PLANT-BASED L-CYSTEINE – IMPROVING DOUGH EXTENSIBILITY

For decades, there had been no substitute for human or animal-derived cysteine. WACKER was the first to offer a plant-based vegan alternative through fermentation. This L-cysteine is a valuable tool for improving bakery products. Even in very small dosages, it offers great advantages for the bakery industry, because it reliably improves dough handling and enables uniform end products.

Cysteine is commonly produced from feathers or human hair, as well as from the bristles and hooves of pigs. Feathers are the raw material of choice in Asia, especially in China. Until now, a large part of the world's demand for cysteine has been met by boiling these substances with large quantities of concentrated hydrochloric acid and activated carbon, followed by electrolysis.

Outbreaks of BSE and avian influenza have reinforced a continuing trend away from animal-based raw materials and are fueling increased consumer interest in the origin of food components. The demand for purely vegan food is also rising due to ethical reasons. Consequently, WACKER offers a range of vegan-grade L-cystine/L-cysteine products. These are manufactured by fermentation from vegetable-based raw materials and inorganic trace elements.

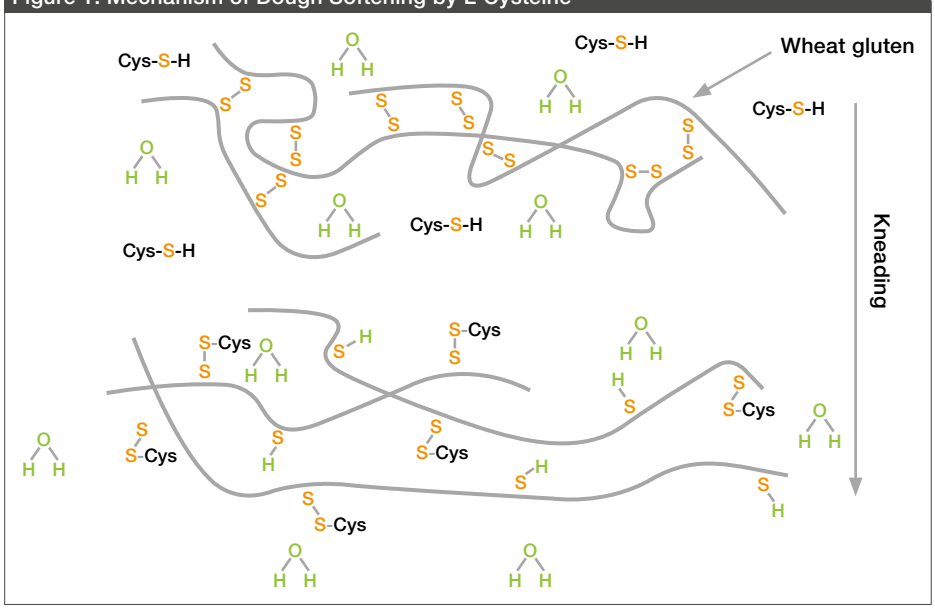
L-Cysteine as a Dough Softener

In industrial baking, the final product always has to look the same. Due to seasonal or harvest deviations, the flour quality often varies with respect to gluten strength. The baking industry has to compensate for these variations. The required combination of strength, extensibility and tolerance of dough mainly depends on the application, flour quality, water absorption and mixing conditions. Moreover, dough improvers are often used to optimize the dough rheology for a regular crumb, increased volume and controlled crust structure. Dough softeners, such as L-cysteine, are mainly added to increase the extensibility of the wheat gluten, especially for "strong" flours with high protein content. This is very important for automated production lines, as the addition of L-cysteine has a positive effect on machinability.

L-Cysteine: Highly Effective in Small Amounts

WACKER's L-cysteine can be used as a dough softener (reducing agent) in baking. Within wheat dough, L-cysteine reduces the single disulfide bonds to two -SH bonds to weaken the gluten network and to relax the dough. Consequently, the dough mass becomes more workable and more "machinable" (see Figure 1). The softening of the dough can easily be shown in an extensogram (see Figure 2, reverse page).

