



**Mühlenchemie**

**makes good flours even better**

# Newsletter

**special**

**Flour Improvement**

Special Edition

INFORMATION FOR CUSTOMERS, PARTNERS AND STAFF

May 1998

## Flour Treatment in Europe

We are doubtless coming closer to a uniform European definition and regulation of chemical flour treatment, but nevertheless there is still a wide scope for the use of numerous generally approved additives for this purpose.

Examples of stricter provisions are the regulations on white bread enforced by France which state, for example, that "pain de tradition" may only contain yeast, leaven, gluten, soy or bean flour, maize flour and fungal amylases but not ascorbic acid or lecithin, and also Denmark's stringent approval regulations for enzymes that rather suggest protectionism.

The following article aims to provide an overview of the flour improvers most commonly used in Europe. It does not go into details of the differences between specific countries, as these will change in the coming years in any case.

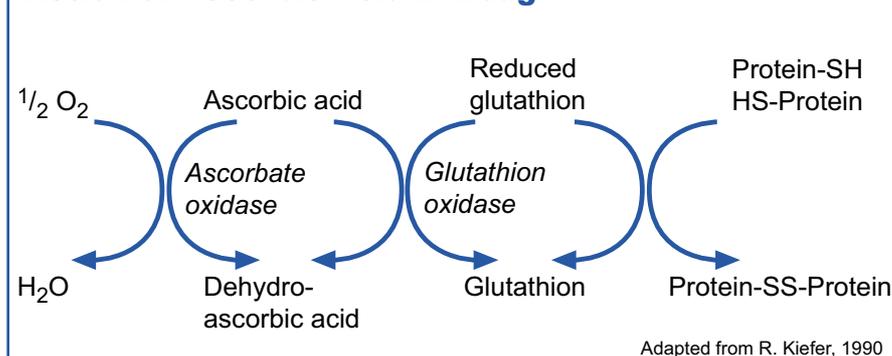
### 1. Oxidation

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, and we now have to speed it 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.

#### 1.1 Ascorbic acid

By far the most important substance for this purpose is ascorbic acid (AA). Using a complex biochemical method it is produced in a very pure form from glucose (grape sugar, dextrose) 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 (Barbados) cherry, with 17-19 % pure AA. Other substances on the market are AA obtained from rose hips and mixed preparations, some of them containing AA of biochemical origin. In all cases this more natural variant is much more expensive than the synthetic product (up to 50 times the price).

#### Action of Ascorbic Acid in Dough



At the mill, flour is treated with about 0.5 - 3 g of pure AA per 100 kg. Very soft gluters 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 protecting against a loss of protein stability by counteracting glutathione, that occurs in the flour naturally and has the opposite effect. This is only possible if AA is oxidized to dehydro-ascorbic acid (DHAA) at the beginning of the kneading process with the aid of the flour's own enzymes (ascorbate oxidase and glutathione dehydrogenase). In this process glutathione is oxidized to glutathione disulphide, thus eliminating the gluten-softening effect of glutathione. (see figure above).

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. 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.

## 1.2 Enzyme-active soy flour

One enzyme from soy flour, lipoxygenase, also has an oxidative effect on the protein of the gluten. During the oxidation of lipids by lipoxygenase, peroxides are formed that have a cross-linking effect on thiol groups. However, the gluten-strengthening effect of soy flour is comparatively slight; its bleaching effect (see below) is more important.

## 1.3 Glucose oxidase

The enzyme glucose oxidase (GOD) is usually derived from the mould *Aspergillus* (in a similar manner to amylase). Honey is also a rich source of GOD, but its suitability is greatly restricted by its taste. The enzyme enters the honey from the pharyngeal glands of the bees.

One effect of GOD in the dough is to oxidize glucose into gluconic acid with the aid of atmospheric oxygen (the slight souring that occurs in the process is negligible); its other effect is to transform water into hydrogen peroxide. This oxidizing agent also acts on the thiol groups of the gluten, causing them to tighten. The limiting factor in this process is the availability of oxygen. Besides other chemical reactions that consume oxygen, yeast also needs oxygen before starting its actual fermenting activity as it initially breathes instead of fermenting. This means that the conditions for GOD are really only good on the surface of the dough as plenty of oxygen is always available there. The problem can only be solved by technical measures during dough preparation, for example overpressure or the supply of extra oxygen.

