PHYSIOLOGICAL OVERVIEW OF RAINBOW TROUT GROWN IN RECLAIMED MINE-WATER[1]

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Abstract. Rainbow trout (*Oncorhynchus mykiss*) aquaculture in Northern Appalachia is a small-scale industry that produces variable quality and quantity food-fish among farms. Further development and expansion of aquaculture in the region has been prompted by increased global demands for food, abundant local water supplies, and struggling rural economies that have some of the highest unemployment rates in the United States. The following study was conducted as part of the West Virginia University Aquaculture Food and Marketing Development Project. As part of the development project, the objectives of the present study sought to investigate the feasibility of using reclaimed mine-water for aquaculture purposes. Specific questions related to the study included: 1. Are the fish grown in reclaimed mine-water healthy (as measured by various physiological parameters)? 2. Are the fish safe for human consumption? 3. Is culture performance in reclaimed mine-water dependent on the rainbow trout strain used? Selected aspects of the second, third and fourth questions of the study will be presented in this abstract.

Three strains of juvenile rainbow trout were grown in a flow-through raceway supplied with reclaimed mine-water (treatment fish) from October 2002 to May 2003. Sibling counterparts (control fish) for each of the strains were grown in flow-through, circular fiberglass tanks at the USDA Center for Cool and Cold Water Research during the same time period. Throughout the study, all fish were fed daily with commercial trout chow. Growth, physiological status, heavy metal content, and water quality parameters were measured at least monthly throughout the study using standard methods and materials. Results for the physiological and heavy metal assessments are presented here. Blood samples were collected using heparinized syringes for assessment of plasma chloride, glucose, and lactate concentrations, and whole fish were collected for assessment of selenium, magnesium, iron, manganese, and aluminum concentrations.

Results of the study show mean plasma glucose and lactate concentrations (indicators of energy-balance and anaerobic activity, respectively) were within the normal physiological ranges of rainbow trout. No differences were noted among the three strains of treatment fish, or between fish grown in reclaimed mine-water

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and the control fish grown at the USDA facility ($p < 0.05$). Plasma chloride differed significantly between the mine-water fish and the control fish, averaging 118.2 (± 1.3 SEM) mEq/L and 104.7 (± 0.3) mEq/L, respectively. However, both means were within the normal range reported for rainbow trout (approximately 100 to 135 mEq/L); the dissimilarity likely resulted from general water quality differences between the two sites, especially pH and the carbonate constituents which have been shown to directly influence plasma chloride steady-state concentrations through the carbonate equilibrium system and concomitant ion balance.

Fillet heavy metal concentrations were highly variable among individual fish from all strains and locations for the study dates. The FDA limit on mercury is 1000 µg/kg in fish fillets. The FDA does not have fish fillet limits for the other metals tested. The following table shows the high and low means for fillet heavy metal concentrations among all study groups, as well as the overall mean and standard deviation for each of the heavy metals assessed in fish between October 2002 and January 2003.

	Mercury*	Selenium	Aluminum	Manganese	Iron	Magnesium	Cadmium
Detection limit*	8.50	0.05	0.1	0.1	0.1	0.1	0.05
Range: highest group mean	72.5	7.72	6.92	7.08	36	346.7	BDL
Range: lowest group mean	< 17.0	0.98	2.62	0.28	14.7	272.1	BDL
Overall mean	40.54	5.05	4.39	1.71	20.57	309.37	BDL
Overall standard deviation	10.26	2.45	1.59	2.27	7.03	25.54	---

* The unit of measurement for all heavy metals was mg/kg, except mercury. Mercury was measured in **ug/kg.**

Results did not indicate notable differences among study groups or among strains for any of the metals assessed. However, because the responses among individual fish within treatment and control groups were highly variable, such results should be interpreted with caution. Individual fish may show unpredictable susceptibility to bioaccumulation of heavy metals, especially when water quality fluctuates drastically through time. Individual fish variation and environmental fluctuations may affect whether individual fish produced from a given reclaimed mine site will be safe for human consumption. Thus, the results of this study are promising, since mercury concentrations were within the limits set by the FDA and physiological responses were minimal; however, additional replicated studies are needed to confirm the preliminary results outlined above.