

## Soy-fed male monkeys become more aggressive, less social

Soy is widely praised for its health benefits, but a new study warns that too much soy may have dangerous effects on male behavior.

Neal G. Simon and colleagues studied adult male macaques living in stable social groups, dividing the monkeys into three groups. For 15 months, the researchers fed one group of the macaques a diet free of soy, while the other two groups ate soy protein-based diets containing either low or high levels of soy isoflavones. (Isoflavones are phytochemicals, present in high levels in soy, which bind to estrogen receptors and mimic some of estrogen's effects.)

The researchers report that rates of aggression increased dramatically in the group fed the high-soy diet, with the monkeys in this group committing 67 percent more highly aggressive acts and 203 percent more submissive acts (the latter occurring in response to increased aggression). In addition, the monkeys fed a high-soy diet were far less social, spending 68 percent less time in direct physical contact and 50 percent less time in close proximity to other monkeys, while spending 30 percent more time alone.

The researchers note that estrogens play a key role in facilitating aggressive behavior in male rodents. Their findings, they say, suggest that soy isoflavones alter male behavior by diminishing the effects of one form of estrogen receptor (ER beta) that appears to modulate the effects of another type of receptor (ER alpha). They also cite evidence that reduced ER beta activity leads indirectly to reduced serotonin function. Reduced serotonin function, in turn, is strongly linked to increases in aggressive and impulsive behavior in both animals and humans.

Simon and colleagues did not detect any changes in the hormone levels of the monkeys fed high levels of isoflavones. This indicates, they say, that soy isoflavones can significantly affect behavior even at concentrations below those needed to produce other physiological changes.

The researchers say the amount of isoflavones fed to the high-soy group of monkeys (125 mg per day) is comparable to levels found in many dietary supplements sold in the United States. When it comes to soy, they say, "There is the thought that what is good for some is good for all and more is better." But they caution, "The present findings suggest that careful attention will be required to balance beneficial and potentially adverse effects."

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"Increased aggressive behavior and decreased affiliative behavior in adult male monkeys after long-term consumption of diets rich in soy protein and isoflavones," Neal G. Simon, Jay R. Kaplan, Shan Hu, Thomas C. Register, and Michael R. Adams, *Hormones and Behavior*, Vol. 45, April 2004, 278-84. Address: Michael R. Adams, Dept. of Pathology/Comparative Medicine, Wake Forest University School of Medicine, Medical Center Blvd., Winston-Salem, NC 27157-1040, madams@wfubmc.edu.

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"In male monkeys, too much soy has adverse effects," news release, Wake Forest University Baptist Medical Center, April 30, 2004.

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