Chapter 3

Yeast Doughs (Fermented Goods)

3.1 Types – (Rich / lean)

1. LEAN DOUGH PRODUCTS

- A lean dough is one that is low in fat and sugar
- Hard-crusted breads and rolls, including French and Italian breads, kaiser rolls and other hard rolls, and pizza
- Other white and whole wheat breads and dinner rolls
- Breads made with other grains. Rye breads are the most common.

2. RICH DOUGH PRODUCTS

- In general, rich doughs are those that contain higher proportions of fat, sugar, and sometimes eggs.
- Nonsweet breads and rolls, including rich dinner rolls and brioche
- Sweet rolls, including coffee cakes and many breakfast and tea rolls

3. ROLLED-IN YEAST DOUGH PRODUCTS

- Rolled-in doughs are those in which a fat is incorporated into the dough in many layers by using a rolling and folding procedure. The alternating layers of fat and dough give the baked product a flaky texture.

• Nonsweet rolled-in dough: croissants

• Sweet rolled-in doughs: Danish pastry

3.2 STAGES IN BREAD MAKING

- There are 12 basic steps in the production of yeast breads. These steps are generally applied to all yeast products, with variations depending on the particular product.
- In particular, many of the handcrafted artisan breads that have become popular require more complex procedures

1. Scaling Ingredients
2. Mixing
3. Fermentation
4. Punching
5. Scaling
6. Rounding
7. Benching
8. Makeup and Panning
9. Proofing
10. Baking
11. Cooling
12. Storing

1. Scaling Ingredients:

- All ingredients must be weighed accurately.
- Water, milk, and eggs may be measured by volume
- Special care must be taken when measuring spices and other ingredients used in very small quantities.

2. Mixing

Mixing yeast doughs has three main purposes:

- To combine all ingredients into a uniform, smooth dough.
- To distribute the yeast evenly throughout the dough.
- To develop the gluten.
- Mixing methods used for yeast doughs:

a) Straight dough method

b) Salt delayed Method

c) No-time dough method

d) Sponge and dough method

e) Ferment and dough method

3. Fermentation

- Fermentation is the process by which yeast acts on the sugars and starches in the dough to produce carbon dioxide gas (CO2) and alcohol
- Doughs with weak gluten, such as rye doughs and rich doughs, are usually underfermented
- It is important to be aware that fermentation continues during the next steps in yeast dough production

4. Punching

Punching is *not* hitting the dough with your fist. It is a method of deflating the dough that

- expels carbon dioxide
- redistributes the yeast for further growth
- relaxes the gluten

- equalizes the temperature throughout the dough

5.Scaling

- Using a baker's scale, divide the dough into pieces of the same weight, according to the product being made.
- During scaling, allowance is made for weight loss due to evaporation of moisture in the oven
- Scaling should be done rapidly and efficiently to avoid overfermenting the dough.

6. Rounding

- After scaling, the pieces of dough are shaped into smooth, round balls.
- This procedure forms a kind of skin by stretching the gluten on the outside of the dough into a smooth layer. Rounding simplifies the later shaping of the dough and also helps retain gases produced by the yeast.

7. Benching, Bench Proofing, Or Intermediate Proofing

- Rounded portions of dough are allowed to rest for 10 to 20 minutes.
- This relaxes the gluten to make shaping the dough easier.
- Also, fermentation continues during this time.

8. Makeup and panning

- The dough is shaped into loaves or rolls and then placed in pans or on baking Sheets
- Proper makeup or molding is of critical importance to the finished baked product.
- All gas bubbles should be expelled during molding. Bubbles left in the dough will result in large air holes in the baked product.

9. Proofing

- Proofing is a continuation of the process of yeast fermentation that increases the volume of the shaped dough
- Proofing temperatures are generally higher than fermentation temperatures.
- Underproofing results in poor volume and dense texture. Overproofing results in coarse texture and some loss of flavor.

10. Baking
    - Oven spring, which is the rapid rising in the oven due to production and expansion of trapped gases as a result of the oven heat. The yeast is very active at first but is killed when the temperature inside the dough reaches 140°F (60°C).
    - Coagulation of proteins and gelatinization of starches. In other words, the product becomes firm and holds its shape.
    - Formation and browning of the crust.

