.33±1.74a	24.67±7.12b	22.00±12.88b	23.41±13.42	3.74±7.20
T4 (25%)	19.00±1.67c	26.67±5.04b	29.00±5.49b	32,00±6.03a	34.67±6.52a	15.67±4.10
T5 (50%)	22.33±0.48c	31.00±5.09a	28.33±7.21b	25.67±9.98c	27.92±13.24b	5.59±6.86
T6 (75%)	21.33±1.74b	24.00±2.90a	21.33±5.44b	22.33±5.44a	18.02±4.66c	3.31±3.20

Note: Data are represented as mean of three samples replicates ± standard error. Means in the same row with the same letter are not significantly different (P>0.05)

Table 11. Growth and food utilization efficiency of all-male Nile tilapia fingerlings fed on the experimental diets

Item	Treatment							Sig
	Non	**With**			**Without**			
	T0 (0.0%)	**T1 (25%)**	**T2 (50%)**	**T3 (75%)**	**T4 (25%)**	**T5 (50%)**	**T6 (75%)**	
Feed intake	92.40± 5.72a	84.27± 7.9d	88.00± 4.1b	89.47± 7.1b	90.80± 14.7a	96.76± 15.7a	81.10± 10.8d	0.10
FEED/EFF	0.22±0.02a	0.20±0.2a	0.20±0.0 5a	0.035±0.19d	0.17±0.34b	0.11 ±0.17c	0.04±0.60d	0. 02
FCR	0.44± 0.04a	0.42± 0.06a	0.46± 0.06a	1.48± 1.64d	0.49± 0.04a	0.65 ± 0.60c	0.71± 0.29c	0.18
P.E Ratio	1.67a	1.43a	1.48a	0.35d	1.31b	0.46c	0.28d	-
PPV	39.24a	38.60b	37.29c	37.13d	37.63c	38.59b	38.52b	-
K (%)	14.68a	12.95a	13.16a	9.87d	11.66b	11.38c	8.86e	-
Survival rate (%)	93.33a	90.00a	86.67b	66.67c	86.67b	63.33c	50.0d	-

Note: Data are represented as mean of three samples replicates ± standard error; Means in the same row with the same letter are not significantly different (P>0.05)

Table 9. Particular accretion rate of all-male Nile tilapia (g/fish) as affected with date seed coalescence in diets/days

Diets	Weight of fish (g) at different times			
	0-11 days	11-21 days	21-31 days	31-41 days
To (0.0%)	2.78±19.41	3.33±9.36	3.22±7.96	3.61±8.10
T1 (25%)	2.80±4.35	3.29±9.91	3.19±19.02	3.49±15.07
T2 (50%)	2.79±13.71	3.20±31.93	2.89±61.13	3.16±75.52
T3 (75%)	2.93±18.08	3.00±41.32	2.50±101.40	2.90±108.75
T4 (25%)	2.67±13.57	3.06±42.32	2.91±39.10	3.14±49.41
T5 (50%)	2.67±8.59	3.27±17.53	3.94±19.61	3.31±19.02
T6 (75%)	2.74±4.92	3.27±4.06	3.18±14.47	3.33±51.10
Sig	0.29	0.64	0.57	0.79

Note: Data are represented as mean of three samples replicates ± standard error. Means in the same row with the same letter are not significantly different (P>0.05)

Table 10. The weight of all-male Nile tilapia group/individual (g)

Treatment	Control (Non)	Group A (with yeast)	Group B (without east)
	4.17±1.61a	3.82±1.57a	4.03±1.76a
Sig		0.57	

Note: Data are represented as mean of three samples replicates ± standard error. Means in the same row with the same letter are not significantly different (P>0.05)

However, the diets T1, T2 and T4 substitution with and without yeast yielded a higher rate of FCR respectively (0.42± 0.06, 0.46 ± 0.06 and 0.49±0.04) and the higher rate of PER (1.43, 1.48 and 1.31) in T1, T2 and T4 palm date seeds; T1 and T5 substitution yielded higher rate of PPV for the palm date seed (with and without yeast) respectively (38.65 and 38.59). The greatest rate (p>0.05)of K was (14.68, 13.16, 12.95 and 11.66) in T0, T2, T1 and T4 respectively. The greatest survival value was in T0, T1, T2 and T4.

