Journal Homepage: -www.journalijar.com
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)
Article DOI:10.21474/IJAR01/1923
DOI URL: http://dx.doi.org/10.21474/IJAR01/1923
ISSN NO. 2320-5407

RESEARCH ARTICLE

THE VALIDITY OF SOME DOMINANT FISH OBTAINED FROM WADI EL-RAYAN LAKE FOR HUMAN CONSUMPTION.

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Manuscript Info

Manuscript History

Received: 22 August 2016
Final Accepted: 16 September 2016
Published: October 2016

Key words:-
Wadi El-Rayan Lakes; fish; cooking methods; quality criteria; pollutants

Abstract

This study aims to evaluate the validity of some dominant fish obtained from Wadi El-Rayan lakes for human consumption and also to investigate the effect of common cooking methods (grilling and frying) on quality criteria, organochlorine (OC) pesticide residues and heavy metals. Nile tilapia (*Oreochromisniloticus*) and mullet (*Mugilcephalus*) (1st Lake) and red belly tilapia (*Tilapia zillii*) and mullet (*Mugilcephalus*) samples (2nd Lake) during winter 2015 were obtained. Results showed that ranges of quality criteria of raw fish samples were 11.35-12.75 mg/100g (total volatile basic nitrogen (TVBN), 0.48-0.80 mg MAD/kg as thiobarbituric acid (TBA) value and 2.15-2.50×10^3cfu/g total plate count (TPC). Organochlorine (OC) pesticide residues, average concentrations ranged between 0.017-0.103 ppm of ΣDDT, 0.003-0.244 ppm of Σ Endosulfan, 0.014-0.126 ppm of Σ Cyclodienes and 0.021 – 0.065 ppm of ΣHCH (β, γ and δ) in the investigated fishes. Heavy metals levels in raw fish samples ranged 0.196-0.456 Pb, UD-0.066 Cd, 0.052-0.226 Mn, 0.018-0.057Cu, and 0.086-0.538Zn (ppm, ww). With regard to the effect of cooking methods, all values of quality criteria, most OC varied as affected by cooking methods applied, location and fish species. Frying of fish was more effective in reduction of OC components than grilling. However, grilling was reduced all heavy metals values in investigated fish samples, while levels of heavy metals were fluctuated in fried products. In conclusion, quality criteria and pollutants; OCP and heave metals in raw and cooked fish were lower the maximum permissible limits (MPLs) and therefore these fishes are validating for human consumption.

Introduction:-

Wadi El-Rayan Protected Area (WRPA) encompasses the globally important Valley of the Whales World Heritage Site and the nationally important Rayan Lakes recreational area, among many other important natural, social and economic values. WRPA is located in the western part of the Fayoum Governorate, about 200 km southwest of Cairo. Also, the Rayan Lakes are a national recreational resource and a cornerstone of the Fayoum Governorate Ecotourism Plan (Palecznyet *al.*, 2007). Both chemical and biological risks are foreseen to impair seafood safety in the future as a consequence of climate change; in particular, toxic metals, organic chemicals residues, algal toxins and pathogens of both humans and marine organisms. However, different species respond differently to such

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stresses. Public health authorities will face new challenges to guarantee seafood safety and to sustain consumers' confidence in eating seafood in a warmer world (Marques *et al.*, 2010).

