الجامعة المستنصرية

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فرع التقانة الأحيائية

المرحلة الرابعة

تقانة اغذية عملي

LAB-

Food Technology

يطلب من

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Food Technology practical Lec. 1.

Food Technology: is the branch of food science which deals with the actual production proces to make foods.

- Early scientific research into food Technology concentrated on food preservation.
- Nicolas apperts development in 1918 the Canning process was a decisive event.
- Louis Pasteur's research on the spoilage and how to avoid spoilage was an early attempt to put food technology on a scientific basis

Developments: Developments in food technology have contributed greatly to the food supply and have changed our world. Some of these developments are:

1. **Instantized milk powder:** it has become the basis for a variety of new products that are rehydratable.
   - This process increases the surface area of powdered product by partially rehydrating spray-dried milk powder.

2. Freeze-drying : The first application of freeze drying was most likely in the pharmaceutical industry ; however, a successful large-scale industrial application of the process was the development of continuous freeze drying of coffee.

3. High-Temperature short time processing: these processes for the most part are charachterized by rapid heating and cooling, holding for a short time at a relatively high temperature and filling aspetically into sterile containers.

1. Decaffeination of coffee and Tea: Decaffeinated coffee and Tea was first developed on a commerial basis in Europe around 1900. Green Coffee beans are treated with water, heat and solvents to remove the caffeine from the beans.

; Process optimization : Food Technology now allows production of foods to be more efficient, oil saving technologies are now available on different forms. Production methods and technology have als become increasingly sophisticated.

Food processing: is the transformation of cooked ingredients, by physical or chemical means into food, or of food into othe forms, food processing combines raw food ingredients to produce marketable food products that can easily prepared and served by the consumer. Food processing typically involves activities such as mincing and macerating, Liquefaction, emulsification and cooking (such as boiling, bbiling, frying or grilling); pickling, pasteurization and many other kinds of preservation and canning or other packaging.; (primary-processing such as dicing, slicing, freezing or drying when leading to secondary products are also included.

Benefits of food processing:

1/ Toxin removal

2/ Preservation

3/ easing marketing and distribution tasks.

4/ Increased food consistency.

5/ it increases ~~food~~ yearly availability of many food

6/ enables transportation of delicate perishable foods across long distances

7/ Makes many kinds of food safe to eat by de-activating spoilage and pathogenic M.O.

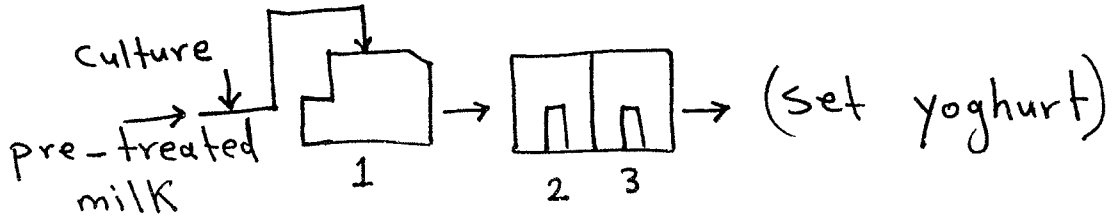
Food Technology

Fermented Milk Products (Yoghurt)

Milk products prepared by lactic acid fermentation (e.g yogurt) or a combination of this and yeast fermentation (e.g Kefir) are called fermented or cultured milks.

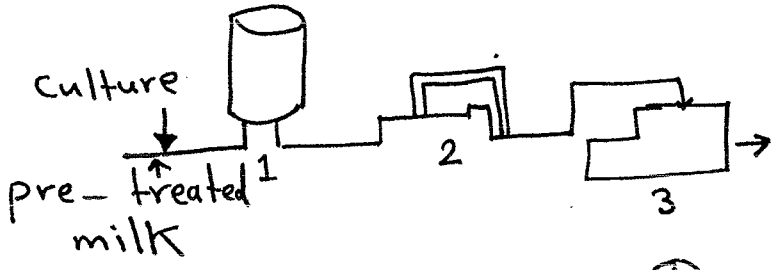
Yoghurt: is the best known of all fermented milk products, and the most popular world wide. The consistency, flavour and aroma vary from the district to another. In some areas, yoghurt is produced in the form of a highly viscous liquid, or in another type, So, Yoghurt is typically classified as follows:

- Set type: incubated and cooled in the package.



