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**WHEAT BREAD**

**Content**

* **Introduction**
* **Definitions**
* **Functional ingredients**
* **Role of each Major and minor ingredient**
* **Methods of bread making**
* **Faults in bread with their remedies**
* **Quality checking of dough rheology for quality wheat bread**

**Introduction**

Wheat belongs to the genus Triticum of the grass family Gramineae. Wheat is the third cereal grain after maize & rice as a staple food. India ranks IInd in wheat production (112.74 MT) during 2022 – 23. Uttar Pradesh is the largest wheat producing state in India. China is the Ist world’s largest producer of wheat (134.33 MT).There are more than 30,000 species & varieties. It is cultivated from prehistoric times (5000 B.C.).The average length of wheat grain is about 8mm.Average weight of single wheat kernel is 35mg.It is ovoid in shape with the germ or embryo at one end & a bundle of hair at another end, along one side there is a furrow like part. Wheat grain have either a dark orange brown appearance or a light yellowish color. Bread is one of the spongy, porous food item. It can be variable from different grain flour for providing a lot of nutrients.

**Definition of Bread**

A staple food in western country which is made by baking dough made with flour & water & additional ingredients.

**Definition of Baking**

A technique of prolonged cooking of foods by dry heat through convection normally in oven under controlled condition.

**Functional Ingredients used in bread making**

1. **Structure builders**

It forms structure during fermentation and baking of bread mould. Flour is the best example for having desirable structure of bread.

1. **Tenderizers**

Ingredient of bread industry that leads to soften the bread loaf. The examples are butter, vegetable oil etc.

1. **Leaveners**

Ingredient is used to allow the fermentation process and allowing to leave CO2. Yeast is the best ingredient used as a leavener.

1. **Moisteners**

It provides moisture & keeping quality. Milk, water, eggs & syrup are examples of moistener.

1. **Driers**

It absorbs & retain moisture & provide the body of the product. Milk solids & starches

1. **Flavors**

* Provide natural flavor
* Cocoa, chocolate, butter,& other natural flavor bearing ingredients.

**The different ingredients used in bakery are:**

1. **Flour**
2. **Sugar**
3. **Shortenings**
4. **Leavening agents**
5. **Eggs**
6. **Water**
7. **Salt**
8. **Milk and milk derivatives**
9. **Minor ingredients**
10. **Flour**

Wheat flour is the basic ingredient used in bread making. It gives better structure to bread because of gluten content it forms when flour comes in contact with moisture. It has extensibility, elasticity. Gradually it becomes capable of holding gas & It form spongy structure on baking in oven.

There are two types of Wheat 1. Hard wheat 2.Soft wheat.

But among these Hard wheat flour is the best source of gluten so used to make quality bread.

**Hard wheat –** Mostly desirable in bread production. High in good quality protein. Hard wheat dough has high water absorptive capacity, excellent gas holding properties & will yield bread with good volume, grain & texture.

**Colour –** The fresh flour has creamy white color.

**Strength –** It leads to produce a bold, big , well risen loaf.

**Tolerance –** It can be strong to have baking quality in the final product.

**Water absorption –** 60 to 65 %

**Uniformity –** Uniform flour to obtain good quality & product

**pH –** The pH of flour must be at the ranges from 5.5 to 6.5. If the pH is at below this desirable range can produce poor result n bread making. **Composition –** Major components of flour are starch (70%), protein (11.5%), water (14%) & minor components are such Ash(4%), sugar (1%) & fat (1%). Gluten protein (glutenin & gliadin) is insoluble in water or dilute solution.

**2. Sugar**

It gives sweet taste to bread. It acts as a tenderizer on flour proteins. Being hygroscopic, sugar helps to retain moisture in bread, which gives freshness to bread. The golden brown crust & colour of cakes is due to caramelization of sugar. Sugar is essential for fermentation activity of yeast to produce CO2 gas which raises the dough & imparts proper volume to the bread. It enhances flavor & helps in moisture retention due to its hygroscopicity.

