Nature Reviews Neuroscience | AOP, published online 14 September 2011; doi:10.1038/nrn3115

BEHAVIOUR

‘Chillax’ with probiotics

> Chronic administration of *L. rhamnosus* (JB-1) reduced anxiety-like behaviour

There is increasing evidence that gut microflora can influence the brain, but the mechanistic basis for these effects is unknown. A new study by Bravo *et al.* shows that chronic administration of probiotic (or ‘good’) bacteria in healthy mice reduces levels of anxiety and depression-like behaviour, and induces changes in the GABAergic system in regions of the brain that are known to be involved in these behaviours.

CORBIS

The authors chronically treated healthy mice with the potentially probiotic strain of the bacterium *Lactobacillus rhamnosus* (JB-1). Chronic administration of *L. rhamnosus* (JB-1) reduced anxiety-like behaviour in an elevated plus maze, increased cue- and context-dependent freezing responses in the recall phase of a fear conditioning paradigm, and decreased the time spent immobile in a forced swim test. In addition, stress-induced plasma corticosterone levels were lower in treated mice. These behavioural changes are indicative of reduced anxiety, increased fear memory and reduced depression-like behaviour.

The GABAergic system is important in the regulation of behaviour, and the authors therefore investigated whether the behavioural effects of chronic administration of *L. rhamnosus* (JB-1) might be linked to changes in this system in brain areas that are involved in these behaviours. Mice that had received *L. rhamnosus* (JB-1) showed alterations in GABA receptor subunit mRNA expression as assessed by *in situ* hybridization. Specifically, chronic *L. rhamnosus* (JB-1) administration decreased expression of GABA type B ($GABA_B$) subunit 1 isoform b ($GABA_{B1b}$) mRNA in the amygdala and hippocampus, and increased it in cortical areas. Furthermore, it reduced expression of $GABA_{A\alpha2}$ receptor mRNA expression in amygdala and cortical areas, whereas levels were increased in the hippocampus. $GABA_{A\alpha1}$ mRNA levels were reduced in the amygdala and hippocampus, suggesting that probiotics might enhance responses to stressful situations through alterations in GABAergic function.

The most likely conduit for information from the gut to the brain is the vagus nerve, and the authors tested whether the effect of *L. rhamnosus* (JB-1) might be mediated by this nerve. They found that vagotomy prevented the anxiolytic and antidepressant effect of chronic *L. rhamnosus* (JB-1) ingestion. It also prevented the alterations in $GABA_{A\alpha2}$ mRNA expression in the amygdala. Although the authors did not assess whether behavioural changes were correlated with changes in mRNA expression levels, they suggest that modifications in the GABAergic system by *L. rhamnosus* (JB-1) treatment may underlie the effect of the treatment on behaviour.

These results show that a bacterium that is potentially probiotic influences brain physiology and function in healthy animals, and that at least some of these effects are mediated by the vagus nerve. There has been increasing interest in potential interactions between gut microbiota and the brain, and consumers of probiotic yoghurts may be encouraged by the findings of this study.

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ORIGINAL RESEARCH PAPER Bravo, J. A. *et al.* Ingestion of *Lactobacillus* strain regulates emotional behavior and central GABA receptor expression in a mouse via the vagus nerve. *Proc. Natl Acad. Sci. USA* 29 Aug 2011 (doi:10.1073/pnas.1102999108)

FURTHER READING Mayer, E. A. Gut feelings: the emerging biology of gut–brain communication. *Nature Rev. Neurosci.* **12**, 453–466 (2011)