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# EFFECT OF WATER SOURCES ON SOME MICROELEMENTS IN FISH FARM

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*Abstract*

The effect of two sources of water, fresh water and drainage water on some microelements (Fe, Mn, Cu, B, Mo, Pb, and Zn) in fish farm was studied. Six earthen pods (0.36 ha each) were stocked with Nile tilapia, mullet and commone carp. Each treatment was replicated in three ponds. Ponds were subjected to chemical fertilization (urea-superphosphate) plus artificial feeding. Results showed that drainage water was significantly higher than fresh water in Fe, Mn, B and Zn concentrations, while, concentrations of Cu, Mo and Pb were not significantly different between the two water sources (P>0.05). No significant effect on all microelements in the surface layer was noticed except a significant increase in Cu and B with fresh water treatment. Drainage water treatment increased significantly Pb. In the subsurface layer, only B increased significantly with fresh water. Drainage water did not show significant effect on all microelements. Phytoplankton abundance was better with drainage water. Ponds supplied with this source of water had higher net fish yield (1570.7 kg/0.36 ha) than ponds supplied with fresh water (1305.1 kg/0.36 ha). Net fish production of all polyculture species was significantly different among treatments except for common carp.

## INTRODUCTION

Because of shortage of better quality water due to current competition between agriculture and aquaculture, it has been necessary to find another available supply for water instead of using Nile water which has been forbidden to be used by fish culture by Law. Drainage water is one of the wealthiest waste water that could be treated and re-used to serve in aquaculture development (Amer and Venderzel 1983).

The present study was carried out to study the effect of water sources (fresh and drainage waters) on some microelements dynamics in pond waters and soil chemistry and on fish production.

## MATERIALS AND METHODS

The present study was conducted to determine the influence of two water sources, fresh water and drainage water, on the dynamics of some microelements (Fe, Mn, B, Mo, Pb, and Zn) in pond water, soil surface layer (0-20 cm) and subsurface layer (20-40 cm). The effect of water source was also studied on phytoplankton abundance and fish production.

Six earthen ponds (0.36 ha each) with average depth 0.9m were used. Each treatment was replicated in three ponds. Ponds are located on the experimental unit at the Central Laboratory for Aquaculture Research (CLAR) - Abbassa, Sharkia Governorate.

In the first treatment (fresh water source), ponds were supplied with fresh water from El-Gadoon canal branched from Ismaelia canal (salinity0.16g/1). In the second treatment (drainage water source), ponds were supplied with drainage water from El-Wady drain (salinity 0.38 g/1).

Ponds were stocked with Nile tilapia (*Oreochromis niloticus*), Mullet (*Mugil cephalus*) and Common carp (*Cyprinus carpio*), with average weight 11.4, 12.5 and 24.5g, respectively. The respective stocking rate was 8000, 800 and 350 fish/ha.

Ponds were subjected to chemical fertilization biweekly with superphosphate (15.5% $P_2O_5$) at the rate of 90 kg/ha and urea (46% N) 45 kg/ha. Supplementary feed (11% protein) was used at rate of 3% of the fish body weight. The feeding load was adjusted according to fish growth and biomass.

Every ten days, water samples were collected from all ponds with water sampler during the cultivation period from 15 April to 5th October 1989.

Water was analyzed monthly for Ph, ammonium, Ca, Mg, total phosphorus, CO3, HCO3, total hardness and salinity. Microelements (Fe, Mn, Cu, B,. Mo, Pb and Zn) were measured every twenty days (APHA 1985).

Soil samples were collected before filling and after draining the ponds at two depths higher layer from 0 to 20 cm and lower layer from 20 to 40 cm (Jackson

1973). The same microelements were determined using Atomic Absorption according to Lindsay and Norvell (1978).

Phytoplankton abundance and chlorophyll-a were analyzed according to Boyd, 1985.

Ponds were harvested in the period form 23 to 25 October 1989. Results were analyzed using ANOVA and Duncan's test according to SAS, 1987.

## RESULTS AND DISCUSSION

Average concentrations of microelements in pond water treated with the two sources are shown in Table 1. Data showed that there was no significant different in average concentration of Cu, Mo and Pb in pond water between fresh and drainage water. However, the average concentration of Fe, Mn and Zn were significantly higher ($P<0.05$) in the drainage water than in fresh water, the average of B concetration was highly significant ($P<0.01$) in drainage water.