Sucrose is superior to the other sweeteners. Sugar does not act as softening agent but by developing crust colour quickly it makes possible a reduction in baking time retention of more moisture in the bread. As sugar percentage is increased, the crust becomes darker i.e. results in more reddish brown crust. High concentration of sugar interferes with gluten formation.

**Uses of Sugar**

1. Gives the necessary sweetness in cakes.
2. Serves as a form of food for the yeast in fermentation
3. It is used in the preparation of variety of icings.
4. Assists in the creaming & whipping process of mixing .
5. Provides good grain texture in the product.
6. Aids in the retention of moisture & prolongs freshness.
7. Promotes a good crust colour.
8. Adds nutritional values to the product.
9. It increases gas production.
10. **Shortenings**

* Fat lubricates the structure of a baked product.
* Lard, butter & some vegetable oils.
* It has tenderizing effect on flour proteins & makes the product tender.
* It is fat part of the mixture which holds large number of air cells incorporated during creaming.
* Vegetable oil is also used for shortening e.g. coconut oil, corn oil, cottonseed oil, peanut oil & soybean oil.

Use of Shortenings

1. Impart shortness, richness & tenderness to the product
2. Improve the eating qualities of the product
3. Provide aeration
4. Contribute to flavor, particularly special fats such as butter
5. Promote a desirable grain & texture.
6. Develop flakiness in product
7. Lubricate the gluten for development of yeast raised dough.
8. Act as emulsifiers for holding of liquids.

**Properties Of Shortening**

It should have

1. Bland flavor
2. White appearance
3. Good plasticity
4. Flavor & oxidative stability

**Butter**

* It is the best of all baking shortenings .
* It imparts desirable flavor to the finished baked products.
* It is widely used for specially breads, sweet goods, cookies & pastries.

**Lard**

* Fat rendered from fresh, clean, fatty tissues from hogs in good health at the time of slaughter.
* Margarine is prepared by blending lard & shortening.

**4. Leavening agents**

**Biological agents** – Yeast

**Yeast**

* Baker yeast is one celled, colorless microorganism called as Saccharomyces cerevisiae.
* Characters of Yeast

1. Yeast exists & is active in air as well as in absence of air.
2. In presence of air it grows rapidly & forms little alcohol.
3. In absence of air it grows slowly but alcohol formation increases.

Yeast is a microorganism that can grow in moist dough and consume carbohydrate and then produce more CO2 and less alcohol in aerobic condition.

**Disadvantage**

It is difficult to control & fermentation flavor can be undesirable.

It is also more expensive than chemical agents.

1. **Eggs**

It adds moisture, structure and color to crust of bread. It adds nutrients too in bread. Proteins of eggs are of particular importance. Coagulation of protein during baking contributes to the structure of finished product & reduces tenderness.

**Function of Eggs**

1. Binding action
2. Leavening action
3. Emulsifying action
4. Flavor
5. Colour
6. Nutritive value

**Egg white**

* Although it reduces the shelf life It adds part of protein in bread.
* Albumin having pH 6.5 to 9.5 has greatest foaming power.
* The pH of egg white is 7.6.

**Egg Yolk**

Yolk is not commonly employed as a foaming agent with the exception of a yellow sponge type baked product. It has emulsifying property (oil water air emulsion). It increases viscosity where air gets incorporated. It is mostly used in manufacture of mayonnaise & salad dressings. pH of egg yolk is 6.0.

Following actions should be kept in mind while using egg as ingredients:

1. Weight of sugar should exceed the weight of flour
2. Weight of total liquid should equal or slightly exceed the weight of sugar
3. In pound cake / layer cake , the weight of Egg solids should approximately 1/4th of the weight of shortening
4. In white cake the weight of egg white solids should exceed 1/10th  of the weight of shortening.

**6. Water**

- In its pure form, water is a tasteless, odorless & colorless liquid.

- It is an essential dough ingredient which helps to form gluten, starch swelling process & to bring dough ingredients into intimate contact with each other.

