ИЗВЕСТИЯ

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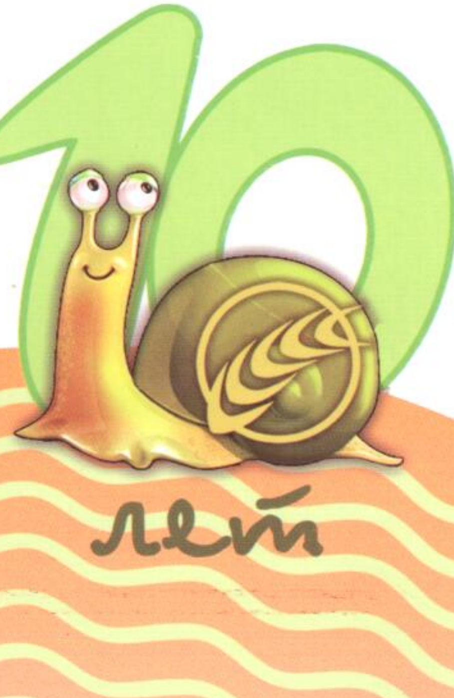

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Հայաստանի ազգային ագրարային համալսարանի **ՏԵՂԵԿԱԳԻՐ**

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ASSESSMENT OF THE RISK OF HEAVY METAL POLLUTION IN THE CHAIN OF FISHPOND WATER – FISH FEED - FISH IN THE FISHPONDS OF ARARAT VALLEY

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Keywords: fish, fish feed, risk assessment, heavy metals

Introduction. In recent years ground water based artificial pond fish farming has been actively developed in Ararat Valley. It is noteworthy that since 2010 the Government of the Republic of Armenia has been carrying out fish farming development policy aimed to the export of fish and fish products to the EU countries. According to the Decision of the Prime Minister of the Republic of Armenia an ecological monitoring program detecting heavy metals, radionuclides and pesticides pollution on fish and fish products for the entire country has been implemented (Decision 835-N).

The surveillances have indicated that the soils of Ararat Valley area are polluted with heavy metals of the 1st (As, Cd, Pb) and 2nd (Ni) classes of hazard (Revazyan 1993, Revazyan *et al.*, 1997). Taking into consideration the heavy metal contamination of the territory the activity taken was aimed to make a risk assessment of the exporting fish contamination. In light of this the surveillances were made for fish intended for human consumption, feed and water.

Heavy metals may occur in water as an outcome of the soil erosion or human activities conducted: municipal, industrial and agricultural waste water and etc. (Abdel-Moati and El-Sammak, 1997; Macfarlane and Burchett, 2000; Mansour and Sidky, 2002). Heavy metals are known for adverse impact on both environment and live organisms (Macfarlane and Burchett, 2000).

Material and Methods. The superficial water of Ararat Valley, sediment, artesian water, and water of several fish farms, fish and fish feed serve as research materials.

It is known that Ararat Artesian Basin is characterized by its own complex geological structure. The quality ground water resources are located in the north-western part, and in the south-east we have underground water with exceeding 1 g/l total mineralization, which is used for irrigation and economic purposes. In 1984 the State Commission set down the number of 90.27 m^3/s where up to 1.0 g/l mineralization presents fresh water and 64.28 m^3/s falls for ground water. Water taken out of 80-180 meters deep is used for fish breeding.

The mineralization in the territory of Masis is up to 2 g/l, magnesium and sulphate – up to 40% eq., and the water in the regions of Artashar – Sev Jur and Apaga – Sev Jur are sodium chloride and of 20-25°C temperature (ATLAS, 1990). During preliminary field study the geographic coordinates of the sample taking points were taken by GPS Etrex navigator (Garmin Inc., USA). The sample taking points of surface water, sediments and ground water are illustrated in the map (Figure). Sample taking, conservation, transportation, store by Standard Operational Procedures (SOPs) were developed according to the International Standardization Organization (ISO) methods (ISO standards).