Pesticides constitute a major group of potential environmental hazards to man and have been routinely used in most countries of the world to control harmful pests. Some of these pesticides are the persistent organic pollutants (POPs) (Binelli and Provini, 2004). Kalyoncu*et al.* (2009) measured the levels of organochlorine pesticides in 18 fish species from Konya markets, Turkey. They found that DDT and its metabolites and HCH were the predominant contaminants in fish muscles. Detectable levels of HCH, aldrin, and heptachlor were found in most samples. However, dieldrin, endrin, endosulfan, DDT, and DDD were not found in *Salmotrutta*. Yatawara*et al.* (2010) measured the concentrations of OC pesticides in 13 species collected from different sites in the bays. The concentration of the sum of DDTs exceeded that the sum of HCHs in the samples. The estimated mean daily uptake of pesticides was below the level for minimal risk to the consumers. Abd-Allah (2013) found that the raw tilapia fish contained of OC pesticide residues (ppm) were 0.493 β-BHC, 0.256 lindane, 0.714 heptachlor, 4.207 DDT complex, 0.124 chlordane, 3.412 total PCBs, 0.672 aldrin, 0.395 endrin, 1.608 dieldrin, and 2.023 toxaphene. However, the heptachlor epoxide and HCH components were not detected. Ghanna*et al.* (2014) found that chlorinated pesticides residues were ranged from 1.09-3.21, 0.48-1.22, 0.68-2.44ng/g of total HGHs, DDTs and cyclodienes, respectively in fish samples collected from ElbahrElpharony drain. Nowadays, Sabir*et al.*, (2016) monitored of water and sediment for pesticide residues and their bioaccumulation in fish of east Kolkata wetland. They found that average concentration of ΣHCH (α, β, γ and δ) ranged between 1.23 – 8.9 µg/kg in *Cyprinuscarpio*, none in *Oreochromismossambicus* and only α-HCH was recorded in *Cirrhinusmrigata*. Also, average concentration of ΣDDT in three fish species ranged between 11.14 – 13.35 µg/kg and Σ Endosulfan in fish flesh varied from 1.91-23.72 µg/kg.

A heavy metal refers to any metallic chemical element that has a relatively high density and is toxic or poisonous at low concentrations (Irwandi and Farida, 2009). Storelli*et al.* (2007) determined four metals (Hg, Cd, Cu and Zn) in the muscle tissue of eels. Zn showed the highest concentrations (mean: 20.2 µg/g wet wt.), followed by Cu (mean: 0.58 µg/g wet wt.), Hg (mean: 0.18 µg/g wet wt.) and Cd (mean: 0.03 µg/g wet wt). None of the fish samples analyzed presented metal concentrations exceeding the proposed limits. Storelli (2008) analyzed edible marine species (fish, cephalopod molluscs, crustaceans) from the Adriatic Sea for content in heavy metals (Hg, Cd and Pb). Health risks to human via dietary intake of seafood were assessed by the target hazard quotients (THQs) and the toxic equivalent factors (TEFs). Abdel-Baki*et al.* (2011) determined concentrations of some heavy metals (Pb, Cd, Hg, Cu and Cr) in water, sediment and tissues of tilapia fish collected from WadiHanifah during summer 2010. Cu had the highest accumulating level in fish whilst Hg had the lowest. Abd-Allah (2013) found that the raw Nile tilapia muscle contained 3.764, 5.091, 2.687, 0.259, 0.180, 1.506, 0.038, 0.225and 0.91 ppm of Fe, Zn, Pb, Cr, Zr, Cu, Cd, Co and Hg, respectively (on wet weight). Fish is rarely eaten raw and usually cooked in different ways before consumption. Heating is one of the common methods in food processing. Heat is applied for food in different ways (Boiling, baking, roasting, frying and grilling) to enhance their flavor and taste; increase shelf life (Garcia-Arias *et al*., 2003). Also, cooking processes are known to reduce the burden of contaminants in fish. However, the mechanisms involved in the transfer and or degradation of contaminants during cooking process are not clear (Zabik and Zabik, 1999). The reduction in trace metals concentrations as affected by cooking methods may be due to the release of these metals with the loss of drip as free salts, possibly in association with soluble amino acids and un-coagulated proteins bounded with metals (Ersoy*et al.*, 2006 and Ganbi, 2010). Abd-Allah (2013) found that the loss rates of OC ranged from 18.40 to 53.24% in fried, 12.8 to 40.15% in grilled products, respectively. On the other hand, the loss rates of the investigated heavy metals ranged from18.40 to53.24% in fried, 12.8 to 40.15 % in grilled tilapia products.

Therefore, this study aims to evaluate the validity of some dominant fish; Nile tilapia (*Oreochromisniloticus*) and mullet (*Mugilcephalus*) from 1st Lake, red belly tilapia (*Tilapia zillii*) and mullet (*Mugilcephalus*) samples from 2nd Lake, during winter 2015 to study the quality criteria, organochlorine (OC) pesticide residues and heavy metals in raw fish and effect of common cooking methods (grilling and frying) on these parameters to evaluate the quality and safety of these fish species have been consumed from local people in Fayoum Governorate.

