EIP

Significant inventions that have gone under the mainstream radar

Powering Kipchoge

Most people interested in sports will be aware of Project 1.59 – Eluid Kipchoge's 2019 first sub-2 hour marathon. Technology played a significant part; he had an arrow-shaped formation of lead runners to draft, a car to pace him and prototype shoes including a carbon fibre plate (which has been the subject of much discussion in the running world and has resulted in new rules about what shoes can be worn in competition).

But what about his fuelling? Kipchoge has relied on Maurten, a carbohydrate-based drink to fuel his runs for a number of years (and Maurten also sponsor professional cycling teams and Tottenham Hotspur FC).

More recently, I've been looking at my on-the-bike and triathlon fuelling strategies and found some intersection with my professional life as a patent attorney; there are a large number of companies selling energy powders which are made up into drinks, and many of them have filed patent applications directed to the composition. However, Maurten claim their powder/drink works in a unique way which offers athletes a competitive advantage and this grabbed my interest.

It has long been known that that drinking carbohydrate solutions during exercise increases performance. Ancillary fuelling products like energy bars and gels are now routinely available but many athletes find that high concentrations of sugar cause slower gastric emptying and gastro-intestinal distress. Manufacturers are trying to solve how to deliver higher carb loading in energy products, whilst maintaining digestibility. This is something of an arms race, with most manufacturers offering high-carb products which

are said to be easier to digest. This is accompanied by investment in patent filings and spending of a sizeable chunk of marketing budgets trying to push the USP into consumer consciousness.

The Maurten solution is to use a powder composition which includes alginate (a seaweed component) and pectin (fruit fibre). On contact with the acidic environment of the stomach, the drink forms a hydrogel - a 3D network of hydrophilic polymers with a high water content. This hydrogel has matrix structure that encapsulates salts and carbohydrates present in the drink and allows effective transit through the stomach, with the carbohydrates and salts protected from the stomach acid. Once into the intestine, the hydrogel dissolves, and the body can absorb the salt and carbohydrates. This approach slows absorption of the carbohydrates and is said to make digestion easier.

Other manufacturers have other solutions; Science in Sport's Beta Fuel and OTE's Super Carb products both utilise specific ratios of maltodextrin to fructose to 'optimise' carbohydrate delivery. Which is best? The different technological approach taken my Maurten is certainly interesting and seems to have escaped general awareness despite some high profile use of the drink. However, in the end, most products claim to deliver similar carbohydrate concentrations so it probably comes down to personal preference!

Innovation is mushrooming

Everyone knows mushrooms. Most people eat them. But I suspect very few people have heard of mycelium, and even fewer will know of the innovative work that is going on around this material. Mycelium has the potential to change what you eat or wear, to provide plastic-free packaging alternatives and to upcycle waste food. Is this the biggest innovative technology to have gone under the mainstream radar?

Mycelium can be thought of as the 'root structure' of mushrooms. Mycelium is root-like, made up of a mass of branching, thread-like cells which can spread over substantial areas (acres and larger). The branched structures naturally extend and interweave to maximise surface area and the ability to distribute enzymes or carry nutrients. The cell walls include chitin (which is what give insect shells their strength). This means that the threads interweave to form a network which is strong, can resist substantial applied pressure and is resistant to water and decay. Moreover, mycelium is involved in the enzymatic degradation of foodstuffs (which can include toxins) to form nutrients.

So how will mycelium be used? Research is ongoing in two main streams:

- Using the mycelia structure: Different fungi have different mycelia with different properties. Scientists working with mycelium have found that control over the

growing conditions coupled with careful selection of the fungal strain can generate interweaved mycelium structures with desired structural properties. With refined design, these can be used to create food substitutes, leather substitutes, automotive materials, and compostable plastic-free packaging and other single-use items. The growth process requires little input, has high throughput and the only waste generated is compostable.

- Using the metabolic products of mycelia: Another research avenue is looking at what mycelia produce in the enzymatic degradation of foodstuffs. As the mycelium grows it produces a variety of useful chemical compounds, some of which break foodstuffs down (by fermentation). These fermentation products can be used, by way of example, as flavours, plant-based meat substitutes and sugar substitutes. Even better, the feed input can be waste food, further enhancing the environmental credentials of this approach. Oman has recently invested in MycoTechnology with a view to improving food security and reducing dependency on food import (and the associated inflationary pressures resulting from the war in Ukraine).

Mycelium-based products are on the market an innovation is accelerating; patent filings are increasing. What does this mean for the public? It depends on the rate of progress, but food security and environmental credentials mean that this area is on-trend and is attracting significant investment. Perhaps the future is a fungus...