Feeding rate (regime%)

Results in Table 12 showed the mean ±SD of feeding administration% for hormone-treated all-male Nile tilapia fed on the experimental diets. The decrease in feeding intake caused the decrease of feed rate in the sample, and the initial highest feed intake was in T5 (26.80±0.58), T6 (25.60±2.09) and T3 (23.60±1.16). Although they indicated a lower percentage at the final feeding administration, namely 10.00±4.40, 9.60±1.46 and 8.80±5.15, respectively. The differences occurred here were due to electricity problem which led to the loss of their appetite and, in the end, to the mortality of them. The mortality rate was higher than that in the rest diets T1 (20.00±1.53), T2 (22.40±2.09), T4 (22.80±2.01) and control (22.40±1.53).

Body composition

The mean± SD of the chemical contexture of the entire fish body as influenced by partial substitution at the end of the experimental period is described in Table 13. In all groups involving date seeds diets, fish body dry matter and protein content became better than that in control diet which has high protein and lower dry matter. On the fish fed on the diet containing 50% date seeds substitution, lower body dry matter was yielded. On the fish fed on the diet containing 25% and 50% date seeds substitution with and without yeast, the highest significant (p>0.05) in protein body content (31.15 and 31.35) respectively was produced. The lowest significant (p>0.05) fat (6.40 And 6.55) was presented in fish fed on the diet with 75% substitution with and without yeast, and the lowest gross energy body contents (376.47 and 377.825) were found in fish fed on diets with 50% and 75% substitution with yeast. The highest number of ash body contents in the dry matter (2.40 and 2.20) were found in fish fed on diet containing 25% and 75% date seeds substitution with yeast.

The water quality

The mean ± SD values of water quality parameters assessed in the nurturing plastic containers (aquarium) are summed up in Table 14 The mean water temperature was 27.55 ºC±0.82). This temperature has been informed as of the optimum range for tilapia growth and yield (Meske 1985). The mean dissolved oxygen was 5.81ppm± 2.21. Siddiqui et al. (1989) claimed that tilapia demands a low oxygen and can stay alive at low oxygen values. Riche and Garling (2003) informed that dissolved oxygen values should be kept above 5.0 ppm for optimum accretion. The pH of water influences a lot of water quality parameters and the rates of many biological and chemical processes. Thus, pH is determined as significant parameters to be inspected and managed in the aquaculture system (Losordo et al. 1998).

In this research, the mean value of pH was 7.64 ±0.36. Pompa and Masser (1999) informed that tilapia can stay alive at pH ranging from 5 to 10 but they perform optimum at pH 6 to 9. Ammonia and Nitrite are a problem in aquaculture systems and should be observed continually. Ammonia establishment is shortly had to do with nourishing and relies on the grade of meal, nourishing rate, fish size and temperature (Riche and Garling, 2003). In this research, ammonia (NH3) was 0.33±0.43 (optimum rate was 0.2 ppm), nitrites (NO_2) was 0.24±1.24 (optimum rate was 0.3 mg/l) and nitrate (NO3) was 0.99±1.34 (optimum rate was 200-300 ppm). The concentration in the nurturing containers was highly significant (p>0.05) but was not within the safe range for tilapia culture. Accretion achievement parameters for tilapia fingerlings after the nourishing experiments are presented in Table 7. It is obvious that there is a notable impact on experimental diets on accretion achievement of the experimental fish.

Length during experiment

Results in Table 15 exhibit that mean ± SD of the initial length (cm) and final length (cm) of all-male Nile tilapia fed on control, 25%, 50%, 75%, 25%, 50% and 75% diets showed no significant differences (P>0.05).

The economic evaluation

The outcome in Table 16 showed that the costs of experimental diets based on the diet substances in the local market during the experiment, the diet substances, price (Sudanese Currency/kg), handlings, food conversion ratio and the total price (Sudanese currency/kg). The lower significance price (p>0.05) was shown (3.38, 3.70 and 3.95) in the 25%, 50% date seeds substitution with yeast and 25% without yeast respectively. The highest price was 11.91 and 5.72 in 75% date seeds substitution (with and without yeast) respectively; in comparison to the control, i.e., 3.54. There is no remarkable difference (p>0.05). This outcome showed that the incorporation of date seeds 25%, 50% and 25% as the partial substitution of fish meal yield better economical and efficiency outcomes as well as better accretion achievement and nutrient utilization. This is in agreement with so many works. Mabrouk et al. (2011) resumed that wet cull date may be expense-effective when partially substitutes yellow corn in tilapia meals as energy fount, and enhances fish performances when they were added with 0.03% digestion. Khadr (2006) informed that tilapia fed by diet bearing 75% date seeds revealed almost-economical outcomes in comparison with control. This result was 25%, 50% and 25% as mentioned above.