Materials andMethod:-

Study area:-

Wadi El-Rayan is a great depression (703 km^2) situated in the Western Desert, 40 km southwest of El-Fayoum Province. Since 1973, the depression has been used as a water reservoir for agricultural drainage water exceeding

the capacity of Lake Qarun. It holds two main lakes, at different elevations, connected by swampy channel. They lie between 30° 20´- 30° 25´ E and 29°05´- 29°20´ N (Fig. 1). The 1st lake of Wadi El-Rayan covers an area of about 53 km^2 at 10 m below the sea level and receives frequent effluent of wastewater from El-Wadi Drain (about 200 million cubic meters of agricultural drainage water are transported annually) (El-Shabrawy,2007). Surplus water from this lake floods to the second one via the shallow connecting channel. The 2nd lake is larger than the first one (110 km^2 at 18 m below the sea level) with maximum water depth recorded is 33 m. It is changing all the time, where newly flooded areas are continuously added at the southwestern side of the lake. The inflow water to the second lake varied from 3.66 $\times 10^6 m^3$ in July to 17.68$\times 10^6 m^3$ in March with a total annual of 127.2$\times 10^6 m^3$/year. The first Wadi El-Rayan lake is less saline (1.4-1.5 g\L) than the second one (4.5-6.1 g\L), where the salinity increases southward (Mansour and Sidky, 2003). Nowadays, the varying degrees of salinity clear disparity between the two lakes, where the average of 1.95 g\L in the first lake and the second an average of 21.97 g\L (EEAA, 2016).

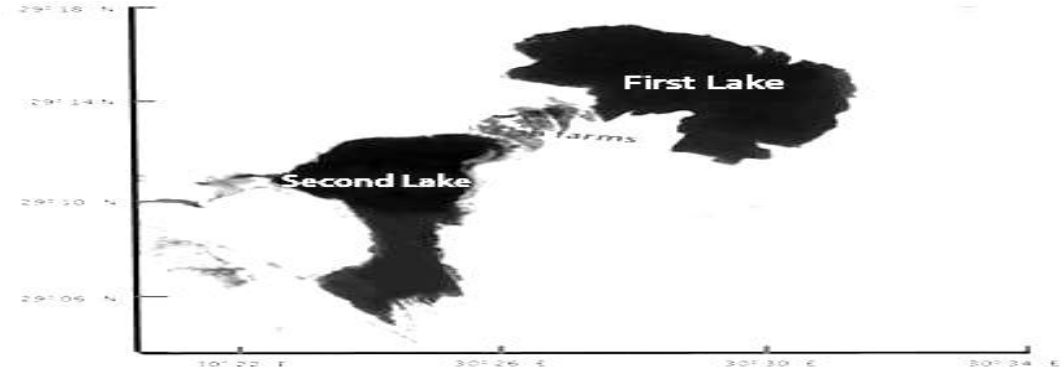

Fig. 1:-Wadi El-Rayan Lakes.

Fish samples:-

Four fish species were obtained fromWadi El-Rayan Lakes;Nile tilapia (*Oreochromisniloticus*) and mullet (*Mugilcephalus*) from 1st Lake, red belly tilapia (*Tilapia zillii*) and mullet (*Mugilcephalus*) samples from 2nd Lake, during winter 2015. Average of weight and length of investigated fish is shown in Table (1). They were kept in an ice chest and transported to the laboratory of Fish Processing and Technology, Shakshouk Station for Fish Research, National Institute of Oceanography and Fisheries, El-Fayoum Governorate, Egypt.The fish samples were beheaded, gutted, washed gently with tap water, then skinned by hand and filleted.

Table 1:- Length (cm) and weight (g) (mean ± SD) of dominant fish species from Wadi El-Rayan Lakes(1 & 2) during winter, 2015.

Scientific name	English name	Length (cm)	Weight (g)
1st Lake			
Oreochromisniloticus	Nile tilapia	27.5 ±2	452.5±50
Mugilcephalus	mullet	52.5±6	1685±100
2nd Lake			
Tilapia zillii	Red belly tilapia	18.5±0.5	112.5±20
Mugilcephalus	mullet	46.5±5	1485±300

Cooking methods:-

The fish samples from each species were divided into three groups, the first one is uncooked (raw) and the other two groups were cooked in the following methods: grilling and frying. The grilling was performed by rubbed fish samples with bran and grilled using electrical grill machine at 180°C for 15 min. In frying, the samples were breaded with wheat flour and deep oil-fried at 160°C for 10 min using sunflower oil. Raw and cooked fish samples were homogenized for analysis the quality criteria, organochlorine (OC) pesticide residues and heavy metals.

