

TRU BLOOD: REAL VAMPIRES AND THE SEARCH FOR AN ARTIFICIAL BLOOD SUBSTITUTE

What are the daily recommended nutritional requirements for a vampire? With vampire chic on the rise from the *Twilight* books and movies to the *True Blood* TV series, it is an interesting time to ask this question. In the old days Hammer Horror would have us believe that Count Dracula could survive exclusively on the blood of comely virgin wenches. But what if there isn't a single wench left? Or what if the Count had pangs of conscience? These are questions addressed by more modern reimaginings of the vampire myths, such as the film *Daybreakers* by the Spierig brothers and, of course, HBO's hit series *True Blood*.

In the *Twilight* movies the good vampires - whilst not vegetarian - at least make do with animal blood, unlike their evil cousins. The choice of victim is portrayed as a straightforward good versus evil decision. In *Daybreakers* the situation is more complex. Animal blood is nutritionally inferior to human blood and the hero's moral decision therefore involves real physical consequences. It also dooms a society run by vampires to preying on humans. This leads the anti-hero to head a biotechnology company that farms humans for their blood. In *True Blood* this problem has been solved by the production of an artificial blood substitute by a Japanese biotechnology company that has made a synthetic blood substitute. Vampires can now come out of the closet. *True Blood* starts with a vampire ordering this drink in an everyday shop. The equivalent first taste of a blood substitute in *Daybreakers* ends with an exploding dead vampire.

Do *Daybreakers* and *True Blood* have any parallels with the real world? Of course bloodsuckers exist. Indeed most people will have had an encounter with one - the humble mosquito. Due to its ability to carry the malaria parasite this animal is responsible for more human misery and death than any other. They are catholic in their tastes - feasting equally well on a variety of animal blood sources. However, the mosquito mostly feeds off fruit juice and nectar. Hunting animals for blood is the preserve of the females, who need extra nutrients prior to laying their eggs. It is most likely that the blood is needed due its iron content; indeed we humans use the same idea. From the black pudding of England to the blood sausage of France we treasure blood for its high iron content. There is even a vegetarian alternative in the juice of African "blood plants" that are high in iron and drunk as a restorative after blood loss.

However, to look for an animal that lives solely on blood we need to turn to that staple of horror movies - the vampire bat. Three species exist that feed solely on blood; all hail from the American continent. Again they tend to feed on a variety of animals. Their mode of attack is perhaps less dramatic than the eponymous Count. They hunt at night-time, spot a sleeping mammal (including humans) and make a tiny incision with their sharp teeth. Whilst the victim remains asleep they lap up their blood - real vampires don't suck! The blood continues to flow, rather than coagulating, because the spit of the bat contains a drug that stops the clotting process. This molecule is called draculin - let no one tell you that scientists don't have a sense of humour! The effect of a vampire bat attack is less dramatic than that of a fictional vampire - the animal after all wants to avoid detection to carry on its meal. The main problem is not that you will die from blood loss or be changed into a vampire; instead the transmission of rabies is the fear with over 70% of the (admittedly very low) incidents of rabies in the USA being traceable to the bite of a vampire bat.

So what is my interest in blood and vampires? I am a biochemist at the University of Essex, England working on developing an artificial blood substitute. I like to think I am the real world version of Edward Dalton - the vampire haematologist in *Daybreakers* played by Ethan Hawke. But lacking the good looks, acting ability and sensitivity to sunlight, I am more like *True Blood*'s Kenji Igawa, the doctor from the Yakonomo Corporation who invents the Tru Blood beverage.

What does my job involve? Of course in the real world we are not looking to make artificial blood as a food supply. Instead we need it as a replacement for blood lost during trauma or surgery. Why not stick to the real thing as Charles Bromley, the evil vampire anti-hero in *Daybreakers* might say? Well, just as in *Daybreakers* there is a shortage of real blood; our ageing population results in an increase in the rate of users over donors; this mimics the problems seen in *Daybreakers* as vampires begin to outnumber humans. In the real world blood needs to be typed (A, O, B etc.), is not long lasting and cannot be readily transported or stockpiled for major emergencies such as earthquakes, wars or acts of global terror.