**Functions of water in Bakery**

1. It leads to form gluten by adding moisture in wheat flour.
2. Actually gluten is not present in wheat it forms after wheat flour comes in contact with water.
3. In presence of water there is better enzyme activity.
4. It dissolves salts, sugar & suspends other material in dough.
5. **Salt**

* Common salt is used in bread making.

Functions of Salt

1. It increases gluten stability
2. Controls fermentation
3. Develops flavor
4. Retains water
5. Contributes to the crust & crumb formation

Common salt should have the following characteristics:

1. It should be completely soluble in water
2. It should be free from lumps
3. It should be pure
4. It should be free from a bitter or biting taste
5. **Milk & Milk derivatives**

* Role in structure formation in cakes.
* It contributes to the crust browning because of protein & sugar content.
* Improves flavor, richness also.
* Improved nutritional value.

1. **Minor Ingredients**
2. **Flour improver / Dough improver**

**Definition**

It is defined as an optional ingredient is added in wheat flour to raise the dough while fermentation.

**Example**: Potassium bromate

Now a days it is banned because it can cause cancer after using higher percent in bread making.

* Bread improvers improves the tolerance during manufacturing stages as well.
* They simplify production by giving spongy, lightweight, attractive final product.
* Bread improvers can also act on the following properties of dough:

1. It improves the dough rheological properties like strength, extensibility, elasticity.
2. It also improves the yeast fermentation by yeast activity and by increasing the gas retention power in the dough.
3. **Flour bleaching agent**

It is a [food additive](https://en.wikipedia.org/wiki/Food_additive) added to [flour](https://en.wikipedia.org/wiki/Flour)  to make the flour whiter and it oxidizes the flour surfaces and help for developing of [gluten](https://en.wikipedia.org/wiki/Gluten) in dough.

**Major flour**[**bleaching**](https://en.wikipedia.org/wiki/Bleach)**agents are:**

1. [**benzoyl peroxide**](https://en.wikipedia.org/wiki/Benzoyl_peroxide)

[Benzoyl peroxide](https://en.wikipedia.org/wiki/Benzoyl_peroxide) and [hydrogen peroxide](https://en.wikipedia.org/wiki/Hydrogen_peroxide) are used as [bleaching agents](https://en.wikipedia.org/wiki/Flour_bleaching_agent).

1. [**Calcium peroxide**](https://en.wikipedia.org/wiki/Calcium_peroxide)

It is also used as a bleaching agent in flour.

1. **Oxidizing Agent**

* **Oxidizing agent** is added in flour that it helps with gluten performance in dough stability.
* It leads to create a stronger dough.

**Oxidizing agents are as follows:**

1. Pottassium bromated
2. Potassium iodate
3. Ascorbic acid
4. **Flour reducing agent**

It reduces the mixing time, proofing time and improves machine ability.

Examples : Fumaric acid, sodium bisulfite.

**Methods of Bread making**

1. Straight dough Method
2. Sponge dough Method
3. Delayed salt Method
4. No time dough Method
5. Ferment & dough Method
6. **Straight dough method**

* All essential & optional ingredients are mixed together.

**Flow Sheet**

Scaling → Mixing →Fermentation →Punching →Scaling →Rounding →Benching →Panning →Proofing→ Baking → Cooling

**Explanation**

1. **Scaling**

* Four basic ingredients Flour, Yeast, Salt & Water. Optional ingredients are sugar , fat & milk. These ingredients are weighed as per the standard recipe.

1. **Mixing**

* Sifted flour is taken into the vat of dough mixer and water is piped into that at desired temperature to mix properly. Flour start to absorb liquid & start to form a dough.
* Check the dough for proper hydration by falling the dough.
* The mixer rotates at speed 35 to 75 rpm. & mixing for 12 min.

Baker must be experienced to check the consistency of the dough.

