Further Limnological investigations on Lake Edku, Egypt

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Studies of some limnological conditions in Lake Edku, an Egyptian shallow brackish-water lake connected to the Mediterranean Sea, were carried out during 1989 and are compared to published data from the last decades.

Lake Edku, a shallow brackish-water basin connected to the Mediterranean Sea via a narrow channel, has an area of 115 Km^2 and a depth ranging from 0.5-1.5 m. The main water supply comes from three main drains. Their total discharge during 1989, ranging from 43.8-119.7 x 10^6 m^3, was higher than that reported by NASR *et al.* (1963), but lower than that stated by SAAD (1976). Such fluctuations in the drainage water supply affected markedly the hydrography and chemistry of the lake. Field measurements and water sampling were carried out monthly during January-December 1989 at 15 selected stations.

In lake Edku, being shallow, no thermal stratification was observed. The monthly averages, ranging from 11.9°C in January to 28.6°C in August, suggest insignificant variations with previous readings during 1969-70, ranging from 14.5-28.5°C also in January and August, respectively (SAAD, 1976).

Transparency varied widely from 0.2-1.5 m. The values showed pronounced local and seasonal variations, with annual mean of 0.53 m. The minimum regional average value of 0.31 m at the lake-sea connection reflects the increase in turbidity from stirring up of the bottom material by the lake-sea and sea-lake currents, as well as from the entering suspended load in sewage and industrial wastes from the adjacent Abu-Kir Bay. The decrease in monthly average Secchi readings during April to September suggests the increase in turbidity mainly from phytoplankton abundance in spring and summer. However, the increase in turbidity, especially in winter, reflects the effect of prevailing wind in stirring up the bottom sediments (SAAD, 1978).

The pH was always found on the alkaline side, ranging from 7.11-10.27, with an annual mean of 8.42. The pH values found in the same lake by SALAH (1947) varied from 8.0-8.8, by NASR *et al.* (1963) from 7.5-9.0 and by SAAD (1976) from 7.63-9.50. This confirms that the pH of Lake Edku has been changed in the last decades.

The spatial average pH values varied slightly from 7.97-8.96 and the locations directly influenced by drainage water discharge gave the lowest values. SAAD (1976) also reported the same condition. However, the highest pH values were found at locations densely populated by macrophytes. The monthly averages varied slightly from 7.83 in October to 8.87 in May. Photosynthetic activity is among the main factors controlling the seasonal variations of pH (SAAD, 1976).

Dissolved oxygen (DO) varied markedly from 1.14-12.93 $ml.l^{-1}$, with an annual mean of 5.3 $ml.l^{-1}$. The highest DO values were found at locations affected by water mixing and the lowest at areas densely populated by macrophytes and near the drainage water discharge. The highest DO averages in winter coincided with increased aeration by strong wind, low temperature and the decrease in the rate of DO consumption by organic matter decomposition. The low DO averages in spring and summer suggest that the rate of DO consumption exceeded that of its supply from phytoplankton.

Chlorosity varied considerably according to localities and seasons (NASR *et al.*, 1963). The values found by SAAD (1976) varied from 0.44-23.24 $g.l^{-1}$ compared with the present values ranging from 0.47-7.88 $g.l^{-1}$. The spatial averages varied noticeably from 0.71-2.27 $g.l^{-1}$, with an annual mean of 1.20 $g.l^{-1}$ which is markedly lower than that of 2.92 $g.l^{-1}$ found by SAAD (1976). The locations directly affected by drainage water discharge gave the lowest chlorosity averages. Thus, distribution of chlorosity in Lake Edku is mainly controlled by the influx of drainage water and the inrush of sea water (SAAD, 1976). The range of monthly averages, from 0.77-2.0 $g.l^{-1}$ differs markedly from that found by SAAD (1976), ranging from 0.69-10.41.

