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LETTER TO THE EDITOR

Call for the establishment of an international research team for the study of myogenic satellite cells derived from fish

Dear Sir,

Fish represent an important food source as they provide approximately 17% of the animal protein in the human diet. Commercial fishing efforts historically met consumer demands, yet decades of over-fishing and the degradation of critical habitats has caused serious declines in wild fish stocks (FAO, 1988; NMFS, 1992). These problems, coupled with increased consumer demands for leaner high-protein food products, have led to the commercial production of aquatic species. World-wide aquaculture production is currently valued at \$35·7 billion per year. Unlike the declining markets faced by many traditional livestock industries, aquaculture has been increasing at an average rate of 9% per year since 1984. This trend is expected to continue as the demand for aquaculture products is predicted to quadruple by the year 2025 (New, 1991). In order for the international community to meet the food demands of its citizens, strategies must be developed for enhancing the production of important species in aquaculture. One direct approach towards enhancing production involves developing methods for increasing the growth rates of commercially important fish species. Because skeletal muscle composes up to 80 per cent of the live-weight of fish (Weatherley and Gill, 1987), the rate at which this tissue develops may ultimately determine the overall growth of these animals. Discerning the cellular and molecular mechanisms, which control the growth and development of skeletal muscle in fish, may bring to fruition the goal of increasing the growth rates of commercially important farmed species such as catfish, salmon and rainbow trout.

It is generally assumed that normal skeletal muscle cell (myofiber) growth occurs by two distinct processes, hyperplasia and hypertrophy. In most meat animals, hyperplasia of myofiber is associated with embryonic muscle growth, and myofiber hypertrophy is associated with postnatal muscle growth. Regulatory events associated with postnatal myofiber hypertrophy have been extensively studied in domestic meat-animals (cattle, sheep, pigs, chickens) because of their economic importance (Dodson *et al.*, 1995, 1996; Hossner *et al.* 1997; Duckett *et al.*, 1998). However, these animals are unsuitable models for studying postnatal myofiber hyperplasia, because postnatal myofiber hyperplasia does not occur in these animals to any appreciable extent. Alternatively, fish are ideal models because myofiber hyperplasia occurs in considerable amounts postnatally in these species (Weatherly and Gill, 1987). Postnatal myofiber hyperplasia in fish is dependent on the activity of postembryonic myogenic stem cells called satellite cells (Powell *et al.*, 1989). Currently, cell culture represents one of the most efficient methods for discerning factors that regulate myofiber hyperplasia. Available reports pertaining to satellite cells cultured from fish involve one marine species, the white seabass (Zimmerman and Lowery, 1999), one anadromous species of salmon (Matschak and Stickland, 1995), and three fresh water species, including carp (Koumans *et al.*, 1990, 1993), catfish (Mulvaney and Cyrino, 1995) and rainbow trout (Powell *et al.*, 1989; Rescan *et al.*, 1994, 1995; Greenlee *et al.*, 1995; Venkateswaran *et al.*, 1995). Our research program has a long-standing interest in fish satellite cells, since we were the first to report their successful cultivation and culture (Powell *et al.*, 1989). This initial work demonstrated that trout satellite cells could be isolated, propagated and maintained in cell culture. Further, we demonstrated that trout satellite cells could withdraw from the cell cycle and fuse with similarly differentiating satellite cells to form myotubes in culture (Powell *et al.*, 1989). When trout myotubes mature into contractile-competent myofibers, they synthesize muscle-specific proteins (Venkateswaran *et al.*, 1995; Greenlee *et al.*, 1995). Our laboratory has also identified several culture conditions (i.e. substrata, growth factors, hormones) which promote the proliferation and differentiation of trout satellite cells (Venkateswaran *et al.*, 1995; Greenlee *et al.*, 1995).

Until recently, much of the research with satellite cells was plagued by inconsistencies in the donor animal (types, sizes, muscle groups, etc.) from which the satellite cells were isolated (Dodson

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et al., 1995) The main problem was one of acquiring sufficient satellite cells from the same anatomical site from numerous individuals in order to have some statistical significance. Back and hind-limb muscles were used for the harvesting of rat satellite cells, but uncertainties about the contribution of satellite cells (per muscle or per animal) meant that all cells were simply pooled into one large population to conduct experiments. Alternatively, in larger meat-animals only one muscle was necessary in order to acquire sufficient numbers of satellite cells for research purposes (Dodson *et al.*, 1995). Due to the cost of cattle, sheep and pigs, however, isolation of satellite cells from sufficient numbers of individual animals in order to acquire statistical significance proved cost-prohibitive. These two problems can be resolved through the use of isogenic fish-derived satellite cells. Hybrid (clonal) lines of isogenic rainbow trout have been successfully developed at Washington State University. These isogenic lines of rainbow trout are analogous to the inbred strains of mice used throughout biomedical research (Ristow *et al.*, 1996). These fish are produced so that progeny exhibit total parental inheritance and within a particular cross all the resultant fish are genetically identical.

We are initiating basic research into the mechanisms that extrinsically regulate isogenic fish satellite cells to proliferate and differentiate into muscle fibers. Consistent with our philosophy that progress in this area can best be made with establishment of a viable research team (Dodson, in press), **we are requesting scientists from the international community to join us in this endeavor**. We foresee that research ideas, research grants and manuscripts will be completed with a team of international scholars, working together for the benefit of the international community.

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