Table 12. Feeding rate (regime%) intake by all-male Nile tilapia/sample

Diets	Feed intake (%) at different sample			
	0 (12%)	**1 (12%)**	**2 (8%)**	**3 (4%)**
Control (0%)	22.40±1.53	28.80±2.66	25.60±1.16	15.60±1.21
T1 (25%)	20.00±1.53	28.80±1.00	22.40±5.05	13.07±1.84
T2 (50%)	22.40±2.09	29.20±0.58	22.93±1.02	13.47±1.58
T3 (75%)	23.60±1.16	34.00±2.09	23.07±2.68	8.80±5.15
T4 (25%)	22.80±2.01	32.00±6.05	23.20±4.39	12.80±2.41
T5 (50%)	26.80±0.58	37.20±6.11	22.67±5.77	10.00±4.40
T6 (75%)	25.60±2.09	28.80±3.34	17.07±4.35	9.60±1.46

Note: Data are represented as mean of three samples replicates ± standard error. Means in the same row with the same letter are not significantly different (P>0.05)

Table 13. The end carcass composition (% DM) of all-male Nile tilapia fed experimental diet

Diets	D.M	Moisture	C.P	E.E	ASH	NFE	G.E/kcal/100g
T0 (0%)	73.5	26.5	31.81	6.85	2.15	32.695	377.144
T1 (25%)	75.0	25.0	31.15	6.70	2.40	34.75	380.205
T2 (50%)	74.0	26.0	30.60	6.70	2.10	34.6	376.47
T3 (75%)	75.0	25.0	30.25	6.40	2.20	36.15	377.825
T4 (25%)	76.0	24.0	30.90	6.75	2.15	36.25	385.255
T5 (50%)	77.0	23.0	31.35	6.75	2.10	36.8	390.02
T6 (75%)	74.5	25.5	31.05	6.55	2.05	34.85	378.61

Table 14. Show the water quality parameter during the experiment

Treatment	T0 0%	T1 25%	T2 50%	T3 75%	T4 25%	T5 50%	T6 75%	Sig
Temp.	27.58±0.9	27.75±1.0	27.42±0.7	27.58±0.9	27.5 ±1.0	27.50±0.8	27.50±0.5	0.98
O_2	5.41±2.3	5.80±2.1	5.80±2.1	5.60±2.5	5.74±2.5	5.90±2.2	6.40±1.9	0.96
pH	7.60±0.5	7.74±0.4	7.65±0.3	7.64±0.3	7.50±0.4	7.60±0.3	7.73±0.4	0.63
NH_3^{*}	0.79±0.9	0.38±0.5	0.15±0.2	0.13±0.1	0.44±0.8	0.27±0.4	0.13±0.2	0.03
NO_2	0.00±0.0	0.00±0.0	0.86±1.9	0.42±1.4	0.00±0.0	0.00±0.0	0.42±1.4	0.32
NO_3^{**}	0.08±0.3	1.83±2.4	2.50±2.6	2.08±2.6	0.00±0.0	0.42±1.4	0.03±0.1	0.00

Note: Data are represented as mean of three samples replicates ± standard error. Means in the same row with the same letter are not significantly different (P>0.05)

Table 15. Length of all-male Nile tilapia during the experiment

Item	T0 0%	T1 25%	T2 250%	T3 75%	T4 25%	T5 50%	T6 75%	Sig
IL (cm)	5.03±0.6a	4.23±0.4a	5.60±0.8a	5.20±0.6a	5.50±1.6a	5.47±0.2a	5.20±1. 2a	0.59
FL (cm)	6.43±0.3a	6.35±0.2a	6.50±0.2a	6.19±0.1a	6.68±0.3a	6.26±1.3a	5.88±0.2a	0.98

Note: Data are represented as mean of three samples replicates ± standard error. Means in the same row with the same letter are not significantly different (P>0.05)