The in-situ field measurements including pond temperature, hydrogen index (pH), conductivity, turbidity, dissolved oxygen and salinity have been carried out by portable analyzer U-10 (Horiba).

Heavy metal content in fish filets depends on several factors, such as season, biological peculiarities (type, size, age, sex, maturity, diet, metabolism), environmental factors (water chemical composition, salinity, temperature, pollution levels) (Kagi, 1998).

One should emphasize that heavy metals penetrate in fish meat through water and feed; thus under the effect of high pollution levels fish as a food product may pose potential risk to consumer health (Ibrahim and El-Naggar, 2006; Jobling, 1995). Some metals, such as Zn, Cu which are microelements and have important biochemical role for living organisms, whereas Pb, Cd

and As even in small quantities are toxic (Fernandes *et al.*, 2008). That is why the research is conducted on As, Cd, Hg, Pb, Zn, Cu. In fishpond water samples we have determined concentrations of As, Cd and Hg heavy metals; and fish samples and fish feed were analyzed for As, Cd, Hg, Pb, Zn, Cu. The samples were analyzed in the Central Analytical Laboratory of the Center for Ecological-Noosphere Studies. Cu, Hg, Cd, Pb, and As were analyzed through the atomic-absorption method on AAS Analyst 800 (Perkin Elmer, USA). Analyses of the concentrations have been conducted following the developed ISO-based SOPs. Concentrations of the studied HMs in different substances are shown in Table 1.

Water pollution with heavy metals depends on their high content in industrial and agricultural wastewater (Monterio and Lopes, 1990).

Figure 1. Map of the Sampling Points of Surface Waters, Sediments and Underground Waters of Ararat Valley

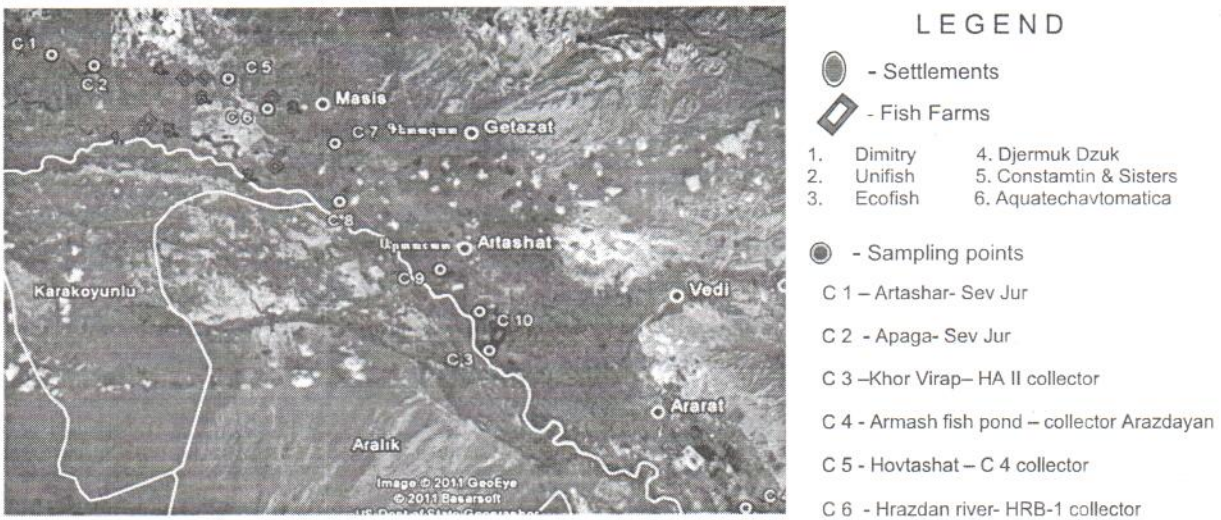

Table 1. The Contents of Heavy Metals in Surface Water, Sediments, Underground Water in Ararat Valley

