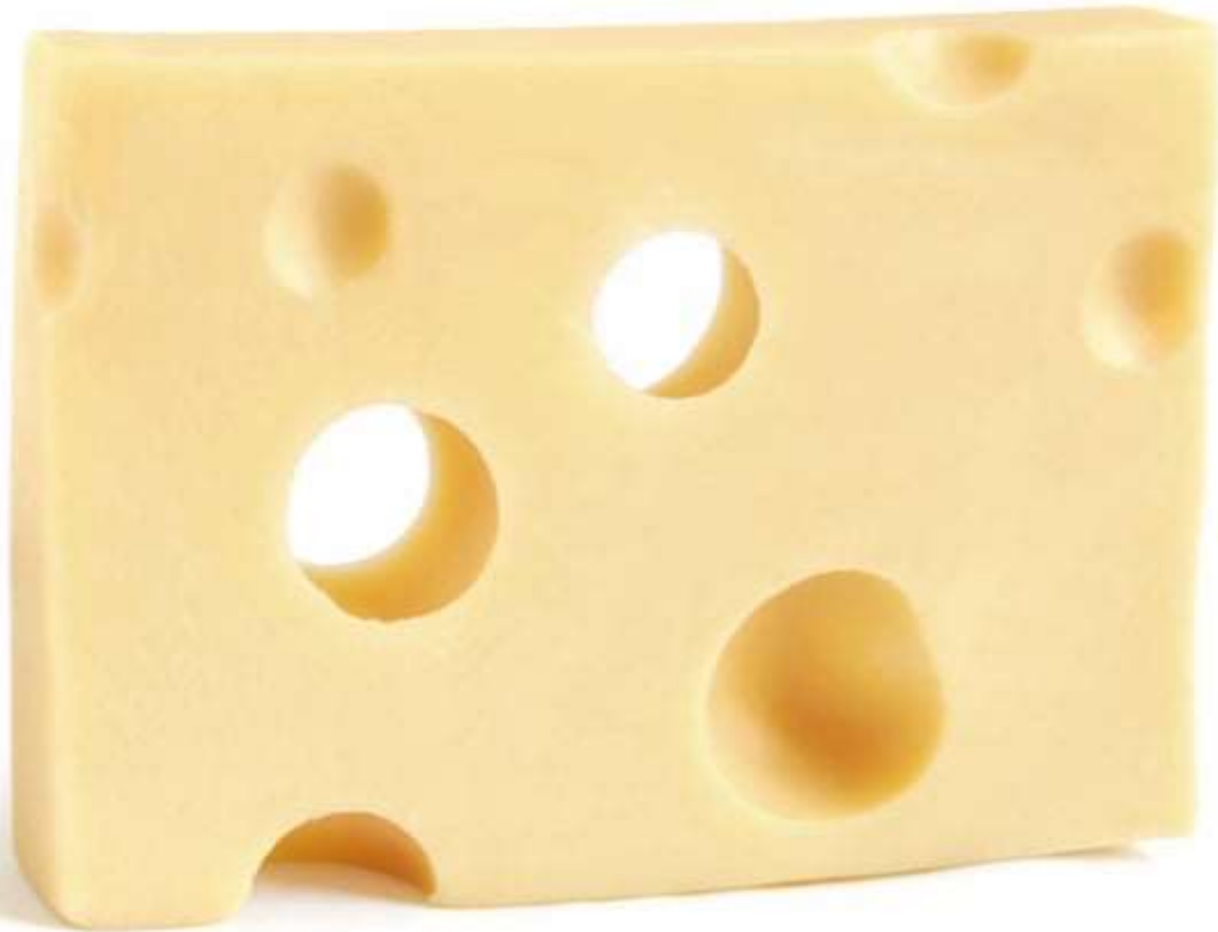


Swiss Cheese



- 1. Originated in Emme valley, Switzerland around 15th century (Emmental cheese).**
- 2. Producers: USA, Switzerland, Italy, Austria, Finland, Denmark, Germany and Argentina.**
- 3. Hard, shining eyes with smooth, waxy texture and sweet nutty taste with mild flavor.**
- 4. Specific grass available in the Emme valley: No duplication of flavor and body.**
- 5. Production ranks third in world, next to Cheddar and Mozzarella.**

Characteristics

Sliceable texture



Regular round eye holes



Dull to brilliant appearance



45% min fat on dry matter basis



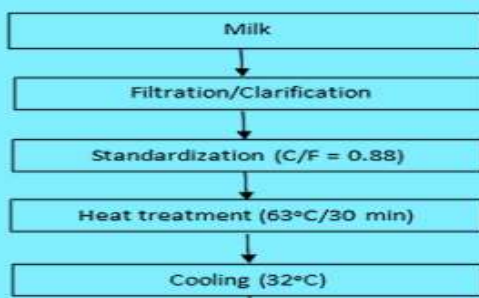
Should be minimum 60 days old before consumption

Composition

Moisture	34.5-36.5%
Ash	3.0-5.0%
Fat	29.5-30.5%
Salt	1.0-1.4%
Protein	27.0-28.0%
FDM	45.0-48.0%