A typical GOD preparation is dosed in similar quantities to other enzymes, i.e. 10 - 50 g to 100 kg flour (about 1,500 to 7,500 units of GOD), but this depends to a very great extent on the product and process.

## 1.4 Bromate

In Europe the powerful oxidizing agent bromate (more precisely: potassium bromate) may now only be used in flours for export.

Although it has a very long-lasting effect this effect starts later than that of AA and allows better processing of the doughs, for bromate clearly oxidizes glutathione only very slowly without the addition of an enzyme (cf. ascorbic acid). It results in very good fermentation tolerance and a high volume yield.

In the main, bromate acts directly on the gluten. Because of doubts about its effects on health it has gradually been replaced by AA since the 1950s. A further problem is that it accelerates fire and explosion (bromate is a constituent of fireworks, especially rockets).

In countries that are now replacing bromate, combinations of AA and enzymes offer good alternative ways of achieving satisfactory dough and baking properties.

Because of the low doses required (similar to AA or less) and its lower price, bromate can hardly be replaced without intervention by public authorities. Bromate is easily detected and determined semiquantitatively with a kit in a similar manner to AA.

## 1.5 Azodicarbonamide

For the sake of completeness, azodicarbonamide should be mentioned as well. This chemical foaming agent used in the manufacture of expanded plastics (not only does it have an oxidative effect, it also decomposes into large-volume gases upwards of 120 °C) has been used as a temporary replacement for bromate and in some cases still is. A great disadvantage is its low dosing tolerance; a slight overdose causes the bread to split badly,

although the properties of the dough are still good. The dosage is approximately similar to that of AA or bromate. Detection is carried out by releasing the gas. The product most often used – in a correspondingly larger dose – is azodicarbonamide mixed with calcium sulphate to reduce its inflammability, usually with 23 % of the pure substance.

## 1.6 Cystine

Cystine is the dimer of the amino acid cysteine (see below) in which two molecules of cysteine are linked by a disulphide bridge. This sulphur bridge gives the molecule a certain oxidative effect. But at low doses it is possible that the gluten may soften, as reducing cysteine is released when cystine reacts with thiol groups of the protein. Although this has yet to be thoroughly investigated, cystine is used in spite of its high price as compared to AA because it is occasionally found to have a positive effect on the properties of the dough.

## 1.7 Dehydroascorbic acid

DHAA is the oxidized form of AA. This means that if DHAA were used instead of AA it would be possible to dispense with the initial step of oxidation. Tests have shown that it is quite possible to use DHAA. One reason why it is so rarely used is its instability, but this could be improved by coating. A further problem is that it is more difficult and thus more expensive to synthesize. Finally DHAA was not included in the directives on additives in the European countries.

## 1.8 Chlorine and chlorine dioxide

Except in the UK and Ireland, these oxidizing agents are no longer used in Europe because of their possible harmful effects on health and the technical risks they involve. There is no doubt that with certain baked goods (for example cake with a high proportion of fat and sugar) chlorination of the flour – that can only be carried out at the mill – produces the best results. This is presumably the reason why the UK is using the enzymes almost as a pledge to achieve the authorization of chlorine and chlorine dioxide in the coming regulation on flour improvers.

## 2. Reduction

Gluten that is too short is difficult to process and results in a low volume yield, since the gas formed by the yeast is not able to expand the dough as it should. The problem can be solved by using substances with reducing properties that break down surplus disulphide bridges and thus give the protein molecules more room to move you might say they release them from their shackles. Short gluten properties may result from the varieties used, but they are sometimes caused by the storage and processing of the grain (overheating) or the use to which the flour is put (freezing shortens the gluten).

### 2.1 Cysteine

A suspected “opponent” of AA is cysteine, a simple amino acid

that is a constituent of all proteins and produced either by hydrolysis of extremely cysteine-rich proteins and complex purification procedures or by synthetic means.

As cysteine splits disulphide bridges like other reducing agents one would expect it to counteract the effect of AA if used at the same time. Initially it was only discovered empirically that this is not the case: AA and cysteine complement each other. One makes the gluten firmer while the other ensures adequate elasticity. This is possible – as it was proved later – because the two substances act on different constituents of the gluten and attack it at different sites.