There is also the ever-present risk of infection - the vampire bat may have given 50 people the rabies virus, but thousands were infected with HIV-AIDS by blood transfusion services (and still are being infected in developing countries without rigorous testing procedures). There is a genuine need for a blood substitute that is universal, long lasting and guaranteed free of all future viral contamination

As *Daybreakers* and *True Blood* reveal blood - red gold - is big business. Almost 10 billion pounds is spent worldwide on blood; in excess of 1 billion pounds has been spent over the last 20 years in an



Dr. Kenji Igawa samples his product.

attempt to create an alternative to blood. So what has this money managed to come up with? The first blood substitutes were completely artificial. If you have watched the James Cameron movie *The Abyss* you will have heard of “fluid breathing”, using oxygen-rich perfluorocarbon molecules to breathe underwater. The same molecules were licensed for use as a blood substitute in the 1980’s, but have since fallen out of favour. My work, and many others, has been based on modifying the natural iron-rich haemoglobin molecule. This is the protein that gives blood its red colour and is responsible for its key function of transporting oxygen. Artificial versions of this molecule have been used in several clinical trials. However, to date the world’s scientists have failed to produce a safe alternative to blood. The real world seems more *Daybreakers* than *True Blood*.

I haven’t shared my interest in *True Blood* with my Japanese scientific colleagues. They would probably react with a shrug of their shoulders (or the Japanese equivalent) to the news that it is a Japanese health care company – the Yakonomo Corporation – that successfully manufactures the Tru Blood drink. In the real world the Japanese-based Terumo corporation cut all the funding for its blood substitute program at about the time as *True Blood* first aired!

What is the reason for this failure? Haemoglobin normally changes colour from red to claret as it transfers oxygen around the body. However, when it is damaged the iron in haemoglobin is oxidised (like a car rusting) to produce dysfunctional brown and green products. Inside the normal red blood cell the haemoglobin is protected; outside it produces free radicals that can damage the heart and kidneys. The trick with artificial blood is to modify the molecule to be less toxic, but still perform the vital role of carrying oxygen around the body. No one has managed this yet. The results may not be as spectacularly bad as the exploding patient injected by the vampiric Edward Dalton, but the regulators have not been impressed enough to license the technology.

Our present research uses genetic engineering tools to make haemoglobin less toxic and we have just submitted a worldwide patent. Other groups in France, Scotland and the USA are attempting to make artificial red blood cells using stem cell technology. *Daybreakers* envisages a race against time to produce an artificial blood substitute to save vampires and the human race from extinction. In the world of science, the consequences are not so dramatic, but the race is well and truly on! I take heart from the fact that a character called Chris eventually solves the toxicity problem of blood substitutes in *Daybreakers*, though I am less enamoured of my namesake’s explosive fate a few frames later!



Professor Chris Cooper shows off the colours of blood. Brown and green are bad!



Christopher Caruso (Vince Colosimo) and Edward Dalton (Ethan Hawke) inject a vampire patient with an artificial blood substitute in *Daybreakers*

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Note: this article is based on one I originally wrote for Fright Club – the on line magazine for Lionsgate films who made the vampire movie *Daybreakers*. The original article can be found at:

http://issuu.com/frightclubmagazine/docs/fright_club_magazine_issue_2

I thought people interested in *True Blood* might want to know more about the science behind trying to make an artificial blood substitute, whether as a drink in a TV series or as something they might encounter when undergoing surgery in a hospital. So I expanded my article to include more references to True Blood. I hope you enjoy it.

If you have any questions about blood feel free to email me at ccooper@essex.ac.uk. My web page is at www.profchriscooper.com

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FRIENDS
DRINK
FRIENDS.**

