Fuelling bad habits

Do feeding regimes and modern diets encourage stereotypies such as crib-biting? The Royal Agricultural College's Dr Andrew Hemmings believes they play a significant part and recent research backs up his views

Molassed mixes can bring on a crib-bitingresponse due to the endorphins released by the high palatability of the feed

A recent study conducted at the Royal Agricultural College (RAC) analysed a small population of crib-biting horses during a period of inactivity (not at a time associated with feeding) during the day. On average, the horses were performing 11 crib-bites every five minutes. When provided with a palatable concentrate feed, this rate shot up to 24 counts and persisted for around 40 minutes.

However, when the horses were fed a forage meal instead, cribbing levels were reduced to five counts. This reduction persisted for at least 50 minutes before rising back to the baseline levels.

Why did this happen and what does it mean for horse owners who are managing a crib-biter? Is there anything to be learned regarding feeding horses with other stereotypies?

Sweet like chocolate

IN much the same way as humans recognise the addictive properties of certain foods — chocolate, for example, tastes good, is easy to eat and is therefore highly palatable — scientists recognise that certain feeds can have the same effect on horses.

Feeding infrequent meals of palatable concentrate feeds will therefore have the tendency to induce undesirable stereotypic behaviour in some horses (see box, top right).

Highly palatable feeds — monitored by texture, volume and taste sensors in the mouth — have been linked to the release of pleasure hormones (endorphins) in human brains. The equine central nervous system seems to respond in a similar way.

So, how does this translate into undesirable equine stereotypies such as crib-biting?

The RAC research suggests that crib-biting arises partly due to stress-induced increases in endorphin sensitivity. Following the initial development of crib-biting behaviour, these endorphin releases can lead to extended bouts of this undesirable habit.

Post-mortem studies using radioactive tracers have shown that crib-biters may have around double the normal number of binding sites for pleasure hormones (endorphin receptors) on the ventral tegmental area (VTA) of their brain (see p19). This region is linked to the crib-biting response. This means that when a horse eats a particularly palatable food, such as a molassed mix, the endorphins that are released during the process of ingestion can more easily bind with receptors in the VTA, bringing about a crib-biting response.

The glucose effect

IN addition to considering the effect that feed palatability has on behaviour, it is also important to consider the part digestion has to play.

Following the chewing phase, food is processed within the stomach and then the small intestine. Concentrate feeds, often rich in the carbohydrate starch, are broken down by intestinal enzymes, which convert starch to glucose. This increase in glucose within the blood, which

This automatic feeding system prototype replicates food-seeking behaviour similar to that in a grazing scenario

> "Horses are not geared to deal with palatable, grain-rich feed as they are poorly equipped at digesting starch"
>
> Dr Andrew Hemmings on the dietary requirements of the modern horse

Pictures by *Horse & Hound*, Illustration by Garry Ashton-Coulton

occurs around two hours after feeding, is known as the "glycaemic response".

In evolutionary terms, horses are not geared to deal with palatable, grain-rich feed because they are relatively poorly equipped at digesting starch. However, an element of starch digestion does occur and it is this glucose boost that has also been linked with excitable behaviour.

Interestingly, in more widely studied species such as rats, glucose elevations in the blood can lead to an increase in another brain hormone linked to pleasure — serotonin. In humans, an elevation in serotonin, brought about by drugs such as ecstasy, is associated with behavioural hyperactivity.

By feeding starch-rich feeds, we are potentially inducing serotonin elevations with similar hyperactive behavioural consequences, but a direct measurement of brain serotonin in the horse has not been attempted and so this notion remains unsupported.

Managing bad habits

THE addictive effect of endorphins, the restrictive nature of a stable environment, together with stimuli that signal the arrival of feed, such as rattling buckets, are often associated with a heightened frustration that leads to non-stereotypic anticipatory behaviour like door-banging. Stereotypies such as weaving and box walking have also been closely associated with this anticipatory period prior to meal delivery.

With this in mind, taking measures to eliminate the meal-time anticipation by providing a horse's daily energy ration in the form of ad-lib forage, can potentially reduce frustration and, consequently, the instance of stereotypic and other unwanted behaviour.

If feeding grain-rich concentrates is necessary due to the energy requirements of high-performing athletes, slow-release systems or calming supplements could be the answer.

Several manufacturers have designed slow-release feeding systems such as "feed balls", which contain the concentrate feed and release it on to the stable floor gradually as the horse manipulates the ball. This simulates natural grazing conditions.

