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Measurement and mitigation strategies for elevated viscosities resulting from microbes present in sugar beet processing.

Microbes are introduced into processing streams from infected beets, piles, and soils, creating operational challenges and overall sugar losses. Contaminating bacteria consume sucrose while producing exopolysaccharides (EPS), like dextrans and fructans, resulting in potentially increased viscosities and associated difficulties with sugar recovery and crystallization. In this study, a set of ~50 bacterial strains from juices and biofilms representing some common genera among isolates were grown in high sucrose-containing medium. Culture broth viscosities were measured using a Brookfield model DV-II+ viscometer with a UL spindle and small sample adapter. A smaller set of samples were grown in the presence of (A) an oxidizing antimicrobial agent, (B) a dextranase enzyme, and (C) an antimicrobial and dextranase concurrently. These samples were measured for viscosity and optical density (OD). In total, 37 flask cultures were classified as watery, 7 flask cultures were classified as intermediate, and 10 flask cultures were classified as highly viscous. The juice and biofilm isolate culture samples had similar absolute numbers of watery and intermediate class samples (juice, watery: n=18; juice, int.: n=4; biofilm, watery: n=19; biofilm, int.: n=3). However, the biofilm-derived isolates had roughly double the number of viscous cultures compared to juice (juice, viscous: n=3; biofilm, viscous: n=7). These results seem consistent with observations that that EPS from biofilm isolates may result in higher viscosities than EPS from juice (planktonic) isolates. Finally, there seemed to be a correlation between increased viscosity and observations of mucoid colony morphology on beet juice agar during the microbial isolations. For experiments on the effect of processing aids, results show that untreated controls of bacterial cultures had high culture viscosity and OD, with treated bacterial cultures being lower. Application of dextranase as a treatment alone resulted in somewhat elevated OD and viscosity values for resulting culture solutions. The antimicrobial treatment was more effective at inhibiting microbial growth; however, the lowest OD and viscosities resulted from the concurrent application of both enzyme and biocide together. This provides evidence to support the hypothesis that EPS mitigation strategies may introduce synergistic microbial control when antimicrobial agents are applied. The results show that there is a wide variety among processing bacteria for propensity to form EPS and elevated viscosities. Through the application of treatments like dextranases, bacteria present during processing may have less opportunity to form EPS and biofilms. As a result, this could predispose dextran-forming bacteria to control measures, like the application of antimicrobial agents. Overall, this strategy may improve operational efficiencies by decreasing required volumes/costs for processing aids and increasing sugar production.