Colitis in donkeys

The presentation of colitis in the donkey may differ from that in the horse. Donkeys typically mask signs of pain and illness, and diarrhoea is not common in colitis. Recognition, treatment and management of colitis requires an underlying understanding of donkey-specific behaviours and an awareness of differences in the pharmacokinetics of certain medications. Colitis may present comorbidly with other pathophysiology, and a careful stepwise diagnostic approach to the dull donkey is essential.
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There are many companion or pet donkeys kept in the UK. Donkeys have certain behavioural and physiological nuances that render their clinical presentation of disease, subsequent treatment and management to have differences from horses and ponies. This article discusses the specific presentation of colitis in donkeys, acknowledging the current 'unknowns' that continue to perplex case management while providing guidelines for diagnosis, treatment and prevention, based on the author's experience. This article will focus on acute colitis but reference is made to chronic presentations.

Colitis refers to inflammation of the colon but in many affected donkeys, the caecum may be the only part of the intestine affected (typhlitis) or more commonly a combined typhlocolitis is seen. The reader should be aware that the clinical presentation does not always allow for easy differentiation of colitis from typhlocolitis. 'Colitis' is used in this article as a general term and encompasses typhlocolitis.

Clinical presentation

The initial presentation of acute colitis or typhlocolitis in the donkey is usually vague. Owners may notice that the donkey's demeanour is less bright than usual, appetite may be reduced or completely anorexic. This is classically known as the 'dull' donkey. It is vital that a veterinary assessment of the donkey is performed without delay. As a prey species, donkeys have evolved with the behavioural characteristic of stoicism – the ability to mask outward signs of pain or illness likely conferred an evolutionary advantage (Burden and Thiemann, 2015). Unfortunately, this ability to avoid signifying weakness to predators can manifest as owners not recognising that their donkey is unwell until pathophysiology is advanced (McClean et al, 2019). The donkey is unlikely to demonstrate clear evidence of abdominal pain, such as rolling or kicking at the abdomen, and diarrhoea is not commonly seen in acute cases of donkey colitis (Du Toit et al, 2010). It is hypothesised that this may be related to the ability of the donkey hindgut to conserve water retention (Barrio et al, 2019), which is another evolutionary advantage for a species that evolved in dry, arid environments. However, there is little scientific proof that this is indeed the reason for the lack of diarrhoea in colitis presentations.

It is not uncommon for a donkey colitis case to initially present with seemingly mild signs of depressed demeanour and appetite changes, with minimal findings on clinical examination, and rapidly progress over 12–24 hours to a moribund presentation. Consequently, arrangements must be made to follow up on the donkey's progress throughout the day. The acute presentation is the norm for donkeys with colitis but chronic colitis has also been recognised in donkeys with insidious weight loss and waxing and waning periods of dullness. It is unclear whether such cases are acute on chronic presentations of inflammatory bowel disease.

If the donkey is kept with one or more companions, as is the norm, it is important to check for any signs of illness with all those equids present at a location. If more than one donkey is affected, an infectious aetiology is higher up the list of differentials.

Clinical examination and diagnosis

Awareness of the potential for colitis as a differential cause of the dull donkey is the key first step in diagnosis of cases. Given the common subtlety of initial clinical signs and usual lack of diarrhoea, it can be very challenging to diagnose colitis on an initial visit. As with all species, thorough history-taking and a stepwise clinical examination are essential. Colitis is often a diagnosis based on exclusion of other causes of dullness, combined with evidence of colitis from diagnostic tests. When taking the history, particular attention should be paid to any changes in management or recent medication. From work with the author's caseload, it is believed that changes in management including change of ownership or living location, companion (including loss thereof), feed provision or a recent procedure such as veterinary treatment, farriery or dental care, may be perceived as stressors for the donkey. Similarly, a change in weather that precipitates more time at pasture, or more time off pasture may also be associated. Although the pathophysiological processes have not been defined, it is suspected that such 'stressors' could precipitate a gut dysbiosis which may be associated with clinical colitis. Recent treatment with antimicrobials has

