

Food from Fungus

Contents: Information, questions and decision-making exercise concerning the production and marketing of a novel food.

Time: 2 periods plus homework or a further single period.

Intended use: GCSE Biology, Chemistry and Integrated Science. Links with work on food, food production, fungi, nutrition and health.

Aims:

- To complement and revise prior work on food, food production, nutrition and health.
- To develop appreciation of an application of biotechnology and of the potential of novel food sources.
- To develop awareness of the techniques needed to market a novel product.
- To develop skills in reading, comprehension, communication and problem-solving.

Requirements: Students' worksheets No. 102.

Background information

The idea of using microorganisms to produce single-cell protein (SCP) has been around since the 1960s. Companies invested millions of pounds in such ventures but many of them failed because of difficulties in getting their products accepted. The production of myco-protein is one of the few ventures that looks like being successful.

The organism used in the process described here is a micro-fungus called *Fusarium graminearum*. It is grown on a glucose syrup which can be prepared from a wide range of starchy crops, particularly cereals and potatoes.

If wheat is the source of glucose syrup, the wheat flour is first separated into starch and gluten. The latter represents the protein part of wheat and is used in animal feed. The starch is then hydrolyzed to give glucose syrup.

The final section of Part 1 includes some reference to conversion efficiency. It will be noted that myco-protein represents a far more efficient conversion of carbohydrate to protein than the same conversion performed by domestic farm animals. However, it is worth noting that even myco-protein is wasteful compared to direct consumption of plant foods. For example, wholemeal flour contains 11% protein and 70% carbohydrate. This means that there are 157g of protein for every 1000g of carbohydrate in wholemeal flour. This is even more than the 136g of protein that would be obtained by using the same 1000g of wheat carbohydrate as a substrate to grow myco-protein.

Notes on questions 6 and 7 in Part 2

The advantages of myco-protein might include its versatility, its more efficient conversion of carbohydrate to protein and its nutritious qualities, particularly compared with meat. Disadvantages might include the fact that additives have to be used to make it palatable, its relatively high price and the problem of getting it accepted.

Notes on Part 3

In this decision-making simulation, students are asked to develop a marketing strategy for myco-protein. They should be encouraged to work in groups and discuss the questions fully before coming to a decision. It might be interesting for the different groups to compare their marketing strategies at the end of the exercise.

Myco-protein was in fact first test-marketed as a filling for a savoury pie.

Acknowledgement Figures 1a, 1b supplied by Countrywide.

FOOD FROM FUNGUS

In this unit you will learn about a new food called **myco-protein**. It is a high-protein food made from a microscopic fungus. The unit is in three parts.

Part 1 Information about myco-protein

Part 2 Questions

Part 3 Decisions – how would you market myco-protein?

Part 1 About myco-protein

Eating fungus isn't new

The fungi are a large group of organisms which includes mushrooms, moulds and yeast. Many fungi are micro-organisms. This means they are very small and can only be seen under a microscope. Fungi are quite often used as food. About 40,000 tonnes of mushrooms are eaten each year in Britain. Yeast is eaten in bread and is used to make yeast extracts such as Marmite. Some cheeses have blue or green veins which contain moulds. In Japan and Indonesia a delicious food called *tempeh* is made by growing fungus on soya beans.

All these fungus foods are traditional and have been eaten for thousands of years. Myco-protein, though, is a new, not a traditional food. One of the problems with myco-protein is persuading people to eat it for the first time.

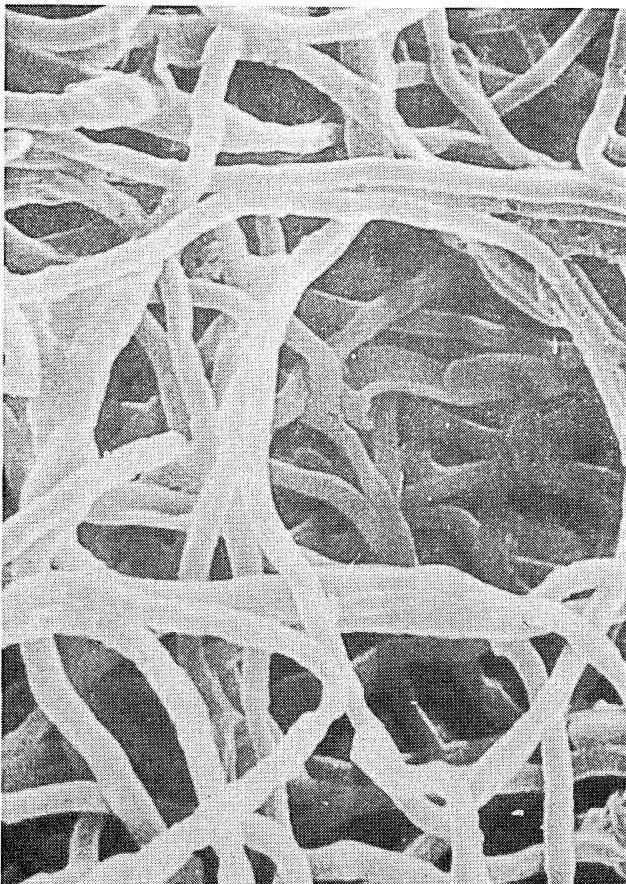


Fig 1a Magnification of myco-protein



Fig 1b Selection of products made with myco-protein

How was myco-protein discovered?

The story begins in the 1960s when a food company decided to look for a way to turn cheap carbohydrate into high-protein food. They decided to use a fungus to produce the food. Fungi need their own food supply in order to grow, and the company started looking for one that would grow in a solution of sugar. The fungus had to

- be safe to eat
- be nutritious
- grow quickly
- have the right taste and texture for using as a food.

Three thousand different fungi from all over the world were collected and tested. In the end, the best fungus was found in the back garden of a house in Buckinghamshire – just four miles from the company's research laboratories. It was a microscopic fungus that grows rapidly in a solution of sugar.

The process of growing and testing the fungus then started. It was tested on animals and human volunteers to make sure it had no harmful effects. It took ten years of careful testing before the myco-protein food was proved safe to put on the market.

How is myco-protein made?

The microscopic fungus is grown in a syrupy solution of sugar inside a big vessel called a fermenter. The sugar needed for the process is obtained by breaking down starch from cereals such as wheat or maize. Ammonia is added to supply the nitrogen the fungus needs to make protein. Air is also needed so that the fungus can respire. The temperature is kept at 32°C. Everything in the fermenter, except the fungus, is sterilized.

The fungus grows quickly, doubling its weight every five hours or so. It is continuously removed from the fermenter, then heated to break down some materials which may be harmful. Finally, the fungus is filtered off from the solution and used to make myco-protein food. Figure 2 illustrates the process.

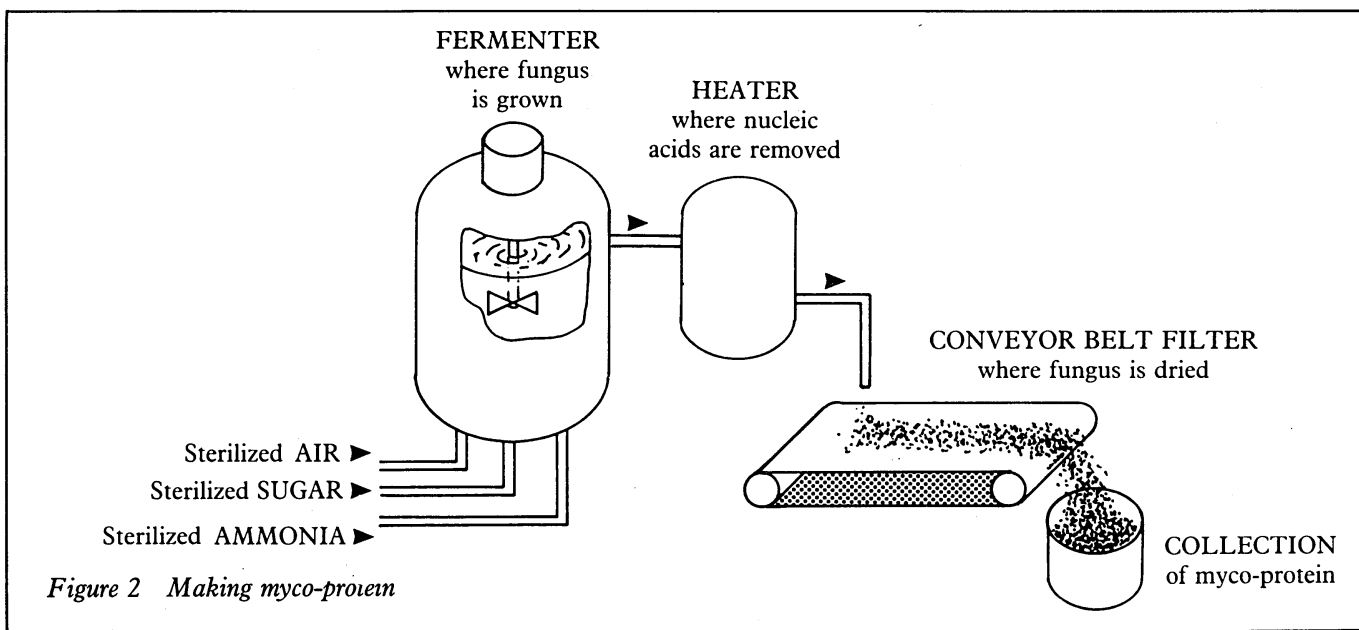


Figure 2 Making myco-protein

What is myco-protein like?

Myco-protein is a pale yellow solid with a faint taste of mushrooms. It is not very suitable for eating on its own because it has hardly any flavour. But it can be flavoured and coloured to make it taste like almost anything.

The texture of myco-protein can also be altered to make it resemble different foods. Myco-protein contains fibres, and the longer the fibres are allowed to grow, the coarser the texture. By lining up the fibres together, myco-protein can be given the 'chewy' texture of meat. Slightly different treatments give it the texture of chicken or fish. Pies, burgers, 'meat' slices and 'fish' fingers can all be made from myco-protein.

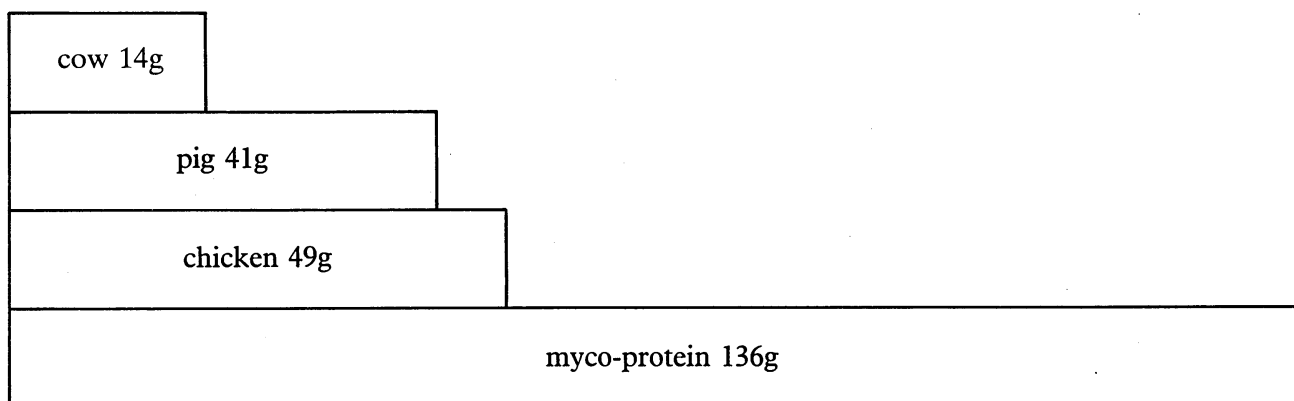
Myco-protein can also be ground into a kind of flour. This flour can be used to make all sorts of different foods including savoury snacks and even sweets.

Myco-protein is therefore very versatile and can be made into many different foods. In Part 3 of this unit, you will be trying to decide the best form in which to sell it.

Myco-protein normally costs about the same, weight for weight, as average quality meat.

Is myco-protein good for you?

Myco-protein is a high-protein food, so it makes sense to compare it with other high-protein foods like beef or chicken. Animals such as cows, chickens and pigs are fed mainly on carbohydrate, just as the fungus which produces myco-protein is. But as Figure 3 shows, myco-protein is more efficient than animals at turning carbohydrate into protein.



Grams of protein produced from 1000g of carbohydrate

Figure 3 Mass of protein produced from 1000g of carbohydrate by different organisms

Myco-protein is probably also a healthier food than animal protein. Figure 4 compares the nutrients in myco-protein and in beef.

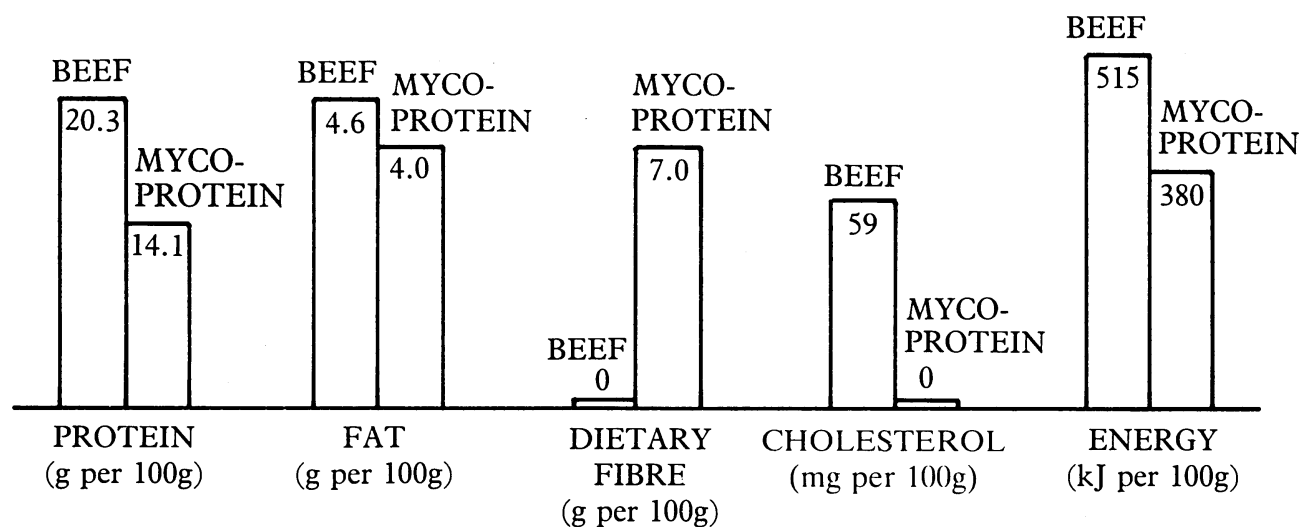


Figure 4 Comparing the nutrients in myco-protein and beef

Fat and cholesterol Doctors believe that both fat and cholesterol are unhealthy if eaten in large amounts. In particular, they are thought to increase the risk of heart disease. Compare the amounts of fat and cholesterol in beef and in myco-protein.

Dietary fibre (roughage) Fibre cannot be digested, but passes straight through the digestive system. This helps keep the contents of the gut moving. Doctors believe fibre in the diet is healthy because it helps prevent diseases of the bowel and stops people overeating.

So you can see that myco-protein is healthier than animal protein, and it is also less wasteful in turning carbohydrate to protein. However, it is also worth comparing myco-protein with other non-animal foods like beans and cereals. These are also healthier than meat, and contain quite a lot of protein. What is more, producing them involves hardly any waste, and they are much cheaper than either beef or myco-protein.

Part 2 Some questions about myco-protein

You may need to look back over Part 1 when you answer these questions.

- 1 *Why was it necessary to test many different fungi before choosing the one to use for making myco-protein?*
- 2 *Why did the myco-protein have to be tested for years before it could be sold?*
- 3 *Proteins contain the elements carbon, hydrogen, oxygen and nitrogen. Where does the fungus get each of these elements from?*
- 4 *Suppose 10kg of fungus are put in a fermenter and left for 15 hours. What mass of fungus would there be by the end of this time?*
- 5 *Why does everything in the fermenter, apart from the fungus itself, have to be sterilized?*
- 6 *List some of the advantages of myco-protein compared with other foods.*
- 7 *Suggest some disadvantages of myco-protein compared with other foods.*
- 8 *Would you be prepared to eat myco-protein yourself?*
- 9 *The public is often reluctant to try out new foods like soya bean or myco-protein. Why do you think this is? What can be done about it? (More about this in Part 3.)*

Part 3 Decisions – Marketing Myco-protein

It is best to work in groups for this part.

Suppose you are working for the company that produces myco-protein. You are certain you have a good product, but your problem will be convincing the public that it is worth buying. Your group task is to put together a marketing strategy for the product. Read through the following points before you start.

- Myco-protein is a versatile food that can be made into many different forms. What form or forms will you sell? (Look back at 'What is myco-protein like?' if you need ideas.) You could market it in several different forms at once, or you might decide to launch one form first, and follow it up later with others.
- You will need to 'test-market' the product first. This means trying it out in a small number of shops. Which shops, and which parts of the country, will you choose?
- What will you tell the customers about the product? Which features of myco-protein will you emphasize? Remember, the customers will know very little, if anything, about what myco-protein is. They may be suspicious of it.
- What kind of advertising campaign will you plan when you get to the stage of full-scale marketing? Remember you have radio, TV, newspapers, magazines, posters, etc., to choose from. If you decide on radio and TV, at what times will you advertise?
- Design an advertising poster for your product, suitable for displaying in a shopping precinct.