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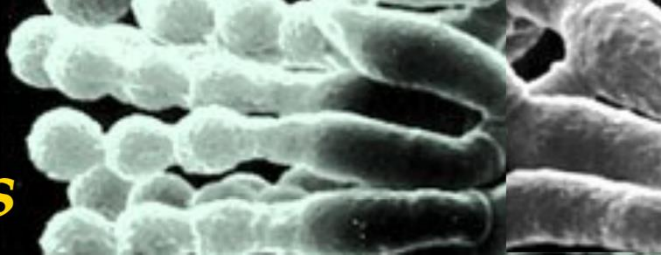

Life in the old Quorn yet!

Why a bright future for mycoprotein™ is good news for the world

David Moore

Quorn™ is the original mycoprotein™, which in UK advertising is currently promoted by Mo Farah, the multiple Olympic gold medal-winning runner. In *The Times* newspaper of July 23rd, 2018, the Retail Editor, Deirdre Hipwell, wrote an article under the headline '*Quorn expects to feel a billion dollars*' which reported that 'Quorn Foods believes that after building on bumper growth last year it is firmly on track to become a billion-dollar business by 2027'. I believe that this expectation of major success is very good news for the whole world.

History of mycoprotein™. In 1964, the Ranks Hovis McDougall (RHM) Research Centre set out to develop a way of converting starch, a waste product from cereal processing, into a protein-rich food. They looked for a filamentous fungus because of the long history of humans using fungi as food, and the fact that it is relatively easy to harvest fungal mycelia from culture broths. Also, fungal filamentous structure simulates the fibrous nature of meat. But most importantly, fungal biomass is a low-calorie, low-fat, and cholesterol-free food. This last point is important for a meat substitute protein. Cholesterol is the chief sterol in the membrane of animal cells, in plants the most common sterols are the phytosterols; sigmasterol, sitosterol and campesterol, whilst in fungi the major sterol in the membranes is ergosterol. Sterols control membrane structure and fluidity. All are derived from a common initial pathway (acetyl CoA to squalene epoxide), the three different endpoints of which result from evolution optimising physiological function to suit the different lifestyles of the fungal, animal, and plant kingdoms. High cholesterol levels in the human bloodstream is a major health risk caused by fatty foods, so the lack of cholesterol in fungal biomass makes it a 'super food' for lowering cholesterol.

Following an extensive screening programme, RHM selected a strain of the common soil fungus, *Fusarium venenatum*; it was isolated from a field in the Leicestershire village of Quorn, which is how mycoprotein got its trade name. Mycoprotein™ was produced by Marlow Foods Limited, which was set up in 1984 as a joint venture between RHM, who had developed the product, and Imperial Chemical Industries (ICI) who had spare fermenter capacity.

Is Quorn safe? Categorically yes. In fact, no food eaten by humans has been subjected to a more rigorous safety testing than Quorn! In the first ten years of production (1970-80), the product was not sold, but was subjected to:

- toxicology testing, involving feeding trials on 11 animal species (including pigs, calves, baboons) that showed no adverse effect on animals or offspring;
- trials with 2,500 human volunteers, which showed no ill effects or immunological response;
- demonstration that the bacteriological load in frozen storage was no different from that experienced with chicken or fish stocks.

Eventually a 2 million-word, 26-volume report was submitted to the then Ministry of Agriculture, Fisheries and Food for approval, which was granted, and the product was first sold to the public in the UK in 1985. For the US, additional toxicology testing of Quorn was completed in 1996 for submission to the US Food and Drug Administration. FDA approval was granted and frozen Quorn was sold for the first time in the USA in 2002.

Figure 1. Supermarket packages of Quorn™ mycoprotein™ products. Top shows a chiller pack of Quorn™ Pieces, bottom shows two chiller packs of Quorn™ mycoprotein™ prepared as a healthy meat-free alternative to conventional sliced meat products. Photograph by David Moore.

Present day mycoprotein. Mycoprotein™ was originally intended as a protein-rich food to compensate for what was widely expected to be a falling world supply of conventional protein. The predicted shortages had not materialised by the early 1980s, so Marlow Foods decided to market mycoprotein™ as a meat-free, sustainable protein product which lacked animal fats and cholesterol, is low in calories and saturated fats, and high in dietary fibre (it has more dietary fibre than wholemeal bread). Growing consumer demand for vegan and vegetarian food choices has helped to make Marlow Foods a global leader in this market. Quorn is made into everything from meat-free sausages and meat-free 'minced meat' to vegetarian bacon and steak and is used as the protein content for over 50 pre-prepared ready-meals. You can also buy it in the uncooked, unflavoured form (as chunks, strips or minced) to use in home-cooked meals. Quorn™ Pieces are 95% mycoprotein™; rehydrated free range egg white, natural flavouring, and the firming agents, calcium chloride and calcium acetate are the only other ingredients (in the vegan range, the egg-white protein used to firm-up the mycoprotein is replaced by potato starch).

