Bread Flavour

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When invited to present bread flavours at today's conference, I saw three ways to pitch it;

One: The chemistry of flavour generation,

Two: A sales promotion for Puratos' bread flavour range or Three: To remind everyone of the lost flavours in many of today's breads.

Fortunately I am not a chemist, which ruled out option one.

Unfortunately (for my career progression at Puratos) I am not here to sell Puratos bread flavours, which ruled out option two.

However I am a baker, so my presentation today looks at the lost flavour in many breads we are accustomed to eating today, by reviewing what contributes to the flavour of bread.

For many reasons including process changes, eating habits and economics, flavour has gradually reduced, even forgotten, in bread. I would imagine now that our younger generation has not experienced sponge or sourdough flavour in bread.

I wonder how many consumers today eat bread on its own. I personally would always eat bread with my meal, therefore would purchase flavoured bread. The flavoured examples we do find are generally speciality breads from around the world; such as Ciabatta, Baguettes, San Francisco Sourdough.

The English breads available today are relatively bland, but when you consider how they are used; sandwich carriers with meats, cheeses, spices etc., then bread flavour could be considered pointless. This is typically the 800g tin bread. It offers a practical solution as a casing around the filling. It is also used extensively for toasting.

When more exotic breads are used to compliment the fillings, they are positioned in the 'Premium' range commanding higher prices. For me, the difference between the

two bread types is wide. If we could make all bread in the 'Premium' category maybe we would help raise some of the lost profile of our industry.

Back in time, bread was baked from a long fermentation. Mainly because the baker had to grow his own 'wild' yeast in order to leaven bread. When bakers yeast became available on the market, shorter processing times were possible. The combination of shorter fermentation and the development of high performance automated processes contributed to lack of bread flavour and aroma.

I came across this nice description of flavour from a colleague. It seemed apt for today's presentation.

"Flavor is one of the most appreciated sensory attributes in bread, the term comprising the total sensation experienced by the consumer; aroma & taste perceptions, tactile sensations and external aspects" (Caul, 1972)

Let us consider how bread flavour is generated.

There are different stages in bread manufacturing, which influence the flavour profile of bread products which are:

- Ingredients
- Recipe and Method
- Fermentation
- Bread Shape
- Baking Process and
- Shelf Life

I shall now talk through each one.

Ingredients

Flour, whether wheat or rye, plays a big role in flavour development. Wheat and rye have their own unique flavour profiles and they also contain enzymes and starch, which contribute to fermentation. One could ask the question; are new wheat varieties deficient in flavour compared to ancient wheat varieties?

Salt contributes greatly to bread flavour. Levels of salt addition will vary with regions, for example, Scotland preferring higher levels. Bread made with very low salt levels is bland, almost inedible to some. Salt also affects dough formation and yeast activity.

Water itself does not impart flavour but without this the formation of fermentable dough is not possible. Water quality and temperature must be controlled.

Yeast in its raw state has flavour, whether pleasant or not, is debateable? Its role in fermentation generates more flavours. However, modern process methods used today have reduced this fermentation time to enable the production of the most economical bread, reducing the associated flavour development.

The fermentation process uses enzymes in the yeast not only to convert starches to sugars and eventually carbon dioxide (gas production) and ethanol, but also to transform amino acids, liberated from the flour protein into aromatic alcoholic compounds and esters with very powerful fruity flavours. In turn, this will impart flavour to the baked bread. The longer the fermentation time, the greater the flavour.

Speciality Flours include:

Malted flours which impart colour, flavour and enzyme activity.

Roasted flours give taste and colour.

Soya flour whitens crumb colour, imparts slight beany taste and improves the ‘feel’ of dough.

Wheat germ provides a unique flavour.

These ingredients generally add mild flavour notes.

Herbs & Spices:

Garlic, Mixed Spice, Basil, Rosemary,

Peppers etc. add more specific flavours, which are

generally featured in the name of the bread, as for ‘Garlic

Bread’.

