

Enzymatic detoxification of fumonisin and zearalenone in the bioethanol process

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Introduction

- Production of >98,000 t of the by-product Distiller's Dried Grains with Solubles (DDGS) p. d. by U.S. ethanol industry
- BIOMIN Mycotoxin Survey: all corn DDGS samples tested, contaminated with at least one major mycotoxin
- Risk of increased exposure of livestock animals to higher mycotoxin levels
- Test of the fumonisin B₁ (FB₁) and zearalenone (ZEN) degrading feed additives FUMzyme[®] and ZENzyme[®] (both BIOMIN) for the detoxification of FB₁ and ZEN directly within the bioethanol process

Conclusion

- FB₁ and ZEN could be simultaneously degraded within the bioethanol production process in 450-mL- and 19-kg-scale.
- Biotransformation was confirmed by formation of the degradation products hydrolyzed FB₁ and hydrolyzed ZEN.
- The treatment offers the possibility to produce high-quality DDGS low in FB₁ and ZEN from corn initially contaminated with these mycotoxins.

Results

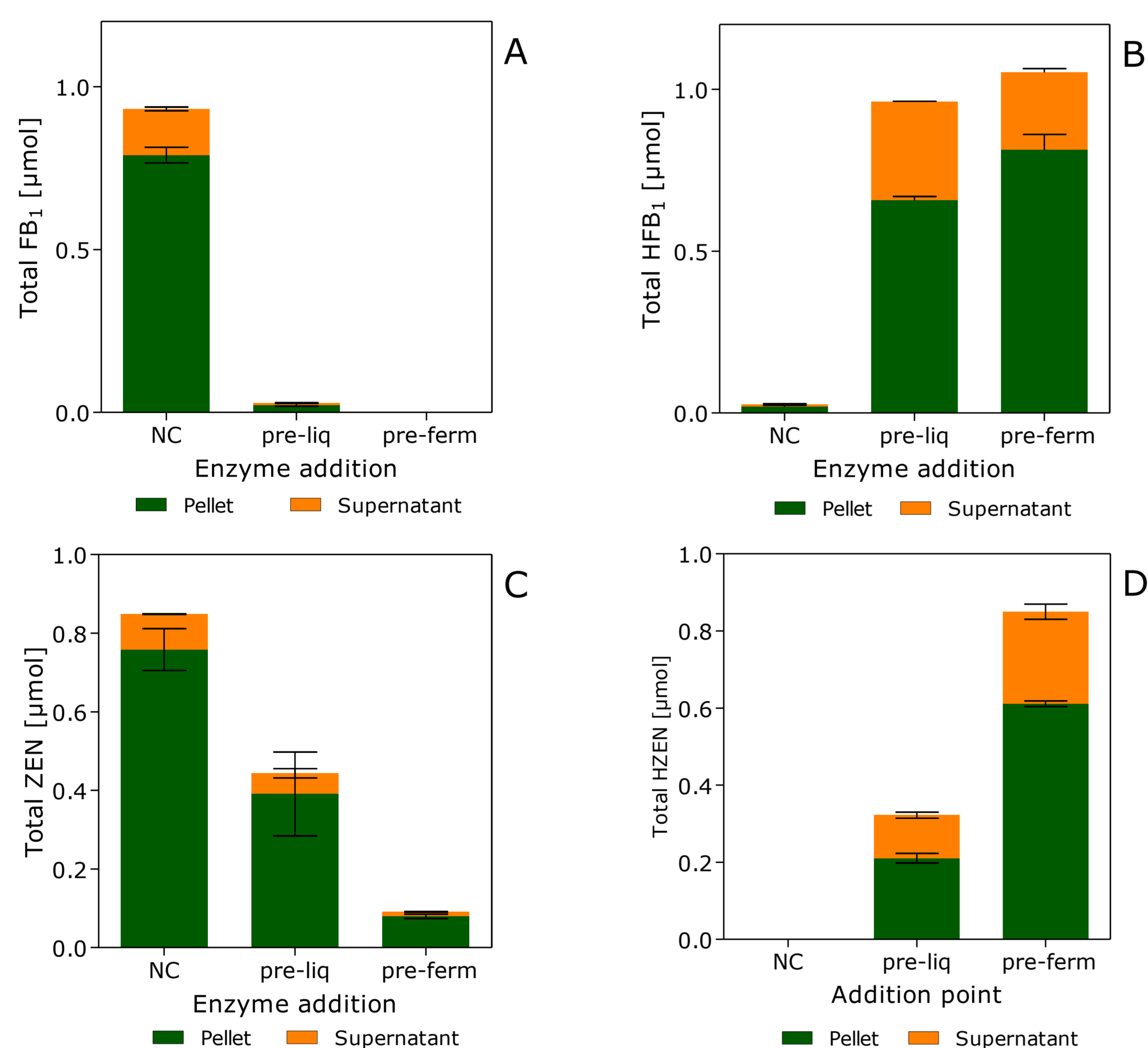


Figure 1. Total amount of FB₁ (A), HFB₁ (B), ZEN (C) and HZEN (D) in mash pellet (green) and supernatant (orange) per batch at the end of the bioethanol process after addition of FUMzyme[®] and ZENzyme[®] before liquefaction (pre-liq) or before fermentation (pre-ferm) compared to the negative control (NC) without enzyme addition. Error bars represent standard deviation (n=2).