Analytical Methods:-

Total volatile basic nitrogen (TVB-N) was determined in 10 g of minced sample by micro-distillation method (Goulas and Kontominas, 2005) and the results were calculated as mg/100g sample. Thiobarbituric acid (TBA) value was calorimetrically determined (Castellini*et al.,* 2002) and the data were expressed as mg Malonaldehyde/kg sample. Total plate count (TPC); ten grams of sample was taken aseptically from different places and homogenized

with 90 ml of sterile saline solution. Standard plate count agar medium was used (Oxid, 1982). The results were expressed as cfu $\times 10^3$/gm sample. Organochlorine (OC) pesticides residues were determined according to TSQ 8000 GC/MS (Koc and Karakus, 2011). Organochlorine pesticides residues were expressed as (ppm, wet weight). Heavy metals; lead (Pb), cadmium (Cd), manganese (Mn), copper (Cu), and zinc (Zn) were determined as described by Ghazaly (1988) using Atomic Absorption Spectrophotometer (Model Savant AA AAS with GF 5000 Graphite Furnace).Also, the results were expressed as (ppm, wet weight).

Results and Discussion:-

Quality criteria:-

Table (2) shows quality criteria (ww) of raw and cooked fish obtained from Wadi El-Rayan Lakes during winter, 2015. TVB-N content was in range 11.35-12.60 mg/100 g sample in raw fish samples from 1st Lake, while in 2nd Lake, the corresponding value was 12.05-12.75 mg/100 g samples. TBA value was in range 0.48-0.75 mg MAD/kg sample 1st Lake while, it was 0.58-0.80 mg MAD/kg sample in 2nd Lake. In addition, TPC was in range 2.25-2.50×10^3cfu/g of raw fish samples obtained lake 1 and 2.15 ×10^3cfu/g sample in 2nd Lake. A little high TVB-N and TBA values were found of fish samples in 2nd Lake compared with that 1st Lake, while TPC load was low. All these values were lower the maximum permissible limits as set by EOS (2005).

Table 2:- Quality criteria (w w) of raw and cooked fish from Wadi El-Rayan Lakes (1 & 2) during winter, 2015.

Criterion	MPLs	Quality criteria of raw and cooked fish obtained from Wadi El-Rayan Lakes;											
		1st Lake						2nd Lake					
		Nile tilapia			Mullet			Red belly tilapia			Mullet		
		Raw	Grilled	Fried	Raw	Grilled	Fried	Raw	Grilled	Fried	Raw	Grilled	Fried
TVN (mg/100g)	**30**	12.60	10.44	11.30	11.35	9.15	11.00	12.75	11.04	11.65	12.05	11.15	11.50
TBA (mg MAD/kg)	**4.6**	0.75	0.42	0.50	0.48	0.38	0.40	0.80	0.47	0.55	0.58	0.43	0.48
TPC (count ×10^3)	**10^6**	2.50	2.00	1.85	2.25	1.45	1.10	2.15	1.60	1.40	2.15	1.60	1.45

TVB-N: Total volatile basic nitrogen (mg/100gm sample); TBA: Thiobarbituric acid (mg Malonaldehyde/kg sample); TBC: Total bacterial count (cfu ×10^3 / gm sample);MPLs: Maximum permissible limits; EOS, 2005:Egyptian Organization for Standardization and Quality.Egyptian Standard, ES.

