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OREOCHROMIS NILOTICUS AND OFFSPRINGS OF RED TILAPIA IN EGYPT: GENETIC PROSPECTIVE.

Ezzat Awwad Badawy

National Institute of Oceanography and Fisheries, Genetic Lab; Barrage Research Station; Kalyobia Governorate, Egypt.

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ABSTRACT

Blood sera were collected from four Orechromis strains, NA from lake Nser, NK from the river Nile Knater area, NH1 (the near offspring of self spawned red tilapia) and NH2(the far offspring of self spawning of NH1) both the fish farms around lake Qarun, El-Fayum Government. The electrophoretical analysis of their sera showed that the strain NA has the highest relative genetic purity followed NK and NH1, but NH2 is the lowest one.

INTRODUCTION

In Egypt, tilapia species constitute the major component of fish production either in fresh or brackish water or fish farms and cages (Badawy, 1993 & Hussein, 1995). Tilapia species were mainly produced from the natural fisheris (lakes and River Nile and its branches and drains) as well as some Governmental and private fish farms (which are established beside or inside the lakes) until the first half of 1980s. During that time, each natural water body (lakes and river) had produced their own *Tilapia* species without transporting them from any water body to another except to the fish farms and no Tilapia species were imported from outside the country. Through the 1980s decade large fish farms (Governmental, or private) were constructed with direct or indirect connection with the natural water bodies. Also, cages -for farming- fishes were istalled in many areas especially in the River Nile (Damietta branch) (Badawy, 1984&1993). Trend has caused a considerable shortage in Tilapia seed supplies required for operating the new farms and cages. Therefore, Governmental hatcheries were established to overcome this problem. Some of these hatcheries produce the seeds of *Oreochromis niloticus & O. aureus*, monosex tilapia hybrids (*O. niloticus* X *O. Aureus*) of high male ratio (El-Atreby *et al.*,

1992 & Badawy, 1993). Other hatcheries had import strains of red Tilapia which are originally a mutant strain of *O. mossambicus* that exhibit lower growth rate than *O. niloticus* and *O. Aureus* (Kuo, 1988). Offsprings of red tilapia (which were produced under recurrent self spawning) and the monosex of the local species were transported to the different fish farms and cages without control. They escaped to the neighboring natural water bodies (Lakes: Manzalla, Borullus, Edku, Qarun and Wadi El-Rayan and the River Nile and its branches and drains in the lower Egypt) where by crossbreeding caused genetic contamination with the local *Oreochromis* species which resulted in misidentifications of them (Badawy, 1993 and Badawy & Rizkalla, 1996)

As for Lake Nasser in Aswan Governorate Egypt, it was believed that *Oreochromis niloticus, Sarotherodon galilaeus* and *tilapia zillii* are the only tilapia species present in Lake Nasser (Payne & Collinson, 1983 and many others). But during 1996, when the present writer together with some fellows were in the Research Centre of the Authority of Lake Nasser Development Authority beside Lake Nasser for selecting and spawning a broad stock of O. *niloticus*, seined from the Lake, fishes of *O. aureus* were then collected among the seine that was considered mainly as *O. niloticus*, in addition to *S. galilaeus* and *Tilapia zillii*. This case was so astonishing to the working in that area. So, Lake Nasser is considered as the only place which is not invaded by the hybrid Tilapia and consequently indicating no genetic contamination.

On the other hand, in spite of the discovery of the presence of *O. aureus* in the Lake, their crossing with *O. niloticus* is extremely rare. This is because (in addition to their very low ratio) in the natural conditions in the nature, each species reproduce internally (inbreeding or self spawning) and the crossbreeding occurs only under unnatural conditions (Mires, 1982 & Badawy, 1993). Therefore, *O. niloticus* exhibits the highest relative genetic purity in Egypt. Thus, the aim of this study is to make genetic comparison between *O. niloticus* -from Lake Nasser- and the hybrid generations of red tilapia that is widely expanded in the fish farms in El-Fayum Governorate and escaped to Lake Qarun and Wadi El-Rayan.