The use of these flour improvers in frozen doughs, especially, makes it necessary to add very large doses of both substances, for on the one hand good fermentation stability is required (AA!) and on the other hand the deep-freezing process shortens the gluten, a problem that can be solved at least in part by cysteine. The amount of cysteine added is often two-thirds of the quantity of AA. The cost of this method is quite considerable, as the prices of cysteine fluctuate greatly and in some cases have even exceeded 100 DM. Cysteine is usually sold as anhydrous L-cysteine hydrochloride or L-cysteine hydrochloride monohydrate, as it is more easily synthesized and has better water-solubility in this form.

Sodium nitrocyanoferate / ammonium hydroxide can be used for detection, but this is an unreliable method as the blue spots are sometimes difficult to see and fade quickly.

## 2.2 Reducing yeast preparations

Yeast also produces reducing substances, but these are only released when the cells die. There are now preparations made of inactivated, killed yeast on the market that have a softening effect similar to that of cysteine. But as the dose required is about 100 times as high (100 - 1,000 g to 100 kg), even the lower price (about 1/10 and above) cannot make up for it. This is true even of so-called glutathione yeast, a variant with a very high reductive potential. So one might say that the main advantages of inactivated yeast are in the field of labelling.

## 2.3 Sodium metabisulphite and sulphur dioxide

Both sodium metabisulphite (MBS) and sulphur dioxide are now approved in the UK and Ireland only. However, MBS is still used occasionally in Spain. These powerful reducing agents are especially good at breaking down the gluten fast and reliably, which greatly simplifies the production of biscuits, crackers and wafers. But as these substances are known to destroy vitamin B1 (thiamin) their use should be avoided. Alternatives based on enzymes are now available; they achieve the same results but react rather more slowly and require more knowledge on the part of the user.

## 3. Enzymes

Enzymes have been in common use in the food industry for many years. In contrast to most other applications in which enzymes

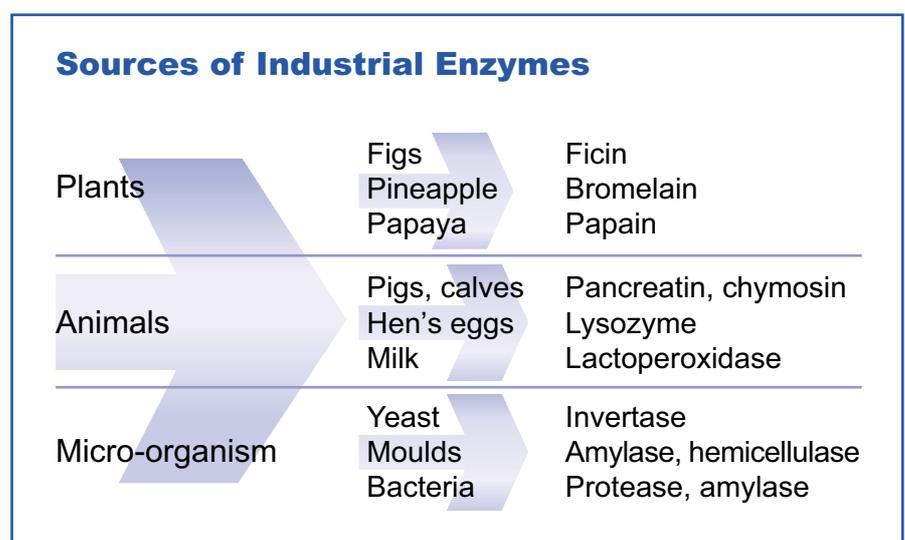
find their way into foods, the enzymes do not in this case react at the place where they are added (in the mill); they do not take effect until the baker adds water. This difference of time and place is a great challenge to the flour treatment sector in general, but in the case of enzymes it is an especially complex matter. On the other hand enzymes are highly specific; that is, if they are pure enough they act on selected targets and only have to be added in small quantities. Moreover, they are entirely natural as they can only be obtained from micro-organisms by way of fermentation or from vegetable or animal tissue and fluids by means of extraction. Like all highly concentrated natural substances enzymes have a strong potential for causing allergies. For this reason care must be taken during processing that as little enzyme dust as possible is inhaled. In Germany, most enzymes are defined as "technical aids" with no significance in the end product and as such do not have to be declared on the label. But clearly the time will come when enzymes require declaration too as the

European regulations become standardized.