1. **Fermentation**

* Fermentation is the process in which complex nutrients especially carbohydrate & protein is converted in to simple nutrients.
* Starch → Sugar → CO2 + alcohol As dough ferment, acidity get develop & leads to stretch the dough.
* Fermentation is carried out by different ways

1. High speed machinery – extreme forces the yeast cells to multiply rapidly.
2. Fermentation by addition of L – Cystein & Vit – C.
3. Dough is kept for fermentation in a trough & stored in temperature controlled room 25oC to 26oC RH – 70%. Dough should be covered with wet cloth. Yeast is more active at 43.33oC.
4. Making a ferment separately
5. **Punching**

* After fermentation dough is punched to expel gas & to redistribute food for yeast.
* It is also called as Knock back stage.

1. **Scaling**

* Using bench knife portion of dough is cut & take a weight.

1. **Rounding**

* Round to restretched the gluten & also make balls / rounds.

1. **Benching**

* Baker then benches the dough before final shaping.

1. **Panning**

* Place the dough on to baking pans.

1. **Proofing**

* Place in proofing unit where 35oC temperature & relative humidity 85 to 90%.

**Main functions**

1. To relax the dough
2. Helps in production & retention of gas during fermentation.
3. To improve strength of gluten & to improve extensibility.
4. To give higher volume to the dough.
5. **Baking**

* Baker then slides the dough into the hot oven directly on the hearth.
* The temperature should be 218.33oC for 25 to 30 min.

**Changes during baking**

1. Increased temperature causes CO2 of dough to expand & increases the size.
2. Moisture loss surface ultimately causes caramelization of sugar.
3. Enzymatic & yeast action are stopped.
4. Right amount of moisture is lost & loaf holds it shape.
5. **Cooling of baked loaf**

* It should not too dry or warm environment for cooling.

1. **Sponge dough Method**

* Here part of flour, water , yeast , sugar mixed together.
* In this method two mixing periods & fermentation periods are used.

**Advantage –** Fermentation in 2 stages so better control on speed of fermentation.

**Disadvantages –** More space requirement

**Flow sheet**

Scaling (Weighing of ingredients)

Mixing (Uniform distribution of yeast)

Sponge mixed (mix previous ferment sponge)

Sponge placed in trough

Fermentation of dough

Sponge placed in mixer

Sponge broken up & mixed with dough ingredients

Final dough is placed in trough

Allowed to rise / Fermentation

Sometimes turned & folded

Punching and Scaling (Punching – To escape excess gas from loaf)

Rounding ( Make the surface of loaf smooth and round)

Benching

Panning (Arrange buns in a pan) / Moulding

Proofing (Resting time for raising extra volume)

Baking (220oC Temp. for 25 to 30min)

Cooling (at Room Temperature)

1. **Delayed Salt Method**

* Same as straight method where ingredients are mixed except salt.
* Speed of fermentation faster (saltless)
* Salt added at Knock back stage
* Salt used in different ways

1. Sifted dry on dough & mixed
2. Creamed with fat & then mixed
3. Some four & water in mixed, then salt is added
4. **No time dough Method**

* Dough is not fermented after mixing.
* Allowed to rest only for 30 min.
* Quantity of yeast is increased 2 to 3 times more than in other method.