Table 16. The economic evaluation of the experimental diets/Sudanese currency

Item	Price SDG/kg	Treatments	FCR	Total price SDG
Fish meal	4.000	T0 (0%)	0.44	3.54
Date-seeds	2.000	T1 (25%)	0.42	3.38
Groundnut cake	5.000	T2 (50%)	0.46	3.70
Wheat bran	4.000	T3 (75%)	1.48	11.91
Wheat bran	6.000	T4 (25%)	0.49	3.95
Starch	5.000	T5 (50%)	0.65	5.23
Mineral mix	35.000	T6 (75%)	0.71	5.72
Vegetable oil	18.000			
Yeas	1.500			
Total	80.500			

Note: *The price of date seeds according to the price of rejected dates

Discussion

This research showed the potential of palm date seeds to be added in commercial all-male Nile tilapia feeds as fish meal, as well as to be an important component for feed production in Sudan. There is little knowledge in the scientific literature regarding the utilization of date seeds in the diets of Nile tilapia, particularly in the level of research and in the commercially profitable levels. Most tilapia uses starch efficiently from 22 to 46% dietary starch and 22% is considered the most advantageous level for juvenile tilapia (Wang et al. 2005). There is significant advantage in the relation of the partial substitution of the fish feed currently used in diets. A valuable sum of research has been carried out on the substitution of fish meal with plant meal as the protein found in diets of Nile tilapia (Temesgen 2004; Shalaby 2004; Sasmal et al. 2005; Johnson and Banerji 2007; Ebrahim et al. 2007; Abd el Hakim et al. 2008; Tartiel et al. 2008; Khan et al. 2013; Labib et al. 2015).

Gohl (1975) informed that Local Palm Kernel Meal (LPKM) used in Indonesia and Malaysia contains 20 to 25% of raw protein. In this study, however, the analysis of palm date seeds has represented that they bear only 6.27% of crude protein, but they remarkably influence in the experimental diets (T1, T2, T3, T4, T5 and T6 Table 4) and in the accretion achievements of all-male Nile tilapia at the time they are incorporated in various levels. This recommends that the availability of accretion hormone; steroid compounds, estrogen, progesterone, and estriol which has been notable since the 1950s (Barreveld 1993) would supply fishes with the significant sum of accretion rates. Assem et al. (2014) stated that the use of five isoenergetic-isonitrogenous diets bearing 0, 0.5, 1.0, 1.5 and 2.0 g/100 g of fungi Trichoderma reesei reduced date seeds (FDDP) of Nile tilapia diets as substitution of α-cellulose; the Oestradiol increases linearly with FDDP content in diets indicating that an FDDP may have phytoestrogenic roll.

The present research obviously testified that as much as 25%, 50% (33.17±2.5 and 36.15± 5.22) and 25% (34.76± 6.52), ($p>0.05$) of the fish meal protein, as seen in Table 7, could be substituted by palm date seeds with and without yeast respectively; without decreasing the accretion rates of all-male Nile tilapia, but further enhancing dietary date fiber to 300 g/kg and this resulted in notable persecution in all parameters (Belal et al. (2015)).

This outcome is in agreement with Omoregie and Ogbemudie (1993) reporting that the substitution of 15% palm kernel/25% fish meal (28.56% dietary raw protein and 13.49% dietary crude fiber) gives the best accretion and food utilization inversely to 30% palm kernel 10% fish meals (27.86% dietary raw protein and 18.99% dietary raw fiber); this might be caused by the high raw fiber, fish age, size, environment and low raw protein level. Similar outcome was gained in Saudi Arabia by Al Amoudi et al. (2001) who tested local Palm Kernel Meal (LPKM) as a partial or a total substitution of fish meal on tilapia (*Oreochromis spillurm*) diets. They discovered that the substitution from 0 to 32.5% of palm kernel increased the mass of Nile tilapia, while 100% substitution gave lower weight. This research utilized four iso-nitrogenous isocaloric diets containing 0, 100, 200 and 300 g/kg date fiber as the substitution of wheat bran. They were given to Nile tilapia fingerlings (0.65 g). Gaber et al. (2014) stated that the average final weight (g/fish), SGR (%/day), feed conversion ratio, PPV and PER were significantly ($p \leq 0.05$) influenced by the level of fresh date and level of digestragrom and the best diet was achieved by the diet with level 30% fresh date and 0.03 of digesragrom; it is presented in Table 9 and 11. Yosif (2012) also informed that the wheat flour was substituted by Dehydrated Entromorpha, Prosopis cineraria pods and date seeds at 0, 10, 20 and 30%. Diets of date seeds achieved the best survival rate ($p>0.05$). The carcass protein levels were alike in all treatments. Different from all the above result was mentioned by Mabrouk et al. (2011) which stated that by utilizing two forms of cull date and date seeds as energy fount, added with feed additives (phytogenics), to be partially substituted (13.5%) by yellow corn (YC), iso-nitrogenous (30.43% crude protein), isocaloric (436.43 kcal GE/100 g)) in feeding Nile tilapia fingerlings, the specific accretion rate of fish and feed utilization can be increased. However, the substitution with either dry cull date or date seed reduced tilapia achievements; meanwhile, date seeds resulted from the worst values which are in contrary to the result of this study as seen in table 4.1 and 4.5. It may be due to the high Fiber content as seen in Table 1; which is regularly indigestible to most cichlids especially because they do not have the needed enzymes for fiber digestion and the movement of native food from the stomach is low and fast. Then, higher meal frequency led to better carbohydrate usage for hybrid tilapia (Tung and Shiau 1991). Image period also affects the accretion of tilapia and El-Sayed, and Kawanna (2004) boosted the accretion of tilapia by practicing longer image period. Osman et al. (2001) stated that the use of acid-treated date seeds as carbohydrate fount for Nile tilapia fingerlings, i.e., with the substitution by 50% (15% of the total diet) and by 100% (30% of the total diet) for treated and untreated date seeds, respectively. Accretion achievement, feed conversion ratio, and protein productive value was significantly ($p>0.05$)