At least fungal amylases are generally approved in all the EU countries except Denmark. Where other enzymes such as hemicellulase or protease are not yet expressly approved they are at least tolerated as "side activities". The UK does indeed recommend an analysis by the COT (Committee of Toxicity), but it has not so far prohibited the use of untested enzymes. Amylases and proteases are generally approved in the UK too.

## 3.1 Amylases

Amylases split unbranched sections of the starch molecule into smaller components. Like all enzymes, amylase only acts on dissolved substrate, i.e. swollen, damaged starch in the dough. This reduces the viscosity of the dough and improves its processing characteristics. The short-chain dextrans formed by the action of  $\alpha$ -amylase serve as a substrate for  $\beta$ -amylase or amyloglucosidase; these in turn split off sugar (maltose, glucose) that can be used by the yeast.



This chain of reactions increases fermenting power and thus volume yield, enhances flavour and browning and prolongs shelf life.

### 3.1.1 Enzyme-active malt flour

Like all other living material, grain needs enzymes for its vital functions. As it does not come back to life, so to speak, until germination, this is the phase when enzymes are produced in large quantities. Bakers and brewers have long put this characteristic to use by germinating cereals before processing them further. Malt flour is the dried product made from germinated barley or wheat. Although the functions are largely identical, approvals for use in flour treatment differ from one country to another. France, for example, only permits malt flour made from wheat. Malt flour contains primarily  $\alpha$ - and  $\beta$ -amylase, but it also contains protease, glucanase and many other enzymes. Some of these may have a positive effect on the baking process (amylases, glucanases), but they can also cause damage (proteases). Like the flour's own amylases, the amylase of the malt flour has a pronounced effect on the falling numbers. If the falling numbers are very high (i.e. the flour's own enzymatic activity is very low), anything up to 150 g of malt flour to 100 kg of flour may be needed to bring the falling number into the range of 250 - 300 s. With falling numbers around 300 s, no more than 50 g should be added to prevent the doughs from becoming too sticky. The activity of malt flours is often expressed in DP for diastatic power and is

usually 400 DP, but occasionally it is stated in SKB/g (see under fungal  $\alpha$ -amylase) and is in the range of 80 to 100.

### 3.1.2 Fungal amylase

Moulds of the genus *Aspergillus* are often used in the production of enzyme preparations for applications in foods as this genus includes numerous well-described strains that have no detrimental effect on health. This is important, for in addition to producing the desired enzyme the moulds might otherwise give off toxins that would then find their way into the finished product. In large fermentation equipment the moulds are made to produce amylase and give it off into their environment (the culture medium) as far as possible. A multi-stage purification process (centrifugation, filtration, ultrafiltration) then results in a crude enzyme concentrate that is usually spray-dried to form a powder with a good shelf life. Various carriers – mainly maltodextrin, starch or flour – are added to make the substance more convenient to use at the mill (dosing, flow properties). Fungal amylase is usually  $\alpha$ -amylase. Most side activities can be eliminated in the production process. In contrast to the cereal amylase in malt flour it has only a very slight effect on the falling numbers since it reacts more sensitively than cereal amylase to the high temperatures at which the falling number is determined and is inactivated before it can break down the starch gel. The dosage of  $\alpha$ -amylase depends on its concentration, or more precisely its activity. The usual international unit is “SKB

per gram”, named after Sandstedt, Kneen and Blish who developed the determination method. Many manufacturers do in fact use the units from their own assays, but they can usually express them in terms of SKB/g if wished. A typical dose for a wheat flour that is neither sprout-damaged nor treated with malt flour is 250 - 500 SKB per kg of flour (i.e. 5 - 10 g of an amylase with 5,000 SKB/g to 100 kg of flour). But even in the case of flours with a very low falling number it is sometimes useful to add small amounts of fungal amylase (1 - 2 g at 5,000 SKB/g) as this slightly improves the properties of the dough and the results of the baking process without affecting the falling numbers.

### 3.1.3 Amyloglucosidase (glucoamylase)

Amyloglucosidase (AMG) is a natural side activity of many amylase preparations, but it can also be obtained in a purer form from specialized *Aspergillus* strains. AMG breaks down starch into its smallest subunits, namely glucose. And in contrast to  $\alpha$ -amylase it does not stop at branched molecules (amylopectin). But it would take a very long time to reduce viscosity through the effect of AMG alone, as the enzyme only acts on the starch from one end and only splits off a single glucose molecule at a time. This means that the main significance of AMG lies in browning and in maintaining the fermentation process over an extended period (controlled fermentation). As it always occurs in conjunction with  $\alpha$ -amylase, AMG is usually dosed in very small amounts (less than 0.1 g to 100 kg).