      In order to control the baking process, the following factors should be considered.
    - Oven Temperature and Baking Time
    - Washes
    - Cutting or Scoring
    - Loading the Ovens
    - Steam
11. Cooling
    - After baking, bread must be removed from pans and cooled on racks to allow the escape of the excess moisture and alcohol created during fermentation.

- Small rolls spaced on baking sheets are often cooled on the pans when air circulation is adequate. On the other hand, if Condensation is likely to make the bottoms of the rolls soggy, it is better to cool them on racks.
- If soft crusts are desired, breads may be brushed with melted shortening before cooling.

12. Storing

- Breads to be served within 8 hours may be left on racks.
- For longer storage, wrap cooled breads in moisture-proof bags to retard staling.
- Bread must be thoroughly cool before wrapping or moisture will collect inside the bags.
- Wrapping and freezing maintains quality for longer periods. Refrigeration, on the other hand, increases staling.
- Hard-crusted breads should not be wrapped (unless frozen) because the crusts will soften and become leathery.

3.3 Methods of Bread Making

1. Straight dough method
2. Salt delayed Method
3. No-time dough method
4. Sponge and dough method
5. Ferment and dough method
6. Continuous Bread making process
7. Chorleywood Bread making process)

1.Straight dough method

- All ingredients are mixed together in one stage & knead until the flour protein is well developed
- Then the dough is allowed to ferment for a predetermined time
- If the fermentation time is upto 5 hours, that is short process method. If it is more than 5 hours that is long process method
- In long process method the dough should be made tighter & reduce yeast quantity & temperature & increase the sugar & salt quantity
- It is advisable to use short process instead of long process

2.Salt delayed method

- Salt delayed method also comes under Straight dough method
- In this method, mix all the ingredients except salt & fat
- Due to absence of salt, the speed of fermentation is enhanced & gluten is matured in a reasonably short time
- For this method, three fourth of mixing should be given initially & one fourth of mixing at the time of adding salt
- The salt is added at the knock back stage

3.No-time dough method

- No-time dough method comes under the Straight dough method and it is the quickest of all methods.
- In this method, the dough is not fermented in the usual manner
- It is just allowed to rest for 30 minutes
- Because of less fermented time, yeast quantity should be increased

- The method is useful in an emergency
- The quality of finished bread is not generally satisfactory.
- This bread stales rapidly.
- This happens because the gluten does not get enough time to soften.
- The bread smells of yeast

4.Sponge & dough method

- Ingredients are mixed in two stages
- In first stage a part of flour (60%), proportionate amount of water, all the yeast & yeast foods are mixed together
- This sponge is fermented for a predetermine time
- When the sponge is ready it should be broken down properly with formula water
- This mixture is mixed the remaining (40%) flour, salt, sugar. Fat etc.
- Mixing operation should be carried out to the right degree
- After mixing it is allowed to rest for 30-45 minutes.

5.Ferment & dough method

- This is a variation of sponge & dough method
- When the bread formula contains milk, milk powder, egg substantial quantity of fat & sugar as in case of sweet doughs, these ingredient have retarding effect on yeast activity
- All the formula yeast, part of flour, yeast foods, sufficient water are mixed together just like flying ferment
- When fermentation is ready, it is mixed into the dough with the remaing ingredients & allowed to ferment for the second stage of fermentation

6. Continuous bread making

- In continuous systems, the dough is handled without interruption from the time the ingredients are mixed until it is deposited in the pan. The initial fermentation process is still essentially a batch procedure, but in the continuous bread-making line the traditional sponge is replaced by a liquid pre-ferment, called the broth or brew. The brew consists of a mixture of water, yeast, sugar, and portions of the flour and other ingredients, fermented for a few hours before being mixed into the dough.
- After the brew has finished fermenting, it is fed along with the dry ingredients into a mixing device, which mixes all ingredients into a homogeneous mass. The batterlike material passes through a dough pump regulating the flow and delivering the mixture to a developing apparatus, where kneading work is applied. The developer is the key equipment in the continuous line. Processing about 50 kilograms (100 pounds) each 90 seconds, it changes the batter from a fluid mass having no organized structure, little extensibility, and inadequate gas retention to a smooth, elastic, film-forming dough. The dough then moves out of the developer into a metering device that constantly extrudes the dough and intermittently severs a loaf-size piece, which falls into a pan passing beneath.
- Although ingredients are generally the same as those used in batch processes, closer control and more rigid specifications are necessary in continuous processing in order to assure the satisfactory operation of each unit. Changes in conditions cannot readily be made to compensate for changes occurring in ingredient properties. Oxidizers, such as bromate and iodate, are added routinely to compensate for the smaller amount of oxygen brought into the dough during mixing.
- The use of fermented brews has been widely accepted in plants practicing traditional dough preparation and makeup. The handling of a fermentation mixture through pumps,

pipes, valves, and tanks greatly increases efficiency and control in both batch-type and continuous systems.

