# Signals to Muscle Growth

Understanding the intricacies of muscle growth could lead to cheaper meat prices at the supermarket, increased profitability for meat producers or even delayed human muscle atrophy in aging.

"Being in a College of Agriculture, meat production is one of the justifications for studying muscle growth in domestic animals," says Ronald Allen, an associate professor of animal sciences at The University of Arizona. "If muscle grows more rapidly and more efficiently, it can be produced at a lower cost.

"But there are other areas where muscle growth is very important. We also are studying muscle growth in relation to human aging. The muscle atrophy that accompanies old age is the opposite of what we're concerned with in growing animals."

Key to this work, is knowing how tiny muscle precursor cells, called satellite cells, are regulated.

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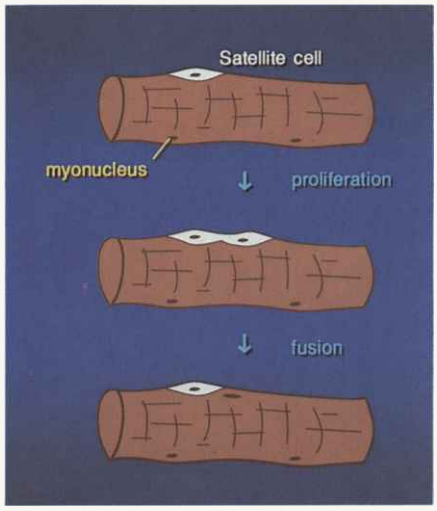
**Ronald Allen**

Throughout life, satellite cells "sit" on the outside of muscle fiber until they receive a signal to divide. After division, daughter cells fuse

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into the muscle fiber, causing the muscle to grow. The remaining cells stay on the outside of the muscle fiber awaiting activation to repeat the process.

The challenge has been finding the source of the signal to divide and fuse. Allen says three hormone-like proteins that occur naturally in the body seem to stimulate or inhibit satellite cell activation. They are: fibroblast growth factor, insulin-like growth factor I and transforming growth factor-beta. Each can be used alone or in differing combinations to duplicate the various active states of satellite cells.

"We didn't discover these growth factors, but we made the connection between them and their potential role in muscle development," Allen says. "In cell culture dishes, these growth factors cause single satellite cells to divide just as they do in living muscle. They fuse together, eventually forming fiberlike cells in the culture." Interestingly, he says, the satellite cells of old animals take much longer to divide than the cells of younger animals.

The next step of Allen's research involves looking at how the growth factors themselves are regulated. He says the biology behind insulin-like growth factor I is the most clear-cut.

The body's growth hormone, which controls normal body development, appears to stimulate synthesis of insulin-like growth factor I in muscle. The growth hormone may signal muscle growth by causing an increase in insulin-like growth factor I, which activates satellite cells to divide.

Fibroblast growth factor may work the same way. Together, insulin-like growth factor I and fibroblast growth factor stimulate much more rapid cell division than either do alone, Allen says.

"The part we don't know, is what regulates the fibroblast growth factor's presence in muscle," he says. "The regulation of transforming growth factor-beta is unknown also, but we do know it has a very powerful effect on muscle satellite cell division—it inhibits it."

As soon as more is understood about all three growth factors, Allen's research will focus on how the process can be regulated in normal growth, during muscle regeneration following injury, and finally, during aging when muscle starts to atrophy.

"If you know how these cells are regulated, then you might be able to develop alternative approaches to the use of growth hormone or intervene in muscle atrophy," Allen says. "Without knowing, it's just a shot in the dark. That's the whole reason for doing this research—to provide that knowledge base."

**—By Jan McCoy**

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