1. Cup filler
2. Incubation room
3. Rapid cooling Room.

- Stirred type: incubated in taks and cooled before packing.



1. Incubation tank
2. Cooler
3. Cup filler

- Drinking type: similar to stirred type, but the coagulum is broken down to a lipid before being packed.
- Frozen type: Incubated in tanks and frozen like ice cream.
- Concentrated: Incubated in tanks, concentrated and cooled before being packed. this type is sometimes called Greek yoghurt or strained yoghurt, sometimes labneh or labaneh.

Flavoured Yoghurts: Sometimes yoghurt is also favoured with fruits, vanilla, honey, coffee essences, etc. Colouring and Sugar in the form of sucrose, glucose or aspartame (a sugar-free diet sweetener) are often added together, with the flavouring. when necessary stabilizers may also be added to modify the consistency.

Milk for yoghurt production must:

1. Have a low bacteria count.
2. Not contain enzymes and chemical substances which may slow down the develop_ment of the yoghurt culture.
3. Not contain antibiotics and bacteriophage.

General Manufacturing Procedure

The following flow chart and discussion provide a general outline of the steps required for making yogurt.

General Yogurt Processing Steps

- Adjust Milk Composition & Blend Ingredients
- Pasteurize Milk
- Homogenize
- Cool Milk
- Inoculate with Starter Cultures
- Hold
- Cool
- Add Flavors & Fruit
- Package

1. Adjust Milk Composition & Blend Ingredients

Milk composition may be adjusted to achieve the desired fat and solids content. Often dry milk is added to increase the amount of whey protein to provide a desirable texture. Ingredients such as stabilizers are added at this time.

2. Pasteurize Milk

The milk mixture is pasteurized at 185°F (85°C) for 30 minutes or at 203°F (95°C) for 10 minutes. A high heat treatment is used to denature the whey (serum) proteins. This allows the proteins to form a more stable gel, which prevents separation of the water during storage. The high heat treatment also further reduces the number of spoilage organisms in the milk to provide a better environment for the starter cultures to grow. Yogurt is pasteurized before the starter cultures are added to ensure that the cultures remain active in the yogurt after fermentation to act as probiotics; if the yogurt is pasteurized after fermentation the cultures will be inactivated.

3. Homogenize

The blend is homogenized (2000 to 2500 psi) to mix all ingredients thoroughly and improve yogurt consistency.

4. Cool Milk

The milk is cooled to 108°F (42°C) to bring the yogurt to the ideal growth temperature for the starter culture.

5. Inoculate with Starter Cultures

The starter cultures are mixed into the cooled milk.

6. Hold

The milk is held at 108°F (42°C) until a pH 4.5 is reached. This allows the fermentation to progress to form a soft gel and the characteristic flavor of yogurt. This process can take several hours.

7. Cool

The yogurt is cooled to 7°C to stop the fermentation process.

8. Add Fruit & Flavors

Fruit and flavors are added at different steps depending on the type of yogurt. For set style yogurt the fruit is added in the bottom of the cup and then the inoculated yogurt is poured on top and the yogurt is fermented in the cup. For swiss style yogurt the fruit is blended with the fermented, cooled yogurt prior to packaging.

9. Package

The yogurt is pumped from the fermentation vat and packaged as desired.

