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HOW THE DIGESTION OF NUTRIENTS MAY IMPROVE HORSES' OVERALL CONDITION

The importance of breeding and training are well established, but there are many differences in the way yards prepare their horses. For several years our group—a trainer, a vet, and a physician specialising in nutrition and the gut—have been working to see if we could improve equine health and performance using a scientific approach.

The aim has been to explore ways in which the biochemistry underlying the digestion of nutrients might improve horses' overall condition. In some cases this involved applying developments in the field of human nutrition to horses. In others we have tackled well-established problems within equine physiology.

Beetroot juice supplementation

Beetroot is a rich source of nitrate and is frequently taken by athletes to improve their performance. Nitrate produces nitric oxide, which dilates blood vessels, thus reducing blood pressure, increasing blood supply and promoting glucose absorption, and potentially increasing the energy available for high-speed exertion. However, not all athletes appear to benefit, and there had been no study so far on the effect of beetroot juice in horses.

Twenty racehorses (colts and geldings) in full training were divided into two groups. All were fed their standard diets. One group received beetroot juice with a sweetener to mask the taste and the other a sweetener only for four weeks. After four weeks, nitrate levels in the blood were measured and compared to the starting levels. The level of nitrate rose very slightly in the test group, but no change in performance or condition was noted in any of the horses. Beetroot juice does not seem to help horses.

Vitamin B12

Vitamin B12 is important, not only for preventing anaemia and maintaining the health of the nervous system, but also because it produces enzymes which are crucial for allowing the entry of nutrients into the biochemical cycles producing the main source of energy in both man and horse: ATP. In

humans, B12 is derived from eating meat, fish and dairy products. Horses and other herbivores, obtain their vitamin B12 by ingestion of cobalt from pasture which is then used by intestinal microorganisms to form the vitamin. As racehorses are rarely turned out on pasture, most feed concentrates are supplemented with B12.

'As the intensity of work increases, the composition of the diet and the amount of food consumed change as a consequence of the increased consumption of starchy cereal grains. This will alter not only the dietary supply of B vitamins but also the intestinal synthesis…and it is an open question whether the rate of their absorption is exceeded by tissue demand when horses are in intensive training' (Frape, 2010, p250).

The amount of soluble carbohydrate in the diet of the racehorse must be carefully regulated. 'Racehorses on a high-concentrate/low-roughage diet and little access to grazing are to some degree already on a metabolic knife-edge' (Ramzan, 2014, p258).

The trainer was concerned that a number of horses in his yard were below par from the start of the Flat season as their appearance and performance were disappointing. Their diet was unchanged, but they ate poorly and failed to regain weight after racing. Veterinary investigations, including full blood screening, failed to reveal any cause.

As lethargy and early fatigue are two of the earliest symptoms of B12 deficiency in man, it was decided also to check the B12 status of the horses affected.

Twenty racehorses, which were out of condition, were identified and divided into two groups. Blood samples were taken, and B12 levels were recorded. One group was supplemented with B12 injections at 3mg twice weekly for three weeks (18mg in total). The other group acted as controls. At the end of that time, the horses' condition was reassessed by the trainer on his return from a week's absence.

The concentration of vitamin B12 in the 20 horses was found to lie within the normal range and was slightly greater than that found in healthy yearlings on pasture at a local stud. After B12 injections, the level rose significantly. A further determination later in the season showed that this initial increase had disappeared. Overall there was no difference between the blood levels of B12 at the end of season compared to the beginning. Changes in B12 concentration, however, did not affect performance. The trainer, who was not informed which horses had received B12 supplements, considered that 8 horses had improved and 12 had not. These were equally distributed between the two treatment groups, and those considered to have improved did not have higher levels of B12.

Thus, despite previous anxieties, racehorses on standard diets have normal B12 levels which remain satisfactory throughout the season. Supplementary injections increase blood concentrations temporarily, but there was no correlation between blood B12 concentration and performance.