Table 1. Average concentration of microlements in pond water (mg/l).

| pond water | Fe | Mn | Cu | B | Mo | Pb | Zn |
|---|---|---|---|---|---|---|---|
| Fresh water | 0.52 b | 0.004 b | 0.026 b | 0.006 b | 0.002 a | 0.002 a | 0.013 b |
| Drain water | 1.08 a | 0.049 a | 0.024 a | 0.569 a | 0.004 a | 0.003 a | 0.025 a |

Mean with the same letter in column are not significant different ($P>0.05$).

The comparison between the average concentration of microelements in surface and subsurface layer of pond soil after supply with fresh water and drainage water is presented in Table 2 which shows that, in the surface layer, Fe, Mn, Mo and Zinc concentrations were not significantly different before and after fresh treatment. The concentration of Cu and B increased significantly in the surface layer after fresh water treatment, whereas, concentration of Pb was significantly higher by drainage water treatment.

In the subsurface layer of pond soil (20-40 cm), after supplying with fresh water, Fe, Mn, Cu, Mo, Pb, B and Zinc concentrations did not increase significantly. Boron concentration increased significantly .

Regarding the concentration of Fe, Mn, B, Mo, Pb, and Zn in drainage water, Prandt (1964) reported that 0.9 mg/l Fe was the safe level for fish, and 1 mg/l Fe was considered safe to aquatic life (Fisheries Advisory Commission 1979). The safe levels of copper 0.025 mg/l, lead 0.1 mg/l, zinc 0.1 mg/l were recommended by the United States Environmental Protection Agency (1971). Chen *et al.* (1985) summarized concentration of microelements considered safe to aquatic life by the Environmental Agency of the Japanese Government as follows : iron 0.3 mg/l, Zinc 0.1mg/l boron 0.4 mg/l, lead, 0.1 mg/l, copper 0.025 mg/l, Manganese 0.1 mg/l and Zinc 0.01 mg/l. Besonof *et al.* (1987) reported that encentration of iron 0.02 mg/l, Zinc 0.01 mg/l and Boron, 0.3 mg/l was the optimal for warm water fish.

Fish in the present study were not affected by concentrations of microelements, however, Fe exceeded the safe levels. This concentration (0.52 - 1.08 mg Fe/1) is encountered for the higher alkalinity of water. Other elements Mn, Zn, Cu, B, Mo and Pb were not higher than the safe limits for fish.

Table 2. Average concentrations of microlements in pond soil (mg/100 g soil) in each layer supplied with the two water treatments.

| Before treatment | Fe | Mn | Cu | B | Mo | Pb | Zn |
|---|---|---|---|---|---|---|---|
| 0-20 cm F | 56.00a | 3.73a | 10.96a | 18.66a | 1.16a | 26.30a | 6.93a |
| 0-20 cm D | 54.60a | 3.830a | 12.10a | 20.90a | 1.20a | 22.20a | 6.33a |
| 20-40 cm F | 62.30a | 3.86a | 11.13a | 20.00 | 0.86a | 20.06a | 6.73a |
| 20-40 cm D | 60.00a | 3.83a | 12.33a | 23.40a | 0.70a | 17.60a | 6.83a |
| After treatment | | | | | | | |
| 0-20 cm F | 56.83 a | 3.85a | 11.73b | 19.01 b | 1.22a | 26.38a | 7.10a |
| 0-20 cm D | 55.91 a | 3.96a | 13.78a | 22.92 a | 1.41a | 22.31b | 6.48a |
| 20-40 cm F | 62.51 a | 3.96a | 11.79a | 20.22b | 0.96a | 20.10a | 6.86a |
| 20-40 cm D | 61.33 a | 3.99a | 13.96a | 25.80 a | 0.80a | 17.80a | 7.00 |

Means with the same letter - in column - are not significantly different (P>0.05).
F = Fresh water
D = Drainage water

Table 3 shows that, phytoplankton is more abundant in the drainage water treatment 6790 organisms/ml represented by 49% chlorophyta, 30.7% pacilariophyta and 19.6% cyanophyta. In the fresh water treatment, phytoplankton density was 4730 organism/ml respresented by 42.5% chlorophyta, 32.3% pacilariophyta and 25 cyanophyta. Chlorophyll-a concentration in pond water was 110.44 and 190.53 μ/l in fresh water and drainage water treatment, respectively.

