THE ART (AND SCIENCE) OF CHEESE-MAKING
MILK

Raw or Pasteurised Milk?

**Good microbes**
- Lactic acid bacteria

**Bad microbes**
- *Salmonella*
- *E. coli* O157:H7
- *Campylobacter*
- *Listeria monocytogenes*
- TB
- *Brucella*
- Spoilage organisms
Starter cultures – adding good bacteria

Turns milk sugar - lactose - into lactic acid
Kills acid sensitive bacteria
Helps the milk coagulate

Lactococcus lactis

http://www.orchard-dairy.co.uk/category/Single-Shot-Cultures-for-100-and-400-litres.htm
Rennet

• Animal rennet
• Vegetarian rennet – microbial
• Plant rennet

• Source of enzyme chymosin – coagulates milk
Hard cheeses eg cheddar
Penicillium camemberti

Mould ripened soft cheese
Eg Camembert

http://www.cheesemaking.com/Camembert.html
Washed rind cheeses

Brevibacterium linens is ubiquitously present on the human skin, where it causes foot odour.

`At best, a washed rind cheese will have a fermented, fruity, pleasantly funky quality`

http://www.thekitchn.com/the-cheesemonger-a-profile-of-73799


Washed with salt water and brandy three times a week for six weeks

http://reluctantgourmet.com/component/k2/item/972-epoisses-cheese

Grayson

Port Salut

Epoisses
Internally mould ripened soft cheese
Stilton Cheese

http://woodsrunnersdiary.blogspot.co.uk/2012/01/interesting-short-article-on-stilton.html
What makes cheeses smell differently?

- Most cheese have a complex array of odour compounds:
  - Buttery
  - Acidic/sour
  - Fruity
  - Nutty
  - Floral
  - Acrid
  - Sulphurous, cabbagey
  - Cheesy/rancid/foot odour - butanoic acid
  - ‘Blue notes’ - n-methyl ketones
Now comes the science bit....

Role of non-starter organisms in cheese ripening
Microbial community structure directly from samples

DNA extraction → Microbial community DNA → Amplify signature DNA sequences → Mixture of DNA signatures from different species → Band purification + Sequencing + BLAST analysis → Microbial species identification

DGGE analysis → Population fingerprint
Cheese ‘DNA fingerprints’

- Robiola
- Belpaese
- Fontina cheese
- Danish cheese
- Brigante
- Sheep cheese
- Parmesan cheese
- Provolone cheese
- Provolone Sorrento
- Goat cheese
- Provolone Padano
- Camembert
- Gorgonzola
- Asiago
- Emmenthal cheese
- Grana
- Cheese 'DNA fingerprints'

Danilo Ercolini
Stilton’s bacterial fingerprint

PCR DGGE analysis of cultured and non-cultured populations from Stilton cheese

- **Lactobacillus plantarum**
- **Staphylococcus equorum**
- **Staphylococcus spp.**
- **Lactobacillus curvatus**
- **Enterococcus faecalis**
- **Lactococcus lactis**
Yeast flora isolated from Stilton

**Blue Veins**
- *Kluyveromyces lactis* 68%
- *Trichosporon ovoides* 9%
- *Debaryomyces hansenii group B* 23%

**White Core**
- *Kluyveromyces lactis* 26%
- *Yarrowia lipolytica* 16%
- *Debaryomyces hansenii group A* 32%
- *Debaryomyces hansenii group B* 26%

**Crust**
- *Debaryomyces hansenii group B* 69%
- *Yarrowia lipolytica* 9%
- *Debaryomyces hansenii group A* 22%

No *Penicillium* isolated from crust
Aroma profiles of the three sections of Stilton cheese

- The blue veins contain a lot of ketones
- The white core contains a lot of alcohols and aldehydes
- The crust is dominated by ketones

Principal Component Analysis plot of the model cheese systems analysed by GC-MS technique (SPME GC-MS)

- More ketones
- More alcohols less ketones
- Reduced key aroma compounds
- P. roqueforti only
Characterisation of non-starter microflora in fermented food production and assessment of their role in aroma production

Flash profile: ranking of model system and real cheeses

Relative position of samples regarding the blue cheese related attributes

General cheese aroma attributes

| Cheddar medium | Cheddar mature | Penicillium roqueforti | Model System 5 | Stilton | Blue cheese spread (St Agur) | Shropshire blue | Black-sticks | Blue cheese aroma related attributes | Danish blue | Roquefort |

Blue cheese aroma related attributes
Cheeses are a complex ecosystem of microorganisms

Most of these are there by luck

http://www.ifood.tv/blog/different-cheeses-to-entertain-your-guests-this-holiday-season
Thanks to
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