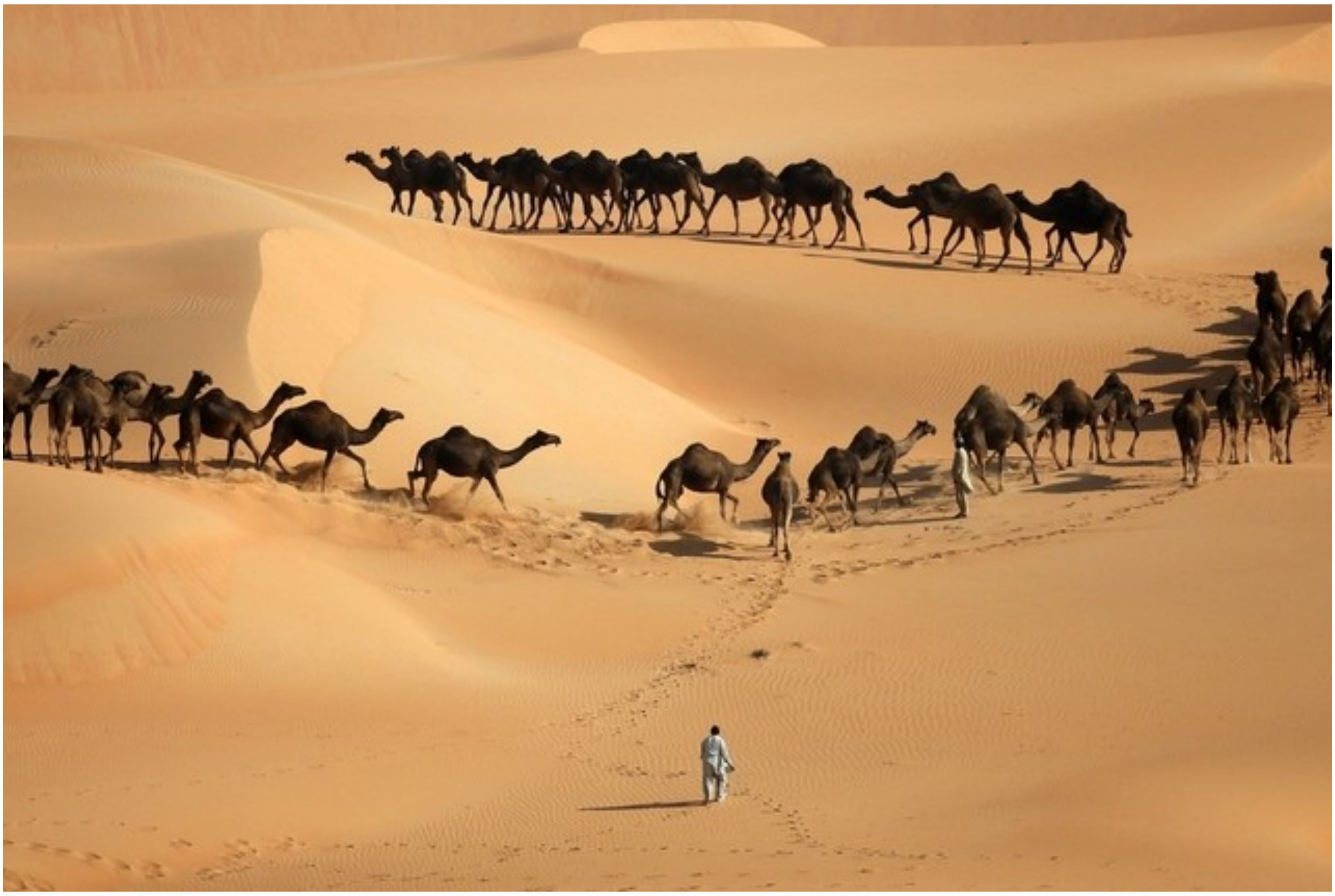

Camels in the dunes of the Liwa desert. A new study highlights how the blood and circulatory system of these creatures cope when they are dehydrated. Karim Sahib / AFP

How can camels survive for months in the desert? It’s in their blood

Daniel Bardsley

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There are few things more iconic of the Gulf region than a camel being led through a desert of sand dunes.

For as long as 5,000 years, people on the Arabian peninsula have been working and travelling with these creatures, whose hardiness is as legendary as the landscape is unforgiving.

The animals can go long periods without eating thanks to their hump, which is filled with fat and can weigh more than 35kg. Perhaps more impressive though is the camel’s ability to carry on as normal even when there is little or nothing to drink.