- Baking and depanning-Ovens-
- The output of all bread-making systems, batch or continuous, is usually keyed to the oven, probably the most critical equipment in the bakery. Most modern commercial bakeries use either the tunnel oven, consisting of a metal belt passing through a connected series of baking chambers open only at the ends, or the tray oven, with a rigid baking platform carried on chain belts. Other types include the peel oven, having a fixed hearth of stone or brick on which the loaves are placed with a wooden paddle or peel; the reel oven, with shelves rotating on a central axle in Ferris wheel fashion; the rotating hearth oven; and the draw plate oven.
- Advances in high-capacity baking equipment include a chamber oven with a conveyor that carries pan assemblies (called straps) along a roughly spiral path through an insulated baking chamber. The straps are automatically added to the conveyor before it enters the oven and then automatically removed and the bread dumped at the conveyor's exit point. Although the conveyor is of a complex design, the oven as a whole is considerably simpler than most other high-capacity baking equipment and can be operated with very little labour. As a further increase in efficiency, the conveyor can also be designed to carry filled pans in a continuous path through a pan-proofing enclosure and then through the oven.
- In small to medium-size retail bakeries, baking may be done in a rack oven. This consists of a chamber, perhaps two to three metres high, that is heated by electric elements or gas burners. The rack consists of a steel framework having casters at the bottom and

supporting a vertical array of shelves. Bread pans containing unbaked dough pieces are placed on the shelves before the rack is pushed mechanically or manually into the oven. While baking is taking place, the rack may remain stationary or be slowly rotated.

- Most ovens are heated by gas burned within the chamber, although oil or electricity may be used. Burners are sometimes isolated from the main chamber, heat transfer then occurring through induced currents of air. Baking reactions in the oven are both physical and chemical in nature. Physical reactions include film formation, gas expansion, reduction of gas solubility, and alcohol evaporation. Chemical reactions include yeast fermentation, carbon dioxide formation, starch gelatinization, gluten coagulation, sugar caramelization, and browning.
- Depanners- Automatic depanners, removing the loaves from the pans, either invert the pans, jarring them to dislodge the bread, or pick the loaves out of the pans by means of suction cups attached to belts.

7. **Chorleywood bread process (CBP)** is a process of making dough in bread production. The process was developed in 1961 by the British Baking Industries Research Association based at Chorleywood in Hertfordshire, and by 2009 was used to make 80% of the United Kingdom's bread. Compared to the older bulk fermentation process, the CBP is able to use lower-protein wheat, and produces bread in a shorter time.

- The Chorleywood bread process allows the use of lower-protein wheats and reduces processing time,[5] the system being able to produce a loaf of bread from flour to sliced and packaged form in about three and a half hours. This is achieved through the addition of Vitamin C, fat, yeast, and intense mechanical working by high-speed mixers, not feasible in a small-scale kitchen.

- Flour, water, yeast, salt, fat, and, where used, minor ingredients common to many bread-making techniques such as Vitamin C, emulsifiers and enzymes are mechanically mixed for about three minutes. The high-shear mixing generates high temperatures in the dough, which is cooled in some advanced mixers using a cooling jacket. Chilled water or ice may also be used to counteract the temperature rise during high-speed mixing. Air pressure in the mixer headspace can be controlled to keep gas bubbles at the desired size and number. Typical operating regimes are pressure followed by vacuum, and atmospheric followed by vacuum. The pressure control during mixing affects the fineness of crumb texture in the finished bread.
- In typical high-volume bread-production, the dough is cut into individual pieces and allowed to "recover" for 5–8 minutes (intermediate proofing). Each piece of dough is then shaped, placed in a baking tin and moved to the humidity- and temperature-controlled proofing chamber, where it sits for about 45–50 minutes. It is then baked for 17–25 minutes at 450 °F (about 230 °C). After baking, the loaves are removed from the baking tin and then go to the cooler, where, about two hours later, they are made ready for despatch, sliced and packaged if required.[6] In UK-standard bread, the dough piece is "cross-panned" at the moulding stage; this involves cutting the dough piece into four and turning each piece by 90° before placing it in the baking tin. Cross-panned bread appears to have a finer and whiter crumb texture than the elliptical shape of the crumb bubble structure resulting from a different orientation,[clarification needed] and it is easier to slice.

