

Poorer quality wheat when carbon dioxide levels in the air rise

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Rising levels of atmospheric carbon dioxide have a negative impact on the protein content of wheat grain and thus its nutritional quality. This is the finding of researchers at the University of Gothenburg, Sweden, in a recently published study in the journal *Global Change Biology*.

Elevated levels of [atmospheric carbon dioxide](#) stimulate the photosynthesis and growth of most plants. However, unless plants increase their uptake of nutrients to a corresponding degree, their yields will have a lower nutritional value. A lower level of the nutrient nitrogen results in a lower [protein content](#), and thus poorer nutritional quality.

"Protein content is the most important quality aspect for crops, with implications for both [nutritional value](#) and the baking properties of the grain," explains Håkan Pleijel, Professor of Environmental Science at the University of Gothenburg's Department of Biological and Environmental Sciences.

Researchers Håkan Pleijel and Johan Uddling have summarised the way in which experimentally elevated [carbon dioxide](#) levels affect the harvest index and protein content of wheat. The study includes 43 [field experiments](#) with 17 different varieties of wheat, carried out in ten countries across four continents. The results of the study are unequivocal:

"Elevated carbon dioxide levels often increase the size of the grain yield, but also lead to a reduction in quality in the form of lower protein

content," says Professor Pleijel.

Wheat – together with rice – is the world's most important crop in quantitative terms. Wheat grain is also unusually rich in protein, and wheat is the crop that provides the human race with the most protein. Reduced protein content as a result of elevated carbon dioxide levels is therefore a serious negative consequence of ongoing atmospheric change.

One reason why the protein content of wheat grain drops as carbon dioxide levels rise is that nitrogen uptake does not keep pace with the increased growth of the [wheat grain](#) – a kind of dilution effect. However, elevated carbon dioxide levels reduce the protein content of wheat even when the size of the wheat yield is unaffected.

"This indicates that carbon dioxide has a negative impact on plants' ability to absorb nitrogen," continues Professor Pleijel. "This is a novel and unexpected finding, and is something we need to study in greater depth in order to understand the causes."

Laboratory studies have shown that elevated carbon dioxide levels can disrupt the process whereby plants convert the inorganic nitrogen molecule nitrate into the forms of nitrogen found in proteins.

Johan Uddling and Professor Pleijel are currently investigating whether the effects they have demonstrated in wheat are also seen in other crops.

"Our results indicate that reduced nitrogen and protein content as a result of elevated carbon dioxide levels is a general response in crops, and cannot be countered simply through increased fertilisation," adds Uddling.

The overall positive effect of elevated carbon dioxide levels on grain

yield therefore has a downside in the form of a reduction in the [nutritional quality](#) of our most important foodstuff.

"This is a serious consequence of rapidly rising global carbon dioxide levels on global food security," concludes Professor Pleijel.

More information: Yield vs. Quality trade-offs for wheat in response to carbon dioxide and ozone, *Global Change Biology*, Vol 18 issue 2. [onlinelibrary.wiley.com/doi/10 ... 2011.2489.x/abstract](https://onlinelibrary.wiley.com/doi/10.1111/gcb.12489)

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