

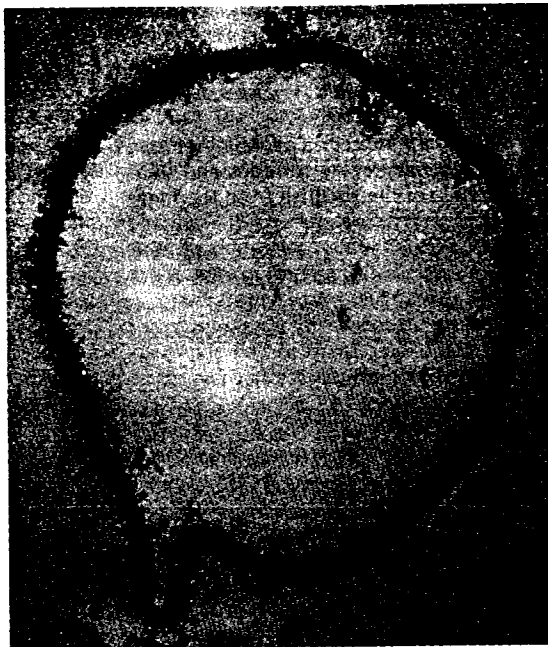
A shot in the arm for synthetic blood

Gabrielle Walker

ARTIFICIAL clumps of haemoglobin the size of blood cells have been developed by two chemists in Illinois. Ken Suslick and Mike Wong of the University of Illinois used an ultrasound technique to make the "microbubbles" of haemoglobin. The discovery could eventually lead to the development of artificial blood.

Real blood has many disadvantages: it must be screened for diseases, matched to the person who is to receive it, and it has a relatively short shelf life. In Britain, even when red blood cells are separated out from the rest of the blood and refrigerated, they can only be kept for 35 days. Several companies are trying to create artificial blood to avoid these problems. Most approaches are based on haemoglobin, the protein inside red blood cells that transports oxygen around the body.

Haemoglobin can be pasteurised to eliminate disease, and can be given to anyone, regardless of their blood type. But when independent molecules of haemoglobin enter the bloodstream they become toxic. One reason for this is that they break down into a form that clogs up the kidneys. As a result, researchers are trying different techniques, including genetic engineering,



University of Illinois

to link together handfuls of haemoglobin molecules so that they can resist breakdown (Technology, 12 March).

Now Suslick and Wong have managed to combine more than a million haemoglobin molecules into an oxygen-filled microbubble. They told the American Materials Research Society in Boston earlier this month that they achieved this by directing ultrasound at an oxygenated solution of haemoglobin in water.

In the solution the ultrasound produces

Blowing bubbles: cross-linked haemoglobin could have a long shelf life

a short-lived aqueous emulsion of haemoglobin microbubbles filled with air. But in a process that is not fully understood, ultrasound creates tiny bubbles in water that collapse dramatically to give sudden intense bursts of heat. The intense heat breaks up the water to form molecules of hydrogen superoxide (HO_2), which is a powerful oxidising agent.

Wong and Suslick found to their surprise that the superoxide oxidises some of the chemical groups on the haemoglobin molecules, cross-linking them to make the microbubbles permanent. The microbubbles turn out to be excellent carriers of oxygen, and release the oxygen when it when it is needed. They are also easy to store—after six months at 4 °C fewer than a quarter of the microbubbles had broken down.

As yet there have been no clinical trials, but Suslick expects that the sheer size of the bubbles will protect them from the enzymes that break down molecules of haemoglobin in the blood, and help to avoid toxicity. "It would be like trying to eat an elephant one bite at a time," he says.

Brian McClelland, director of the Edinburgh and South East Scotland Regional Centre for Blood Transfusion, says: "Everyone is interested in the prospect of wrapping haemoglobin up in a form that's closer to nature's red blood cell. But we need to wait for the human trials to see if it's really going to be practicable." □