**Disadvantage –** poor keeping quality & lack in aroma.

1. **Ferment & dough method**

Ferment making separately & then mixed it to make a dough

**Bread faults, causes and remedies**

|  |  |
| --- | --- |
| **1. Under volume**  a) Used weak flour (less protein)  b) More salt  c) Less use of butter/ oil/ fat  d) Use of hot water for yeast  e) More quantity taken in a dough mixer  f) under mixing was performed  g) Over mixing for more time  h) Young and hand mixed dough  i) Extremely old and sour dough  k) Long time proofing  l) Incomplete proofing  m) High steam pressure in oven  n) Hot oven  **2. Too much volume of bread**  a) Less use of salt  b) Use of wrong type of flour (Extra hard wheat flour)  c) Dough over aged (stale)  d) Too much dough stuck to the pan  e) More time for proofing  f) No more heat in onen.  **3. Too dark color on crust**  a) More sugar used  b) High percent milk in recipe  c) Aged dough  d) Too hot oven during baking  e) More time for baking  **4. Crust colour too pale**  a) Too lean formula for bread making  b) Flour lacking diastatic activity (less fermentation)  c) Excessive mineral yeast food for fermentation  d)Aged dough is mixed  e) Insufficient humidity in proof box is used  f) not hot oven  g) Not sufficient time for baking | **5. Blisters under the crust**  a) fresh dough  b) Excessive baking in proof box  c) Over proofing  d) Rough handling at oven by baker  **6. Crust too thick**  a) Insufficient use of shortening  b) Minimum use of sugar  c) Aged dough  d) Less moisture in proof box  e) More steam in proof box  f) Cool oven during baking  g) Over baking of bread  **7. Shell tops of bread**  a) New flour for bread making  b) Stiff dough is prepared  c) Dough too young and fresh  d) Not sufficient moisture in proof box  e) Less pan proofing  f) Excess heat on top  **8. Lack of break and shred on bread**  a) Weak flour having less protein  b) Excess amount of mineral yeast used  c) Young dough  d) Extremely old dough  e) Excessive proof  **9. Crumb is grey in color**  a) More quantity malt is used  b) Old grain dough  c) Excess proofing time  d) Pans big in size for amount of dough  **10. Streaked crumb of bread**  a) Improper addition of ingredients  b) Sponge or dough crusted  c) Improper breaking of sponge  d) Excessive greasing of trough |

|  |  |
| --- | --- |
| **11. Coarse grain of crumb**  a) Weak less gluten flour  b) Not proper mixing in bread making  c) Slack dough while making  d) Use of young dough  e) Use of old dough  f) Not proper moulding  g) More time for proofing  h) Rough handling at oven in bread making  i) Oven become cool  **12. Poor Texture**  a) Weak less protein flour  b) Less use of shortening  c) Not proper mixing  d) Slack dough while making bread  e) Excess trough greasing  f) Use of Young dough for bread making  g) Aged dough was preferred.  h) Excess use of divider oil of process  i) Excess dusting flour on platform  j) Improper moulding  k) Cool oven was preferred | **13. Poor keeping qualities of bread**  a) Too lean formula for bread making  b) Low quality ingredients in bread making  c) Not proper storage of ingredients  d) Aged dough was used  e) Dough become Stiff before baking  f) More time for proofing  g) cool oven was used  h) More time for cooling  **14. Holes in Bread**  a) Unbalanced formula for bread making  b) Too strong flour was used.  c) Not proper addition of ingredients  d) Under mixing of dough  e) Over mixing of dough  f) Excess trough greasing  g) Young dough was used  h) Old dough  l) Excessive use of divider oil  m) Excess dusting flour on platform  i) Too much machine punishment  j) Proof box too hot than baking  k) Over proofing was used |

**Measurement of Dough rheological properties**

Rheological tests are used to predict baking performance and behavior of the dough during processing before baking.

These measure the following mechanical properties of dough with the help of Farinograph, mixograph, extensograph, alveograph and amylograp etc.

1. **Farinograph**
2. **Alveograph**
3. **Mixograph**
4. **Amylograph**
5. **Extensiograph**
6. **Farinograph**

Among all It is the most commonly used flour quality test. It is used to find out the quantity of water required to make dough. It is to evaluate effects of used ingredients. It evaluates the flour blending requirements. It is used to predict finished texture.

**The Farinograph Test**

It measures the resistance of a dough that mix with paddles.

**1. Absorption**

The amount of water required to center the farinograph curve. It is measured on the 500BU (Brabender Unit) line. The amount of water needed for a flour to process end product. Finally, the absorption is expressed as a percentage.

1. **Peak time**

It shows the dough development time. At the beginning of procedure amount of water is added till it reaches desired consistency of dough. It gives an indication to get optimum mixing time. It is expressed in minutes.

1. **Arrival time**

The time when the top of the curve touches the 500 BU line. This indicates the rate of flour hydration. Arrival time is expressed in minutes.