### 3.1.4 Hemicellulase

Wheat flour contains about 2.5 % pentosans (rye flour about 7 %) that can bind up to ten times their weight of water. These pentosans belong to the category of the hemicelluloses, relatives of cellulose, and are made up of different sugar molecules (including glucose, xylose and arabinose). Hemicellulases (synonyms: pentosanase, xylanase) break these substances down. Initially this process leads to the formation of soluble molecules from pentosan, which is suspended in water but insoluble, and this increases the binding of water and thus viscosity. These molecules are broken down still further as the process continues; water is released and the viscosity reduced. It is assumed that pentosans form a network with gluten; the more pentosans are involved, the firmer is the network.

This is why darker wheat flours and mixtures containing rye flour have a lower volume yield. The volume yield can be increased

considerably by adding hemicellulases. Hemicellulases have little effect on the falling numbers, but their activity can sometimes be recognized very clearly in the amylogram (lower T and AU) and in the extensogram where some hemicellulases cause a change in the curve similar to that produced by cysteine but without any breakdown of the protein. Most of these enzymes are also derived from *Aspergillus* strains, but these are strains that have been selected for or specialized in the production of hemicellulases.

Hemicellulases are mostly sold in compounds with amylase. It is not possible to give a general dosage recommendation as there is no standard method of determining hemicellulase activity. The available methods are usually based on determining the release of reducing sugars, the reduction of viscosity or the breakdown of synthetic or coloured molecules and are very difficult to relate to each other. Moreover, even the use of a standard method for different hemicellulases does not necessarily permit conclusions in respect of baking properties. Presumably the points at which hemicellulases of different origin attack the pentosan molecules are too various.

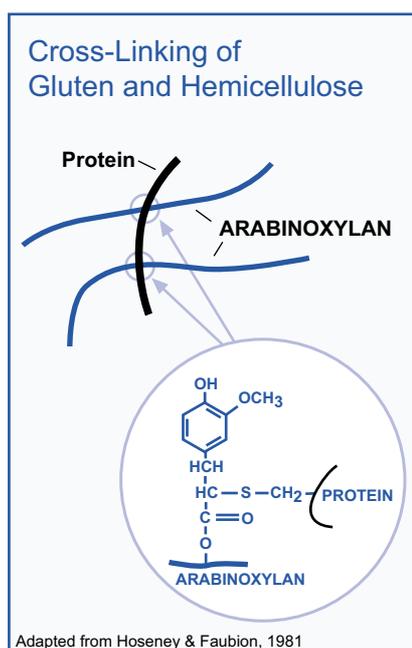
### 3.1.5 Protease

Protease (also proteinase or peptidase) splits the protein strands of the gluten molecule and thus leads first to a softening and then to a complete collapse of the structure. With short gluten structures a slight softening may well be desirable; in this case it has a similar significance to the

use of cysteine. But unlike the amino acids, protease does not stop acting when the additive is used up. As a result, its effects increase with the fermentation time of the dough. This is why there is a considerable demand for enzyme preparations that do not contain even traces of protease. The use of protease is less of a problem with flours that are rich in gluten. Furthermore, proteases are very useful in the production of biscuit or wafer flours. With these the elasticity of the gluten is undesirable; sometimes even the complete suppression of gluten formation is necessary. Here protease also makes it possible to use greatly fluctuating raw materials as it gives them uniform technical characteristics.

### 3.1.6 Other enzymes

Glucose oxidase is often mentioned, and has already been described above under "oxidation". The literature also contains frequent references to lipase. This enzyme splits fats into mono- and diglycerides. Theoretically this should lead to the formation of in situ emulsifiers with the well-known effects described below. But quite apart from the inconsistency of the information given in the literature (it is disputed whether the doughs have to contain additional fat, and if so what kind of fat) there is also the problem of a possible impairment of taste due to the release of fatty acids. Phospholipases, arabinofuranosidase and transglutaminase have also been tested for their possible suitability as flour improvers, but they have not yet been used on a large scale. The development of