MATERIAL AND METHODS

During operating the private fish farms around Lake Qarun, El-Fayum Governorate (1996), two *Oreochromis* strains -similar to *O. niloticus*- were found in the

farms. The 1st strain, which was silvery bright in appearance, was originally brought from a hatchery in Alexandria Governarate (as mentioned by the farms) and later was known to be the nearby offspring of self spawning of red Tilapia. But the 2nd strain was known to be the far offspring of recurrent self spawning of the offspring of red Tilapia in a private hatchery near Lake Qarun.

Sera were collected from the blood of four *Oreochromis* strains: 1)*O. niloticus* (NA) from Lake Nasser (collected during selecting and spawning *O. niloticus* the Japanese hatchery near Lake Nasser, 1996), 2) *O. niloticus* (NK) From the River Nile (at Kanater City region, Kalyobia Governarate), 3&4)1st and 2nd *Oreochromis* hybrid strains (NH1) and (NH2), both from El-Fayum fish farms as previously mentioned. After sera collection, they were iced, sent to the Barrage Research Station and kept under –30°C. The sera were fractionated on disc electrophresis using 7.5 acrylamide (Herzberg and pasteur, 1975). After running, the gels were stained in Amidoblkack 10B for 30-60 minutes, destasined and stored in 7% acetic acid. The gels were scanned using densitometer. The change in genetic characters of each strain was represented by the polymorphism in the serum proteinogram fractions depending on their frequency of appearance (Payne *et al.*, 1971 & Wilkins, 1971. The similarity between the strain pairs of electrophorotic patterns can be calculated (Ferguson, 1980) from the equation:

$$\text{Similarity coefficient} = \frac{\text{No. of bands of common mobility}}{\text{Maximum No. of band in an individual}}$$

High SC between pairs means high genetic similarity and vice versa. The height and area of the peak indicate the fraction's intensity and thickness, respectively.

RESULTS

The results presented in Table (2) show that the electrophoretic serum proteinogram of the *Oreochromis* (NA) -from Lake Nasser- has revealed polymorphism in the fractions number 5, 6 & 9 (frequency of appearance among individuals :86.7, 86.7 & 73.3%). But NK strain, from the River Nile, (Kanater area) showed polymorphism in 5 fractions (No. 3, 4, 6, 8 & 14, their appearance % is 83.3, 83.3, 33.3, 75.0 &58.3 %, respectively). While the polymorphic fractions, numbers 2. 3, 8 & 9 (appearance % : 70.0,

70.0, 80.0 & 80.0%) and those number 2, 3, 6 & 7 (app. %: 70.0, 80.0, 70.0 & 70.0%) were recorded in the electrophorogram of the two strains NH1 and NH2, respectively. While the fractions 13 & 15 disappeared completely from NH2 strain (Tables 1&2).

The genetic similarity between the members of the 4 strains appears from the values of the similarity coefficients (SC) of the mobility of their nonsignificant fractions (Table 3). The NA strain showed SC of 0.67, 0.60 and 0.53 with the strains NK, NH1 & NH2, respectively. While SC of 0.60, 0.40 & 0.53 were between NK and both of NH1 & NH2 and between NH1 & NH2, respectively.

The quantitative statistical analysis between areas under peaks (Fraction's intensity and thickness)for the fractions of different strains in their sera electrophorograms revealed that NA X NH2 (9 fractions), NA X NH1 (8 fractions), NK X Nh1 (8 fractions), NA X NK (6 fractions) and the lowest number was beNK X NH2 (5 fractions).

DISCUSION

Oreochromis niloticus exhibits the highest growth rate among *Tilapia* species (Wohlfarth & Hulata, 1981 and Badawy, 1993). Also, the female *O. niloticus* produces 9 hybrids (of high male percentage, may reach 100% males). The male ratios, in these hybrids, depend on the degree of genetic purity of the parents (Mires, 1982; Badawy 1993 & Badawy & Rizkalla, 1996).

In the present study, the four *Oreochromis* strains, NA, NK, NH1 & NH2 showed polymorphism in 3 fractions (No. 5, 6 & 9) and 4 fractions (No.: 2, 3, 6 & 7), respectively. This polymorphism is of genetic character. Chen and Tsuyuki (1970) declared that transferrin (Beta-globulin represents the major fractions in the serum of tilapia) showed marked produced polymorphism and genetically controlled by different alleles. Wajdani (1970) mentioned that in *Sarotherodon niloticus* and *S. aureus* (now *Oreochromis)* and their hybrids, there are 5 bands (fractions) from number 5 to number 9 that are restricted to transferrin.

