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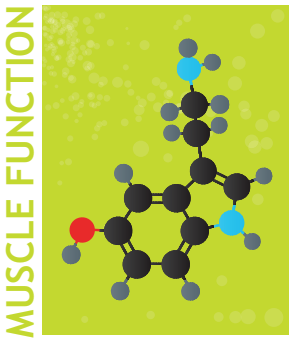
OUTSIDE JEB

Manakins' superfast wings are on steroids



Your monster truck will never win a Grand Prix and my Lamborghini will never crush a row of pick-ups. In much the same way, the muscles that make animals move are rarely both fast and furious because there is a biomechanical trade-off between speed and strength. An exception to this rule is the scapulohumeralis caudalis (SH) wing muscle of the male golden-collared manakin. This tropical bird performs an elaborate courtship display that includes a distinct wing 'snap'. The sound is produced as he collides his wings together above his back in rapid successive movements that are barely visible to the human eye. To make the wings snap, the SH muscle must contract and relax as fast as a rattlesnake's tail-shaker muscle, but it must also be strong to help the manakin fly. How, then, can the SH muscle contract with both the speed needed to attract females and the force needed to power flight?

Matthew Fuxjager, from Wake Forest University, USA, and his colleagues knew that seasonal increases in the male steroid hormone, testosterone, are crucial for triggering courtship displays in manakins. He also knew that the SH muscle of the male golden-collared manakin contains considerably more receptors for testosterone (androgen receptors) than the SH muscles of related species that do not snap their wings. So Fuxjager and his team packed their bags for Panama to catch some golden-collared manakins and determine whether testosterone signaling at these androgen receptors enables the superfast contractions of the SH muscle. After collecting the birds from the tropical forest, the team divided the animals into two groups. One group of birds received enough testosterone to maintain their hormone levels at breeding season values. The second group received the same amount of testosterone plus a drug to block the testosterone from binding to the androgen receptors.

One week after the birds received the hormone and drug treatments, Fuxjager and his team began testing the animals' SH muscles for speed and strength. First, the researchers stimulated the muscle to contract at high frequencies while they measured the force that it produced to test how well the SH muscle relaxed between successive contractions. They found that relaxation between contractions was impaired in manakins given the androgen receptor blocker, meaning that testosterone signaling in the SH muscle is required for the rapid and distinct movements of the wing snap.

Next, the researchers measured how quickly the SH muscle reached maximum contraction when it was burdened with weights; this is like comparing how long it takes you to do a push-up with someone sitting on your back – the heavier the person, the harder the task, the slower your push-up. Fuxjager's team found that while the SH muscles of birds given the androgen receptor blocker generated the same amount of force as the muscles of birds given testosterone alone, they did it at a much slower rate. In other words, they could still do the push-ups, but it took longer with blocked androgen receptors. This means that testosterone signaling supports the SH muscle's superfast contractions without compromising its strength.

So with a bit of well-timed natural doping, the golden-collared manakin can snap its wings all over the forest dance floor!

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Fuxjager, M. J., Miles, M. C., Goller, F., Petersen, J. and Yancey, J. (2017). Androgens support male acrobatic courtship behaviour by enhancing muscle speed and easing the severity of its tradeoff with force. *Endocrinology* **158**, 4038-4046.

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