Table 1. Summary of considerations for diagnostic test selection

Blood sample	Faecal sample	Other
• Biochemistry profile. Must include triglycerides • Haematology • Lactate • Inflammatory markers (eg serum amyloid A and fibrinogen)	• *Clostridium* spp, including *C. difficile* and perfringens toxins • Salmonella culture and polymerase chain reaction • Coronavirus • Lawsonia intracellularis if age appropriate, rotavirus if foal • Faecal worm egg count • Aerobic/anaerobic culture	• Abdominocentesis, including total nucleated cell count, protein and lactate • Feed sample analysis • Histopathology of post mortem caecocolonic biopsy samples

also been proposed, as with horses, although there are no donkey-specific cited definitive reports of this in the literature. Larval cyathostominosis has been identified in donkeys (Matthews and Burden, 2013) and history taking should include questions relating to pasture management, whether the donkey is included in endoparasite monitoring and any recent anthelmintic use. Note that the small redworm ELISA and tapeworm ELISA tests developed for horses (Lightbody et al, 2016; 2024) have not been validated in donkeys, and as such their use is not recommended currently as the results may be difficult to interpret.

If more than one donkey is affected, the attending vet should be cautious of an infectious aetiology and/or ingestion of spoiled or toxic feed. Salmonellosis was positively identified in acute presentation of multiple donkey colitis cases in a single location in the UK (unpublished data).

On clinical examination, the veterinarian should be aware of donkey specific parameters (*Box 1*). Many donkeys later diagnosed with colitis initially present as pyrexic, but obviously not all pyrexic donkeys have colitis and vice versa. The mucous membranes should be examined, assessing for colour, capillary refill time and moisture. The skin tent test as a crude marker of dehydration is unreliable in the donkey (Thiemann and Sullivan, 2019). If the owner has noted the donkey urinating recently this is useful information but is typically lacking, not least because most donkeys are either out at pasture or stabled with a companion. Both sides and ventrum of the abdomen should be auscultated. The presence of reduced borborygmi is common in donkey colitis, but normal gut sounds do not preclude a diagnosis in the author's experience. A nasogastric tube may be passed to assess for reflux and for administration of fluids and other therapeutics. Donkeys have a narrow nasal meatus and narrow-bore pony or foal-sized nasogastric tubes will be needed.

If the donkey can be adequately and safely restrained and it is safe to do so, a rectal examination is as important as in the horse, unless presented with a miniature breed. The use of smooth muscle relaxants can greatly aid the examination and short-acting alpha-2 agonists are useful for fractious patients. The author uses standard equine doses, adjusted to the estimated weight of the donkey. Weights of donkeys in the UK are variable, from less than 100 kg for miniature donkeys through to >300 kg for giant breeds. As a broad generalisation, the 'average' UK non-miniature, non-giant donkey is typically around 150–200 kg. A fresh faecal sample should be collected and sent for analysis where colitis is suspected. See *Box 2* for a summary of considerations for diagnostic tests.

It is essential to take blood samples for routine biochemistry and haematology, and triglyceride assessment is paramount as comorbidity with hyperlipaemia is possible. Donkey specific reference ranges have been established for biochemistry and haematology and can be found online (The Donkey Sanctuary, 2020).