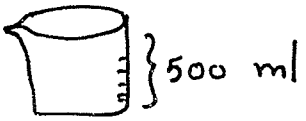
yogurt production:

Milk (Dry) 100 gm

+

Distil water 300 ml

↓



↓

Homoginization

↓

95 c°

↓

Cooling 42 c°

↓

add Cultures

cool 7 c°

↓

~~Cultures~~

(We can add the ~~cut~~ (flavors)

↓

package

Cheese Production: Lab: 3

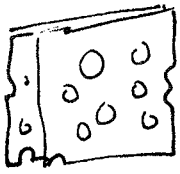
① Introduction: ETYMOLOGY

- word "cheese" - latin "casues" meaning to ferment / become sour.

② Type of cheese:

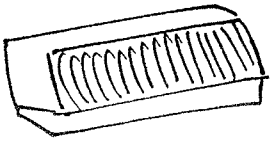
- Gorgonzola
- Requefort
- Grana
- Cheddar
- Gouda
- Gloucester
- Stilton
- Camembert

③ Cheese : ultimately a milk product, widely used all over the world as food product., Purely a product of microbial fermentation. flavor and aroma changes depending upon the M.Os being used., Before long, people learned that curds can be aged for over weeks and months and then pressed together to form large cakes of cheese., the art of cheese making have traveled from Asia to the Europe and then spread all over the world.

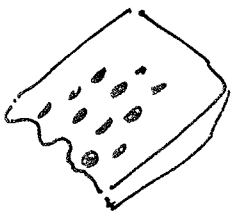


Swiss cheese

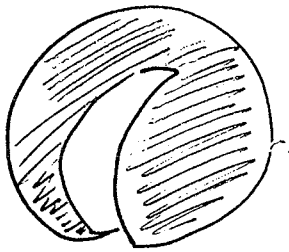
camembert cheese



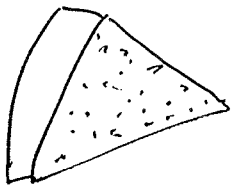
brie



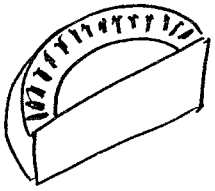
Roquefort



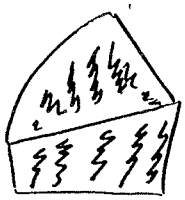
Gouda



Grana



Glaucester



Gorgonzola

■ Cheese manufacture:

The manufacture of cheese involves the following:

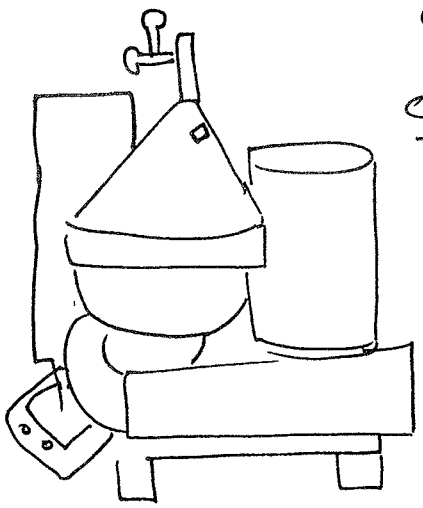
* Pasteurization: 72 -73°C for 15-20 seconds.

Kills nearly all M.Os that cause disease.

Clostridium tyrobutyricum can survive and produce butyric acid and H_2 gas by fermenting lactic acid.

Note: chemical Inhibitors can be used such as H_2O and $NaNO_3$.

* Bactofugation: process in which separate the bacteria and spores that present in milk. eg. Bacillus cereus is reduced., 60-63°C is applied.



Bactofuge

* Microfiltration: A membrane filter with a pore size of approximately 0.2 micron can filter bacteria froma

reducing efficiency, microfiltration allows production of hard and semi-hard cheese without any need for chemicals to inhibit growth of Clostridia spores.

* Additives in cheese milk
  - essential: starter culture and the rennet
  - certain conditions: calcium chloride and saltpetre.
  - Inhibitor of clostridia: lysozyme.