3.4 Bread Disease

- Bread is mostly affected by two main diseases:

1. Rope
2. Mold

- Bread is affected by diseases when the weather is warm & humid

1. Rope

- The bacteria responsible for causing “rope” is known as Bacillus mesentericus vulgatus
- This is the soil borne bacterial.

- It is deposited in the crease of the wheat berry & in spite of thorough cleaning during milling process, all of these bacteria do not get removed completely & get mixed with flour
- Other sources are ingredients such as salt, sugar & unhygienic conditions in bakery

Symptoms of rope

- At the initial stage of disease, it develops a peculiar smell, which may be similar to rotten fruit or overripped pineapple
- The crumb becomes a little discoloured & sticky
- When separating two slices from each other, a thin rope like thread is seen
- Very heavy infection may almost liquefy the crumb

Control of rope

- Some acid substances may be added to the dough when mixing
- Cleaning of the bakery
- Satisfactory storage conditions for the flour & other ingredients
- Storage room should be well ventilated
- Warm & humid conditions should be avoided
- Cooling the loaves as quickly as possible
- Bread always should be well baked
- An under baked bread should never be packed with the well baked bread

2. Mold

- Spores of various kinds of molds are always present in the atmosphere
- Bread is normally infected by three kinds of mold

- White- Mucor mucedo
- Greening or bluish- Penicillium, Aspergillus
- Black-Aspergillus Niger

Control of mold

- Under baked or under cooled bread is sliced
- Store room should be well ventilated
- Avoid packing of bread, storage of bread in a warm & humid atmosphere
- Immediately dispose the spoiled products
- The bread slicer blade should be cleaned before & after slicing bread
- Bakery & equipment's should be clean

3.5 Bread Improvers

- Types of improvers

1. Chemical improvers

- Chemical improvers make the gluten strong, lend extensibility & also stimulate the yeast
- Eg.
- Potassium bromate
- Ammonium chloride
- Potassium lodate
- Lime water
- Calcium peroxide
- Calcium propionate
- Ascorbic acid

- Lactic acid

2. Natural improvers

- Milk
- Malt
- Eggs
- Fat
- Sugar
- Soy flour

3.6 Bread faults & their causes

Fault	**Causes**
Shape	Too much salt
Poor volume	Too little yeast
Too much volume	Too little liquid
	Weak flour
	Under- or overmixing
	Oven too hot
	Too little salt
	Too much yeast
	Too much dough scaled
	Overproofed

Poor shape	Too much liquid Flour too weak Improper molding or makeup Improper fermentation or proofing Too much oven steam
Split or burst crust	Overmixing Underfermented dough Improper molding—seam not on bottom Uneven heat in oven Oven too hot Insufficient steam
Flavor	
Flat taste	Too little salt
Poor flavor	Inferior, spoiled, or rancid ingredients Poor bakeshop sanitation Under- or overfermented
Texture and crumb	
Too dense or close-grained	Too much salt Too little liquid

Too coarse or open	Too little yeast Underfermented Underproofed Too much yeast Too much liquid Incorrect mixing time Improper fermentation Overproofed Pan too large
Texture and crumb *Streaked crumb* *Poor texture or crumbly* *Gray crumb*	Improper mixing procedure Poor molding or makeup techniques Too much flour used for dusting Flour too weak Too little salt Fermentation time too long or too short Overproofed Baking temperature too low Fermentation time or temperature too high
Crust	

Too dark	Too much sugar or milk Underfermented dough Oven temperature too high Baking time too long Insufficient steam at beginning of baking
Too pale	Too little sugar or milk Overfermented dough Overproofed Oven temperature too low Baking time too short Too much steam in oven
Too thick	Too little sugar or fat Improper fermentation Baked too long or at wrong temperature Too little steam
Blisters on crust	Too much liquid Improper fermentation Improper shaping of loaf