Future of mycoprotein. Quorn product ranges are sold in the UK by Quorn Foods under Marlow Foods Ltd branding, although since its formation in 1984 Marlow Foods Ltd has changed hands several times. In 2015, Monde Nissin, one of the leading food consumer goods companies in the Philippines, purchased Quorn Foods for £550 million https://www.mondenissin.com/. Quorn Foods has 800 employees across manufacturing sites in Belasis on Teesside (where mycoprotein is produced by fermentation); Stokesley, North Yorkshire (where Quorn is formed and packed) and Methwold in Norfolk (where cooking and packing of ready-meals takes place). Around the world the meat-free category is growing by between 10% and 20% a year and the product's website is truly international https://www.quorn.com./.

Why is this good for the world? The global benefit of all this comes down to the arithmetic comparing the size of the human population (constantly increasing) and the amount of agricultural land available to feed that population (constantly reducing as we build on it, and perhaps reducing further as the climate changes).

At the time of writing, the human population totalled 7.6 billion and was showing a net increase of 82.5 million per year (visit https://www.worldometers.info/world-population/ for up-to-date statistics). Unfortunately, only

about 7.5% of the Earth's surface provides the agricultural soil on which we depend for the world's food supply; this amounts to about 0.25 hectares of farmland per person, but only about 0.12 hectares per person of farmland is suitable for producing grain crops. A subsistence diet requires about 180 kg of grain per person per year, which can be produced on 0.045 hectares of land. In contrast, an affluent diet requires at least four times more grain (and four times more land, 0.18 hectares) because the animals are fed on grain and conversion of grain to meat is very inefficient. There are approximately two billion cattle worldwide, two billion pigs, and about one billion sheep. A large amount of agricultural land is devoted to feeding those animals. As it stands, the Earth does not have enough land for all its human inhabitants to enjoy an affluent diet. Meat-free alternatives produced by industrial fermentation, like mycoprotein, may safeguard the Earth's resources and satisfy our taste for meat.

Why all the opposition? Quorn mycoprotein was intended to penetrate established markets, and the people who supplied those markets were not too keen on the idea. Initially the organism from which Quorn is produced was described as 'related to mushrooms'. Mushrooms are in the same Kingdom, but a different phylum, so that didn't go down well with the mushroom industry! Claiming mycoprotein to be a plant protein is also scientifically wrong; it's a different kingdom and challenges major agricultural industries like soybean growers. And then, of course, offering a meat substitute challenges all the people whose livelihoods depend on those 5 billion farm animals being turned into meat.

So, from the start, there has been no shortage of vested interests who considered themselves threatened by upstart Quorn and would take any opportunity, whether based on truth or not, to criticise the new product. Today, of course, we have the Internet. Where it is very easy to find information, and even easier to find negativity! So, when you find a website that's less than enthusiastic about Quorn, ask who supports it and which of their toes Quorn is treading on.

This article is dedicated to the memory of my good friend and colleague Geoffrey David Robson, a mycologist of distinction, who died suddenly on 15th May 2018.

Further information

The *GCSE GUIDE* Mycoprotein revision (December 2015): https://www.youtube.com/watch?v=N2fU-tuS7NQ

Quorn™ is now in the Philippines, check out: https://www.mondenissin.com/news/title/quorn-world-leader-in-meat-free-food-is-now-in-the-philippines and https://www.quorn.com/

Wiebe, M.G. (2004). Quorn mycoprotein - overview of a successful fungal product. *Mycologist*, **18**: 17-20. https://doi.org/10.1017/S0269915X04001089

AUTHOR PROFILE

Dr David Moore was formerly Reader in Genetics in the Faculty of Life Sciences at Manchester University. His research interests were in fungal physiology and mutant isolation and linkage mapping in *Coprinopsis cinerea*. David has held a number of senior positions in the British Mycological Society including that of President and was creator and webmaster of its web site. He was instrumental in establishing the society's outreach and education work in schools, science fairs and RHS shows for which he has received the society's awards. David is the author of a number of books on mycology.