

## **Study finds how BPA affects gene expression, anxiety; Soy mitigates effects**

September 7 2012

New research led by researchers at North Carolina State University shows that exposure to the chemical bisphenol A (BPA) early in life results in high levels of anxiety by causing significant gene expression changes in a specific region of the brain called the amygdala. The researchers also found that a soy-rich diet can mitigate these effects.

"We knew that BPA could cause anxiety in a variety of species, and wanted to begin to understand why and how that happens," says Dr. Heather Patisaul, an associate professor of biology at NC State and lead author of a paper describing the work. BPA is a chemical used in a wide variety of polycarbonate plastics and <u>epoxy resins</u>, and is used in consumer products such as some <u>food containers</u>.

In the study, rats were exposed to low doses of BPA during gestation, lactation (nursing) and through puberty. One group of animals was fed only soy; one group was fed a soy-free diet; one group was fed only soy and exposed to BPA; and one group was fed no soy and exposed to BPA. Blood tests showed that the animals exposed to BPA had BPA levels well within the range found in humans. Similarly, blood tests of animals fed soy showed levels of genistein, an estrogen-like chemical found in soy, were at levels within the human range for vegetarians and others who regularly consume soy foods.

Among adolescent rats on the soy-free diet, both <u>males and females</u> that had been exposed to BPA exhibited significantly higher <u>levels of anxiety</u>. The researchers also found, for the first time, gene changes within the



brain associated with this elevated anxiety.

Specifically, the study reveals that <u>gene expression changes</u> in the amygdala, a brain region known to play a role in mediating responses to fear and stress, are associated with the behavioral changes. Two of the affected genes were estrogen receptor beta and the melanocortin receptor 4. Both are required for oxytocin release, thus changes in oxytocin/vasopressin signaling pathways may underpin the behavioral changes. Oxytocin is a hormone and neurotransmitter that has been linked to social behavior.

However, the researchers also found that adolescent rats on the soy-rich diet did not exhibit anxiety – suggesting that the soy-rich diet may mitigate the effects of BPA. But a soy-rich diet raises questions of its own.

"Soy contains phytoestrogens that can also affect the endocrine system, which regulates hormones," Patisaul says. "It is not clear whether these phytoestrogens are what mitigate the effect of BPA, or if it is something else entirely. That's a question we're hoping to address in future research."

**More information:** The paper, "Anxiogenic effects of developmental Bisphenol A exposure 1 are associated with gene expression changes in the juvenile rat amygdala and mitigated by soy," was published Sept. 5 in the journal *PLOS ONE*.

## Provided by North Carolina State University

Citation: Study finds how BPA affects gene expression, anxiety; Soy mitigates effects (2012, September 7) retrieved 1 May 2024 from <u>https://medicalxpress.com/news/2012-09-bpa-affects-</u>



gene-anxiety-soy.html

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