	MAC Data	Surface water, *mkg/l*				
		As	Pb	Cd	Zn	Cu
		50	30	1	300	1000
1	2	3	4	5	6	7
C 1	17.05.2010	1.62	0.3	0.02	25	10
C 2	15.07.2010	2.12	0.34	0.02	29.05	15
C 3	09.09.2010	0.89	0.3	0.02	32.32	9.82
C 4	26.05.2010	2.16	0.3	0.02	10.2	9.99
C 5	19.03.2010	10.95	0.3	0.02	162	9.0
C 6	19.03.2010	11.89	0.3	0.02	13.5	10.01
C 7	19.03.2010	13.36	0.3	0.02	30.01	11.04
C 8	19.03.2010	15.33	0.3	0.02	22.51	18.01
C 9	19.03.2010	**81.17**	0.3	0.02	37.5	15.5
C10	19.03.2010	**90.90**	0.3	0.02	25.51	15.0

1	2	3	4	5	6	7
		Sediments, *mg/kg*				
		2.0	*6.0*		*23*	*3.0*
C 1	21.06.2010	**4.97**	0.3	-	**109.8**	**39.51**
C 1	09.09.2010				**325**	**39.66**
C 4	26.05.2010	**2.35**	0.3	-	**112.5**	**51.25**
C 5	25.05.2010	**2.19**	0.3	0.02	**272.7**	**30.0**
C 9	22.02.2011	0.18	1.41	0.1	**65.20**	**37.14**
C10	16.03.2010	**143.9**	**7.74**	0.04	**105.0**	**60.0**
		Underground water, *mkg/l*				
		50	*1*	*300*	*1000*	
C 1	09.09.2010	0.79	< MDL	2.00	2.66	
C 4	09.03.2011	0.81	< MDL	2.3	3.06	
1	09.03.2011	n/f	< MDL	-	-	
2	10.03.2011	n/f	< MDL	-	-	
4	10.03.2011	n/f	< MDL	-	-	
5	24.03.2011	n/f	< MDL	-	-	

Note: MAC according to (ISO standards), «–» there are no data, «n/f» is not detected, < MDL- less of Method Detected Limit.

Marginal Permitted Concentrations for sanitary-life water using and Monitoring Residue Level have been used for data assesment.

Results and Discussion. According to the research results the temperature of fishpond water varies from 12.8 to 15.5°C, pH from 6.8 to 8.2, turbidity – 2-7 NTU, dissolved oxygen – 10.7-12.6 mg/l, conductivity – 0.356-1,01μS/cm. At the "Djermuk dzuk" fish farm water salinity was registered 0.03%, that of for the other farms is 0.01-0.02%. No HMs under study have been determined in underground water (Table 1). The fishpond water is estimated to be good for fisheries. In the ground water the contents of HMs are significantly low from the maximum allowable contents (C1, C4) (Table 1).

Even if there is no enough information about underground water quality, we can suppose that, in general, the quality options of the underground water sources are very high.

In collector sediments of the water drainage system of Ararat Valley we detected that the contents of Zn, As, Pb, and Cu exceed the maximum allowable contents 4.7-14.13, 1.1-72, 1.3, and 10-20 times respectively. In surface water samples we determined that As exceeds the maximum allowable contents in 1.6-1.8 times (Table 1).

The soils are contaminated with heavy metals according to several researches in Ararat Valley, but our research showed that there are no significant contents of heavy metals in artificial pond water.

Table 2. Heavy Metal Concentrations in Fishpond Water in 2011

Element/Index	Quantity of samples	Results, mg/L
Cadmium / Cd	10	0.0167±0.0026
Mercury / Hg	10	n/d
Arsenic / As	10	n/d
Lead / Pb	10	n/d

Note: n/d* - not detected.

The studied water samples contain only Cd, which do not exceed MRL (Table 2).