Sweeteners:

Like Sucrose, Lactose, Fructose, Molasses add

sweet notes and provide fermentation food.

Dairy Ingredients:

Like Sour milk, Yoghurt, Cheese powder, Milk powders impart dairy flavours; mild to very strong.

Lipids:

Including butter, which imparts its own unique flavour.

Lard considered by some as the original bread fat, does have an ‘animal’ taste.

Oil, of which olive oil is very distinct in flavour.

Chemical Acidifiers:

Lactic and Acetic acids acidify the dough but impart poor flavour.

Nature Identical Flavours:

Are intense flavour, which can be incorporated into a no-time dough to enhance crust and crumb aroma and flavour. These are generally used at levels as low as 0.2% on flour weight. These provide a quick way to add flavour to bread. Using this type of flavour requires the labelling of the bread to contain the word ‘flavour’ in the ingredients listing.

Others:

Vine fruits, Yeast extract, Chocolate, Nuts, Beer, Scrap

dough, Honey all add their own unique flavour and often

'added value' to bread.

Recipe and Method

We have to follow formulation rules to produce bread, but within those rules the choice of ingredients and process method employed will determine what bread and flavour we produce. It is relatively straight forward to produce flavoured bread by incorporating ingredients like cheese, herbs and spices for examples.

The choice of process method employed can produce wonderful natural flavours in bread, from only the basic of raw materials.

Hydration:	The amount of water used is of major importance for perception of the flavour and mouth feel. More hydration in the dough, generally leading to a moister crumb in the baked bread, often allows for more taste.
Kneading:	The incorporation of oxygen will have an important influence on the bread flavour as it influences the oxidation reactions, fermentation and enzyme activities.
Fermentation:	The length of time dedicated to fermentation or the amount of yeast or sourdough added on flour weight will influence flavour generation. I will focus on fermentation shortly.
Proving:	Time and temperature during proving have a major impact on the flavour. An example of which is Scotch

Roll, which uses long, cool proof with low amounts of yeast to develop extra flavour.

Fermentation

Fermentation is a determining factor in bread flavour generation through yeast as mentioned previously, or sourdoughs. Sourdoughs are natural acidifying fermentations, which develop the unique acidic tastes and aromas, unpleasant to some, found in Italian, Spanish and Californian breads, to name a few.

Making a sourdough will impart flavour but requires; stringent controls with the fermentation, skilled operatives, production planning, large areas and containers for storing the ferments, temperature and time controls in place. If these points are managed, flavoured breads can be produced. If consistency is not met then variability in the quality of the baked product will result; volume, aroma, flavour may all be affected.

Let's take a look at some different types of fermentation possible in bread manufacture, which impart varying amounts of flavour:

- Bulk Fermentation
- 'Old' dough
- Retarding
- Sponge, and
- Sourdough

I shall now talk through each process.

Bulk fermentation

Bulk Fermentation Process (BFP) is a traditional method. Ingredients are mixed together to form a dough and left to ferment for up to three hours. During fermentation the dough changes from a short dense mass into an elastic dough. The time taken to reach this state largely depends on the amount of yeast, flour type and dough temperature. During this time flavour and aroma is generated.

Old Dough

Old dough from is kept back and used with fresh dough, of the same product type. The longer the scrap dough is left, the more yeasty flavour is generated. Strict controls are required to maintain consistency of the bread made from adding old dough; the amount added and the age of old dough can both affect final bread appearance and impart an unwelcome 'spent' flavour and aroma.

Retarding

In retarding, the formed dough pieces are left at refrigeration temperature for a period of time, during which fermentation continues, albeit slowly. Yeasty flavours and aromas generate with changes to the crumb texture and crust colour occur when baked, compared to the same dough piece proved and baked with no retardation.

The San Francisco Sourdough is an example of bread type, which uses retarding to enhance the flavour already generated in the dough and also create a rich red / brown crust covered in small blisters known as 'fish eyes'.