Digestive enzyme supplementation

The investigation into the role of digestive enzyme supplements began during a conversation between vets and a medic in the Jockey Club Rooms. 'Do horses get irritable bowel syndrome?' This led to a search for information on horses' digestion in the university library revealing that as horses had evolved to graze on pasture grasses containing little starch, their pancreas secreted very low levels of the enzymes required to digest it. Race horses require much more energy to sustain active training, but it is well known that excess starch can lead to all manner of problems—acidity, endotoxaemia, colic and even death.

It was decided to try supplementing racehorses with digestive enzymes to see if this improved their performance. Germinating barley generates hydrolytic enzymes to allow the growing plant access to the nutrients stored in the barley grain. These enzymes are usually destroyed by heating when malt is produced for human food, but cold-processing allows the enzymes to remain active. The enzymes are contained as an extract in a liquid organic matrix which allows them to survive acid immersion in the stomach and remain active in the small intestine.

The most important of these enzymes is amylase, which breaks starch down into sugars. In horses, the amount of amylase secreted by the pancreas is insufficient to allow

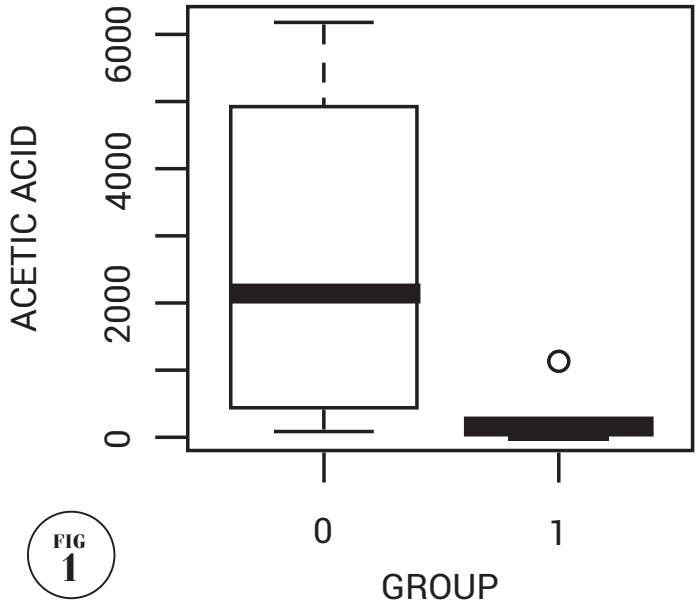


FIG 1

BELOW: Effect of enzyme-rich malt extract on faecal acetate excretion in 8 racehorses.

complete digestion of all of the dietary carbohydrate, leaving residues which pass undigested into the large bowel. Here, together with fibre from grass and hay, they are fermented by the micro-organisms found there (known as the microbiome). In excess this may result in the production of toxic chemicals such as D-lactate, ammonia, alcohols, acetaldehyde and hydrogen sulphide, which all may promote disease.

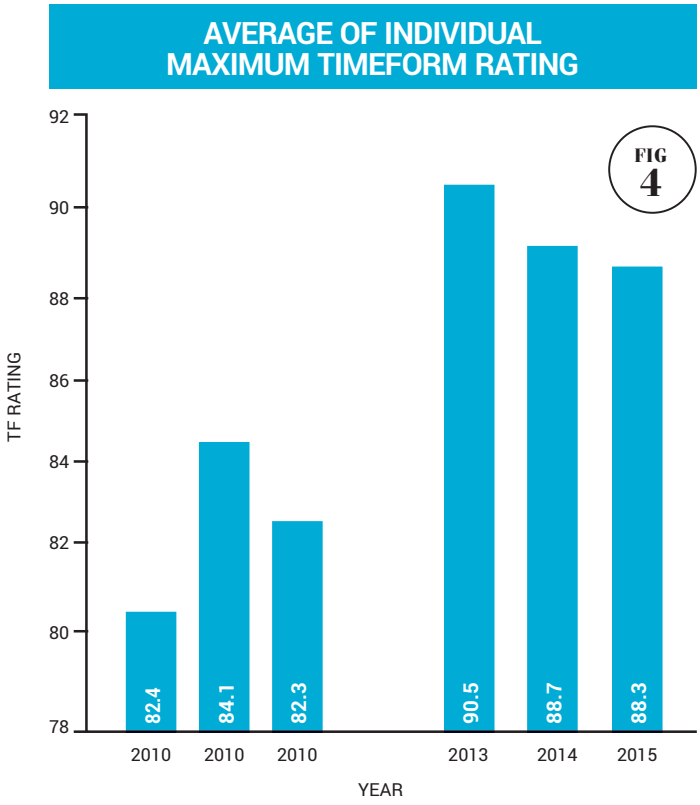
An enzyme-rich malt extract was prepared for us by local maltsters. We fed it to eight horses in full training and took stool samples to follow its effect on fermentation by the microbiome. The extract contains maltose, and horses love its taste; so it has proved a good way of encouraging finicky feeders.

