Natural cloning in plants

Bulbs *e.g. daffodils*	Leaf bases contain stored food, buds develop internally and make new shoots.
Runners *e.g.straw-berry*	Lateral stem grows, eventually withers away.
Rhizomes *e.g. marram grass*	Specialised horizontal growth, stem develops buds -which becomes new plant.
Stem tubers *e.g. potatoes*	Tip of underground stem becomes swollen with stored nutrients. Buds develop on that storage organisms and form new shoots.

Uses in horticulture:

Can take cuttings from bulbs/runners to increase the yield because it is faster than growing seeds.

This also guarantees quality (because genetically identical).

e.g. used in sugar cane cloning.

Artificial cloning in plants

Micropropagation:

Sample taken from meristem (sterile conditions).

Sterilised. Collected tissue = **explant**.

Placed in sterile culture medium containing plant hormones. Cells form Mass of identical cells (**callus**).

Callus is divided and transferred to different medium. This stimulates the development of genetically identical **plantlets**.

Plantlets are planted in compost and grow.

Young plants planted out to grow as crops.

Artificial twinning and SCNT

Artificial twinning

Animal w/ desired trait is given hormones for super-ovulation.

Ova is fertilised in vitro or by insemination (by desired male).

Before 6 days, cells are split (still totipotent).

Each cell becomes an embryo.

Embryos are inserted in surrogates.

Develop into foetuses and born normally.

Somatic Cell Nuclear Transfer (SCNT)

Transfer nucleus from adult somatic cell into enucleated egg cell (no nucleus).

Nucleus and egg are fused with an electric shock

OR *electrofusion* - Cells are left next to each other with constant current running through.

+ More offsprings than usual

+ Guarantees desirable genes from sire.

+ Useful in pharming

+ Can clone rare and endangered animals

- SCNT = inefficient -- many eggs required to successfully produce one offspring.

- Cloned embryos fail to develop, produced deformed offsprings...

- Most clones have a shorter lifespan, which also means we have not been successful in cloning extinct species yet.

Biotechnology and microorganisms

Biotechnology:	Applying biological organisms / enzymes to the synthesis / breakdown / transfer of materials in the service of people

e.g. foods, penicillin, insulin...

Pros / cons of using microorganisms:

+ No ethics

+ Easily manipulated genetically

Biotechnology and microorganisms (cont)

+ Short life cycles

+ Simple + cheap nutrient requirements

+ Growth conditions = low temperatures / oxygen / food...

- Can produce toxins

- Have to be separated from nutrient and processed.

- Sterile conditions needed (increases cost).

- Less natural flavour.

Direct / indirect food production

Indirect food prod	Use microorganisms for their effects on other foods.

e.g. bread -- yeast caused it to rise. yoghurt -- bacteria make it sour.

Direct food prod	Grow microorganisms to eat

e.g. Quorn, fusarium venetatum (grown on glucose syrup).

Brewing

Indirect food production	**Yeast** anaerobically respires.
	Optimum temp about 20-28^{o}C, but can also be genetically modified to function at lower temperatures.

Malting - Barley germinates and digests starch into sugars so yeast respires.
Mashing - Malt + hot water. Enzymes break down starch, worth is formed.
Fermentation - Wort + yeast. pH a lowered as yeast runs out of O_2 and produces ethanol.
Maturation - Low temperatures for about a month.
Finishing - Filtered, pasteurised and bottled with CO_2.

By **Anais** (Anais_Pe)
cheatography.com/anais-pe/

Published 18th June, 2024.
Last updated 18th June, 2024.

Baking bread

Indirect food prod	Yeast feeds on sugars and ferments them into ethanol and CO_2 which makes the bread rise
	Optimum temp. of 38-46^{o}C
	Optimum pH - 5.0 / 5.5
	Yeast requires O_2 and sugars for fermentation.

Cheese-making

Indirect food prod	**Bacteria** feed on lactose, inhibit growth of bacteria which makes milk go off.