Sponge

A sponge is a fermentation of flour, water and yeast normally for approximately 4-6 hours.

Flour is roughly 20-40% of flour in recipe.

Water is taken from total in recipe.

Yeast can be used at 0.5-2% depending on the time to ferment.

The sponge is used at around 30% on flour weight in fresh dough. It imparts increased yeasty and alcoholic flavours and aromas, plus some added strength to the crumb. No acidic taste will be generated.

Sourdough Bread

In sourdough bread, a characteristic lactic acid taste is developed by encouraging the development of lactobacillus bacteria in tandem with the development of yeast fermentation. These bacteria typically associated with yoghurt production, generate distinctive clean acid flavours in the dough.

Lactobacillus can be separated into two groups; homofermentative and heterofermentative. Homofermentative species produce lactic acid exclusively, whereas heterofermentative, in addition to lactic acid, also produce acetic acid, alcohols and carbon dioxide.

A simple diagram illustrates various ways to produce sourdough bread using either sourdough or direct processes.

Sourdough breads can be made using either:

- A 'home grown' starter
- Commercially available ready-to-use starters, or
- Commercially available ready-to-use natural dried / liquid sourdough flavours.

I shall now focus on these three methods.

Making a 'Home Grown' Starter

It will roughly take 14 days to make a starter from scratch by fermenting flour, water and a source of beneficial lactic-acid producing bacteria. Leaving the mixture exposed to the environment for a while will pick up some. You can also use unwashed organically grown grapes, live yoghurt or soured milk as a known bacterial source (Lactobacillus).

The mixture, at the moment known as a 'culture', is left for ten days. From 10 days and onwards, a feeding regime commences and the culture turns into a 'starter'. The starter is fed flour and water daily to maintain it for use, basically for ever. Some bakeries, which use their own starters, might have been originally been started by their granddad.

If the starter is kept fed, two or three times a day with flour and water, it will have both leavening capabilities and acidic flavour. If you starve the starter, by not feeding it the flour and water, the yeast will be overrun by the bacteria. When this is added to dough it will impart strong acidic flavour but yeast will be required to leaven the bread.

Commercially Available Starter

Using commercially available ready-to-use starter cultures will impart consistent and unique flavours to the sourdough.

Specific strains of lactic acid bacteria have been identified, which generate their own unique flavour profiles. These bacteria are commercially grown and are available either fresh or freeze dried.

Using these starters you have more consistency and choice of flavour produced, as there are many different cultures available from a variety of bacteria, each imparting their own unique flavour.

An example of its use:

100kg of both flour and water, plus 250g starter culture are blended and left for 20 hours.

Of the 200kg produced, 180kg can then be used in dough at around 20% on flour weight. The remaining 20kg is the added to 100kg flour and 100kg water and left for 10-12h hours.

Of this now 220kg, 200kg can then be used in sourdough at around 20% on flour weight. The remaining 20kg is then added to the same amount of flour and water.

This process is kept going for around a week, then it is best to start afresh. If not, the risk that some natural micro-organisms present in flour, added within each refreshment, become dominant in the total amount of bacteria, therefore changing the flavour profile of what you originally started out with. Starting afresh assures consistent quality of the sourdough.

Commercially Available Sourdoughs

Adding a natural ready-to-use sourdough to a no-time dough removes the fermentation control management requirements and also delivers consistent flavour to bread.

This type of product is available in powder or liquid form and will be based on wheat or rye flours. Lactic acid bacteria will grow much better on rye flour due to the higher ash content, which contains more nutrition for bacteria, which in turn imparts more acid notes.

French, Spanish and Italian countries prefer wheat based sours as they have a less sharp note compared to the rye based sours. German, Austrian, Scandinavian, Eastern counties prefer the sharper, rye based sours.

To commercially manufacture these products; flour, water, yeast, maltose and specific bacterial strains are fermented, pasteurised and are either dried (spray or roller) or concentrated for the liquid versions.