Concerning the effect of different cooking methods on quality criteria, cooking methods could be reduced in TVB-N and TBA values of cooked products in particular grilled products compared with fried samples whereas, frying was more effective in reduction of TPC than grilling. The loss of TVB-N due to the heating effect of cooking process may be related to the volatilization of the volatile nitrogen during frying or to its separation with dripping in grilling (El-Sherif*et al.,* 2011). The lower of TBA values during cooking processes may be due to the formation of secondary products of lipid oxidation, which do not reaction with the TBA reagent or to the reaction (MA) with protein (Gokalp*et al.,* 1983). TPC was sharply reduced in all cooked fish samples and influenced by cooking method; the highest reduction rate was observed in fried followed by grilled as compared with raw fish sample. This destruction occurred in TPC may be due to thermal processing during applied cooking methods. These changes in quality criteria are mainly depending on fish species, technological processes and cooking conditions used. All quality criteria of raw and cooked samples were less than the maximum permissible levels (MPLs); 30 mg TVN/100g sample, 4.6 mg MAD/kg and < 10^6cfu/ g as set by **(**EOS, 2005**).** Therefore, all investigated fish species obtained from Wadi El-Rayan Lakes; 1st Lake and 2nd Lake were high quality and safety due to lower TVB-N, TBA and TPC values. These results are in agreement with reported byEl-Akeel (1983) and El-Sherif*et al.* (2011).

Organochlorine (OC) pesticides residues:-

Organochlorine (OC) pesticide residues (ppm, ww) of raw and cooked fish obtained from Wadi El-Rayan Lakes during winter, 2015 are presented in Table (3). Sixteen components of OCP in raw and cooked fish products were determined; only 10 components (4, 4'-DDD, 4, 4'-DDE, endosulfan-I, endosulfan-II, endosulfan-sulfate, endrin, β-HCH, γ-HCH and δ-HCH)were detected and 6 others (4, 4'-DDT, heptachloro, heptachloroepoxid, endrin-aldehyde,

Dieldrin and α-HCH) were not detectable. Ranges of detected components (ppm) were 0.017-0.028 4,4'-DDD, UD-0.032 4,4'-DDE, 0.065-0.126 endosulfan-I, 0.188-0.244 endosulfan-II, 0.003-0.021 endosulfan-sulfate,UD-0.043 endrin, 0.021-0.052 β-HCH, 0.037- 0.067 γ-HCH and 0.014-0.0.043 δ-HCH in raw fish samples obtained from 1st lake.

Table 3:-Organochlorine (OC) Pesticide residues (ppm, ww) of raw and cooked fish from Wadi El-Rayan Lakes (1 & 2) during winter, 2015.

Component	OC pesticide residues level (ppm, ww) of raw and cooked fish obtained from Wadi El-Rayan Lakes;												MPL** (ppm)
	Lake 1						Lake 2						
	Nile tilapia			Mullet			Red belly tilapia			Mullet			
	Raw	Grilled	Fried	Raw	Grilled	Fried	Raw	Grilled	Fried	Raw	Grilled	Fried	
4,4'-DDD	0.017	0.002	UD	0.028	UD	0.003	0.019	0.014	0.010	0.041	0.022	UD	**0.5**
4,4'-DDE	0.032	0.035	0.058	UD	UD	0.083	0.103	0.121	0.167	0.060	UD	0.086	**0.5**
4,4'-DDT	UD*	UD	UD	UD	UD	UD	UD	UD	UD	UD	UD	UD	-
Endosulfan-I	0.126	0.117	0.110	0.065	0.037	0.024	0.164	0.055	0.051	0.127	0.013	0.009	**0.3**
Endosulfan-II	0.244	0.115	0.041	0.188	0.033	UD	0.237	0.211	0.177	0.220	0.103	0.046	**0.3**
Endosulfan-sulfate	0.021	0.022	0.049	0.003	0.055	0.008	UD	0.018	0.009	0.011	0.001	UD	**0.3**
Heptachloro	UD	UD	UD	UD	UD	UD	UD	UD	UD	UD	UD	UD	-
Heptachloroepoxid	UD	UD	UD	UD	UD	UD	UD	UD	UD	UD	UD	UD	-
Endrin	0.043	0.070	0.048	UD	0.060	0.023	0.065	0.143	0.067	0.021	0.026	0.031	**0.3**
Endrin_aldehyde	UD	UD	UD	UD	UD	UD	UD	UD	UD	UD	UD	UD	-
Aldrin	UD	UD	UD	UD	UD	UD	UD	UD	UD	0.040	0.021	UD	-
Dieldrin	UD	UD	UD	UD	UD	UD	UD	UD	UD	UD	UD	UD	-
α-HCH	UD	UD	UD	UD	UD	UD	UD	UD	UD	UD	UD	UD	-
β-HCH	0.052	0.038	0.027	0.021	0.030	0.019	0.054	0.038	0.031	0.045	0.041	0.015	**0.3**
γ-HCH	0.037	0.018	0.034	0.067	0.055	0.032	0.041	0.032	0.013	0.080	0.034	0.012	**0.3**
δ-HCH	0.043	0.026	0.031	0.014	UD	0.012	0.068	0.050	0.038	0.126	0.021	0.055	**0.3**

UD*: undetectable MPLs: Maximum permissible limits.