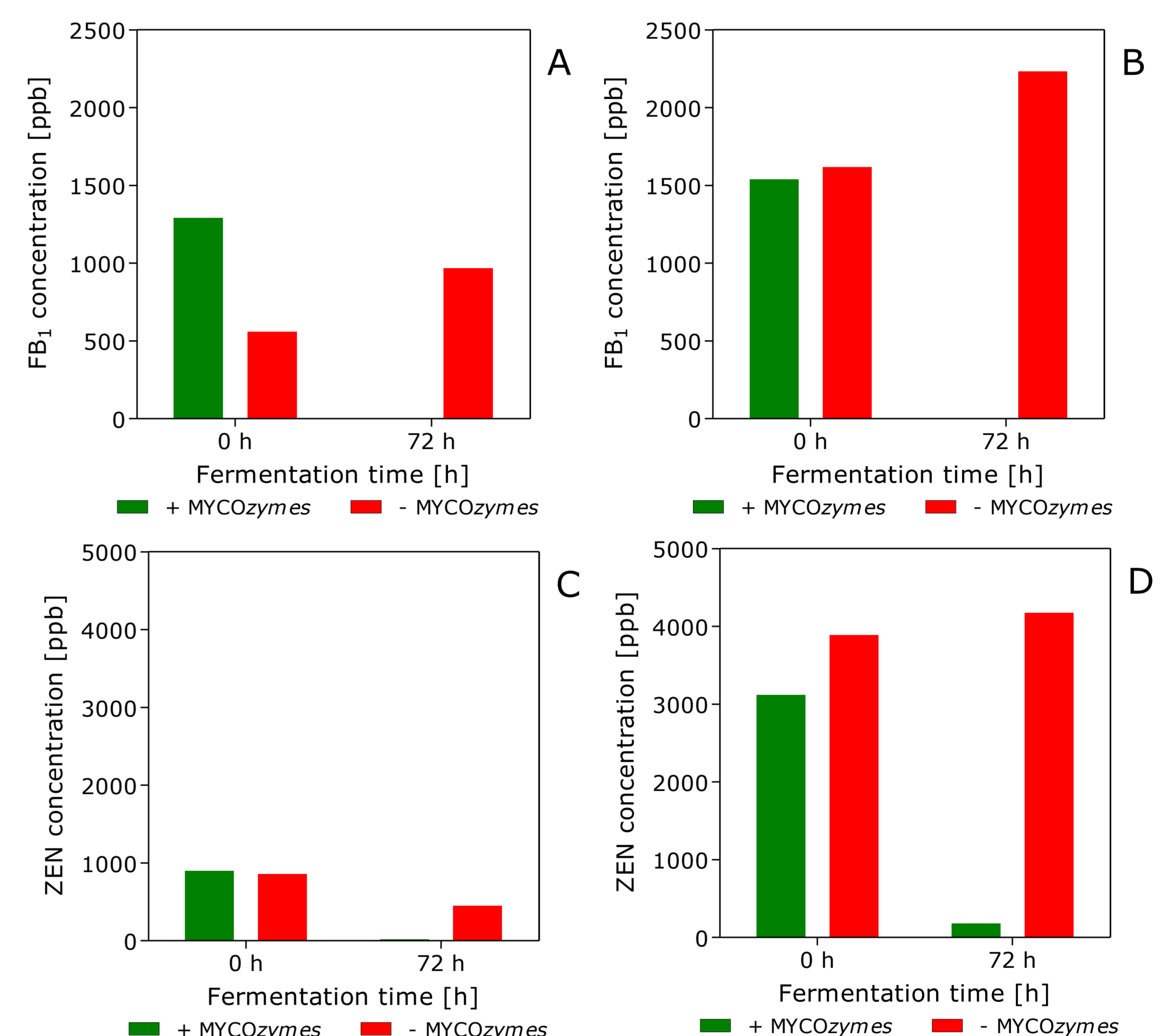


Figure 2. FB₁ concentration in supernatant (A) and pellet (B) and ZEN concentration in supernatant (C) and pellet (D) at the beginning (0 h) and end of bioethanol fermentation (72 h) in 19-kg-scale after treatment with FUMzyme[®] and ZENzyme[®] during fermentation (green) compared to the control (red) without mycotoxin degrading enzymes. As dry matter results of pellet are not available yet, results are presented in concentration [ppb].