3.7 Artisan Bread

Artisan bread has many definitions. Most of the possible definitions include expressions like homemade, handmade, made in small quantities, lacking in preservatives, and using traditional techniques. But for every definition, it is possible to find exceptions. Clearly, none of those terms completely defines what we understand to be artisan breads or separate them from conventional breads. After all, every bread formula in this book can be made by hand in small quantities, yet many of them would not be considered artisan. At the same time, commercial bakeries use machines to transform thousands of pounds of flour a day into high-quality breads that nearly anyone would call artisan, or that at least have all the eating qualities of artisan breads. Furthermore, now that supermarket chains are selling mass-produced loaves with "artisan" on the label, the word is harder than ever to define, if not impossible. The dictionary defines an artisan as a "skilled manual worker, a craftsperson." An artisan bread, then, is one made by hand by a skilled baker. This is a good start, but it is not precise. Another definition sometimes given is that artisan breads are made using traditional methods. This is also important, but we still must determine what is meant by traditional methods. We may not be able to come up with a definition of artisan bread that satisfies everyone, but we can list the characteristics that, according to many bakers, should be present. Handmade. This is the characteristic most closely related to the dictionary definition of artisan. Does this mean that machinery cannot be used at all? A home baker can make bread from start to finish without machinery, but clearly it would be difficult for a bakery to produce enough bread to be commercially viable without using even a mixer. Some form of machinery is used in virtually every baking operation. Nevertheless, hand work plays an important role in artisan production, and the manual skill and judgment of the artisan baker are essential. By necessity, then, artisan bread production is usually small-scale, not

high-volume. Making artisan bread is not an automatic or purely mechanical process. Use of pre-ferments and sourdough or culture starters. A pre-ferment is a fermented dough or batter used to provide leavening for a larger batch of dough. The discussion of the sponge mixing method in the previous chapter introduced the subject of pre-ferments. As you learned, one advantage of using a sponge is that it creates more flavor by means of a long, slow fermentation. A sourdough starter is similar to a yeast pre-ferment, except it uses wild yeast instead of commercial yeast. Pre-ferments and sourdough starters are discussed in more detail later in this chapter. No chemical additives or preservatives. The classic artisan bread is crisp-crusted and contains nothing but flour, water, and salt; and it is leavened either by wild yeast (sourdough) or commercial yeast. Other ingredients may be added for specialty breads, including dough ingredients such as milk, eggs, and butter, and add-ins such as herbs, spices, nuts, dried fruit, and olives. But all ingredients should be recognizable by the consumer as familiar food items. Traditional production methods. Bread has been made for centuries without the use of machinery except, of course, ovens; and until recently those ovens were wood-fired. Today's artisan bakers try to duplicate as much as possible these traditional methods. As already noted, at least part of the production should be by hand, even if mixers are used to make the dough. Bakers also seek out flours similar to those used for old-fashioned European breads, most notably flours with slightly lower protein content and higher ash (see p. 59). Also, because the fermentation process is so important for flavor, doughs are usually fermented for longer times at lower temperatures, often without the use of proof boxes. Hearth ovens or deck ovens are invariably used, and some bakeries have even installed wood-fired hearth ovens for their breads

3.8 Understanding Quick breads

As their name implies, quick breads are quick to make. Because they are leavened by chemical leaveners and steam, not by yeast, no fermentation time is necessary. And because they are usually tender products with little gluten development, mixing them takes just a few minutes. Although prepared biscuit and muffin mixes are available, the only extra work required to make these products from scratch is the time to scale a few ingredients. With a careful and imaginative selection of ingredients, and an understanding of basic mixing methods, you can create superior products.

DOUGH MIXTURES FOR quick breads are generally of two types: 1. Soft doughs are used for biscuits. They are, with a few exceptions, rolled out and cut into desired shapes. 2. Batters may be either pour batters, which are liquid enough to be poured, or drop batters, which are thick enough to be dropped from a spoon in lumps.