* Acid Coagulation:
- Any soft cheeses are produced without use of rennet, by coagulating milk with acid, such as citric acid or vinegar, or the lactic acid produced by soured milk.
- Cream cheese, paneer and rubing are traditionally mad by this way.

* Coagulation of casein:
- pH is lowered, rennet is added.

* Syneresis: or shrinking of the coagulum, it causes loss of whey and is accelerated by cutting, stirring, cooking, salting, amount of acid, and cheese making.

* Salting: it affects the texture and flavour of the final cheese by controlling microbial growth and enzyme activity.

* Curd Manipulation:
Heat treatments: alters the composition and texture

like cheddar and Mozzarella.

* Stretching the curd: the curd was immersed in hot (about 8C°), water and the fluid mass of cheese was pulled into strands to align the protein fibers and then poured into a container to cool. such as pasta filata and also mozzarella.

* Washing: helps remove more lactose which changes the pH of the cheese.

* Moulding: some cheeses are pressed in moulds. such as Roquefort cheese.

* Maturing or Maturation or ripening: is the breakdown of proteins, lipids and carbohydrates (acids and sugars) which releases flavour compounds and modifies cheese texture.

* Packaging: in large blocks, porous boxes, ect.

Make the cheese in home

Milk (1 liter)
(full fat)
↓
Bring the milk to a simmer just below a boil over medium - high heat.
↓
Stir constantly to keep milk from scorching
↓
when it comes to a simmer reduce the heat medium ↑

Add 1 cup of white vinegar few at a time (Limon or lime juice)
↓
stirr after each addition
↓
The milk will seperate into curds & whey
↓
Remove from heat, let sit for 15 min. to complete the separation process.
↓
Line a colander with a double layer of cheese cloth.
↓
↑

↓

This recipe can be scaled up or down

↓

press to remove excess whey.

↓

Let rest for 1 hour or until the cheese has reached your preferred texture .....

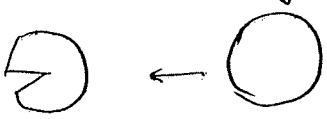
↓

The longer you wait, the firmer it will get

↓

After 1 hour.

↓

 hard cheese

So, Yummy, fresh and chewy this cheese won't last long.

↓

you can add salt, olive oil or any seasonings you like.

↓

you can crumble it, cube it and marinate it in olive oil

↓

Note - Ricotta cheese, let the curds strain for about 15 minutes (Don't forget to sprinkle the curds with salt)

Cream cheese : add salt and mix until smooth cream.

OJ د. يسرى محمد باقر Lab 4. ①

Pickles:

The term pickle is derived from the Dutch (is a west Germanic language) word pekel, meaning brine. In most of world countries, the word pickle alone refers to a pickled cucumber, except when it is used figuratively., other types of pickles will be described as pickled onion, pickled beets, etc.

Types of Pickles:

1. Gherkin
2. Brined pickles
3. Kosher dill
4. Polish and German
5. Hungarian
6. Romania
7. Lime
8. Cinammon pickles
9. Swedish and Danish

Brined pickles: are prepared using the traditional process of natural fermentation in a brine which makes them grow saur. the brine concentration can varg between 20 to more than 40 grams of salt per litre of water., there is no vinegar usedin the brine of naturally fermented pickled cucumber.

Fermentation: The fermentation processes is dependent on Lactobacillus bacteria that naturally occur on the skin of growing cucumber. These may be removed during commercial harvesting and packing processes.

Nutrition:

① contain a moderate amount of vitamin K.

② offers 3 Kilo calories., most of which come from carbohydrate

③ high is sodium, one pickled cucumber contain 350_500mg.

④ ability to act as vegetables with a high probiotic content.