Phytoplankton abundance and chlorophyll-a concentration were significantly higher in the drainage water than in the fresh water (P<0.05).

Table 1. Average concentration of microlements in pond water (mg/l).

| treatment | chlor. | paci. | cyan. | total number | chlorophyll-a |
|---|---|---|---|---|---|
| Fresh water | (1406-2615) | (1322-1734) | (759-1607) | (4032-5427) | (129.1-91.78) |
| mean | 2011 b | 1528 b | 1183 b | 4730 b | 110.44 b |
| drainage water | (3153-3501) | (1973-2197) | (1260-403) | (6610-6970) | (147.8-173.2) |
| mean | 3327a | 2085 a | 1331 a | 6790 a | 160.5 a |

chlor = chlorophyta paci = pacilariophyta cyan = cyanophyta
Mean with the same letter in column are not significant different (P>0.05).

Higher concentration of iron, manganese, boron and zinc in the drainage water may be suitable for phytoplankton abundance (El-Ayouty and Awad 1976 and Salah 1986).

Average net fish production is presented in table 4. Results showed that, the total fish production in ponds supplied with drainage water (1570.7 kg/0.36 ha) was significantly higher than production of ponds supplied with fresh water where the production was (305.1 kg/ 0.36 ha) in drainage water treatment. Therefore, fish production increased by 265kg about 20% above that of the fresh water treatment. Tilapia, mullet and silver carp production increased significantly in drainage water treatment, whereas, common carp production did not increase significantly. Common carp consumed primarily artificial feed more than phytoplankton in both fresh and drainage water treatment. Manandhar (1977) reported no effect on common carp growth rates as a result of increased phytoplankton abundance in ponds. Shaker (1992) reported that concentration of Fe 0.98 mg/l, Mn 0.05 mg/l, B 0.53 mg/l, Pb 0.004 mg/l and $Z_{n0.029}$ mg/l in a mixture of Nile plus drainage water gave high phytoplankton abundance and chlorophyll-a concentration, fish production increased 18.9% above that of the Nile water. We concluded that drainage water could be used in aquaculture if the microelements concentrations in the region are similar to those shown in this study.

Table 4. Average fish production (kg/0.36 ha).

| treatment | Tilapia | Mullet | silver carp | common carp | total production |
|---|---|---|---|---|---|
| Fresh water | 660.1 b | 102.5 b | 321.7 b | 220.9 a | 1305.1 b |
| Drain water | 804.4 a | 135.7 a | 428.1 a | 202.6 a | 1570.7 a |

Mean with the same letter in column are not significantly different (P>0.05).

## REFERENCES

1. Amer, M. and H.J. Venderzel. 1983. The Egyptian-Dutch advisory panel on land drainage : its activities and impact. Annual report of Inst. Land Reclamation and Improvement. Ministry of Irrigation, Water Res. Cent.

2. APHA. 1985. American Public Health Association, Standard method for examination of water and waste water. Ed. American Public Health Association. Washington.

3. Besonof, N.M. and U.M. Prezentsef. 1987. Water chemistry for aquaculture. Pub. Agri. Moscow-159 pp .

4. Boyd, C.E. 1985. Water quality in warm water fish ponds 3rd. ed. Pub. Auburn Univ. Agri. Exp. Sta. AID/Dsan-G.G. 0049. pp. 259 .

5. Chen, J.C., Y.Y. Ting H. Lin and T.C. Lian. 1985. Heavy metal concentrations in sea water from Grass prawn hatcheries and the coast of Taiwan. J. World Maricul. Soc., 16: 316-332 .

6. El-Ayouty, E. and E. Awad. 1976. Some studies on the Nile ecosystem, Phytoplankton distribution along the river Nile. Inst. Oceanog. Fish lake Nasser and River Nile project, prog. rep. 14-28 pp .

7. Fisheries Advisory Commission. 1979. The control of pollution from hydrographic modifications. EPA 430/9 - 73-017, US Government printing office, Washington, D.C.