Racehorses on high-energy diets usually have irregular bowel function, but one of the first changes noted was that this became quite regular after starting the extract. Furthermore, biochemical testing showed that the microbiome was functioning smoothly. The main nutrient produced by microbial fermentation of fibre in the large intestine is acetate, which provides nearly 80% of a horse's energy requirements. The level of acetate in the stools fell dramatically (Fig 1) showing that this key nutrient was not being lost in the stools but absorbed into the body virtually completely.

Unsurprisingly, increased intake of energy led to improvements in condition—the horses maintained weight, their coats improved, and they were more sprightly on the gallops. (Figs 2 & 3) The improvement was so apparent that the trainer decided to start his whole yard on the extract. The maltsters agreed to dilute this from 80% solids to 65% solids, making it less viscous and easier to feed to over 100 horses twice daily.

Horses' performance appeared to improve overall so that after three years, it was decided to put racing results to formal examination by an independent outside assessor.

ABOVE: Before feeding with enzyme-rich malt extract.



RIGHT: Changes in maximum Timeform rating before malt extract (2010-2012) and after its introduction (2013-2015).


FIG 3

For this, the assessor took the individual maximum annual Timeform Performance Ratings for all horses in the yard, with the lower limit bounded at 35 during three years on the extract—compared to the three preceding years. The survey was restricted to racing in Britain and Ireland. There was a clear difference between the levels before supplementation (average 83.0 across three years) and afterwards (average 89.2). (Fig 4)

Timeform performance average in British yards is about 72, so this was an over-performing yard to begin with. However, it went from over-performing by 11lbs before supplementation to over-performing by more than 17lbs afterwards; and the effect was seen immediately. As an indication of what these figures might mean in practical terms, a Timeform Performance Rating of 83 would have won 59.5% of maidens in Britain and Ireland in 2016, while one of 89.2 would have won 87.3% of such races.

The improved condition of the horses was emphasized by the fact that they were able to run more frequently. Although the number of horses in the yard was little changed, between 2005-12 the mean number of entries was 155, which rose significantly to 211 in 2013-4.

In another yard, a three-month controlled trial of the extract again showed that it reduced the stool content of acetate—indeed the fall in acetate was directly proportional to racing performance. The control group had 18% winners during the test period and 17% during the following three months. The test group enjoyed 44% winners on malt extract, but which fell to 11% after malt extract was stopped.

ABOVE: Effect of enzyme-rich malt extract on racehorse condition fed for 3 months.

Our studies of the horses' biochemistry showed two other reasons for this improvement, apart from the reduction of undigested starch reaching the large intestine. One was the increased amount of energy derived from the diet, reducing the need for energy from the tissue breakdown during exercise which leads to prolonged recovery. The second was that analysis of the microbiome showed a four- to five-fold increase in beneficial bacteria. (Fig 5)

Enzyme-rich malt extract appears to be a beneficial food supplement for racehorses. T

BELOW: Beneficial effects of changes to the microbiome after malt extract; each organism increased 4- to 5-fold.

FIG 5

Micro-organism	Beneficial effect produced
Veillonella	Convert L-lactic acid to propionate to combat fatigue
Ruminococcus	Increase digestion of fibre in intestine releasing energy
Bacteriodales	Combat metabolic syndrome

Further Reading

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