1. **Departure time**

It is the time when the top of the curve leaves the 500BU in the graph.

Here dough is beginning to break down and shows dough consistency during processing. This departure time is expressed in minutes.

1. **Stability time**

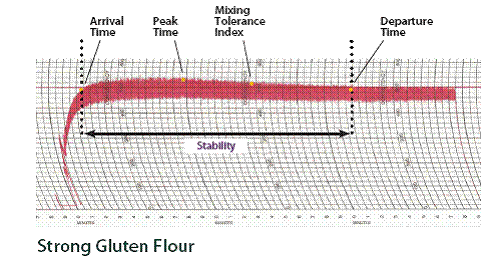
It is the difference between arrival & departure time. Here dough maintains maximum consistency & it is a good indication of dough strength. This Stability time is expressed in minutes.

1. **Mixing Tolerance Index**

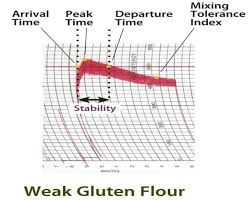
Mixing Tolerance Index is the difference between the peak time & the value at the top of the curve 5 minutes after the peak. It indicates the degree of softness. It is expressed in min. Here in this the Weak gluten flour has a lower water absorption & shorter stability time than strong gluten flour.

**Method**

1. Keep 50 or 300gm flour sample having 14 % misture is weighed & placed into the farinograph mixing bowl for testing.
2. Secondly Water is taken from a burette to the flour & mixed to form a dough.
3. The farinograph curve is showing as water absorbed by flour.
4. Less quantity of water increases dough consistency & moves the curve upward is showed on the graph.
5. Here curve is centered on the 500 BU line ± 20 BU by adding the proper amount of water & is move forward until the curve leaves the 500 BU line.
6. **Strong Gluten Flour**



1. Weak Gluten Flour





1. **Extensiograph**

It determines the gluten strength. It assures the bread making characteristics of flour. It evaluates the dough performance.

**The Extensiograph Test**

It measures & then record the resistance of a dough to stretching.

1. **Resistance to Extension of sample**

It is termed as R value & it is indicated by the maximum height of the curve. It is measured in centimeters, BU (Brabendar Unit) or EU(Extensiograph Unit).

1. **Extensibility**

* It is also known as E value. It is the length of the curve. It is measured in millimeters(mm) or centimeters (cm).

1. **R/E ratio**

It is the ratio of dough strength (resistance to extension R) to extensibility (E).

1. **Area under the curve**

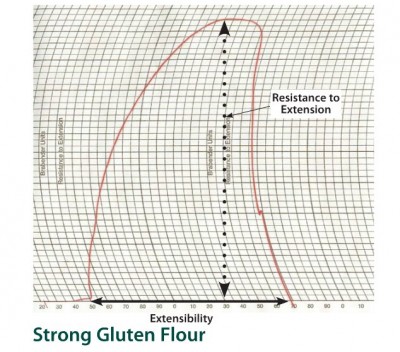
It is the combination of resistance & extensibility. It is expressed in cm2. Here weak gluten flour has a lower R to E ratio than strong gluten flour.

**Method**

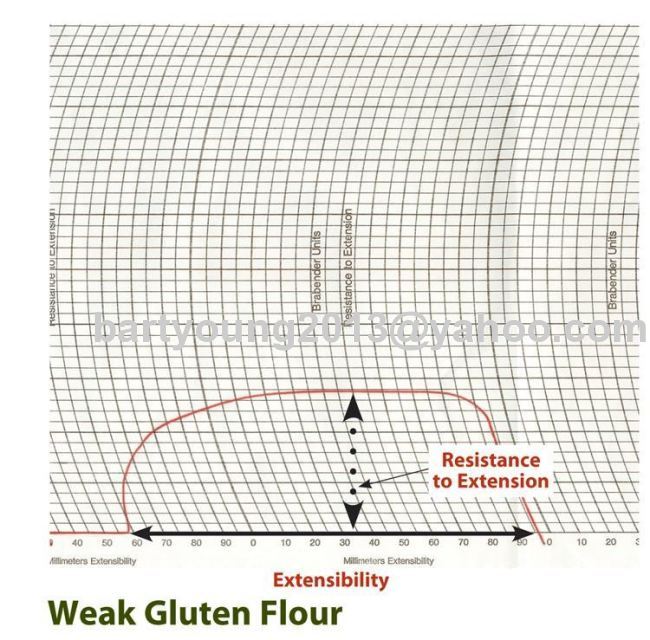
1. A 300gm flour having 14% moisture is combined with a salt solution and form a dough in the farinograph.
2. Allows the dough for 5 minutes and then it is mixed to maximum consistency that is called peak time.