higher in fish fed by 50% treated date seeds. Khadr (2006) claimed that the utilization of date seed meal (DSM) instead of yellow corn as an unusual energy fount in Male of Nile tilapia diets at level 0, 25, and 75% respectively resulted well. The diet holding 75% date seed meal showed best accretion achievement.

Table 11 showed that the mean ±SD of meal intake and nourishing administration (% values) tend to give higher result in fish fed on diets control and on T5 (50% date seeds without yeast). Fish food intake might be affected by many environmental factors such as water temperature, food concentration, stocking density, fish size and fish behavior (Houlihan et al. 2001). Khadr (2006), stated that cumulative feed consumption was influenced by feeding date seed meal. The diet comprising 75% of date seed meal showed better accretion achievement as unusual energy found, than the current result and it may be caused by the various purpose of the inclusions. The least value of food conversion rate (FCR) was in T3 and T6 as shown in Table 4.5. Al Amoudi et al. (2001) informed that the highest value of FCR was recorded on fish fed on control, i.e.1.73 and on diet with 25% with yeast, namely 0.42.

The condition factor (K) was utilized as a barometer of health in fishing biology research, such as accretion and nourishing frequency. this factor gives information on the variety of physiological status of fish which can be utilized in the comparison of populations fed on certain diets. Ighwela et al. (2011) informed that the use of diet with various maltose levels (0.0, 20%,25%, 30% and 35%) given to fingerlings of Nile tilapia resulted from higher values of k in all treatment (1.64, 1.77, 1.72 and 1.79) than the present result from other diets. Table 11 showed that the highest mean ±SD ($p \leq 0.05$) of factor (k) was in T0 (control), T2 and T4, but all treatment results in good health. On the contrary, digestgarom addition raised fish achievements either fed on diets of fresh cull date or control diets (YC). Mabrouk et al. (2011) stated that this result in accordance with the previous result of the study done by Mabrouk with the yeast additives. Carcass analysis notably presented ($p>0.05$) smaller raw protein level in fish given by treated date seeds than the groups given by untreated date seeds. Osman et al. (2001) presented the result of the initial carcass analysis was 17.35. Table 6 showed that there is a notable discrepancy ($p> 0.05$). The greatest number of ash ($p>0.05$) was gained from 50% date seeds replacement with yeast as shown in Table 13. It was dissimilar from Yousif (2012) who reported that the ash level was higher ($p>0.05$) in the group fed on control diet than on other. Dry matter and ash level in acid treated date seeds were not influenced, as claimed by Osman et al. (2001). The dampness level was inversely associated to fat content, irrespective of treatments, Yosif (2012), the greatest level of dampness was gained from 50% date seed substitution (without yeast), while the highest value of fat was gained from 50% date seed substitution (with yeast). Table 14 shows the result of the measurement in the nurturing plastic containers (aquarium) during the experiment describing the mean values of water quality parameters. The mean value of water temperature was (27.55°C ± 0.82). The mean value of dissolved oxygen was (5.81 ppm± 2.21). Siddiqui et al. (1989) informed that tilapia has a low oxygen need and can stay alive at small oxygen levels. Riche and Garling (2003) informed that the levels of dissolved oxygen should be kept above 5.0 ppm for best accretion. Water pH has an effect on many water quality parameters and the values of many biological and chemical procedures. In the present research, the average value of pH was (7.64±0.36) in which it was the optimum rate of Nile tilapia culture. Pompa and Masser (1999) informed that tilapia can remain alive at pH of 5 to 10 but they stay their best at pH of 6 to 9. Ammonia and nitrite make a problem in the aquaculture system and must be watched frequently. Ammonia establishment is directly connected to feeding and is conditional on the grade of the meal, the number of feeding, fish size, and temperature (Riche and Garling 2003). In the present study, ammonia (NH3) was 0.33±0.43, nitrites (NO_2) was 0.24±1.24 and nitrate (NO_3) was 0.99±1.34, so they were not within the safe range for tilapia culture, as the concentrations in the nurturing containers are highly important ($p>0.05$). For this reasons, some treatments showed poor accretion achievement, and reduced the survival rate as shown in Table 11. Accretion achievement parameters for tilapia fingerlings after the feeding experiments are shown in Table 4.1; It is obvious that there is a remarkable impact of experimental diets on accretion achievement of the experimental fish. The economic evaluation on Table 16 indicates that the smaller remarkable fare ($p>0.05$) was (3.38, 3.70 and 3.95) represented in the T1 (25%), T2 (50%) date seeds substitution with yeast and T4 (25%) without yeast respectively. These results are consistent with so many previous researches. Mabrouk et al. (2011) resumed that call date may be expense-effective at the time it partially substitutes yellow corn in tilapia dietary as energy fount, and it also enhances fish achievements at the time it increases 0.03% digestion. Khadr (2006) informed that tilapia fed on the diet containing 75% wet cull date showed more economical outcomes than on control.