* such as L. plantarum and L. brevis

Isolation of Lactobacillus after fermentation:

cucumber
↓
washing
↓
cutting
↓
brine solution
(5gm NaCl + $\frac{1}{4}$ Liter D.W)
↓
{fermentation} Incubator 37°C for 3 days

⇒

Isolation

1% of fermented cucumber
↓
MRS broth (Man_Rogosa_sharpe)
↓
Incubated (anaerobic_condition) 37°C for 48 hr.
↓
Serial dilution
↓
0.1 ml on MRS agar
Incubated (anaerobic condition) at 37°C for 48 hours.

Diagnosis in: Smear Slide → pickup colony → stainning → examined under microscope.

Microscope

SauerKraut:

German pronunciation, is finally cut cabbage that has been fermented by various lactic acid bacteria., it has along shelf -life and a distinctive sour flavor, both of which result fro the lactic acid that forms when the bacteria ferment the sugars in the cabbage.

Note: The word "Kraut" derived from this food, is a derogatory term for the German people., during World war I, due to concern the American public would reject a product with a german name, American saureKraut makers relabeled their product as "Liberty cabbage" for the duration of the war.

Cabbage fermentation: SaureKraut is made by a process of pickling called lactic acid Fermentation., That is analogous to how traditional (not-heattreated) pickled cucumbers are made., the cabbage is finely shredded, Layered with sal , and left to ferment. Fully cured sauerKraut Keeps for several months in an airtight container stored at 15C° o below., Neither refrigeration nor pasteurization is required although these treatments prolong storage life.

The Microorganisms that can be found in saure Kraut: (4) after fermentation

① Lactobacilli is introduced naturally, as these air-borne bacteria culture on raw cabbage leaves where they grow.

② Yeasts also are present, and may yield soft sauerKraut of poor flavor when the fermentation temperature is too high.

③ First phase of Fermentation (naturally): anaerobic bacteria such as Enterobacter lead to fermentation., and begin produci an acidic environment that flavors later bacteria.

④ Second phase starts as the acid levels become too high for many bacteria, and Leuconostoc mesenteroides and other leuconostoc spp. take dominance.,

⑤ Third phase: various Lactobacillus species, including L. brevis and L. plantarum, ferment any remaining sugars, further lowering the pH.

[these 3 phases in Fermentation process, collectivelly sometimes reffered to as population dynamics.]

Note Properly cured saure Kraut is sufficiently acidic to prevent a favorable environment for the growth of Clostridium botulinum, the toxins of which cause botulism.

(6) The genomic study found an unexpectedly large diversity of Lactic acid bacteria in saureKraut., Weissella was found to be a major organism in the Initial, heterofermentative stage, up to day 7. It was also found Pediococcus pentosaceus had smaller population numbers in first 14 days.

The benefits: 1/ Source of Vit. B, C, and K.

2/ high in calcium and magnesium.

3/ Very good soure of dietary fiber, iron, copper.

4/ Supply of probiotics improve digestion and promote the growth of healthy bowel flora., protecting against many disease.

5/ is a time_honored folk remedy for canker sores.

6/ Inhibit the growth of cancer cells because it has Key detoxifying enzymes., and its' chemoprerentive activity.

7/ is high in the lutein and zeaxathin (antioxidant) both associated with preserving ocular health.

Fermentation and Isolation: as the same as in Pickles.

Food Technology

Wine production:

Lab :5

Introduction:

- Wine is an alcoholic beverage made from fermented fruit juice.
- Grape wine is produced by fermenting crushed grapes using various types of yeast.

Types of wines: 1. Red wine 2. White wine.

Classification of wines:

1/ Sparking wine
2/ Desert wine
3/ Ice wine
4/ Fortified wine.
5/ Table wine.

Wine Production
Main steps

1. Vit culture
2. Harvesting
3. Stemming
4. Fermentation
5. Draining
6. Pressing
7. Mixing
8. Clarification
9. Aging
10. Bottling

1. Vitculture:

Factors which influence grape's flavor:

- Climate (sun, humidity and others)
- Soil quality

2. Harvesting:

- Grappes are picked up by hand or mechanically.
- Descision of harvest informed by level of sugar and acid.