**Analysis**

1. A dough sample of 150gm is kept in extensiograph and shaped into a ball.
2. Make the ball into a cylinder form.
3. The dough cylinder is kept into the extensiograph dough cradle, fixed with pin, & rested for 45 minutes in a desired environmental condition.
4. The dough is hanged in a hook and stretch it down till it breaks.
5. This graph records a curve on graph paper.
6. This step is repeated for two times more, at 90 minutes & at 135 minutes gradually.
7. **Strong gluten flour**



1. **Weak gluten flour**





1. **Alveograph**

It ensures a more consistent process & product. Strong gluten flour will have high P values & preferred for breads. It is the acceptable value.

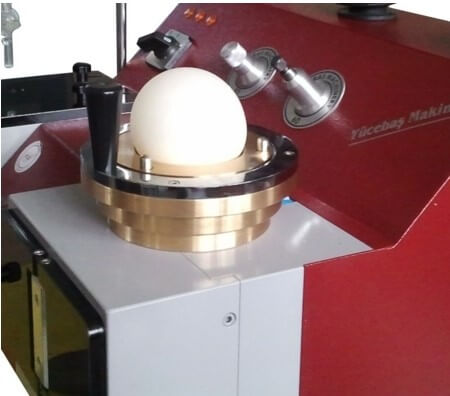
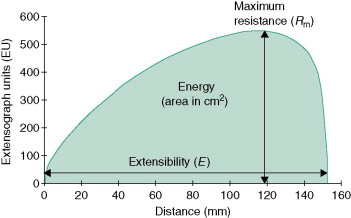
**The Alveograph Test**

* Measures & records the force required to blow & break a bubble of dough.

1. P – value – The force required to blow the bubble of dough. It is indicated by the length of the curve & is expressed in millimeters (mm).

**Method**

1. A 250 gms of flour sample is mixed with a salt solution to form a dough.
2. Make five different dough patties having 4.5 cm each.
3. Then rested in the alveograph in a temperature regulated compartment has 25oC for 20 minutes
4. Each dough patty is taken for testing. This Alveoraph blows air in a dough to expand bubble and gradually break it. The pressure inside the bubble is recorded as a curve on graph paper.

- Fig – Alveograph 

**4. Mixograph**

It analyzes small quantities of flour for dough gluten strength quickly. Flour water absorption is measured by the mixograph often serves as bake absorption in bread baking tests.

**The Mixograph Test**

It measures & then record the resistance of a dough mixing with pins.

1. **Peak time**
2. **Mixing tolerance**
3. **Peak time**

The dough development time beginning the moment the mixer & recorder are started & continuing until the dough reaches maximum consistency.

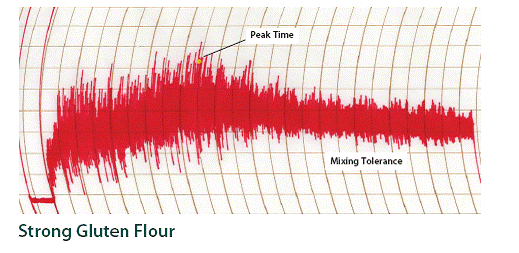
It indicates optimum mixing time & is expressed in minutes.