In conclusion, the substantial discrepancies in the results noted in advance for the most advantageous dietary protein needs for optimum accretion might be caused by dissimilarities in fish genetics, size , age, stocking density, raw stuff, protein quality, hygiene and environmental circumstances or other unidentified factors, which conceal the standardization of the parameters (Ahmad et al. 2004). We presumed that the addition of 25%, 50% and 25% date seeds (*Phoenix dactylifera*) substitution with and without yeast respectively is a great herbal protein fount, which could partially substitute fish nourishment in all-male Nile tilapia (*Oreochromis niloticus*) for its positive impact in accretion achievement, feed utilization and economically decreasing the feed expense; at the same time, it can be concluded from the present study in general that bakery-yeast could perform as an excellent feed additive in all-male Nile tilapia dietary.

REFERENCES

Assem A, Khalifa M, ElShalia M. 2014. Physiological and microbiological indices as indicators of evaluating dietary fungi degraded date pits as a probiotic for cultured Nile tilapia *Oreochromis niloticus* fingerlings and its effect on fish welfare. Egypt J Aquat Res 40 (4): 435-441.

Abdel-Hakim NF, Lashin ME, Al-Azab AA, Nazmi HM. 2008. Effect of replacing soybean meal protein by other plant protein sources on growth performance and economical efficiency of mono-sex Nile tilapia (*Oreochromis niloticus*) cultured in tanks. 8th International Symposium on Tilapia in Aquaculture 2008. Department of Animal Production, Faculty of Agriculture, Al-Azhar University, Cairo.

Ahmad MH, Abdel-Tawwab M, Khattab Y. 2004. Effect of dietary protein levels on growth performance and protein utilization in Nile tilapia (*Oreochromis niloticus*) with different initial body weight. Sixth International Symposium on Tilapia in Aquaculture, Manila, Philippine.

AOAC. 2003. Official Methods for Analysis of the Association of Official Analytical Chemists. 17th ed. AOAC, Gaithersburg, MD, USA..

Al Amoudi MM, El Ghobashy, AE, Nouma VBM. 2001. The use of local palm kernel meal (LPPKM) as a protein source in diets of tilapia (*Oreochromis* sp/Lurus GJ cultured in red sea water. Egypt J Aquat Rial Fish 5: 69-82.

Ali BH, Bahir AK, Alhadrami GA .1999. Reproductive hormonal status of rats treated with date pits. Food Chem 66 437-441.