3. Stemming / Crushing:

Stemming: is the separation of the stems and grapes (which are sends to the press)

Crushing: A horizontal press squeezes the broken grapes, separating the fresh juice (must) from the skins (marc).

4. Fermentation: Sugar and acids that naturally react with wild yeasts, fermentation can take from 10 to 30 days to convert natural sugar to alcohol.

5. Draining: Liquid wine is drained from the vat without being pressed and go into barrels (free-run wine) the remaining pulp retains about 20% of the wine.

6. Pressing: The remaing pulp, after draining, is pressed to squeeze out the press wine.

7. Mixing: The free-run wine and press wine, always from the same source, are mixed together in appropriate ratios to obtain the desired balance.

8. Clarification: done in numerous ways:
   1. Fining 2. Filtration 3. Siphoning 4. Floatation

9. Aging: the clarified wine is transferred into either wooden barrels or metal vats to mature the wine and develop flavors.

10. Bottleing: A dose of Sulfite is added to help preserve the wine and prevent unwanted fermentation in the bottle.

Note: Saccharomyces cerevisiae has been favored due to its predictable and vigorous fermentation capabilities, tolerance of relatively high levels of alcohol and Sulfurdioxide as well as its ability to thrive in normal wine pH between 2.8 and 4.

Yeasts:

Yeasts are naturally occuring micro-organisms which are essential in the fermentation process. Yeasts attach themselves to the bloom on the grape skins: wild yeasts and wine yeasts are two types and basic groups of yeasts presents on the skins. Wild yeasts (mostly of the genus Klockera and Hanseniaspora, need air in which to operate, Once in contact with the grape sugars, they can convert these sugars to alcohol, but only up to about 4% alcohol by volume, at which point they die. Wine yeasts of the genus Saccharomyces, then take over and continue to work until either there is no more sugar left or an alcoholic strength of approximately 15% has been reached, at which point they die naturally.

Note • Saccharomyces bayanus is tolerate alcohol levels 17-20%, so it's often used in fortified wine production such as ports and varieties such as Zinfandel and Syrah harvested at high brix sugar levels.

• Brettanomyces: is presence in wine fault or added note of ↑ Complexity

beer production:

Essential Ingredients of Beer:

1. Malted Barley 2. Hops 3. Yeast
4. Water 5. Not required, but frequently found Ingredient.
6. Starch adjuncts (corn and rice starches).

Yeast: Yeast can be found naturally on the surface of most plants including barley seeds.

* "Wild" yeast will most likely produce flavors that are undesirable.

Saccharomyces cerevisiae is the species most often used for ales, its optimum fermentation temperature is 16_24C.

Saccharomyces uvarium is largely used in lagers, and steam beers, the optimum temperature for this fermentation is 2-13°

What qualities should yeast have?

1. Rapid initiation of fermentation.
2. High fermentation efficiency.
3. High ethanol tolerance.
4. Desired flavor characteristics.
5. High genetic stability 6. Range of alcohol product.

Raw materials:

Malt: is one of the main ingredients and is obtained from barley, which is subjected to a process of germination under controlled conditions., this operation called (malting)

corn: is very common, the oils are extracted, then it is milled and called grits.,

Barley: rice or wheat may also be used.

Humulus lupulus (hops): hops are the flowering portion of the hop vine., these flowers not only fight off bacterial infections in the beer, they aid in clarification of the beer, stabilize the flavor, help retain head, and aid in ones ability to drink the beer.

Production process:

The first phase in the process of beer production is the preparation of the wort (8-14% total solids, 90-92% are carbohydrate: glucose, maltotriose and fructose, Vitamines: biotin, inositol, pantothenic, Nitrogenous compounds)

Wort preparation has four stages:

1. Milling -
2. Mashing
3. Filtration of the wort
4. Boiling the wort

Milling: In order for the malt components to be rapidly extracted and converted the malt is milled to obtain coars flour.