1. **Mixing tolerance**

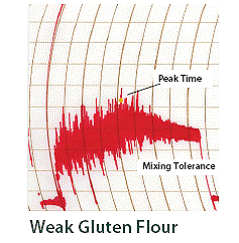
It resists to break the dough while mixing and that affects the shape of curve. It tolerates over mixing. Strong gluten flour has a greater peak time and more mixing tolerance.

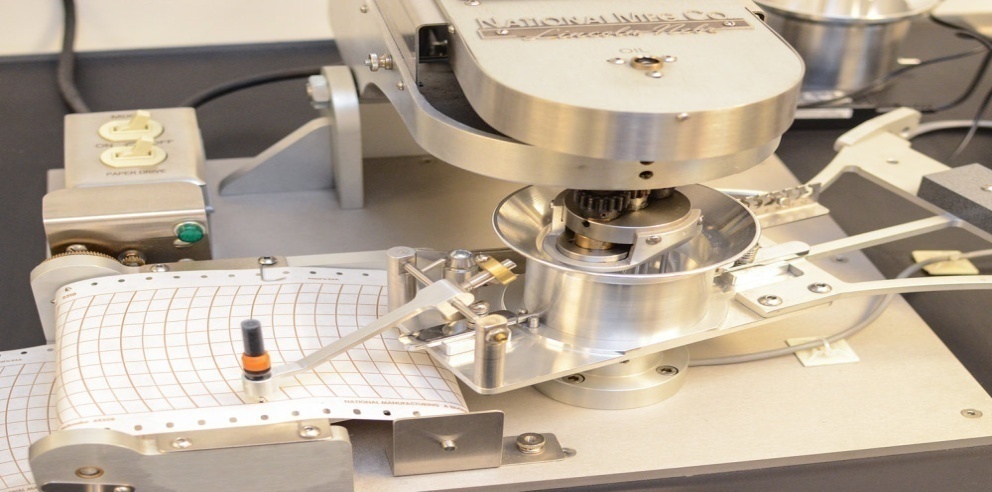
**Method**

1. A flour sample of 35gm weight that is placed in a mixograph bowl.
2. Water is added into that and placed in a mixograph to make a dough.
3. As the dough is mixed, the mixograph records a curve on graph paper and result is showing on that .
4. **Strong Gluten Flour –**

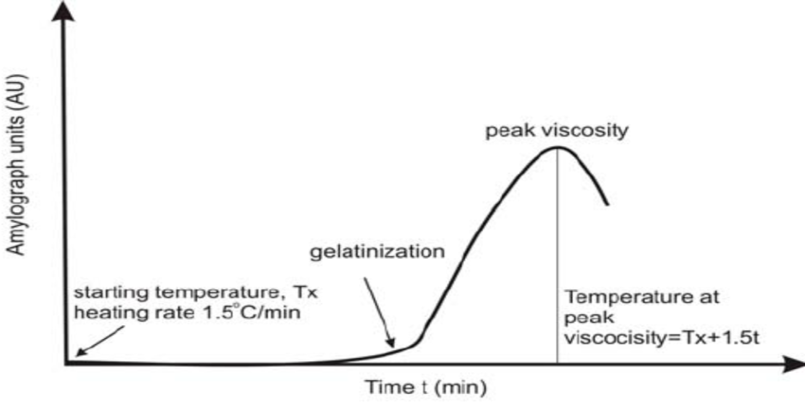


1. **Weak Gluten Flour –**





1. **Amylograph :**
2. It measures the viscosity of a flour water suspension as it is heated.
3. It measures the changed viscosity as the starch granules gelatinize & swell during heating of that.
4. This suspension of flour & water is made as per standard process.
5. This mixture is heated from 30oC to 92oC in a rotating bowl.
6. It records the viscosity as Brabender Amylograph (AU) against time or temperature.
7. If the gelatinization is maximum between 300 & 700 AU is the good bread making performance.
8. In case of low level of alpha amylase activity, there is low level of bread making quality.
9. Rapid Visco-Analyzer can be replaced with amylograph.



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