Figure 1: Mechanism of Dough Softening by L-Cysteine



Cysteine reduces the disulfide bonds (S-S) within the gluten network. The interaction of cysteine with the disulfide bonds increases the flexibility of the gluten network during kneading.

Figure 2 shows that even a small amount of L-cysteine has a major effect on the rheology of the dough – it significantly decreases the resistance to extension while increasing the extensibility. As the typical cysteine addition (0.5–5 g/100 kg flour) is about 100 times lower than it is for inactivated yeast (100–300 g/100 kg flour), L-cysteine is much more cost-effective. The use of inactivated yeast as a dough improver is based on glutathione, which is prone to the deviations of yeast as a raw material. In addition, other metabolic byproducts of inactivated yeast can influence the texture and flavor of the end product. In comparison, L-cysteine functions in an efficient and reliable way.

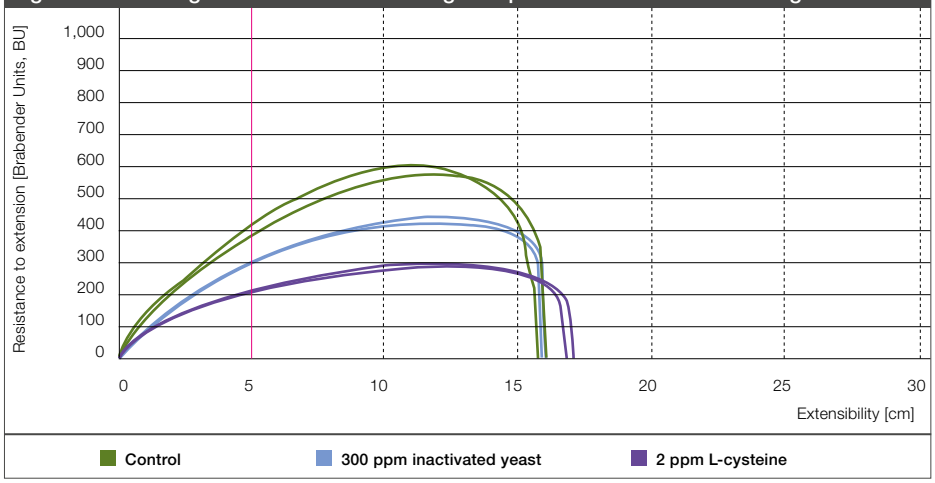
Functional Properties

The combination of strength, extensibility and tolerance that dough needs depends mainly on water absorption, flour quality and the mixing conditions. Reducing agents are used with high-strength flour and high-speed processes, in particular, to lower the energy input, reduce mixing times and improve machinability. Especially for the production of toast, buns and baguettes, the application of cysteine can likewise enable control of the oven spring and, thus, increase the volume of the end product. Extensibility and reproducible stretchability are key parameters for tortilla and pizza dough processing, which are getting more and more industrialized. Reducing agents decrease the elasticity that can cause these products to shrink or curl after they are formed. Hereby, L-cysteine as a dough conditioner helps the baking industry to optimize the throughput of the baking lines. Improving dough extensibility with cysteine is also valuable for multiple other yeast and chemically leavened applications, including cookies, saltines and other crackers.

Benefits and Effects of Using WACKER's L-Cysteine

- Vegan product derived from plant materials
- Dough softening
- Improved pumpability of liquid dough
- Eliminates shrinkage and breaking
- Controlled rising and oven spring
- Reduced cracking of biscuits and crackers
- Enables increased loaf volume
- Uniform crumb structure

Figure 2: Extensogram of Wheat Flour Dough Prepared with and without Dough Softeners



Without additives (control), the dough has the highest resistance (curve maximum). L-cysteine considerably reduces not only resistance, but also extensibility (curve width).

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