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## **Comparative environmental evaluation in bakery and brewing sectors with the use of BSG and unsold bread in a circular economy context**

**KORBEL E. (1), DRAGAN I. (2), PETIT G. (3), AISSANI L. (4), JURY V. (1)**

1 UMR GEPEA, Oniris, Nantes, France

2 Department of Agricultural and Food Sciences, University of Bologna, Bologna, Italy

3 ARENES UMR CNRS 6051, Rennes Institute of Political studies, Rennes, France

4 UMR OPAALE, French National Institute for Agriculture, Food, and Environment (INRAe), Rennes, France

This study assessed the environmental impact of beer and bread production in the context of a circular economy using the LCA approach. It consists in evaluating innovative products like brewery spent grain breads and beers made by unsold bread. The supply chain considers, for both systems, the cultivation phase, milling, malting and production of ingredients (salt, yeast and hops). One of the most important hot spot for both productions is cultivation. In bread production, the hot spots are also bakery and proofing steps. In brewery process packaging step is the biggest contributor by far followed by boiling and hopping. In addition, along BSG and unsold bread stabilisation process the hot spots are drying and co-product transportation. Non-innovative products have the highest impact. In the majority of organic cases land use and marine eutrophication are significantly reduced after the use of co-products. The results support innovative products. In fact, it helps to give a general idea of which product is better from an environmental point of view and if it is significant. The last step was to compare innovative and circular system with a non-innovative one. The innovative one underlines few environmental impact categories with significant less values like Freshwater Ecotoxicity, Land Use, Marine Eutrophication, Mineral Resource Scarcity, Stratospheric Ozone Depletion and Terrestrial Acidification; Fine Particulate Matter Formation; Global Warming; Ozone formation, Human Health; Ozone formation, Terrestrial ecosystems and Terrestrial Eutrophication. In conclusion, positive results about circular economy are found. However, further studies are needed in order to obtain more primary data and less assumptions.