Belall EH, El-Tarabily KA, Kassab A, El-Sayed AFM, Rasheed NM. 2015. Evaluation of date fiber as feed ingredient for Nile tilapia *Oreochromis niloticus* fingerlings. J Aquac Res Dev 6: 320. DOI: 10.4172/2155-9546.1000320

Belal IEH, Al-Owafeir MA. 2004. Incorporating date pits *Phoenix dactylifera* and their spouts in semi-purified diets for Nile tilapia *Oreochromis niloticus* (L.). J World Aquat Soc 20: 26-33.

Barreveld WH. 1993. Date Palm Products. FAO Agricultural Services Bulletin No.101. FAO, Rome.

Ebrahim MSM, Zeinhom MM, Abou-Seif RA. 2007. Response of Nile tilapia (*Oreochromis niloticus*) fingerlings to diets containing Azolla meal as a source of protein. J Arabian Aquacult Soc 1 (2): 54-68.

El-Sayed AFM, Kawanna M. 2004. Effects of image period on the performance of farmed Nile tilapia *Oreochromis niloticus*: Growth, feed utilization efficiency and survival of fry and fingerlings. Aquaculture 231: 393-402.

El Hag MG, Ekhanjari HH. 2000. Date and sardines as potential animal feed resources. FAO, Rome.

El Hag GA, Al-Yousef YM, Al-Mulhim FN. 1993. A study of different proportion of dates in the ration of sheep, The 3rd Symposium on the Date Palm, Saudi Arabia, January 17-20, 1993, Vol. II. Date Palm Research Center, King Faisal University, Al-Hassa, Mars publishing House, Riyadh.

Elgasim EA, Al Yousef YA, Humeida AM. 1995. Possible hormonal activity of date pits and flesh fed to meat animals. Food Chem 52: 149-152.

Gaber MM, Labib EH, Omar EA, Zaki MA, Nour AM. 2014. Effect of partially replacing corn meal by wet date on growth performance in Nile tilapia (*Oreochromis niloticus*) fingerlings, diets supplemented with digestarom. J Geosci Environ Protect 2: 60-67.

Gohl B. 1975. Tropical Feeds. FAO, Rome.

Houlihan DT, Boujard, M. Jobling. 2001. Food Intake in Fish. Blackwell Science. Oxford, UK.

Hussein AS, Alhadrami GA, Khalil YH. 1998. The use of dates and date pits in broiler starter and finisher diets. Bioresour Technol 66 (3): 219-223.

Ighwela KA, Ahmed AB, Abol-Munaf AB. 2011. Condition factor as an indicator of growth and feeding intensity of Nile tilapia fingerlings (*Oreochromis niloticus*) feed on different levels of maltose. American-Eurasian J Agric Environ Sci 11 (4): 559-563.

Johnson C, Banerji A. 2007. Influence of extract isolated from the plant *Sesuvium portulacastrum* on growth and metabolism in freshwater teleost, Labeo rohita (Rohu). Fishery Tech 44 (2): 229-234.

Khan MSK, Siddique MAM, Zamal H. 2013. Replacement of fish meal by plant protein sources in Nile tilapia (*Oreochromis niloticus*) diet: growth performance and utilization. Iran J Fish Sci 12 (4): 864-8.

Khadr NA. 2006. Non-traditional ration containing Industrial by-products for Nile tilapia (*Oreochromis niloticus*). The use of date stones meal as non-conventional energy source in Nile tilapia diets. Benha Vet Med J 17 (2): 113-126.

Labib EH, Zaki MA, Nour AM, Gaber MM. 2015. Effects of dietary protein sources supplemented with and without garlic and onion on Nile tilapia fingerlings. Intl J Agric Sci Nat Resour 2 (4): 83-89.

Losordo TM, Masser MP, Rakocy J. 1998. Recirculating aquaculture tank production systems, an overview of critical considerations. Southern Regional Aquaculture Center (SRAC) Publication, No. 451, Mississippi State University, Starkville, MS, USA.

Mabrouk HA, Zaki MA, Nour AM, Labib EH. 2011. Effect of partial replacement of dried, wet cull dates and date pits instead of yellow corn, supplemented with feed additives on growth performances of Nile tilapia (*Oreochromis niloticus*). Egypt J Aquat Biol Fish 15 (2): 207-224.

Meske C. 1985. Fish Aquaculture. Pergamon Press, Oxford.

Osman AMH. 2001. Palm cultivation and dates production in Sudan. Forum Nectar of Agriculture Research Corporation (ARC), Sudan.

