8

Laminated products

8.1 What causes puff pastry to rise during baking?

Most of the lift in puff pastry comes from the water vapour generated from the water held in the dough layers which when converted to steam becomes trapped in the melting fat between the dough layers (see Fig. 23). The thickness of the dough layers changes little during baking and makes no significant contribution to pastry lift.

Expansion of the paste can occur only if the dough layers are separate and discrete from the fat layers. Any strong bridges between the dough layers, such as may be caused when adjacent layers are crushed together in sheeting, restrict

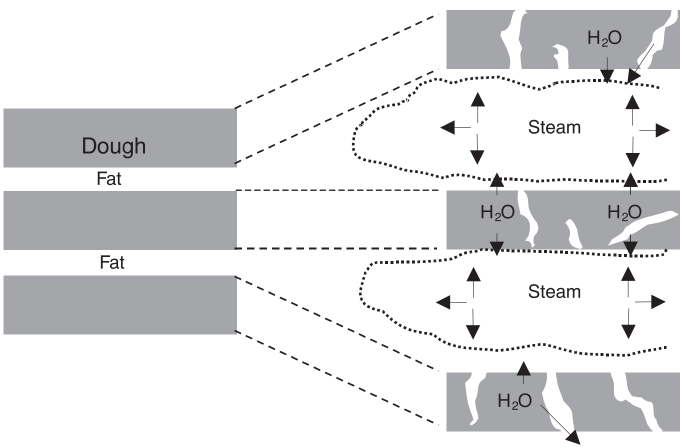

Fig. 23 Mechanism for puff pastry lift.

the rise that can be obtained. However, if no crushing occurs then the baked pastry may be so flaky that it falls apart after baking.

Most of the expansion of puff pastry occurs in the first half of the baking time but more water must be driven off before the pastry is set firm enough to stand without collapsing (Cauvain and Young, 2000).

Many factors contribute to the degree of puff pastry lift and some of these are discussed in other questions below.

Reference

CAUVAIN, S. and YOUNG, L. (2000) *Bakery Food Manufacture and Quality: Water control and effects*, Blackwell Science, Oxford, UK.

8.2 Why do we get a less regular lift in our puff pastry when we use the Scotch method compared with the English or French?

The so-called Scotch method of producing puff pastry differs fundamentally from the English or French in that the laminating fat is added at the dough-making stage rather than later in the process. To achieve this the laminating fat is usually cut into small cubes, with sides of about 20 mm, and added to the mixing bowl along with the other ingredients. After mixing, the paste will be sheeted and laminated in a similar manner to paste prepared by the other two methods.

Telloke (1991) used light microscopy and dye-stained laminating fat to study the layer formation in puff pastry and showed that the distribution of laminating fat between dough layers was less structured in paste made with the Scotch than with the English or French methods. This is hardly surprising since we would expect that the initial mixing of dough ingredients and laminating fat would effectively prevent the formation of separate and discrete dough and fat layers.

Variations in pastry lift with the Scotch method are common because of the lack of uniformity in the paste, and the overall pastry lift will be less than might be obtained with the English or French methods. Because of the variation in pastry lift it is not common practice to use Scotch method paste, for products such as vol-au-vent rings or other shape-sensitive products. Scotch method paste does find use within products such as the British sausage roll where a flaky eating character but restricted lift is required of the paste. Often the number of laminations given to Scotch method paste will be increased beyond that seen with English or French methods in order to help distribute the fat lumps as evenly as possible within the paste structure.

A benefit of using the Scotch method is that because discrete dough layers are not a feature of the method long paste relaxation times can be avoided and so it provides a more rapid means of making puff pastry products.

Reference

TELLOKE, G.W. (1991) Puff pastry I: Process and dough ingredient variables. *FMBRA Report No. 144*, CCFRA Chipping Campden, UK.

8.3 We are experiencing a problem with our puff pastry, which fails to lift and shows no sign of layering on baking. Why is this?

The layered structure in puff pastry relies on the formation of discrete and separated layers of fat and dough. The mechanism by which puff pastry rises relies on this separation as described above (see 8.1) and any number of ingredient, recipe or processing changes may cause the problem.

We suggest that you examine the following:

- The solid fat content of the fat that you are using since fats with low contents can result in poor lift.
- The number of laminations you are giving the paste. Too many laminations cause the fat layers to rupture and allow the broken dough layers to stick together and reduce lift.
- The application of any docking mechanisms because excess pressure or large numbers of docking holes can pin dough layers together and restrict expansion.
- Your oven temperature, as higher temperatures encourage lift. You should bake at around 230 ºC.