Mashing: The flour from the cereals is mixed with water. These conditions encourage the development of complex starch molecules and proteins.

Filtration of the wort: it is done to seperate the spent grains from the wort itself.

Boiling the wort: the filtered wort is boiled for 2 hours.

The purpose of boiling is to:

- Transform and make soluble the bitter substances in the hops.
- Sterilise the wort.
- Establish the final concentration of wort
- Eliminate undesirable volatile substances.
- Provoke the precipitation of proteins of high molecular weight.

Fermentation / Maturation

Fermentation: The wort sugars are converted by the transformation of yeast into alcohol and carbon dioxide.

Maturation: The period in which the beer is allowed to rest at suitable temperatures in order for the undesirable valatile.

Stabilisation: This consists of letting the beer stabilise at temperatures of between 24-30c°.

Clarification: is the operation that gives the beer it's clear limpid, quality, eliminating the last remaining traces of Clouding still in suspension.

Transferring: The final stage of beer production, process is transferring the beer into different kinds of containers (bottoles, barrels, cans etc).

Note Type of beer depend on the type of used yeasts in production process.

Baker's Yeast Production:

It is one of the largest profit grossing industry. Since demand is directly associated with bread demand and there is an ever increasing demand for bread.

- Marketed in the form of cake, powder or cream.
- By-products are not required so ... directed towards max. biomass production.
- Saccharomyces cerevisiae is the most commonly used organism, unicellular, rich in protein and Vit. B., Budding and has enzymes :- Maltase : converts maltose to glucose. Invertase : converts sucrose → glucose + fructose and Zymase complex : converts sugars to CO_2 & ethanol.

Yeast production:

- Pure Culture : S. cerevisiae
- Media : sugars (Molasses)
  Nitrogen (Urea, NH_3 salts or NH_3)
  Phosphorus (phosphoric acid)
  Trace elements (Magnesium, iron, calcium, Zinc)

S. cerevisiae

⇩

media

⇩

incubated for 2-4 days in flask

⇩

Transferred to a large vessel (16-24) hr.

⇩

Tranferred to intermediate fermenter. ①

⇩

Yeast separated through centrifugation ②

① Duration of final trade fermentation is about 19-22 hrs., the yeast cells increase in number 5-18 fold., pH ↑ $^{4.5-5.5}$ and nutrients and airflow must are monitored carefully. Temperature is kept in 85 F°.

② A// Yeast is separated and washed with water and re-centrifugated to yield cream yeast.

B// Yeast cream is pumped to rotary vaccum filter or plate fram filter and dewatered (Solid content 30-32%. After this 2 types of Baker's yeast is obtained.

Types of Baker's Yeast

1. Cream Yeast: is charachterized by:
   - Suspension of yeast cells.
   - Cream yeast in not termed as baKer's yeast but is a marKetable product.
   - Solid contents about 18 - 20.

2. Compressed yeast:
   - Most of the moisture is removed and dried by passing through fluid-bed drier.
   - Emulsifiers and oils are added to texturize and aid in cutting process.
   - Solid contents range between 27-33%
   - Shelf life of compressed yeast is about 1-2 years.
   - Compressed yeast can be A form or B as follows:

(A) Granular Yeast
- Small granules
- High age of live cells
- Can be added to driest doughs
- Small amount of ascorbic acid added as preservative.

(B) CaKe Yeast
- Also Known as active dry yeast.
- Long shelf life.
- Cells encapsulated in a thick jacket of dead cells
- More sensitive.

Yeast Testing:

- Strain purity and trueness to type is tested.
- Strict adherence to GMP rules is required.
- Complete microbiological testing.
- Tested for gassing activity.
- pH.
- Gm/ltr of yeast.

Application:

- Production of CO_2 (cause expansion of Dough).
- Dough maturation (Result in light dry « leavening agent » physical structre.
- Development of flavour (characteristic flavor bread).

Yeast production stages