The genetic similarities (similarity coefficients, SC)exhibited by NA with NK, NH1 & NH2 were 0.67, 0.60 & 0.53 and significance in the relative area in 6, 8 & 10 fractions, respectively. This indicates that the NA strain from Lake Nasser has the highest relative genetic purity followed by NK strain from the Nile (Kanater area) and the NH1

strain (the near offspring of red tilapia). But the NH2 strain (the far offspring by recurrent self spawning of red tilapia) showed the lowest relative genetic purity.

On comparing the fractions of NKxNH1, NKxNH2 and NH1xNH2 they showed SC of 0.60, 0.40 & 0.53 with significance in 8, 5 & 9 fractions in the relative area. This substantiate that NA strain is the most genetically pure strain followed by NK and NH1 and NH2 strain is the lowest one. These results are in agreement with the present status of *Oreochromis niloticus* in the different Egyptian water bodies as previously mentioned in the chapter of introduction.

On the other hand, it was noticed that the SC between the different strains ranged between 0.40 and 0.67. This indicates that the genetic similarity between the 4 strains is low. This because the NH1 & NH2 strains are generations of the selfspawning of red tilapia which was originally a red strain (caused by mutation in Taiwan) of *Oreochromis mossambicus* whose growth rate is low (Kuo, 1988). Therefore, spreading of the offspring of red tilapia in the majority of the natural water bodies caused crossing with the local *Oreochromis* strains that resulted in introgression of unwanted genetic characters causing genetic contamination. Similar results were recorded by Hulata *et al.* (1981) who found that the growth rate of the hybrid *Sarotherodon niloticus* X *S. hornorum* is faster than that *S. mossambicus and S. hornorum*

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Table (1): Means and standard deviations of relative mobility and relative area percentage for individual serum protein fractions of the studied *Oreochromis* strains

Fraction		Realtive mobility				Realtive area pecentage			
No.	Mean	NA	NK	NH1	NH2	NA	NK	NH1	NH2
1	X̄	100	100	100	100	10.7	11.8	11.4	7.8
	± SD	0.00	0.00	0.00	0.00	5.06	5.54	2.99	2.45
2	X̄	93.0	93.3	94.1	94.0	8.0	4.8	11.9	3.9
	± SD	1.31	1.74	1.05	1.24	2.35	2.35	2.20	1.41
3	X̄	86.9	87.5	90.1	89.6	3.8	3.8	8.6	3.2
	± SD	2.23	2.77	1.52	1.78	2.76	1.33	4.87	1.69
4	X̄	81.7	81.5	86.1	85.0	3.3	2.2	3.1	3.1
	± SD	1.62	1.38	3.45	1.22	1.80	1.04	1.23	1.23
5	X̄	76.4	76.2	81.5	78.4	2.5	3.5	2.4	3.9
	± SD	2.84	1.34	2.76	3.47	1.77	1.08	1.01	1.25
6	X̄	71.4	71.8	74.5	72.5	2.1	2.5	2.6	3.5
	± SD	2.54	0.57	2.30	1.50	0.56	4.61	0.96	1.19
7	X̄	65.9	68.2	62.2	65.9	3.0	6.3	3.4	6.4
	± SD	3.74	1.73	4.23	1.17	1.77	2.60	1.22	4.86
8	X̄	59.2	6.9	60.6	59.4	3.9	5.2	2.7	9.9
	± SD	3.86	2.20	3.39	4.36	2.66	3.60	1.39	9.01
9	X̄	52.9	56.2	55.1	50.8	7.1	8.1	4.0	12.7
	± SD	3.60	1.97	1.78	3.39	3.45	3.11	2.70	8.79
10	X̄	48.3	48.7	50.5	44.9	8.8	9.7	8.4	18.8
	+ SD	2.42	1.75	2.36	2.26	2.08	3.78	4.72	6.69
11	X̄	43.1	41.3	42.2	42.9	9.6	11.6	14.5	17.0
	± SD	1.30	2.13	2.98	3.14	3.06	5.61	4.56	8.73
12	X̄	39.1	38.0	39.4	36.1	10.3	15.0	13.9	13.2
	± SD	1.50	1.50	1.21	1.10	2.29	5.80	2.47	6.30
13	X̄	35.1	33.8	34.9	-	10.3	12.7	14.0	-
	± SD	1.15	1.63	1.14	-	2.80	7.57	5.21	-
14	X̄	30.9	30.9	30.0	30.2	11.8	8.9	5.5	3.0
	± SD	1.20	0.99	1.65	1.10	4.40	3.91	3.30	0.94
15	X̄	25.3	25.4	25.0	-	7.2	3.6	2.9	-
	± SD	2.27	1.29	1.95	-	4.21	2.45	0.80	-