You can increase pastry lift by using a stronger flour, provided sufficient rest is given to achieve the optimum dough rheology during processing and before baking. Low levels of an oxidising agent, e.g. ascorbic acid, may help but you should note the comments on pastry shrinkage (see 8.2 and 8.5).

8.4 What are the purposes of the resting periods in the production of laminated products?

The rheology of the base dough is very important to the formation of the discrete dough and fat layers in the manufacture of laminated products. The successive sheeting and lamination stages during manufacture continue to change the dough rheology because of the work that is imparted, especially by the sheeting rolls. The overall effect of the work is to increase the dough elasticity and to reduce its extensibility and this may lead to tearing or breakdown of the individual dough layers. The holes that form in the dough sheet provide a ready escape route for the steam generated during baking and this restricts the pastry lift that can be obtained.

If a dough is left to rest after mixing or some other form of work its rheological character changes with time. In particular its character becomes less elastic and more extensible and the effects of subsequent sheeting are less severe. Thus, a key role for the resting period is to modify the dough rheology so as to preserve the separation of dough and fat layers so important to the formation of laminated product structure.

The degree of change in dough rheology is influenced by temperature and varies with different flours. Strong flours, that is ones high in protein or with strongly elastic glutens, require longer periods of relaxation than weaker ones to achieve the necessary rheological changes for optimum product quality. This change in rheological properties with resting time is linked with the natural natural reducing agents (glutathione) and enzymic activities in the flour.

In the case of strong flours, some resting time is required to achieve optimum pastry production while with weaker flours less resting time is desirable. While weaker flours are more suited to rapid processing they are less tolerant to plant delays. These observations allow us to conclude that weak flours are more suited to rapid processing methods but will not be tolerant to plant delays.

8.5 We have been experiencing some problems with excessive shrinking of our puff pastry products. What are the probable causes?

Some shrinkage of puff pastry during baking is inevitable, though it can be minimised. It is also important to recognise that in most cases puff pastry lift and shrinkage are linked with greater lift, often leading to greater shrinkage and vice versa.

Causes of excessive shrinkage may come from a number of recipe and processing sources, including the following:

- The flour is too strong for the processing methods being used. Strong flours require longer resting periods than weak flours in order for the dough rheology to become optimised for sheeting and laminating.
- Oxidants, such as ascorbic acid, may be present in the flour or dough formulation.
- The pH of the dough is too low because of the addition of acidic materials (see 8.6).
- The sugar level, if present, is too high.
- The level of recycled trimmings in the paste is too high. This is especially the case if the trimmings are added at the sheeting stage rather than in the mixer.
- Insufficient relaxation of the paste during the processing stages whatever the flour strength. This often applies to the stage after cutting out and before the product enters the oven.

Shrinkage may be overcome to some degree through the addition of a reducing agent, such as sodium metabisulphite or L-cysteine hydrochloride, or a proteolytic enzyme.

However, since such materials remain relatively active in the paste the effect in recycled trimmings may lead to excessive softening of the paste. We recommend that you try to reduce shrinkage by other means before considering the addition of such materials.

8.6 Why are acids sometimes added to puff pastry?

The acidification of doughs was commonly seen as a means to 'strengthen' the flour gluten, making it more pliable and extensible, which, in turn, would lead to extra pastry lift. While it is certainly true that puff pastry lift is increased by the addition of a suitable food-grade acid (see Fig. 24), there is also a tendency for pastry shrinkage to increase. With high levels of acid addition shape-critical products (e.g. vol-au-vent rings) may expand excessively and non-uniformly in the oven and may topple over during baking.

The optimum level of acid addition varies according to the type of acid and the flour being used. Variations in pastry shrinkage from the addition of a given level of acid to a range of flours are usually greater than variations in pastry lift. The reasons for the variations are not clear but are most likely to come from variations in the natural buffering effects of different flours (i.e. variations in paste pH) and the rheology of the gluten.

Where possible greater pastry lift should be sought through other means (see 8.3) rather than through the addition of an acid to the dough.