Pasteurised - 95^{o}C for 20 seconds.
Mixed with bacteria culture and enzymes.
The milk is separated into solid curds and liquid whey.
Cheese - Curds are separated and cooked in whey, sometimes pressed and dried.

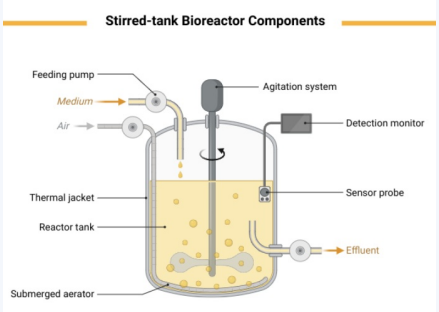
Yoghurt-making

Indirect food prod	Skimmed milk powder, milk is pasteurised and cooked.
	L. bulgarius / S. thermopilus **bacteria** added to the milk and milk is stored at cool temepratures.

Cultivating microorganisms

Inoculating broth	Bacteria suspension, mixed with sterile nutrient broth. Incubated and shook.
Inoculating agar	Inoculating loop Sterile and dipped in suspension. Streaks made across a Petri dish.

Bioreactors - making penicillin



Semi-continuous batch
Fungus grows and produces penicillin. The drug is extracted and purified.
The container is sealed to avoid contamination (asepsis).
The mixture is constantly stirred so it stays oxygenated.

Bioremediation

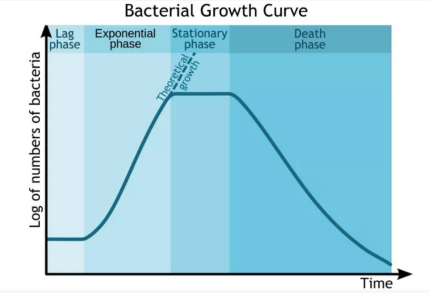
Microorganisms are used to break down pollutants and contaminants in soil / water.

Natural organisms	Used on crude oil / sewage.
GM microorganisms	Break down material they don't normally encounter (e.g. mercury in water).

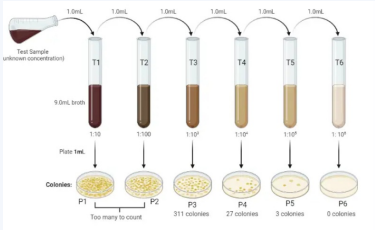
Bacterial growth stages

Lag phase	Bacteria adapting to environment. Growing and synthesising enzymes.
Exponantial phase	Close to / at theoretical max.
Stationary phase	Growth rate = zero --> Cells formed cancelled out by cells dying.
Death phase	Reproduction almost stopped, death rate increases (resources used up).

Bacterial growth graph



Serial dilutions



Immobilised enzymes

Alternative to using microorganisms is to isolated their enzymes.

***Immobilised enzymes** are when those enzymes are fixed so substrate washes over them.*	+ Reusable so cheaper, greater temperature tolerance, less downstream processing.

Surface immobilisation - Surface adsorption (sticking to the surface) to inorganic carrier.	+ Simple and cheap. + Activity virtually unchanged.	- Enzymes can be lost from matrix easily.

Immobilised enzymes (cont)		
Surface immobilisation - covalent / ionic binding to inorganic carrier.	+ Enzymes bound strongly, unlikely lost. + Accessible to substrate. + pH / substrate concen-tration = little effect on activity.	- Cost varies - Active site may be modified.
Entrapment - in matrix.	+ Applicable to different processes.	- Expensive. - Difficult to entrap. - Diffusion can be slow.
Entrapment - encapsulation or semi-perm-eable membrane.	+ Relatively simple to do. + Small effect on enzymes activity. + Applicable to different processes.	- Expensive. - Diffusion can be slow.

By **Anais** (Anais_Pe)
cheatography.com/anais-pe/

Published 18th June, 2024.
Last updated 18th June, 2024.