Table(2):Comparative identification map, showing the frequency of appearance of individual sreum proteinogram fraction for the different four Oreochromis strains(NA, NK, NH1 & NH2)

Fish group	No. Of samples	Number of fractions														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
NA	15	a	a	a	a	p(86.7)	p(86.7)	a	a	p(73.3)	a	c	a	a	a	a
NK	12	a	c	p(83.3)	p(83.3)	a	p(33.3)	a	p(75.0)	c	a	a	a	a	p(58.3)	a
NH1	10	a	p(70.0)	p(70.0)	c	a	c	a	p(80.0)	p(80.0)	a	a	c	a	a	a
NH2	10	a	p(70.0)	p(80.0)	a	a	p(70.0)	p(70.0)	c	a	a	a	a	d	c	d

a: Fractions appeared in all gr c: Fractions appeared in 90-99.9% of group individuals
p: polymorphic appeared in le d: Fractions disappeared completely from all group individuals

Table (3): Significant fractions in the mobility and relative area percentage in the serum proteinogram between the four *Oreochromis* strains

Oreochromis strains	Mobility		SC	Relative aera %	
	Significant fractions			Significant fractions	
	No.	Fraction No.		No.	Fraction No.
NA X NK	5	7,9,11,12,13	0.67	6	2,4,6,7,12,15
NA X NH1	6	2,3,4,5,6, 10	0.60	8	2,4,9,11,12,13,14,15
NA X NH2	5	2,3,4, 10, 12	0.53	10	1,2,5,6,7,8,9,10,11,14
NK X NH1	6	2,3,4,5,6, 10	0.60	8	2,3,5,7,8,9,11,14
NK X NH2	7	3,4,5,7,9, 10,12	0.40	5	1,4,10,11,14
NH1 X NH2	5	5,6,9, 10, 12	0.53	9	1,2,3,5,7,8,9,10,14

SC: Similarity coefficient of fraction mobility

البلطى النيلى ونتاج البلطى الأحمر فى مصر : منظور وراثى

عزت عواد بدوى

المعهد القومى لعلوم البحار والمصايد-معمل الوراثة-محطة القناطر الخيرية

تم جمع عينات من مصل الدم من أربع سلالات من البلطى النيلى من ١-بحيرة ناصر, ٢-نهر النيل (عند مدينة القناطر الخيرية) ٣-سلالة قريبة نابجة من التلقيح الذاتى للبلطى الأحمر ٤-سلالة نابجة من التلقيح الذاتى المتكرر للسلالة الثالثة. السلالتان الثالثة والرابعة جمعتا من المزارع السمكية الأهلية حول بحيرة قارون - قرية شكشوك- محافظة الفيوم.

تم تحليل بروتين مصل الدم لهذه السلالات عن طريق الحمل الكهربى. وثبت من هذه الدراسة أن سلالة البلطى النيلى من بحيرة ناصر هى أنقى الأنواع ووراثيا تليها سلالة نهر النيل ثم السلالة الثالثة والرابعة (نتاج البلطى الأحمر) .

وخلصت هذه الدراسة إلى أنه يجب الحفاظ على بحيرة ناصر كمحمية طبيعية وألا ينقل إليها أو حولها أى من أنواع البلطى من أى مكان آخر.