
by *Marisa Wexler MS* | March 8, 2022

Immune Reaction to Milk Protein May Explain Dairy's Link to MS

Immune system reaction to casein, a protein in cow's milk, can trigger an inflammatory neurological disease in mice that's similar to **multiple sclerosis (MS)** and includes the loss of myelin, a study reported.

"These results identify how consumption of milk and milk products may exacerbate the autoimmune response in MS," its researchers wrote.

The study, "[Antibody cross-reactivity between casein and myelin-associated glycoprotein results in central nervous system demyelination](#)," was published in **PNAS**.

Reports linking cow's milk consumption to a greater risk of developing MS date back as far as the 1970s, and many patients report feeling worse when they consume dairy. However, a biological mechanism that could explain this connection has been lacking.

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"We hear again and again from [MS patients] that they feel worse when they consume milk, cottage cheese or yogurt. We are interested in the cause of this correlation," Stefanie Kürten, MD, a study co-author with the Institute of Anatomy at University Hospital Bonn in Germany, said in a [press release](#).

To learn more, the researchers immunized mice with several different components found in milk. That is, the mice were injected with the milk components as well as with substances to promote an immune response.

Mice immunized with the milk protein called casein exhibited motor weakness and disorientation, and analyses of their brains and spinal cords showed significant inflammation and myelin loss. These features are broadly similar to what is seen in MS, which is **caused** by an autoimmune attack that damages the myelin sheath, a fatty coating around nerve fibers that helps them send electrical signals.

Notably, mice immunized with other milk components did not develop this MS-like disease.

Further analyses in the mice immunized with casein showed no inflammatory immune cells at the sites of myelin loss. However, there were high levels of antibodies, which are proteins made by the immune system that can drive autoimmunity in diseases like MS.

A given antibody is able to bind with extremely high specificity to a particular molecular target, referred to as the antibody's antigen. In further tests, the researchers showed that antibodies from casein-immunized mice were able to bind to antigens in the brain. Since antibodies from casein-immunized mice would by definition target casein, this opened two possibilities: either the casein protein itself was produced in the mice's brains, or there is a brain protein that is structurally similar enough to casein to be targeted by anti-casein antibodies. This phenomenon — when an antibody recognizes two structurally similar antigens — is called cross-reactivity, and has been implicated in the **development of MS** and other autoimmune diseases.

Through a battery of experiments, the researchers illustrated that anti-casein antibodies could cross-react with a protein called myelin-associated glycoprotein (MAG), which is expressed by oligodendrocytes. These cells are chiefly responsible for producing myelin. The MAG protein “looks markedly similar to casein in some respects — so much so that antibodies to casein were also active against MAG in the lab animals,” said Rittika Chunder, PhD, a postdoctoral fellow in Kürten's research group and a study co-author. Further work showed that anti-casein antibodies were toxic to oligodendrocytes, and could kill these myelin-making cells by activating a group of immune proteins called the complement cascade.

“The body's defenses actually attack the casein, but in the process they also destroy proteins involved in the formation of myelin,” Chunder said.

To illustrate the relevance of these findings in patients, the researchers tested for anti-casein antibodies in 39 people with MS and 23 individuals with other neurological diseases. Results showed that average anti-casein antibody levels were significantly higher in the MS patients.

The researchers are now working to develop a self-test that patients can use to check their levels of antibodies against casein. Though they stressed more work is needed to validate their findings, they suggested that MS patients with higher levels of these antibodies might be particularly advised to avoid dairy.

“We speculate that, once tolerance to an otherwise harmless food antigen like casein is broken, it might exacerbate ongoing autoimmunity like in MS, as a result of cross-reactivity to self-antigens,” the researchers wrote.