Gluten Development in Quick Breads Only slight gluten development is desirable in most quick breads. Tenderness is a desirable quality, rather than the chewy quality of many yeast breads. In addition, chemical leavening agents do not create the same kind of texture yeast does, and they are not strong enough to produce a light, tender product if the gluten is too strong. Muffin, loaf bread, and pancake batters are mixed as little as possible—only until the dry ingredients are moistened. This, plus the presence of fat and sugar, keeps gluten development low. Overmixing muffin batter causes not only toughness but also produces irregular shapes and large, elongated holes inside the muffins. This condition is called tunneling. Biscuit dough is often lightly kneaded, enough to help develop some flakiness but not so much as to toughen the product. Biscuit dough that has been lightly kneaded rises more than dough that has not been kneaded. Unkneaded dough spreads more than kneaded dough. Popovers are the exception among quick breads. They are made with a thin batter and leavened only by steam. Very large holes develop

inside the product during baking, so the structure must be strong enough to hold up without collapsing. Thus, bread flour is used and the batter is mixed enough to develop the gluten. The high percentage of egg in popovers also helps build structure.

Mixing Methods

Most quick-bread doughs and batters are mixed using one of three mixing methods. The biscuit method is used for biscuits, scones, and similar products. It is sometimes called the pastry method because it is like that used for mixing pie pastry. ## The muffin method is used for muffins, pancakes, waffles, and many loaf-type or sheet type quick breads. This method is fast and easy. However, the danger is the dough can quickly become overmixed, resulting in toughness. Muffin batter should be mixed only until the dry ingredients are just moistened. Do not attempt to achieve a smooth batter. Some loaf breads and coffee cakes are higher in fat and sugar than muffins, so they can withstand a little more mixing without becoming tough. This mixing method is not as suitable for formulas high in fat, unlike the creaming method described next. Consequently, quick breads mixed by this method are not as rich and cakelike as muffins and other products mixed by the creaming method. They tend to be a little drier, more like breads than cake. High-fat muffins sell better in today's market (in spite of the public's concern about fat), so the muffin method is not used as often as it once was. Keep this in mind as you try the muffin-method formulas in this chapter. ## The creaming method is a cake-mixing method that is sometimes applied to muffins and loaf breads. Actually, there is no exact dividing line between muffin products and cakes, and if they are rich enough, muffin products may be considered cakes rather than breads.

3.9 Pre-ferments and Sour dough

Pre-ferments give the fermentation a strong head start, and they contribute to flavor by extending the fermentation period. In addition, the use of pre-ferments allows the baker to reduce or eliminate the amount of commercial yeast used. Third, short-fermentation straight doughs may be difficult to handle, requiring the use of dough conditioners and other additives. Pre-ferments, on the other hand, naturally improve the

dough texture, making it easier to work without resorting to additives. There are two basic types of pre-ferments: yeast pre-ferments, sometimes called yeast

starters, and sourdough pre-ferments, usually called sourdough starters or natural starters. (Note that some bakers use the term pre-ferment only for yeast starters. In this book, we use the term generically for any fermented dough used to provide leavening.) Sourdough starters are similar to yeast pre-ferments except they are made with wild yeasts. As a result, they are handled somewhat differently. These starters are "sour" because of the acidity created in the dough during the long fermentation. This acidity affects not only the flavor of the bread but also the texture. The starches and proteins are modified by the acids, resulting in a moister crumb and better keeping qualities. Note that some sourdough cultures produce only a mild acidity, resulting in a bread that does not taste particularly sour (see the discussion of bacterial fermentation on page 132). The term sourdough, however, is commonly used for wild cultures of any degree of acidity. Some bakers prefer the terms levain or culture starter to describe this category, reserving sourdough for only those cultures with a strong acidity.

3.10 Controlling fermentation

The process of controlled fermentation is one where fermentation of the dough used to manufacture bread is controlled using a combination of temperatures passing from cold to hot. This provides numerous advantages:

Prevents the need for night work. Bread loaves can be produced during the day and then baked at any time desired.

Savings on yeast since the desired fermentation time can be programmed in the chamber.

Better preservation and flavour for the end product since a long fermentation time can be applied.

Warm bread can be available at the point of sale at a wider range of times.

3.11 Enzymatic reaction in bread

Enzymes catalyze three main reactions in bread-making: breaking starch into maltose, a complex sugar; breaking complex sugars into simple sugars; and breaking protein chains. The breakages could happen without enzymes, but the energy barrier is so large that it is very unlikely. Essentially, the enzymes are necessary for the reactions to occur

The first enzyme to take action in bread dough is amylase. Amylase acts on starch (either amylose or amylopectin), breaking the starch chain between adjacent sugar rings. There are two kinds of amylase: α-amylase (alpha-amylase) randomly breaks the chain into smaller pieces while β-amylase (beta-amylase) breaks maltose units off the end of the chain.