Table 3. Heavy Metal Contents in Fish Feed and Fish Filets in 2011

Element / Index	Quantity of samples	Results, mg/L	
		Fish feed	Fish filets
Zinc / Zn	10	98.6367±4.7876	18.7500±2.2619
Copper / Cu	10	5.5083±0.1140	2.4817±0.2597
Cadmium / Cd	10	0.0507±0.0265	0.0011±0.0006
Lead / Pb	10	0.0193±0.0022	0.0610±0.0117
Arsenic / As	10	0.0002±0.0001	0.0002±0.0001
Mercury / Hg	10	n/d	n/d

Heavy metals have been found in fish feed and fish filets, which do not exceed the MRL (Table 3).

Conclusion. Taking into account the above mentioned we can conclude that:

- Heavy metals were found in sediments and in surface water of Ararat Valley.
- The heavy metal contents in the studied samples of the artificial pond water were not significant; because the latter are concrete and an irrigation system with underground origin water operates.
- Heavy metal concentrations were high in fish filets from the Ararat Valley fishponds but they met the established international safety standards for fish and fish products (Commission Regulation).
- Arsenic concentrations in all fish samples were similar to those respective fish feed samples, whereas insignificant concentrations of Cd and Pb in fish samples was found out in fish feed. High contents of Zn and Cu in fish and fish feed samples were explained by the fact of their being microelements.
- The fish raised in the Ararat Valley fishponds is safe as food and thus poses no risk to the consumer health.

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ОЦЕНКА РИСКА ЗАГРЯЗНЕНИЯ ТЯЖЕЛЫМИ МЕТАЛЛАМИ В ЦЕПИ ПРУДОВАЯ ВОДА – РЫБА И КОРМ – РЫБА В НЕКОТОРЫХ ПРУДОВЫХ ХОЗЯЙСТВАХ АРАРАТСКОЙ РАВНИНЫ

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Целью исследования было выявление и оценка риска загрязнения тяжелыми металлами, а также определение их концентраций в цепи прудовая вода – рыба и корм – рыба в некоторых прудовых хозяйствах Араратской равнины. Были проведены полевые и лабораторные исследования, выполненные по стандартам ISO и в соответствии с техническим регламентом и нормами безопасности.

Полученные результаты позволили заключить, что выращенная в некоторых искусственных прудовых хозяйствах Араратской равнины рыба как продукт питания безопасна и может употребляться без риска для здоровья населения.

ՃԱՆՐ ՄԵՏԱՂՆԵՐՈՎ ԱՂՏՈՏՎԱԾՈՒԹՅԱՆ ՌԻՍԿԻ ԳՆԱՀԱՏՈՒՄԸ ԼՃԱԿԱՅԻՆ ՋՈՒՐ-ՁՈՒԿ ԵՎ ԿԵՐ-ՁՈՒԿ ՇՂԹԱՅՈՒՄ ԱՐԱՐԱՏՅԱՆ ՀԱՐԹԱՎԱՅՐԻ ԱՐՀԵՍՏԱԿԱՆ ԼՃԱԿԱՅԻՆ ՈՐՈՇ ՏՆՏԵՍՈՒԹՅՈՒՆՆԵՐՈՒՄ

Դ.Ա. Պիպոյան, Լ.Պ. Գրիգորյան, Հ.Գ. Խաչոյան, Գ.Դ. Բաղդասարյան
ՀՀ ԳԱԱ էկոլոգանոոսֆերային հետազոտությունների կենտրոն

Հետազոտության նպատակն է եղել ծանր մետաղներով աղտոտվածության ռիսկի հայտնաբերումը և գնահատումը, նաև դրանց պարունակության որոշումն Արարատյան հարթավայրի արհեստական լճակային որոշ տնտեսությունների ջուր-ձուկ և կեր-ձուկ շղթայում: Կատարվել են դաշտային և լաբորատոր հետազոտություններ ISO ստանդարտներով, համապատասխան տեխնիկական կանոնակարգով և անվտանգության նորմերով:

Ստացված տվյալները թույլ են տալիս եզրակացնել, որ Արարատյան հարթավայրի արհեստական լճակային տնտեսություններում աճեցված ձուկը՝ որպես մթերք, անվտանգ է և չի սպառնում բնակչության առողջությանը: