

The Uses of Microbes Quiz

Decide if you think microorganisms are involved in making the following products. Tick Yes or No

Product	Yes	No
Antibiotics		
Toothpaste		
Soft Centre Chocolates		
Yoghurt		
Paints		
Vinegar		
Beer		
Bread		
Cheese		
Quorn™		
Steroids		
Soy Sauce		
Tinned Fruit and Vegetables		
Pot Noodle		
Margarine		
Explosives		
Washing Powders		
Loud Speakers		

How Many did you get right?

Antibiotics



YES

Alexander Fleming, working at St Marys hospital first noted the effect of *Penicillium notatum* (a fungus) had on certain bacteria.

Penicillin was later purified by **Florey** and **Chain**, in 1941, spurred by the necessity of developing a treatment for war casualties.

Penicillin was heralded as a wonder drug and has been responsible for increasing life expectancy by a decade

Despite the importance of penicillin, most of our clinically useful antibiotics come from a group of bacteria called the *Streptomyces* (picture on the right). These are filamentous bacteria which live in the soil, and are responsible for the lovely 'damp earth' smell when it rains.



Antibiotic	Bacterium
Cyclohexamide	<i>Streptomyces griseus</i>
Streptomycin	<i>Streptomyces griseus</i>
Erythromycin	<i>Streptomyces erythreus</i>
Tetracycline	<i>Streptomyces rimosus</i>

Toothpaste



YES

There are in fact several ingredients in toothpaste which come from microorganisms

- 1) **Gluconic acid** is produced by the fungus *Aspergillus niger*.
- 2) Glycerols are produced by the fungus *Saccharomyces cerevisiae* (this is a single cell fungus called a yeast).
- 3) Diatoms as single celled silicon based organisms,

Soft Centred Chocolates

Yes

The soft centre of many chocolates contain a product called invertase, this is an enzyme which converts sucrose (the sugar you normally use) to glucose and fructose Invertase comes from species of the fungus *Aspergillus*.

Yoghurt

Yes

We are all very familiar with the dairy product yoghurt. This is made by adding a starter culture of lactobacillus to milk. Lactobacillus is a bacterium which ferments the milk

- also used in the 'friendly' bacteria market! To make probiotics

Paints

yes

A compound called **Itaconic** acid is used to improve the properties of vinyl polymers, such as those used in fibre and emulsion paint production it is produced by a fungus called *Aspergillus terreus*, grown in stainless steel aerated tanks.

Vinegar

Yes



Vinegar is the result of converting ethyl alcohol to acetic acid by acetic acid bacteria, (members of the genera *Acetobacter* and *Gluconobacter*).

It can be produced from any substance which contains alcohol, the usual starting material is wine, beer or cider, giving rise to white wine vinegar, beer vinegar or cider vinegar!

Bread and Beer

Yes



The origins of bread and beverage are lost in antiquity, but it's known that the Sumerians produced a beer consisting of moist fermented

bread prior to 7000 B.C. The Egyptians also made this 'bread-beer'

Both bread- making and brewing were refined by the Greeks and Romans, and became a normal part of household activities.

The production of bread and alcoholic beverages utilises yeasts, most often strains of *Saccharomyces cerevisiae*.

The yeasts ferment glucose to yield ethyl alcohol and carbon dioxide, the carbon dioxide gives the bread its light and fluffy texture.

Cheese

Yes

Microbes are used for making cheese in two different ways

- 1) Rennin
- 2) Cheese flavour

The rennin used for cheese production used to come from calves stomachs, but this has now been replaced by a microbial form of rennin from the fungus *Cryphonectria parasticia*.

Fungi are also used to flavour cheese. The fungus secretes proteolytic and **lipolytic** enzymes which produce pungent flavours from the hydrolysis of fats and proteins. For example, **Roquefort cheese** is made from sheep's milk. Curds are loosely packed together and inoculated with spores of *Penicillium roqueforti* (previously grown on bread).



Quorn™

Yes

In 1991, Marlow foods (a subsidiary of ICI) built a production plant to grow a species of *Fusarium graminearum* isolated from soil in Buckinghamshire. The name is now familiar to us as **QUORN**. It is marketed as a health food, it has 12% protein with no animal fat or cholesterol, and appears to help reduce the fats in the blood stream. Quorn has a fibrous nature which resembles meat; this feature can be used to mimic burgers sausages and mince meat. The annual sales of Quorn are now in excess of £15 million in the UK.

Steroids

Yes

The Upjohn chemical company found that the mould *Rhizopus arrhizus* was able to convert **diosgenin**, a steroid found in Mexican yams to an intermediate which could then be converted to cortisone. This reduced the cost of cortisone dramatically.



Soy Sauce

Yes

Shoyu (soy sauce) is made in East and Southeast Asia. The sauces are made by fermenting a mixture of soybeans, wheat kernels, raw or roasted wheat flour with *Aspergillus oryzae*.

Japan is the leading producer of shoyu with some 27, 000 manufacturers.

Tinned Fruit and Vegetables

Yes

In the tinned food industry, citric acid is used to prevent the loss of vitamin C, it's also used in soft drinks and jams. Early in the nineteenth century, citric acid production was an Italian monopoly. However, neglect of lemon and lime groves during the First World War meant a decline in output and an increase in price. Pfizer set up the first citric acid production plant in Brooklyn in 1923 using the fungus *Aspergillus niger*.

Pot Noodles

Yes

Pot noodles have an ingredient in them called mono sodium glutamate. Indeed this is a common component of many processed foods.

Margarine

Yes

Margarine contains a colouring agent called Beta-carotene. This is produced by a fungus called *Phycomyces blakeleeanus*

Explosives

Yes

Explosives use glycerol, and glycerol is produced by the fungus *Saccharomyces cerevisiae*. Glycerols are also used in solvents, plasticizers, sweeteners, soaps and anti-freeze.

Washing Powders

Yes

Enzymes for washing powders-proteases, cellulases, amylases. Produced by *Bacillus spp* eg *B. licheniformis*. These enzymes are able to tolerate the heat needed to wash our clothes.



Loud Speakers

Yes

Bacterial cellulose from *Gluconacetobacter xylinus* is used in the production of audio membranes, as it is pure, and the fibres lie in the right orientation. Maybe your sound system at home uses bacteria!