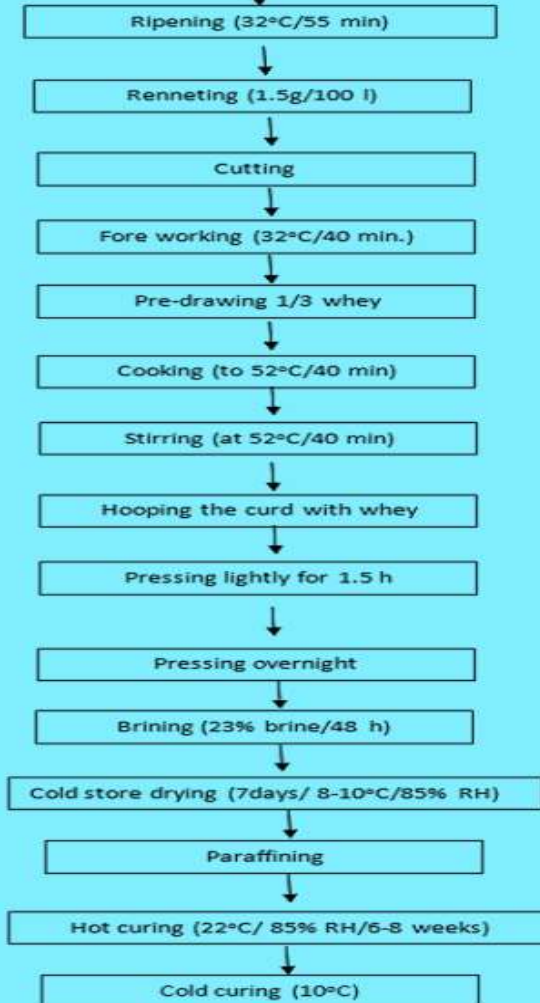
Mechanism of Eye Formation

- i) **Propionic acid fermentation:** Propionic acid bacteria grow under anaerobic conditions, using calcium lactate as substrate.
- ii) **End products:** Propionate, acetate, water and carbon dioxide.
- iii) Part of CO_2 may be produced by dicarboxylation of tyrosine and arginine by enterococci due to high salt concentration and low pH (5.1-5.2) in periphery of cheese.
- iv) To initiate propionic acid fermentation, ripening temperature must be raised approx. to 18-25 C for certain period of time. Relative humidity of curing room (22 C/85% RH/6-8 weeks) influences eye formation. Uneven RH leads to uneven eye formation.
- v) Eyes are formed by continuous production of CO_2 which diffuses out at weak points, 1.25–2.54 cm diameter and spaced at 2.54 – 7.62 cm.
- vi) After development of sufficient eyes, PA fermentation is retarded by storing cheese at lower temperatures.



Starter addition

{*Sterptococcus salivarius* subssp. *thermophilus* (1%), *Lactobacillus delbrueckii* subsp. *bulgaricus* (0.045%), *Propionibacterium frudenreichii* subsp. *shermanii* (0.025%)}



Methods of Manufacture

Defects of Swiss Cheese

a. Late Fermentation:

Occurs during ripening of cheese

The gas may form pin holes or the resulting eyes may appear in clusters

Caused by lactate fermenting bacteria (*Clostridium*, strains of butyric acid bacteria isolated from brown cheese). *C. tyrobutyricum* produces brown cheese

b. Bitter Cheese:

1.

- *Streptococcus faecalis* var. *liquefaciens* forms major part of ripening flora and responsible for bitterness.

2.

- Caused by some starter that may not contain enough peptidases to degrade peptides produced by proteolysis.

3.

- May result from higher proteolytic activity of rennet at lower pH, which leads to accumulation of polypeptides including bitter ones.

c. Flavour Defects: Putrid, unclean, fermented, yeasty, rancid and fruity

Putrid flavor: Caused by objectionable protein decomposition and odor resembles H₂S. *Clostridium lentoputrescens* is associated with this flavor and development of white, crumbly conditions and large irregular eyes.

Rancid flavor: Because of higher conc. of butyric acid produced by *C. butyricum*/*C. tyrobutyricum*. Oxidative rancidity resulting from lipid oxidation also may occur. Lipolysed milk may also yield rancid cheese.

d. Colour Defects:

- Colored spots may be formed by growth of pigmented propionibacteria in Swiss cheese.
- Round brown spots on cut surface or eyes of cheese could overcome by adding **starter propionibacteria**. This defect is most pronounced when cows are not on pasture and when milk contains fewer propionibacteria.
- *Propionibacterium rubrum* and *P. theonii* are brightly colored and may cause spots.
- Dark spots may be caused by other pigmented microbes.

Defects in Swiss cheese

Defect	Description	Probable cause
Blind	No eyes	Overripe or too acid milk
Small eye – overset	< 0.4" dia. Excess in number	Excess gas generation or inclusion, disturbed curd
Shell	Crinkled, nutshell appearance on eye surface	Excess fat in milk and curd, eyes that develop too slowly
Glass	Noticeable, clear-cut parallel cracks. If excess, cheese does not slice properly	Too acid & too fat rich milk. Poor whey drainage & curd becomes brittle
Frog mouth	Rind splits on surface to give appearance of an open frog's mouth	Poorly developed, weak, inelastic rind, careless handling of cheese in the press, becomes too cold
Blow hole	Very large eyes (5" or more in dia) if extreme, only one large hole in the centre of cheese. Structure of cheese torn & deformed	Poor sanitary conditions of milk production, cows fed on grass silage.
Uneven normal eye distribution		Cooled too quickly on one side
Whey spotted		Poor whey drainage – becomes water logged under rind surface