FOOD FROM BIOMASS

U.K. SINKS ITS TEETH INTO MYCO-PROTEIN

LONDON—Two British companies are developing a commercial biotechnology process to produce a novel human food. Ranks Hovis McDougall (RHM), the milling, bakery, and animal feedstuffs group, has joined forces with Imperial Chemical Industries PLC (ICI) to scale up and test-market meat products made from the fungus *Fusarium graminearum*. The collaboration offers a unique attempt to fill the world's protein gap.

Over the next two years the partners will spend £4–5 million (a third from the Department of Trade and Industry) scaling up myco-Protein production in a pilot plant designed for ICI's own microbial product, Pruteen. The team will also test-market "fish cakes," "veal patties," and "meat pies" through British food companies. If all goes well, this would establish ICI's highly sophisticated Pruteen technology—which is not being fully exploited at the moment (see BIO/TECHNOLOGY **2**:606)—as an adaptable process and a leading contender in continous fermentation technology.

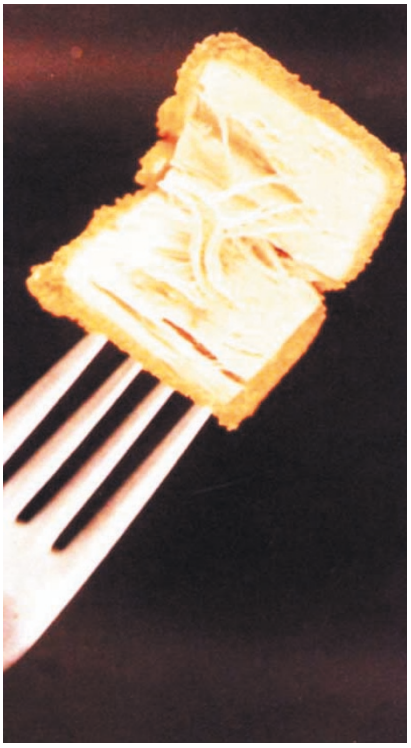
The partnership is the culmination for RHM of more than 20 years of research into converting waste starch, a by-product of producing wheat protein (gluten), into meat analogs. During that time, the economic incentive for developing high-protein food substitutes faltered when meat prices failed to post predicted increases.

In 1980, the company received clearance from the Ministry of Agriculture of Fisheries and Food to test market the limited amounts of myco-Protein made in RHM's own pilot plant, but further development awaited substantial injections of cash and large-scale fermentation expertise from ICI. If trials in the pilot plant go well and market surveys look promising, the two companies plan to manufacture 20,000 tons a year eventually, perhaps in the now underutilized Pruteen production plant.

ICI has sunk some $150 million into developing Pruteen fermentation technology, which some critics say was "overdesigned" for its purpose. According to one ICI spokesman, it comes as a "pleasant" surprise that the preliminary work with myco-Protein in the Pruteen pilot plant indicates that the process could be so flexible. Success with RHM's fungal protein could help sell Prutein technology at a time when buyers have been slow to come forward.

F. graminearum is a microscopic fungus belonging to the same family as truffles. It is naturally fibrous, and its tiny filaments, or hyphae, resemble in strength and size those found in meat. The fungus can be formulated into chewy meat-like analogs that retain their texture in the mouth. Such chewiness is principally a function of the material itself, but RHM scientists have cleverly designed their process to exploit this.

The RHM process, like the Pruteen method, is totally sterile and can operate continuously over extended periods of time. The organism is grown at 30° C and pH 6 in medium containing glucose syrup, mineral salts, trace metals, choline, and biotin. RHM has tested molasses, hydrolyzed wheat, potato, and rice starch as feedstocks, but most work has involved commercial glucose from hydrolyzed corn starch.



The levels of oxygen supplied to the fermentor must be strictly controlled—too little produces anaerobic fermentation and unwanted by-products while too much reduces fermentor productivity. The harvested myco-Protein is a buff-colored slurry with a slight aroma of mushrooms.

One crucial difference between the Pruteen process and RHM's technology is the method of stirring the slurry. ICI developed a highly sophisticated "air lift" fermentor that uses rising air bubbles to mix the broth, while RHM employs more conventional mechanical stirrers. The environment around the microorganism must be just right to ensure that the morphology of its structure (the length and frequency of branches, for example) remains the same. Work so far in the Pruteen pilot plant indicates that the morphology of the product is the same.

Immediately after fermentation, large amounts of RNA must be removed to conform to World Health Organization guidelines. Technicians administer a thermal shock that not only kills the organism, but also activates its enzymes that break down RNA into smaller units. These then then pass through the cell wall and into the spent medium.

The fungus is harvested continuously by vacuum filtration on a horizontal belt filter, where it forms a mat of interwoven fungal hyphae that is bland in flavor, aroma, and color. The distribution of water in the harvested "filter" cake is crucially important to the texture of the products made from it.

The filter cake is then mixed with color, flavorings, and egg albumin that "sets" the texture at the steaming stage, which follows. For products requiring no texture, such as "veal escalopes," myco-Protein is simply molded into the required shape.

However, for "chicken breasts," say, the mycoprotein must be further texturized. It goes through a rolling machine, which treats it like a piece of pastry, rolling the myco-Protein cake out and folding it over. This aligns the matted fibers, and produces laminations for a truly meat-like texture.

Using this technology, myco-Protein has been turned into savory snacks, chicken-flavored bites, "fish cakes," simulated chicken-and-ham patties, and something resembling a game pie. It can be rehydrated in 15 seconds, does not shrink when cooked, and can be canned or kept frozen for up to three years.

The product's protein content is about 44 percent, 13 percent lower than that of lean steak, but its lipid content is less than half, and it contains no cholesterol. Myco-Protein contains more fiber than whole-meal bread; some fifty tons of it have already gone into foods sold in RHM's staff canteens and restaurants. The company reports, "every product has been very favorably received."

—Stephanie Yanchinski