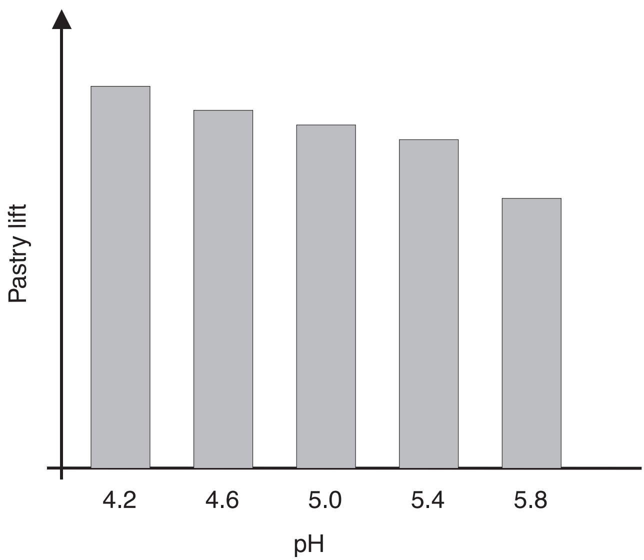

Fig. 24 Effects of pH on puff pastry lift.

8.7 How should we handle the trimmings we get during the production of puff pastry shapes?

The production of trimmings from the manufacture of many puff pastry shapes is inevitable and it is perfectly acceptable to recycle them provided a few simple rules are followed. The trimmings contain naturally occurring microflora which become active in the paste and during any standing periods before reuse. The changes brought about by microflora include:

- lowering of the pH of the trimmings;
- softening of the trimmings because of proteolytic enzyme activity;
- the development of musty and off-odours;
- the growth of unsightly microbial colonies which can cause paste discoloration.

In the case of Danish pastry and croissant the presence of bakers' yeast in the dough will also influence the effects of trimmings on product quality. All the above microbial activities are temperature- and time-dependent and proceed faster at higher temperatures and become more pronounced with longer times.

To use trimmings successfully we suggest the following guidelines:

- Recycle trimmings by adding them to the mixer rather than trying to add them at the sheeting stage. Addition at the mixing stage ensures their uniform dispersion and should avoid problems with uneven layering and shrinkage.
- Keep all trimmings at refrigerated temperatures (4 °C) until required for use to minimise microbial activity.
- Allow a reasonable length of time for the trimmings to warm before reuse to avoid adversely affecting dough or paste temperatures.
- Every three or four days stop using trimmings to avoid excessive build-up of microbial activity in the paste.

8.8 We are experiencing a problem with the discoloration of unbaked puff pastry stored under refrigerated conditions. Sometimes black spots appear on the surface. Why does this happen and how can it be avoided?

The discoloration and dark spots that you see comes from enzyme-assisted oxidation of the polyphenols naturally present in the flour. These polyphenols are associated with the bran particles that come through from the milling process for white flour. The greater the level of bran present in the flour, the greater will be the number of black spots, and the larger the bran particle size, the larger the spot.

While enzymic activity is reduced as the storage temperature is lowered there is still sufficient activity at refrigerated temperatures for the problem to be manifest because of the long storage time involved. One possible way to avoid the problem would be to lower the storage temperature even further, perhaps even low enough to freeze the paste. However, using this approach you will have to ensure that the paste is sufficiently defrosted for subsequent processing.

Other means of minimising the problem include:

- excluding oxygen such as by storing the paste in gas-tight film;
- adding ascorbic acid, though this may adversely affect pastry lift and shrinkage (see 8.6);
- adding citric acid at low levels, i.e. up to 0.2% flour weight, but this too may adversely affect pastry lift and shrinkage, and flavour (see 8.6).

The easiest and most reliable solution is to change to a white flour with a lower level of bran present (e.g. lower grade colour figure or lower ash).

The addition of low levels (5–15 ppm) of glucose oxidase is claimed to prevent the formation of spots and general discoloration of fermented and non-fermented doughs after freezing and thawing (Unilever, 1992).

Reference

UNILEVER NL (1992) *Improved doughs*, European Patent Application 0 469 654.

8.9 We wish to make croissant with the moulded ends joining to form a circle but find that they open up during baking. How can we overcome this problem?

During sheeting and processing the rheology of the paste changes because of the work that is done on the laminated dough. After work doughs tend to become more elastic and less extensible in character. The relaxation periods that commonly follow sheeting and laminating allow the paste to 'relax', that is become less elastic and more extensible. In a simple shape, such as a vol-au-vent ring or a square, the elastic component of paste rheology manifests itself as an eccentricity of shape, i.e. one side or radius shrinks more than the other. Thus is not uncommon for a round vol-au-vent ring to become oval or a square shape to become rectangular.