On the other side, raw fish samples from 2nd Lake contained0.019-0.041, 0.060-0.103, 0.127- 0.164, 0.200-0.237, ud-0.011, 0.021-0.065, 0.045-0.054, 0.041-0.080 and 0.068-0.126, respectively, while aldrin component was detected only in raw and grilled mullet fish samples (2nd Lake). It was noticed that the levels of pesticides detected in the raw fish were low, and did not exceed the maximum permitted levels EPA (2007) and FAO/WHO (2007), the higher levels of most detected components were found in fish samples from second Lake compared to that in first Lake. Similarly, Mansour and Sidky (2003) recorded some pesticide residues in the fish from Wadi El-Rayan Lakes and the second lake was more contaminated by trace metals and pesticides than the first. These traces of OC in fish flesh are due to agricultural and municipal discharges. Our results are in accordance with some those findings by Said and Hamed (2005); Storelli *et al*., (2007); Kalyoncu*et al.,* (2009); Takahashi *et al*., (2010); Yatawara*et al.*, (2010); Ghanna*et al.,* (2014) and lower than those found by Abd-Allah (2013) and Yehouenou*et al.*, (2006) who reported that DDT, its metabolites and isomers were the most frequently identified pesticides in fish flesh. In addition to, Sabir*et al.,* (2016) reported that though residues of certain pesticides were detected in fish, but their

concentrations were much below the tolerance limit and the hazard index was very low. Concerning the effect of cooking methods, they could be reduced of 4,4'-DDD, endosulfan-I, endosulfan-II, endrin , aldrin, β-HCH, γ-HCH and δ-HCH, while levels of 4,4'-DDE while,endosulfan-sulfate components were slightly increased, this is phenomenon may be due to decline in water content. In general, frying process of fish meat was more effective in reduction of some OC components than grilling. OCP in fish are depending on fish species, locations and cooking conditions. Our results are in agreement with Trotter *et al.* (1989) and Zabik*et al.* (1995); Witczak (2009) and Abd-Allah (2013) who showed that reduction level in OCPs residues of processed fish tissues was depending upon the nature and solubility of pesticide itself, fish species, preparation treatments, the method of cooking or processing.

Heavy metals levels:-

Table (4) demonstrates heavy metals levels of raw and cooked fish from Wadi El-Rayan Lakes during winter, 2015. The levels of heavy metals in raw fish samples ranged from 0.196 - 0.415 pb, undetected (UD) - 0.058 Cd, 0.062 - 0.116 Mn, 0.026 - 0.051Cu, 0.086 - 0.221 Zn and (ppm, fresh wet weight) in first lake. The corresponding levels ranged 0.299 - 0.456, 0.048 - 0.066, 0.052 - 0.226, 0.018 - 0.057 and 0.218 - 0.538 ppm, respectively in second lake samples. The concentrations of heavy metals in our study were slight lower than reported by Mohamed and Sabae (2015); who found that metal concentrations in *Tilapia spp.* from the first and second Wadi El-Rayan Lakes were 1.03, UD, 1.46, 3.20 and 36.58 (ppm, dry weight) of pb, Cd, Mn, Cu, and Zn in 1st Lake, while the corresponding levels were 5.6, UD, 7.57, 3.40 and 61.55 ppm, respectively in 2nd Lake. Based on the obtained results, it was found that the levels of heavy metal in fish samples obtained from 2nd Lake were higher concentration than that in 1st Lake according to the increase in salt concentration, this agreed with those reported by Sayed and Abdel-Satar (2009). Also, the levels of Pb, Cd, Mn, Cu and Zn in all investigated fish samples from Wadi El-Rayan Lakes were lower than the maximum permissible levels; 2.0, 1.0, 1.0, 30.0 and 100 ppm, respectively as set by WHO (1989). With regard to the effect of cooking methods, it was found that thermal process led to decrease or increase in investigated metals. Pb concentrations were decreased by both cooking methods; grilling or frynge in all types of fish investigated. The decrease in Pb concentrations in grilled fish samples is higher, when compared with the fried fish. The similar results were reported by (Diaconescu*et al.*, 2012), who found that the Pb concentration in raw four fish species had values between 0.12-0,14 mg/kg dry weight decreased to 0.11 mg/kg in grilled samples and 0.12 mg/kg in fried fish.