While a human can typically survive only for days without water, for camels the timespan is measured in terms of months, at least in winter. They can

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lose as many as 25 gallons of water before their condition begins to seriously deteriorate.

One recent study on the dromedary, or Arabian camel, like those found in the UAE and elsewhere in the Gulf, highlights how the blood and circulatory system of these creatures cope when they are dehydrated.

The work, carried out by three Austrian-based researchers on camels kept at 1,700 metres above sea level in Gauteng province, South Africa, relates to the oxygen-carrying capacity of the blood. It was undertaken for a conference in Kazakhstan.

The scientists took blood samples from 11 camels, 10 horses and 10 people then calculated what is known as the optimal haematocrit (opt.HCT) for the blood at a number of "shear rates".

Haematocrit is the ratio of red blood cells to the total blood volume and the term derives from haemoglobin, the protein in blood that carries oxygen. The opt.HCT is the blood's ideal concentration of red blood cells for transporting oxygen.

Below the opt.HCT, as the concentration of red blood cells rises, the blood's oxygen-carrying capacity increases but, beyond it, the blood becomes so thick with cells it struggles to move and becomes less effective at carrying oxygen.

Meanwhile, the shear rate roughly equates to how fast the blood is moving.

By taking blood samples, centrifuging out the cells and carrying out calculations based on the viscosity of the blood, the researchers calculated a theoretical opt.HCT for camels, horses and people at a variety of shear rates.

In horses and people, opt.HCT becomes higher as shear rates increase. This is what we would expect: when blood is being pumped faster, a higher concentration of red blood cells allows blood to transport oxygen more effectively. When blood is moving more slowly, a higher concentration tends to impede flow, so the opt.HCT will be lower.

With camels, however, the opposite is found: with higher shear rates, the opt.HCT falls.

This result is surprising: at low flow rates, such as in venules (the small veins that collect blood from the capillaries and take it to the larger veins), blood flows more smoothly and easily when the blood is thicker.

There is, says Dr Roland Auer, a researcher in the Department of Biomedical Research at the Medical University of Vienna and one of the study's authors, an explanation for this.

"That the 'optimal haematocrit' is higher in venules and veins may offer an advantage when blood is thickened, for instance due to dehydration," he says.

The scientists suggest in their paper that the pattern of opt.HCT in camels represents "the result of the remarkable adaptation of this species to the harsh natural environment".

The study's lead author, Dr Ursula Windberger, a veterinary surgeon and associate professor at the same university, says the characteristic represents “a great benefit for the animal” in dry, desert environments with little food and water.

“It’s extremely specified to starving and water deprivation, so we should expect the blood would get thicker and more viscous. When there are regions in the peripheral circulation where there’s low blood flow, that would increase the viscosity dramatically,” she said.

The mechanism that prevents sluggish blood flow is, she added, a “most important” adaptation and one the researchers did not expect to see.

Factors that could explain this property of the camel’s circulatory system include the shape and properties of the camel’s red blood cells. The skeleton of these cells is much more inflexible than in other mammals, and so the cell shape changes less even when blood velocity is high. Also, the cells have less of a tendency to aggregate than those in many other animals, something else that could help to explain the surprising properties of camel blood.

Another feature of camel physiology, described by the same authors in a separate paper published recently in the Emirates Journal of Food and Agriculture, is that when camels exercise, the concentration of red blood cells does not increase much. This contrasts with horses, where exercise leads to a significant increase in the haematocrit level.

When a camel is running, the shear rate of the blood increases. Because at higher shear rates in camels, the opt.HCT falls, so there would be little advantage in an increase in the haematocrit level – it would not give them any advantage.

However, Dr Windberger cautions that the camels were being exercised at a high altitude and the results may be different if similar tests are carried out closer to sea level. So, for the moment, it is difficult to draw any firm conclusions that could have relevance for racing camels.

She is now in touch with scientists in Saudi Arabia with a view to repeating the work in a desert environment at sea level.

“We would really like to repeat our experiment there to see if we can repeat it, if we can get the same values,” said Dr Windberger. The third co-author of the two recent studies is Dr Andreas Gleiss, also of the Medical University of Vienna.

The researchers are looking to carry out similar work with other camelid species to see if they, too, show the same physiological adaptations to the Arabian camel.

These detailed adaptations highlighted by the recent work are less obvious to the naked eye than the large hump that sits on the camel’s back – but they are just as remarkable.

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