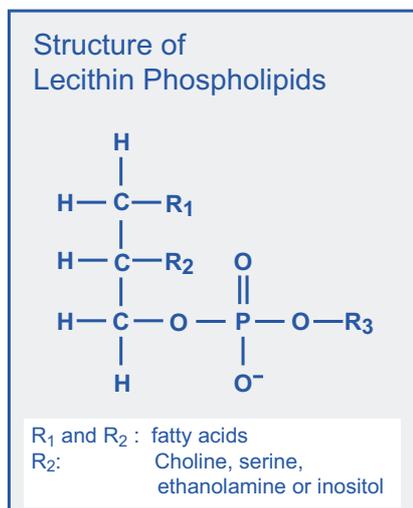


microbial lipoxygenase as an alternative to the enzyme in soy and bean flour is a further highly interesting topic. Initial approaches failed because of the unsuitable pH optimum of the microbial enzyme and presumably the fact that it is not type II lipoxygenase. Only the latter is capable of oxidizing and thus bleaching carotenoids in the flour.

## 4. Emulsifiers

### 4.1 Lecithin

Bakers, especially, have been



familiar with lecithin longer than with any other emulsifier. At first it was mainly the effect of lecithin from egg yolk that was used to distribute large amounts of fat evenly in the product and achieve a finer crumb and higher baked volume, but now concentrated lecithin from soybeans is available for this purpose. In its deoiled form it is also well suited for use in mills. The most obvious benefit of lecithin is probably the noticeably drier surface of the dough; bound up with this is better machinability, that is also a result of greater smoothness.

The interaction of lecithin with the starch and its ability to bind water also prolong the shelf-life of the crumb. Lecithin also has a positive effect on volume yield, but in this respect it tends to fall behind synthetic emulsifiers such as diacetyl tartaric esters of mono- and diglycerides (DATEM). A trend towards slightly lower volume yields observed in some parts of Europe is likely to increase the use of lecithin again. Moreover, lecithin fractions are available that offer the advantage of being natural emulsifiers with properties specially adjusted to specific applications.

The dosage of lecithin for flour treatment is in the range of 30 - 150 g to 100 kg of flour. Such low doses mainly have the effect of improving the processing characteristics of the dough, whereas a considerably larger dose increases the stability of the dough and fermentation tolerance.

### 4.2 Mono- and diglycerides

Mono- and diglycerides are produced by splitting off two fatty acids or a single fatty acid from edible fats and oils. By selecting the fatty acids left on the glycerol backbone it is possible to produce emulsifiers with greatly differing properties. For flour treatment there is mainly a demand for the mono- and diglycerides with good anti-staling properties. These are most often found with linear, saturated fatty acids that interact well with starch and thus slow down the staling process. In other respects, too, these emulsifiers have similar effects to lecithin, namely greater volume yield and a finer crumb. With fat-rich products, especially,

the dose required may be up to 1 % of the flour.

### 4.3 Emulsifier complexes

In many cases it is possible to enhance the properties of an emulsifier by combining it with another emulsifier. An example of this is the mono- and diglycerides, that only achieve their optimum suitability for use in flour treatment through combination with lecithin. The lecithin improves their flowability, solubility and dispersion and clearly their interaction with constituents of the flour as well. Well-known and widely used "organic" flour improvers fall into this category. The combination makes it possible to reduce the dose necessary for optimum effect to 100 - 300 g with 50 % emulsifier in the complex. Diacetyl tartaric esters of mono- and diglycerides are also receptive to enhancement with lecithin: the addition of as little as 10 % lecithin improves their emulsifying effect and also reduces the vinegar smell. The above combinations are only effective if the emulsifiers are mixed before being converted into their powdered form. Interestingly, it is not sufficient just to mix the individual powdered components.

### 4.4 Diacetyl tartaric esters of mono- and diglycerides (DATEM)

One very effective group of emulsifiers in respect of volume yield is mono- and diglycerides of edible fats esterified with mono- and diacetyl tartaric acid. DATEM is one of the main constituents of most baking

improvers, especially when the aim is to produce voluminous baked goods with a crisp crust. In Europe, DATEM esters are not often used in flour treatment. The optimum dose is about 300 - 400 g to 100 kg.