To develop this concept, a recent collaboration between the RAC and Aberystwyth University led to the development of an automatic feeding system that delivers small quantities of feed when the horse activates a button. This means that food-seeking behaviour similar to a grazing scenario is replicated, but without the issue of lost feed in deep bedding.

Furthermore, the number of button presses leading to feed delivery can be varied, meaning that the effort required to obtain the feed can be increased or decreased. This adds an additional element of control to the horse owner.

While this device is very much at the prototype stage, more compact production models could be used in the future to better regulate delivery of concentrate feed. H&H

Convenience vs nature

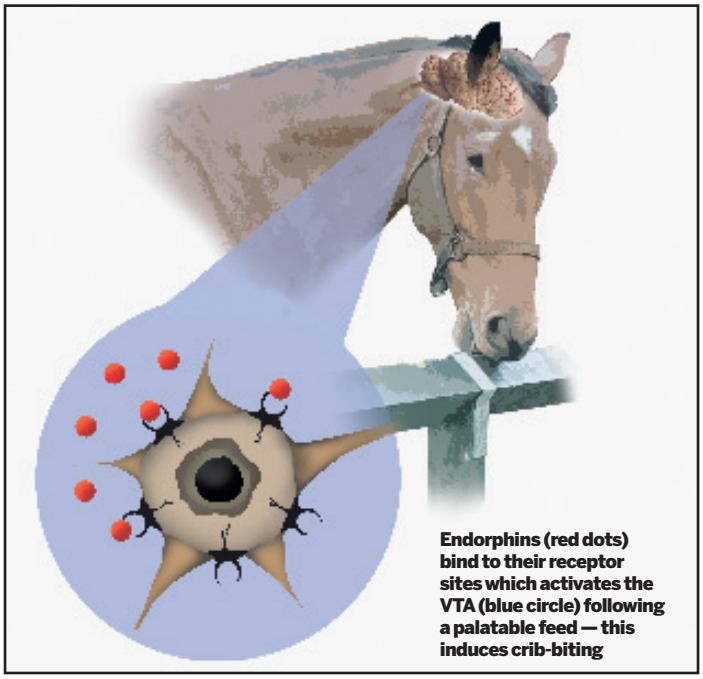
OUR domestic horses' ancestors lived in tropical rainforests some 50 million years ago. These horses were accustomed to palatable, nutrient-dense feeds such as berries and soft shoots. Given the high-nutrient status of this diet, it is probable that they derived their sustenance from a few discrete meals every day rather than constant foraging.

But gradual deforestation over the millennia has shaped the modern horse's reliance on low-palatability grasses associated with steppe and tundra regions of the planet. The low-nutrient status of this fodder means that modern horses are geared to spend up to 18 hours of every day grazing to glean sufficient nutrients.

Modern feeding regimes that feature just two meals of nutrient-dense, palatable feeds per day may therefore be more suited to our distant equine ancestors than to modern equine athletes. This is particularly relevant for stabled horses that tend to consume their high-concentrate, low-forage ration very quickly.

The knock-on effect of a feeding regime that is concentrate-rich and puts ease and convenience first is multidimensional. One of these is that the type of food, as well as its delivery, can influence behaviour.

> "When the horses were fed a forage meal cribbing levels were reduced to five counts"
>
> **Dr Andrew Hemmings on the findings made by the Royal Agriculture College**



Endorphins (red dots) bind to their receptor sites which activates the VTA (blue circle) following a palatable feed — this induces crib-biting

Tests on magnesium have revealed that it reduces the heart rate of stressed horses

Calming supplements – how do they work?

SOME horses have a genetic tendency to be highly strung despite what they are fed. A healthy market for feed additives developed to have a calming effect helps cater for this.

Magnesium is one of the more popular active ingredients. Recent independent testing, by RAC students Sarah Field and Nikki Stradling, of a commercially available magnesium supplement revealed that heart rate (a reliable measure of arousal) in supplemented animals was significantly reduced when confronted with everyday stressors like short periods of isolation.

So how does magnesium exert a calming effect? It has the potential to reduce the release of dopamine — a brain hormone also linked to hyperactivity.

Interestingly, dopamine release within the brain leads to a higher level of eye blinking. In another study, we found that magnesium-supplemented animals exhibited lower blink rates, which indeed suggests that this active ingredient functions at the level of lowered brain dopamine.

Calming supplements do not work for all horses. In competition animals consideration of the risks of using a possibly prohibited substance — see the FEI website — should be discussed with your vet.