

There was one question posed during the webinar on the blog that was not responded to:

Q: exactly what constitutes "huge"? (minute 42:10)

In the webinar the following point was discussed:

How much variability is there between the responses of the strains of the same bacteria, e.g., growth rate, or death rate?

It was mentioned that strain variability was large, and that this could be seen as a large variability between different strains if growth is considered. But for inactivation the variability is even higher, so this variability is huge.

This effect can be seen in Aryani et al. (2016):

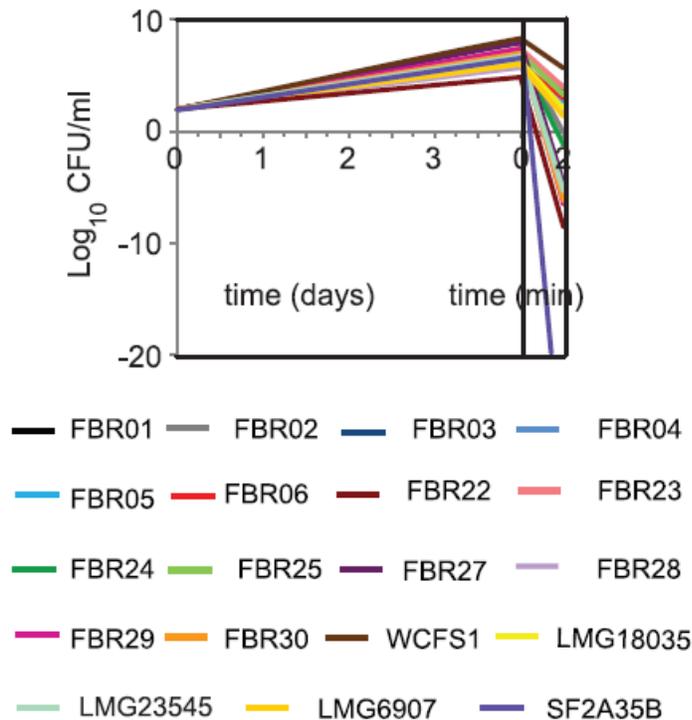
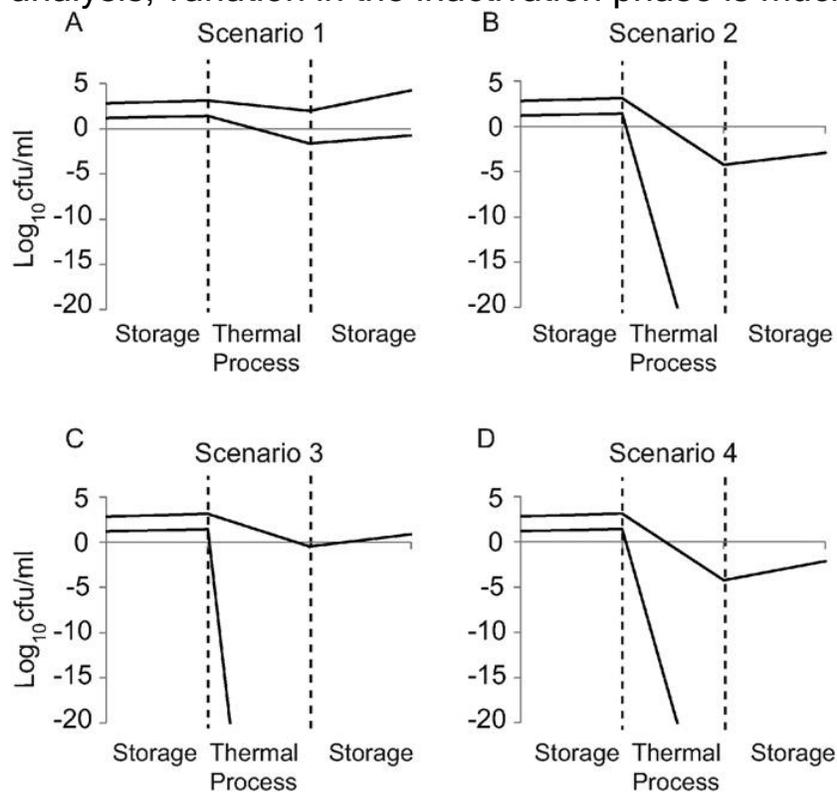


FIG 8 Illustration on the effect of strain variability on growth and thermal inactivation of 19 *L. plantarum* strains.

Figure 8 shows that growth at 7°C during 4 days gives a couple of logs difference (about 4 logs) between the fastest and the slowest strain, however subsequent inactivation at 60°C 2min gives really huge differences between about 3 log inactivation and >20 log inactivation. So the comment "huge" is referring to the effect in inactivation between strains (>17-order of magnitude differences).

It should also be noted that the variability increases with longer (growth and) inactivation times.

Also in den Besten et al. (2017) it is shown in Figure 6 in a Monte Carlo analysis, variation in the inactivation phase is much more prominent:



In that paper it is mentioned also:

“The impact of strain variability (especially for heat) is very large and overwhelming many other effects.”

#### References:

D. C. Aryani, H. M. W. den Besten, M. H. Zwietering. Quantifying variability in growth and thermal inactivation kinetics of *Lactobacillus plantarum*. 2016. Applied and Environmental Microbiology 82: 4896-4908

Heidy M.W. den Besten, Diah C. Aryani, Karin I. Metselaar, Marcel H. Zwietering. Microbial variability in growth and heat resistance of a pathogen and a spoiler: All variabilities are equal but some are more equal than others. 2017. International Journal of Food Microbiology 240: 24-31