#### 4.5 Sodium and calcium stearylactylate (SSL and CSL)

Under the new "Miscellaneous" directive, these emulsifiers (made from the fatty acid stearic acid esterified with a double ester of lactic acid) have now been approved as food additives throughout Europe. The remarks concerning DATEM also apply to these, but with the difference that SSL and CSL are especially suitable for baked goods with a soft crust.

### 5. Acidulants and acidity regulators

Sprouting in rye and wheat results in a high level of amylase activity in the corn itself with the usual effects on baking properties. It is generally known that even flours with very low falling numbers produce good baking results if well acidified. But for one thing acidity is not something every European likes, and for another the bakeries have less and less time and available personnel. This means that other ways and means had to be sought.

By adding fruit acids and the salts of these and also carbonates and phosphates approved for use in foods it is possible to adjust the pH of the dough slightly so that it moves out of the range in which the enzymes of the grain have their strongest effect. Moreover, these

substances influence the swelling of the flour constituents, and this helps to counteract the negative effects of excessive enzyme activity (e.g. water release). The most suitable preparations are those that stabilize the pH at the level to which it has been adjusted, i.e. so-called buffer substances. Examples are mixtures of the salts of fruit acids. In most cases the dosage is in the typically low range for flour treatment, that is about 50 to a maximum of 200 g to 100 kg of flour.

Nevertheless, with the inorganic phosphates and carbonates care has to be taken not to exceed the limits of the flour grades, as these substances pass into the ash. With sprouted grain it is in any case advisable, whatever the treatment, to use a smaller proportion of the enzyme-rich outer layers of the grain and produce lighter-coloured flours that then tolerate the addition of flour improvers containing ash.

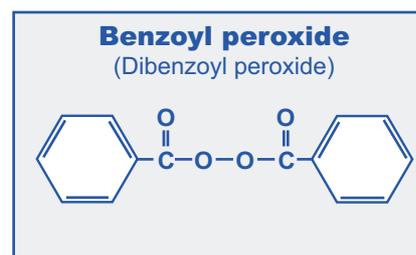
### 6. Bleaching agents

Although we are now aware of the importance of roughage, minerals and vitamins there is still a demand for a very light-coloured crumb in many wheat products. This is true of a wide range of baked goods from Arabian bread and baguettes to toast slices. Even the German language bears witness to the low opinion our travelling neighbours once had of the dark bread made from rye flour that is so popular in our country. Pumpernickel (pain pour Nickel); apparently Nickel was the name of the horse ridden by Napoleon, the first. The flavonoids responsible for the colour can be bleached with oxidizing agents.

### 6.1 Benzoyl peroxide

For a long time benzoyl peroxide was a familiar oxidative bleaching agent, and it is used to this day in flours for export.

In addition to its good bleaching effect it has a slight influence on the structure of the gluten, but this is not apparent when other flour improvers such as AA are used.



The dosage for benzoyl peroxide is about 5 - 10 g to 100 kg of flour. It is usually sold as a 30 % product, and the dose is then correspondingly higher. The effect of benzoyl peroxide on the flour is already visible after 24 to 72 hours of storage.

### 6.2 Enzyme-active bean flour and soy flour

Only enzyme-active flour made from soy or faba (horse) beans may now be used throughout Europe to achieve a light-coloured crumb. The quantity that can be used is very much limited by another enzyme urease that is present as a side activity. This causes an undesirable, bitter taste. For this reason the maximum quantities used are usually 0.5 % for soy flour and 2.0 % for faba bean flour. The classic application for soy flour is doubtless baguettes, in which it is increasingly replacing the less effective bean

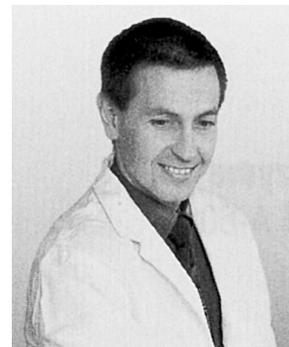


flour. A typical dose of 0.5 % already has a definite bleaching effect. It is used at about the same concentration in flours for toast slices and flat bread.

### **6.3 Other agents with a bleaching effect**

The brightening effect noticed when ascorbic acid or emulsifiers

are used has a physical cause: the finer texture changes the reflecting properties of the crumb and the colour appears lighter. On the other hand strong oxidizing agents such as bromate or chlorine really do remove the colour from the dark pigments, although this is only a desirable side-effect.



*Dr. Lutz Popper*