

18 Flour Treatment

L. Popper, with an introduction by W. Schäfer

18.1 Flour Treatment and the Improvement of Flour

There is a huge demand for flour improvers these days, in the baking trade and in the food industry. In the past, fifty or sixty years ago, millers were not faced with this topic – except, perhaps, in the context of some very special sideline tasks such as the first attempts to vitaminize light-coloured flours (now generally known as "flour fortification"). After the hardship and privation of the war and the years that followed, the world's populations were satisfied with what grew on the soil, what farmers and cooperatives delivered to the mills and what could be shipped across the oceans in the context of world trade. And if the worst came to the worst one delved back into the past. Holger Jörgensen discovered it in 1935; P.R.A. Maltha confirmed it fifteen years later: ascorbic acid offers a reliable way of closing many a gap in quality (Jörgensen, 1935; Maltha, 1950). This, along with the intelligent use of malt flour, was the only possibility that existed for some long time.

But the mid 1960s saw the start of a new development. The useful properties of certain mono-diglycerides, and especially lecithin, as an aid to baking had been discovered, and it was now possible to use compounds for virtually all the stages of the improvement process. At the same time an extremely practical new theory had become known. Flour improvement is not a question of achieving particularly "good" rheological or analytical values. The secret is to adjust certain empirical data precisely. The rheology must "be just right". And of course the results of baking must correspond to the parameters set: it is this that determines the specific nature and intensity of flour treatment.

Ultimately it does not matter what technical means are used to "train" a commercial flour for the tasks it is to perform; but there can be

no doubt that in practice the specific use of certain additives and ingredients plays the leading role throughout the world. However, the demands made have changed in a characteristic manner in recent years. Ten years ago it was an attractive objective to construct an "all-round" flour from which biscuits and also bread rolls and toast slices could be made in excellent quality. These days – especially in the food industry – priority tends to be given to top qualities for limited, special purposes. There has always been, and there remains, a great need for research.

18.2 Flour Treatment is an Essential Part of the Industrial Production of Flour

Wheat is of increasing importance for feeding the world's population, whose growing number and changing food consumption habits require more and more wheat flour. At the same time the processing of wheat flour is changing; although small craft bakeries still predominate in many parts of the world, industrial bakeries are taking an increasing share of the market and thus of the raw material, flour. In these bread factories it is not uncommon to find engineers at the production line rather than bakers. The direct interaction of the raw material or dough with the person responsible has been reduced to a minimum, and this necessitates a minimum of fluctuation in the properties of the raw materials since the machines do not (yet) have a "feeling" for the dough. Consequently, the flour producer, the mill, is considered responsible for uniform flour quality. This goal of standardization is achieved by the art of milling and with flour improvers. At bakeries, specialization of the flour is carried out by means of bread improvers. The ingredients used on both levels are often the same. The main difference lies in the dosage of the improver preparation: typically 10 - 100

ppm at the mill, 1,000 - 100,000 ppm at the bakery (0.1 - 10%). The continuous production of large amounts of flour at the mill requires additives with good flow properties as well as low dosages. This means that additives such as emulsifiers or fat powders that tend to form lumps are not suitable, and salt and sugar are not added at the mill either because of their high dosage. Flour mills generally apply single ingredients separately – only occasionally in premixes – whereas bakeries apply bread improvers composed of several additives. This chapter mentions the most common flour improvers. They may also be part of bread improvers.

18.3 Oxidation and Flour Maturation

The present necessity for oxidative treatment might be regarded as a disadvantage of the fast and gentle processing of grain into flour. Natural ageing of the flour by exposure to the atmosphere alone is no longer possible, so maturation has to be speeded up with oxidative preparations. Oxidation primarily affects sulphur containing amino acids that are constituents of the gluten. The oxidation of two adjacent hydrogen sulphide (thiol) groups results in the formation of a disulphide bridge between different sections of the long gluten molecule or between different gluten molecules. This causes a hardening of the protein.

18.3.1 Ascorbic Acid

By far the most important substance for this purpose is ascorbic acid (AA). Using a complex biochemical method starting with starch as the raw material it is produced in a very pure

form and sold as a fine or crystalline powder in various concentrations to facilitate dosing. Less often, AA of purely biological origin is used. The most common product is Acerola fruit powder, the dried juice of the Acerola cherry, with 17 - 19% pure AA. However, this more natural variant is up to 50 times more expensive than the synthetic product. Other substances on the market are AA obtained from rose hips and mixed preparations, some of them containing AA of biochemical origin.

At the mill, flour is treated with typically 0.5 - 3 g of pure AA per 100 kg. Very soft glutes or flours for certain applications (mainly frozen dough) require a larger dose of 6 - 10 g. AA does not act on the protein directly; it may be seen rather as an agent protecting against the loss of protein stability by counteracting glutathione, a reducing (softening) agent, that occurs naturally in the flour. This is only possible if AA is oxidized to dehydroascorbic acid (DHAA) at the beginning of the kneading process with the aid of the flour's own enzymes (i.e. ascorbate oxidase and glutathione dehydrogenase). In this process, glutathione is oxidized to glutathione disulphide, thus eliminating the gluten-softening effect of glutathione (Grosch and Wieser, 1999; Fig. 107).

Proof of an adequate quantity and homogeneous distribution of the product in the flour can easily be obtained with Tauber's reagent in conjunction with a Pekar test (Fig. 108). A convenient and storable set with the two solutions required is available on the market. Titration with iodine, which is more accurate but less convenient, is still common practice as well. In biochemical laboratories, test kits with ascorbate oxidase and also HPLC are used to determine AA very accurately.

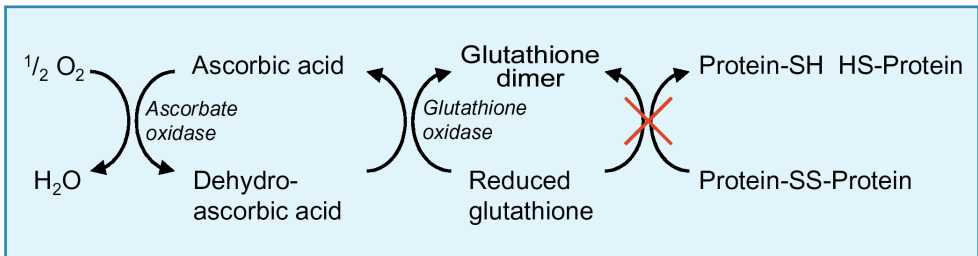


Fig. 107: Reaction of ascorbic acid in wheat dough (modified from Grosch and Wieser, 1999)