8. Jackson, M.L. 1973. Soil chemical analysis. Prentice-Hall, englowood Cliffs, New Jersey.

9. Lindsay, W.L. and W.A. Norvell. 1978. Development of DTPA soil test for zinc, iron, manganese and copper. Soil Sci. Soc. Amer. J., 42: 421-428.

10. Manandhar, H.N. 1977. Digestibility by common carp and three tilapia in polyculture with channel catfish. Thesis, M.Sc., Auburn Univ., Ala., 49 pp.

11. Prandt, H.H. 1964. Intensified injurious effects on effects on fish, especially increased toxic effect produced by a combination of sewage poisons berit, wass. Abwass. fisheri. chemi., 15.

12. Salah, H. M. 1986. Studies on fish production in Serow station. Thesis, M. Sc., Agri. Sci. Agri. Fac. Zagazig Univ.

13. SAS Institute. 1987. SAS/STAT User's Guide Release 6.03 ed., SAS Institute Inc., Cary MC, USA.

14. Shaker, I. M. 1992. Water quality in aquaculture. Thesis, M.Sc., Agri. Fac. Zagazig Univ.

15. United States Environmental Protection Agency. 1971. Algae and water pollution. office of Research and Development, Environmental Research Information Center, Cincinnati, Ohio.

# تأثير مصادر المياه على بعض العناصر الصغرى بالمزارع السمكيه

زينب عطيه نجدى ، ابراهيم شاكر عبد الفتاح

المعمل المركزى لبحوث الأسماك - العباسة - مركز البحوث الزراعية - الجيزة - مصر .

أجريت هذه الدراسة فى الأحواض التجريبية بالمعمل المركزى لبحوث الاسماك - بالعباسة - محافظة الشرقية، خلال الفتره من أبريل الى أكتوبر ١٩٨٩ . تم استخدام مصدرين من مصادر المياه. الأول : ماء عذب (ماء ترعة الاسماعيلية)، الثانى : ماء مصرف (ماء مصرف الوادى). وذلك لدراسة أثر استخدام هذه المصادر على ديناميكية بعض العناصر الصغرى (الحديد ، المنجنيز ، النحاس، البورون ، المولبيدنيم ، الرصاص الزنك) فى الماء والتربة والانتاجية السمكية. استخدم عدد ٦ أحواض ترابية مساحة كل حوض ٠,٣٦ هكتار ومتوسط عمق ٠,٩ متر (٣ تكرار لكل معاملة). استزرعت أسماك البلطى ، المبروك العادى ، والبورى بمتوسط وزن ١١,٤ ، ٢٤,٥ ، ١٢,٥ جم وذلك بمعدل تخزين ٨٠٠٠ ، ٣٥٠ ، ٨٠٠ سمكة/هكتار على التوالى .

كان معدل التسميد ثابت لكل الأحواض كالتالى : ٩٠ كجم سوبر فوسفات (١٥,٥٪ خامس اكسيد الفوسفور)، ٤٥ كجم يوريا (٤٦٪ نيتروجين) / هكتار / اسبوعين. كانت التغذية الصناعية بمعدل ٣٪ من وزن الأسماك باستخدام عليقة ١١٪ بروتين لمدة ٦ أيام / اسبوع.

أشارت النتائج الى أن ماء المصرف كانت أعلى معنويا من الماء العذب فى تركيز الحديد ، المنجنيز، البورون والزنك ، بينما لم تختلف تركيزات النحاس، المولبيدنيم والرصاص معنويا. وكانت نتيجة المعاملة بالماء العذب عدم وجود تأثير معنوى على تركيز معظم العناصر الصغرى فيما عدا زيادة معنوية فى النحاس والبورون فى الطبقة السطحية للتربة، بينما فى الطبقة تحت السطحية ازداد البورون معنوياً بالمعاملة بالماء العذب بينما لم تؤثر مياه المصرف معنوياً على العناصر الصغرى فى هذه الطبقة.

وقد أدت المعاملة بماء الصرف الى زيادة الفيتوبلانكتون بالمقارنة بالماء العذب مما أدى الى ارتفاع الانتاجية السمكية الى ١٥٧٠,٧ كجم مقابل ١٣٠٥,١ كجم / ٠,٣٦ هكتار.