Osman MF, AlhadramiGA, Ben ZAA. 2001. Sulfuric acid treated date pits as dietary ingredient in Nile tilapia (*Oreochromis niloticus*) diets. Egyptian J Nutr Feeds 4: 753-754.

Omoregie E, Ogbemudia FI. 1993. Effects of substituting fish meal with palm kernel meal on growth and food utilization of the Nile tilapia, *Oreochromis niloticus*. J Aquacult Bamidgeh 45 (3): 113-119.

Pompa T, Masser M. 1999. Tilapia, Life history and Biology. Southern Regional Aquaculture Center (SRAC) Publication, No. 283, Mississippi State University, Starkville, MS, USA.

Riche M, Garling D. 2003. Feeding tilapia in intensive recirculating systems. North Central Regional Aquaculture Center (NCRAC) Publication Number 114, Iowa State University, Ames, Iowa.

Sulaiman NA. 2014. Effect of Feeding Graded Level of Rejected Jua Date on Broiler Performance. Sudan University of Science and Technology, Khartoum.

Sasmal D, Babu CS, Abraham TJ. 2005. Effect of garlic (*Allium sativum*) extracts on the growth and disease resistance of *Carassius auratus*. Indian J Fish 52 (2): 207-214.

Shalaby SM. 2004. Response of Nile tilapia, *Oreochromis niloticus*, and fingerlings to diets supplemented with different levels of fenugreek seeds (Hulba). J Agric Sci 29 (5): 2231-2242.

Siddiqui AQ, Howlader MS, Adam AA. 1989. Culture of Nile tilapia, *Oreochromis niloticus* (L.) at three stocking densities in outdoor concrete tanks using drainage water. Aquacult Fish Manag 20: 49-57

Tartiel MB, Ibrahim EM, Zeinhom MM. 2008. Partial Replacement of Fish Meal With Dried MICROALGA (*Chlorella* spp. and *Scenedesmus* spp.) in Nile tilapia (*Oreochromis niloticus)* Diets. 8th International Symposium on Tilapia in Aquaculture. Arizona University, USA.

Temesgen G-MG. 2004. Utilization of *Gliricidia sepium* Leaf Meal as Protein Source in Diets of *Mozambique tilapia*, *Oreochromis mossambicus* (Pisces: Cichlidae). [Thesis]. Universiti Putra Malaysia, Selangor, Malaysia.

Wu TT. 2003. Nutrition and Prepared Diet for Aquatic Animals, Training Course, Freshwater Fisheries Research Centre Wuxi, China

Tag El-Din AE, Nour AM. 1993. Utilization of palm tree leaves in feeding of sheep. The 3rd Symposium on the date palm, Saudi Arabia, January 17-20, 1993, Vol. II. Date Palm Research Center, King Faisal University, Al-Hassa, Mars publishing House, Riyadh.

Tung PH, Shiau SY. 1991. Effects of meal frequency on growth performance of hybrid tilapia, *Oreochromis niloticus* × *O. aureus*, fed different carbohydrate diets. Aquaculture 92: 343-350.

Vandepopuliere JM, Al-Yousif Y, Lyons JJ. 1995. Dates and date pits ingredients in broiler starting and Coturnix quail breeder diets. Poultry Sci 74: 1134-1142.

Yousif OM. 2012. The potential of dehydrated enteromorpha, *Prosopis cineraria* Linn. (Leguminosae) pods meal and date pits in formulated feed for bluespot grey mullet fry, *Valamugil seheli* (Forsskal). J Sci Technol 13 (1): 36-48.

Yagoub YM, Elemam MB. 2011. Effect of date pits on the performance of Sudanese Desert lambs. J Anim Feed Res 2 (1): 95-97.

Yosif OM 2004. Digestive Physiology and Fish Nutrition-Ministry of Sudan Science and Technology, Khartoum. [Arabic].

Yousif OM, Osman MF, Alhadrami GA. 1996. Evaluation of dates and date pits as dietary ingredients in Tilapia (*Oreochromis aureus*) diets differing in protein sources. Bioresour Technol 57: 81-85.

Wang Y. Liu YJ, Tian LX, Du ZY, Wang JT, Wang S, Xiao WP. 2005. Effects of dietary carbohydrate level on growth and body composition of juvenile tilapia, *Oreochromis niloticus* × *O. aureus*. Aquacult Res 36: 1408-1413.