In more complicated shapes, such as croissant, other changes may be observed when the dough is too elastic and these may include the opening-out of the circular shape. Increased paste elasticity may be overcome in a number of different ways including:

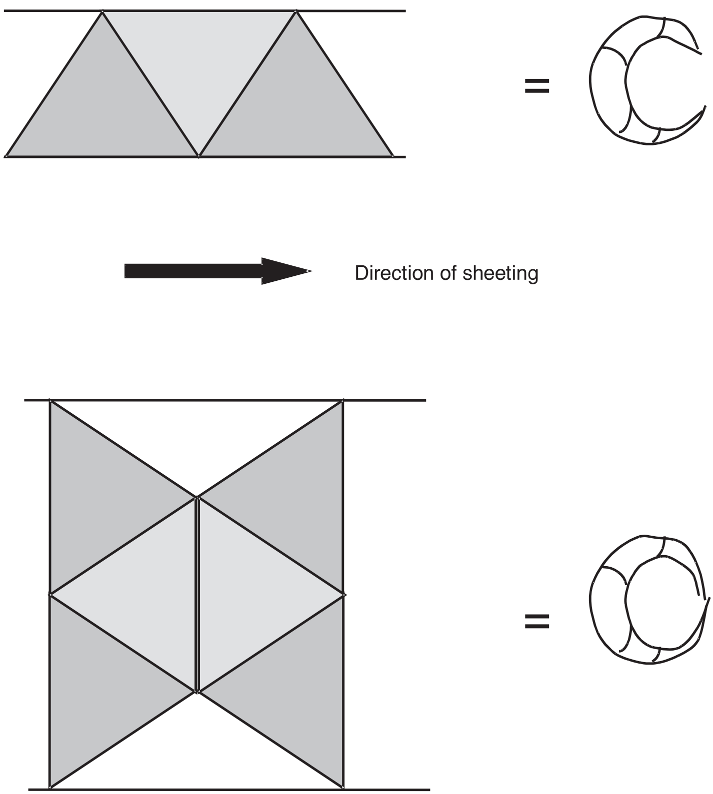

Fig. 25 Effect of direction of cutting on croissant quality.

- higher water levels in the base dough;
- a weaker flour;
- longer resting periods after sheeting and lamination, especially if strong flours are used;
- a suitable resting period after the formation of the circle and before the croissant enters the oven. This usually occurs in the prover.

The complicated shape of a croissant and the manner in which it is cut from the paste sheet can play a very important role in controlling shape. Towards the end of processing much of the roller action on the paste is in one direction, that is in the direction of travel on the plant. The apex of the triangular shape required for croissant before it is rolled up may be cut either in the direction of travel or at right angles to it (see Fig. 25). In the latter case the stresses within the curled piece can often lead to the problem you describe. If you cannot change the direction of the cut we recommend that you employ a cross-pining roller, that is one that moves at right angles to the travel of the plant to even out the stresses.

8.10 Why should croissant and Danish pastry doughs be given less lamination than puff pastry?

A key difference between puff pastry and Danish pastries and croissant is the presence of bakers' yeast in the latter two products. The yeast plays a significant part in the aeration of the paste during proving and baking but also disrupts the integrity of the dough and fat layers in the paste. In order to counteract this disruption of the dough layers and retain a degree of flakiness in the eating quality of the product it is necessary to keep the dough and fat layers thicker than would be normal with puff pastry.

Telloke (1991) suggested that optimum lamination for puff pastry occurred with about 100 to 130 theoretical fat layers, while Cauvain and Telloke (1993) suggested that the optimum for Danish pastry and croissant was between 18 and 32.

The aerating effect of yeast places a significant strain on the gluten network in the dough during proving. Higher yeast levels and longer proving times are likely to cause greater rupturing. It is important to ensure that the gluten network in the dough has good extensibility otherwise the baked products will lack volume and definition. This may require an increase in the strength of the flour used.

References

CAUVAIN, S.P. and TELLOKE, G.W. (1993) Danish pastries and croissants. *FMBRA Report No. 153*, CCFRA, Chipping Campden, UK.

TELLOKE, G.W. (1991) Puff pastry I: Process and dough ingredient variables. *FMBRA Report No. 144*, Chipping Campden, UK.

Further reading

BENT, A.J. (1998) Speciality fermented products, in *Technology of Breadmaking* (eds S.P. Cauvain and L.S. Young), Blackie Academic & Professional, London, UK, pp. 214–239.