Table 4:- Heavy metals levels (ppm, ww) of raw and cooked fish obtained from Wadi El-Rayan Lakes (1 & 2) during winter, 2015.

Item	Heavy metals level (ppm, ww) of raw and cooked fish obtained from Wadi El-Rayan Lakes;												MPL* (ppm)
	Lake 1						Lake 2						
	Nile tilapia			Mullet			Red belly tilapia			Mullet			
	Raw	Grilled	Fried	Raw	Grilled	Fried	Raw	Grilled	Fried	Raw	Grilled	Fried	
Lead (Pb)	0.415	0.373	0.388	0.196	0.145	0.185	0.456	0.395	0.416	0.299	0.281	0.312	**2**
Cadmium (Cd)	0.058	0.034	0.058	UD*	0.021	0.053	0.066	0.053	0.062	0.048	0.022	0.047	**1**
Manganese (Mn)	0.116	0.097	0.118	0.062	0.043	0.095	0.226	0.158	0.291	0.052	0.044	0.098	**1**
Copper (Cu)	0.026	UD*	0.018	0.051	0.016	0.021	0.057	0.017	0.021	0.018	0.003	0.033	**30**
Zinc (Zn)	0.221	0.089	0.263	0.086	0.038	0.116	0.538	0.282	0.587	0.213	0.023	0.346	**100**

UD*: undetectable **MPLs**: Maximum permissible limits.

These findings also supported by Abdelhamid*et al.*, (2016) that Pb in fresh Nile and farm tilapia fish were 0.205 and 0.152 ppm, wet weight, respectively decreased to 0.130 and 0.143 ppm after frying. Cd concentrations were decreased in all types of fish investigated by two cooking methods, grilling and frying. This result is in accordance with the notes of Diaconescu*et al.* (2012). The Mn content of all investigated fish samples were increased by frying method but decreased in grilled fish samples. This result is in accordance with reported by Ersoy and Ozeren (2009), the Mn content of raw African catfish was 0.29 mg/kg increased in fried samples to 0.40 mg/kg and decreased to 0.25 mg/kg in grilled fish samples. The same trend of Mn was found in Zn, The Zn content of fish samples was increased by frying but not for the grilled fish. Similarly,Ersoy and Ozeren (2009) reported that Zn content of raw

African catfish was found to be 3.48 mg/kg increased to 5.99 mg/kg in fried fish while, decreased to 3.43 mg/kg in grilled fish. Changes occurred in heavy metals levels are in according to fish species, season, cooking methods and others as reported by Ersoy*et al.*, (2006); Ganbi, (2010); Abd-Allah (2013) who reported that the reduction in trace metals concentrations as affected by cooking methods may be due to the release of these metals with the loss of drip as free salts, possibly in association with soluble amino acids and un-coagulated proteins bounded with metals, while, the increase in metals may be related to decrease in the moisture content that occur during cooking (Ersoy*et al*,.2006).Therefore, grilling method was found higher appropriate for human consumption than frying for reducing the dangerous effect of heavy metals.

Conclusion:-

Based on these results, it could be summarized that all investigated fish species obtained from Wadi El-Rayan Lakes were high quality and safety due to lower TVB-N, TBA and TPC values. The burden OC pesticide residues and heavy metals were higher in fish samples in 2nd Lake than those one 1st Lake. The effect of cooking methods in reduction of pollutants; Frying caused loss in concentrations of most organochlorine pesticides examined compared with grilling and on contrast, grilling was high in reduction of heavy metals. However, OCP and heavy metals levels were well lower the safety permissible levels. Therefore, it can be concluded that common fish obtained from Wadi El-Rayan Lakes are validating for human consumption.

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