Material & Methods

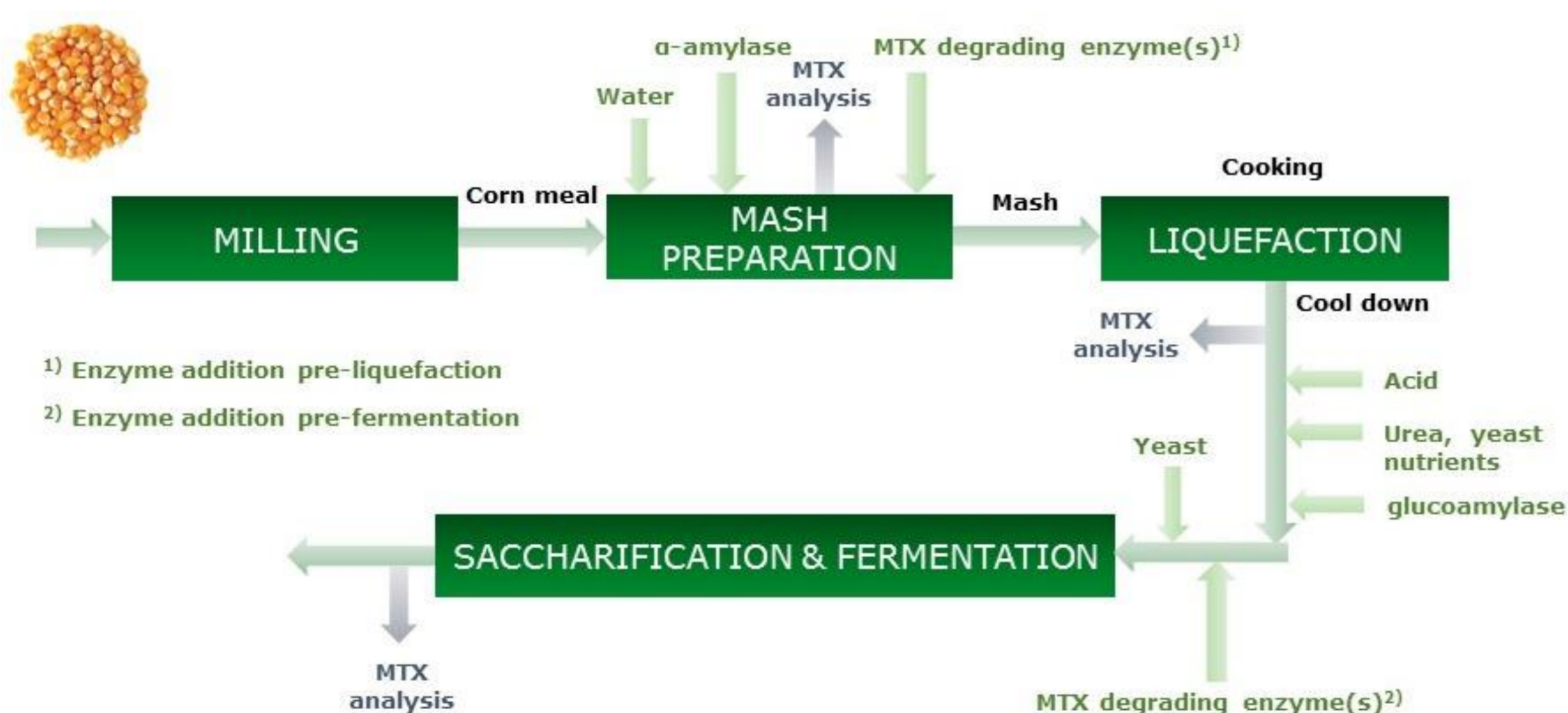


Figure 3. Process flow diagram of the lab-scale bioethanol process

Bioethanol process simulations were performed in 450-mL-scale as shown in Figure 1 using naturally contaminated corn (2324 ppb FB₁, 1486 ppb ZEN). FUMzyme[®] and ZENzyme[®] were either added before liquefaction or before fermentation. FB₁, hydrolyzed FB₁ (HFB₁), ZEN and hydrolyzed ZEN (HZEN) were quantified by LC-MS. Experiments in 19-kg-scale with naturally contaminated corn were performed by Südzucker with addition of FUMzyme[®] and ZENzyme[®] before fermentation.