During this controlled fermentation, the lactic acid bacteria consume the carbohydrates of the flour and produce organic acids; lactic and acetic and other flavour compounds comparable to yeast alcohols. This acid production reduces the pH from 6 to 3.5 in 1-2 days, at the same time the degrees acidity increases imparting the sour flavour. The degrees acidity is a titratable measure of acidity. Mild sours have an acidity of 50, whereas strong sours have an acidity up to 200.

Some benefits of using commercially available sours include:

- The long time required for flavour development has already been invested by the manufacturer.
- They utilise modern short time processing methods where flavours are not given time to generate.
- A consistent flavour imparted.
- It is possible to mix two different sours together to create you own unique flavour profile.
- Product is always available.
- They carry a clean label declaration.
- The bread made from using these will have ‘added value’.
- Does not change crumb texture of the baked bread as compared to that of a sourdough, which could be seen as a positive point if making sandwich bread.

Commercially Available RTU Sponge Fermentation

Is a biological process using a blend of flour, yeast, water, sugar, which is fermented for 48 hours. During this sponge fermentation the yeasts consume the carbohydrates, producing ethanol, aromatic alcohols and fruity esters. The pH is reduced to 4.5-5, which is higher than a sour. The flavour profile is yeasty, alcoholic.

The liquid product is concentrated and packed for sale. This product will have similar advantages to that of the commercially available sourdough previously mentioned.

Bread Shape

We have considered the impact of fermentation and the role of sourdoughs, let us now take into account the influence of bread shape on flavour.

Size and configuration will influence flavour, mostly from the way it bakes. A large dough piece will generally produce bread with a higher crumb to crust ratio. A small dough piece can be the reverse making crust the dominant flavour in the bread. Naturally some shapes; pointed sticks for example, could contain both; the ends of the bread eat and taste totally different to the middle, although produced from the same dough piece.

The eye is the first selection criterion.

You can never make a second 'first impression'.

Although we can produce good flavoured breads, we still require the visual aspect to contain enough appeal to attract potential customers.

The Baking Process

The baking process will contribute to bread flavour; mainly to the crust. As the surface temperature increases through 110-140ºC maillard reactions take place between the proteins and reducing sugars.

A further increase in temperature brings about caramelisation to the crust; imparting colour and flavour. If this dough has been retarded overnight, even more colour and flavour is achieved due to the extra time the enzymes have had converting starches into sugars.

As the surface temperature continues to rise, the crust will begin to carbonise. We generally reach this state when we have forgotten to put the timer on the oven. Seriously though, some customers actually ask for the baker to burn the bread as the carbonised flavour is appealing. Each to his own!

Shelf Life

The shelf life of bread is not only determined by the softness and the mouth feel, but certainly a fresh flavour impression is a key argument to help prolong consumer shelf life of baked products.

However, bread's physical aspects change during storage. The firming of the crumb over time will begin to mask the flavour. As mentioned earlier, flavour is more pronounced in moister environments.

Preservatives like calcium propionate, although are beneficial for extending mould-free shelf life, have a negative effect on the flavour and aroma of baked bread. Sourdough will also help to increase the mould-free shelf life of breads by reducing the pH, similar to the benefit of adding vinegar.

Frozen bread will partially lose flavour through sublimation. This is not the case with frozen dough pieces, as fermentation is done after de-freezing, but in all other cases flavour loss can be expected.

Conclusion

Optimisation of bread flavour is a very complex issue, where the ingredients and the processes go hand in hand.

Many different products are available to achieve an endless range of flavoured breads, some of which are able to eliminate long processes but still deliver the unique acidic and fermentation flavours, with the benefit of consistency.

I hope my talk has stimulated your taste buds because I have organised some breads for tasting produced from some commercially available sourdough and sponge products. There is also one, which I have been nurturing at home, much to my wife displeasure.

Thank you for your attention.

If anyone does have a question please do ask now or whilst we look at the breads in the next room.