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A FACTORIAL STUDY TO INVESTIGATE THE EFFECTS OF SWIMMING SPEED AND DISSOLVED OXYGEN CONCENTRATION ON RAINBOW TROUT PERFORMANCE, HEALTH, AND WELFARE

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Circular tank-based water recirculating systems are capable of conserving water, concentrating waste for ease of removal, and increasing the overall production capacity for a given flow. Circular tanks can rapidly flush settable solids and self clean through the adjustment of rotational water velocities as fish grow. Rotational velocities can produce a range of swimming speeds, from approximately 0.5–2.0 body length per second. In addition, circular tank-based water recirculating systems often use low head oxygenation systems to maintain dissolved oxygen near or at saturation. This can increase carrying capacity without increases in water flow rates. It is important to understand that circular tank culture environments can be radically different from those found in typical raceway serial reuse systems. Typically, raceway systems operate with low water velocities that can be insufficient for quick removal of fecal matter and waste feed. This scenario can allow solids to accumulate and degrade, and lead to decreased fish performance and health. In addition, some raceway systems do not utilize pure oxygenation. Therefore, dissolved oxygen concentrations may be less than saturation and the potential carrying capacity of a given flow is reduced.

Dissolved oxygen is known to affect salmonid performance. In addition, increased swimming speeds have been found to improve fish stamina while increasing the blood oxygen-carrying capacity, the oxidative metabolism of swimming muscles and skeletal muscle contraction efficiency, and the calcium handling capacity of swimming muscles. However, little research has been carried out to determine both the individual effects and the potential interactions of swimming speed and dissolved oxygen concentration on the performance, fish health, and final product quality of rainbow trout (*Oncorhynchus mykiss*). The objectives of this study were to determine the impacts, both alone and in combination, of swimming speed and dissolved oxygen concentration on rainbow trout performance (growth, feed conversion, and survival), health (tissue histopathology and blood gas and chemistry changes), welfare (fin condition, spinal deformities), and final product quality (fillet yield, proximate analysis).

A 2X2 factorial study was designed with treatment groups consisting of the following: three tanks with high swimming speed (1.5 body lengths per second) and high dissolved oxygen (100% saturation), three tanks with low swimming speed (<0.5 body lengths per second) and low dissolved oxygen (70% saturation), three tanks with high swimming speed and low dissolved oxygen, and three tanks with low swimming speed and high

dissolved oxygen. Rainbow trout were stocked at 20 g into twelve small circular tanks (285 fish per tank).

The study was carried out over 225 days, and by end-of-study rainbow trout from all treatments weighed approximately 838 to 1049 grams (Figure 1.). Analysis of variance was used to assess the effects of swimming speed and dissolved oxygen on fish performance outcomes (Table 1.). No significant ($p<0.05$) interactions were detected between the two treatments. Dissolved oxygen had a significant influence on final weight. In addition, swimming speed had a significant influence on cardiosomatic index, which increased with exercise. There were no significant differences between mortalities, length, feed conversion rate, or butterfly fillet yields among treatment groups.

Additional investigations, including fillet fatty acid profiles and proximate analyses, heart morphology assessments, and spinal deformities evaluations, are underway at the time of abstract submission, and will be presented at the conference in August 2010.

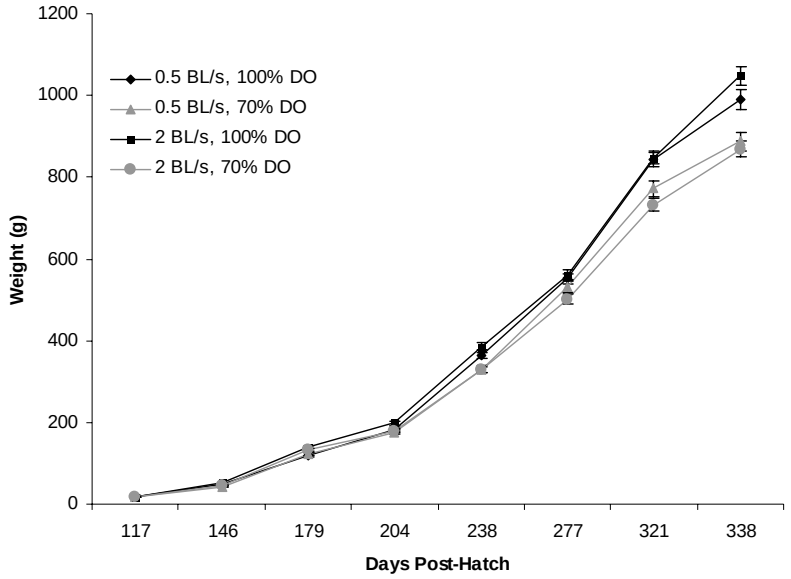

Figure 1. Growth curve comparison for all four treatment groups from hatch to end-of-study.

	Treatment Group			
Outcome	**2 BL/s, 100% O_2**	**2BL/s, 70% O_2**	**0.5BL/s, 100% O_2**	**0.5BL/s, 70% O_2**
Weight (g)	1048 ± 41.1	868.3 ± 9.02	989.9 ± 56.4	887.4 ± 14.8
Length (mm)	391.8 ± 10.7	372.9 ± 5.75	378.7 ± 8.33	378.6 ± 7.69
FCR	1.25 ±.023	1.31 ± 0.021	1.24 ± 0.059	1.26 ± 0.019
TGC	2.56 ± 0.044	2.37 ± 0.009	2.51 ± 0.054	2.39 ± 0.038
Fillet Yield%	66.3 ± 2.92	66.8 ± 2.13	66.2 ± 2.44	67.2 ± 3.62
Mortality %	2.12 ± 0.816	0.942 ± 0.312	1.77 ± 0.000	1.65 ± 0.236
Cardiosomatic Index	0.00123 ± 0.00015	0.00124 ± 0.00021	0.00109 ± 0.00011	0.00111± 0.00012

Table 1. Summary of performance outcomes for all four treatment groups.