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Comparative study of metalic ions penetration and bioaccumulation in *Tilapia zilli* Gerv living in fresh and saline water (30‰)

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Laboratory experiments for investigation differential penetration and bioaccumulation of calcium ($Ca^{45}Cl_2$) as macroelement, iron ($Fe^{55}Cl_2$) as microelement, and mercury ($Hg^{203}Cl_2$) as inorganic pollutant in the euryhaline fish *Tilapia zilli* Gerv living in fresh and saline water (30‰) aquaria containing the previous mentioned isotopes for 40 days showed that the permeability of $^{45}Ca^{++}$ is 20% and 8% respectively for fresh and saline water, and its accumulation factors (AF) in the different organs and tissues of the fish are ones or tens except in the skin which is higher. While that of $^{55}Fe^{++}$ is 37.5% and 25% respectively for the permeability, and its accumulation factors (AF) are tens or hundreds. On the other hand, the permeability of $^{203}Hg^{++}$ is nearly complete and its accumulation factors (AF) are hundreds or thousands (Table 1).

It was noticed also that the bioaccumulation of $^{203}Hg^{++}$ is maximum in the kindey which probably means that the chronic toxicity of mercury is mainly due to its destruction of the fish kindey, as mercury reacts with its components rich in Ca, P and S (LEESON and LEESON, 1970). The bioaccumulation of $^{55}Fe^{++}$ is maximum in the liver and intestine which probably causes its chronic toxicity due to alternation in the liver structure which could be noticed in swelling of its cells, its blood vessels are extremely congested and lobular liver structure is largely disappeared (SALEH and HAMZA, 1986). KOHLER and HALZEL (1980) demonstrated that the pollution of aquatic environment with heavy metals causes highly damage in the intestine of the fish as the submucosa is unfiltered occasionally with lymphocytes and small intestine vessels are congested. The architecture of the villi is largely destroyed and the intestinal epithelium has disappeared and bleeding.

The bioaccumulation $^{45}Ca^{++}$ is maximum in the caudal fin "skin" which means that the fish absorbs calcium directly from the surrounding water through its skin to regulate metabolic rate as calcium role in decreasing permeability of the skin to elements and ions is well known (Table 1).

However, the permeability of elements and ions, their accumulation factors (AF), and their bioaccumulations in organs and tissues of *Tilapia zilli* living in fresh water aquaria are higher than those of the fish living in saline water aquaria due to the tendency of the fresh water fish to absorb more elements and ions to avoid hypotonism.

Tab. 1.- Bioaccumulations (B) of $^{45}Ca^{++}$, $^{55}Fe^{++}$ and $^{203}Hg^{++}$ as impulses/minute x gram organ or tissue of *Tilapia zilli* living in fresh or saline water (30 ppt) aquaria. Their accumulation factors (AF) and their contents in the aquarium water, as impulses/minute x ml, are also indicated.

Organs	Fresh water aquaria						Saline water aquaria					
	$^{45}Ca^{++}$		$^{55}Fe^{++}$		$^{203}Hg^{++}$		$^{45}Ca^{++}$		$^{55}Fe^{++}$		$^{203}Hg^{++}$	
	B	AF	B	AF	B	AF	B	AF	B	AF	B	AF
Kidney	3900	11,5	182	18,2	30850	15425	1860	4,6	109	9	15270	6108
Liver	555	1,5	1122	112,2	10910	5455	460	1,1	209	17,4	5540	2216
Intestine	8900	26	5960	596	3270	1635	580	1,6	1850	154	5820	2324
Gills	5890	17,5	51	5,1	1874	935	410	1	41	3,4	1400	500
Caudal fin	6440	191	51	5,1	380	190	3230	8	40	3,3	550	220
Gonads M	1220	3,6	250	25	3010	1505	880	2	200	17	620	248
Gonads F	630	1,9	110	11	560	280	70	0,2	65	5,4	90	36
Fish flesh	765	2,2	5,6	0,58	145	77,5	37	0,12	4,2	0,35	110	44
Water	Start	436		16		72		439		16		72
aquarium	Final	339		10		2		402		12		2,5

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