Amylase is found in flour. Wheat kernels contain amylase because they need to break starch down into sugar to use for energy when the kernels germinate. The amount of amylase varies with the weather and harvesting conditions of the wheat, so mills generally test for it and add extra or blend flours to get an appropriate amount.

Amylases are mobilized when water is added to the flour. This is one reason why doughs with a higher hydration often ferment faster—the amylases (and other enzymes) can move about more effectively. To reach the starch molecules, amylases must penetrate the starch's granules; thus, most of the action in bread dough happens at broken granules, where the starch is available for reaction. Fortunately, a percentage of starch granules are damaged during milling and accessible by the amylases.

An amylase is a big molecule, with hundreds of amino acids linked together. Many different groups contribute to the bonding between the amylase and the starch substrate. In addition, there are several different amylase molecules, and each functions differently. The examples of enzyme action presented above give the general idea.

Because of amylase, some of the starch in bread dough is broken into maltose, a double-ring sugar composed of two glucose molecules; but fermentation reactions require single glucose rings. Simple sugars like glucose also provide flavor to the bread and participate in browning reactions that occur at the crust during baking.

Fortunately, the yeast used in bread-making contains the enzyme maltase, which breaks maltose into glucose. When the yeast cell encounters a maltose molecule, it absorbs it. Maltase then bonds to the maltose and breaks it in two. Yeast cells also contain invertase, another enzyme that can break sucrose, like the sucrase described above. This enzyme works on the small percentage of sucrose found in the flour. These two enzymes are responsible for producing much of the glucose needed by the yeast for fermentation.

The other major enzyme at work in bread dough is protease. Protease acts on protein chains, breaking the peptide bonds between amino acids. Carboxypeptidase, described above, is an example of a protease. There are hundreds of proteases, but only a few are found in bread dough,

where they chop the gluten into pieces. Proteases occur naturally in flour, yeast cells, and malt. Their levels are measured at the mill and adjusted in the same way that amylase levels are adjusted.

Proteases in bread dough have been the subject of scientific research for the past hundred years. There has been much debate about their importance. In the early years, scientists were trying to prove their existence and measure relative activity in different brands of flour. They amplified the protease activity by adding non-gluten substrates to the mix. These substrates were ones that protease readily attacks. Eventually someone thought to look at protease activity in normal bread dough and found very little activity.

It seems, however, that this very small activity might be just what is needed in bread dough. Too much protease activity would break up the gluten, destroying the network that forms during kneading. A little bit, however, softens the dough and makes it more workable. If the dough is allowed to autolyse (i.e., rest) or if preferments are used, proteases have time to work before kneading, making the dough easier to knead. (I wonder if this is the origin of the word "autolyse," from "autolysis," which means "self-breaking" and could refer to the protein proteases at work on the protein chains.)

In addition to affecting the dough's consistency, proteases affect its flavor. Proteases result in single amino acids when they break the last peptide bond of the protein chain. These amino acids can participate in the flavor and browning reactions that occur at the crust during baking.

So now, my simplified diagram of the chemical reactions in bread dough looks more like this:

This diagram includes the presence of enzymes. Without enzymes, bread-making would not be possible.

3.12 Characteristics of Good Bread

Crust

A bread without a nice, crispy crust isn't a bread that's worth your time. Artisan bread should have a variety of hues in its crust, ranging from golden brown to a light golden color. This ensures you'll have the best tasting experience.

Air Pockets

Wheat flour is commonly used to make bread because it holds two gluten-forming proteins, but some bakers over-work their dough and end up with a bread that's far too dense. What you should be looking for in fresh bread is a variety of bubble sizes.

Glossy interior

Not every bread should look wet on the inside, but a quality bread will have a slightly glossy finish on the inside. In addition, it will spring back when you press your finger into it.

Flavor

If a bread bakery claims to make a good flavored bread, you should be able to smell that flavor before you even bite into a piece. Any decent bread should have a good flavor; it shouldn't taste like eating air!

Finish

While a loaf of bread doesn't have to look gorgeous to be tasty, a pretty bread certainly makes eating all the more enticing. A good finish or glaze, especially on sweet breads, should be an indicator of quality.