Effects of Roundup and glyphosate on three food microorganisms: Geotrichum candidum, Lactococcus lactis subsp. cremoris and Lactobacillus delbrueckii subsp. bulgaricus.

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Abstract

Use of many pesticides poses the problem of their effects on environment and health. Among them, the effects of glyphosate (G) with its adjuvants and its by-products are regularly discussed. The aim of the present study was to shed light on the real impact on biodiversity and ecosystems of Roundup® (R), a major herbicide used worldwide, and the G it contains, by the study of their effects on growth and viability of microbial models, namely on three food microorganisms, Geotrichum candidum (Gc), Lactococcus lactis subsp. cremoris (Lc) and Lactobacillus delbrueckii subsp. Bulgaricus (Lb), widely used as starters in traditional and industrial dairy technologies.

Presented results evidence that R has an inhibitory effect on microbial growth and a microbicide effect at lower concentrations than those recommended in agriculture. Interestingly, G at these levels has no significant effect on the three studied microorganisms.

Our work is consistent with previous studies which demonstrated that the toxic effect of G was amplified by its formulation adjuvants on different human cells and other eukaryotic models. Moreover, these results should be considered in the understanding of the loss of microbiodiversity and microbial concentration observed in raw milk for many years.

Introduction

Uncontrolled microbiodiversity => lack of interest in the endangered bacteria hypothesis (Panoff et al., 2002)

R formulations = G (active component) + adjuvants (Cos 2004):
- Major herbicide used worldwide
- Have negative effects on fauna + flora and are cytotoxic to human cell lines (Relyea 2005; Richard et al., 2005; Benachour et al., 2007; Benachour & Seralini 2009; Guenin et al., 2009)

Glyphosate:
- Blocks EPSPS (5-enolpyruvylshikimate-3-phosphate synthase), key enzyme involved in aromatic amino acids biosynthesis via shikimic acid pathway in plants (Borrvall et al., 1992)
- Affects growth + metabolism of Saccharomyces cerevisiae (Bruneau et al., 2006)

The work described here was carried out on three microorganisms of food interest, to highlight the impact of the R herbicide and of G.

Materials and methods

Strains and culture conditions

R & G treatments

Table 1: Minimal inhibitory concentration (MIC) and minimal microbicide concentrations (MMC) for three microorganisms (Gc, Lc and Lb) after 24 hours of incubation in growth media supplemented with R400 or R450.

Microbicide effect of R was obtained at concentrations 1.6, 1.2 and 2 times higher than the measured minimal inhibitory concentrations for Lc, Gc and Ll, respectively.

Conclusion

The pesticide Roundup sprayed on Roundup tolerant GmOs and on non-agricultural soils could thus impact specific microbiodiversity including food interest microorganisms. This is illustrated by the fact that actual food processing requires industrial food starters for milk fermentation. Furthermore, unpredictable consequences of Roundup on soil microorganisms have to be considered.

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References


Figure 1: Growth inhibition of three microorganisms (Gc, Lc and Lb) after 24 hours of incubation in growth media supplemented with R (400 and 450) or equivalent amount of G evaluated by turbidimetry (600 nm).