Inclusion of inflammatory markers is recommended, as well as consideration of peripheral lactate levels but there are no donkey-specific validated reference ranges for either of these at the time of writing. If abdominocentesis is indicated then cytology, protein content and lactate level should be assessed as for a horse. Note that the ventral abdominal body wall fat can measure several centimetres thick in a donkey, as seen in numerous postmortem examinations performed at the author's clinic, and ultrasound guided needle placement may be preferable for sample collection. Clinician preference and individual donkey abdominal fat thickness will dictate the size of the needle required and if significant fat deposits are present, a teat cannula may be a wise option. In a clinical setting, ultrasonographic examination of the abdomen is useful to assess colon wall integrity and thickness and may help differenti-

Box 1. Normal parameters for adult donkeys

- Temperature: 36.5–37.8 °C
- Pulse: 36–52 beats/min
- Respiration: 12–28 breaths/min

(The Donkey Sanctuary, 2018)

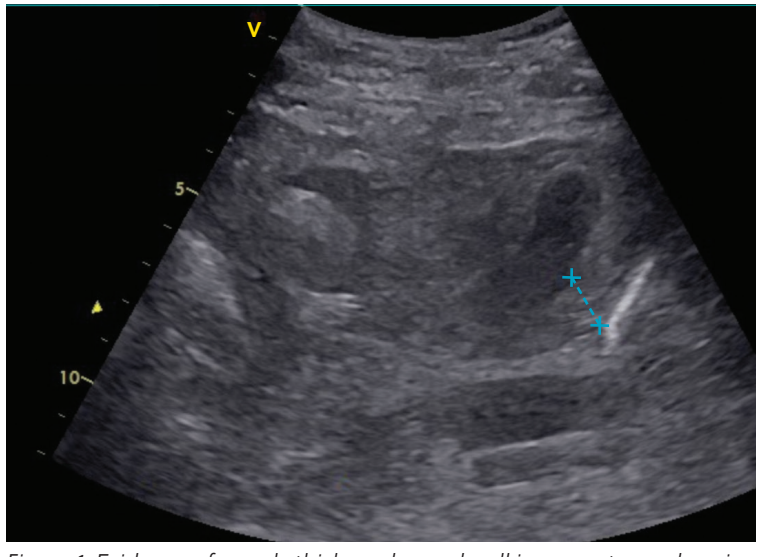

Figure 1. Evidence of grossly thickened caecal wall in an acute on chronic presentation of colitis.

ate from other causes of dullness. However, ultrasonography is not usually available/performed on the first visit. At the time of writing, there are no donkey-specific reference ranges for expected normal intestinal wall measurements. Profound thickening of the caecum and colon has been seen in acute and chronic typhylocolitis cases, as demonstrated in *Figure 1*. Results of clinical examination, bloodwork and the donkey's response to treatment may all help to rule in or out colitis as a cause of symptoms. In the absence of ultrasonographic confirmation of intestinal inflammation, other markers of colitis include (but are not limited to):

- Presence of hypoalbuminemia
- Leucocytosis or leucopoenia in the face of initial overwhelming infection
- Elevated inflammatory markers
- Lack of other gastrointestinal lesions such as gastric or large colon impaction
- Suspected surgical colic
- Any subsequent results of colitis panel screens on faecal analysis.

If the patient is euthanised, the samples of colon taken at postmortem can be sent for histopathological analysis. This is recommended if more than one donkey is affected, as the findings may guide treatment and prognosis for surviving affected companions, although the aetiology remains undefined in the majority of cases (Du Toit et al, 2010).

At the author's clinic, there have been a small number of cases with positive polymerase chain reaction results for *Clostridium difficile* toxins, but the significance of these results remains uncertain. It is difficult to know whether the positive *Clostridium* toxin polymerase chain reaction could be causative of colitis, or whether there is a dysbiosis as a result of colitis, which leads to *C. difficile* toxin release. In the author's opinion, larval cyathostominosis should be considered in a donkey with hypoalbuminaemia, evidence of erupting hypobiotic L3 larvae and ultrasonographically detectable colonic mural thickening. The clinical presentation of larval cyathostominosis is similar to that of horses (Lawson et al, 2023), with the exception of a general lack of diarrhoea.

As with horses, recent administration of anthelmintics may be a risk factor (Rendle, 2014). The author has seen two cases of donkeys presenting with pyrexia and suspected colitis (one confirmed at post-mortem) tested positive for coronavirus. The non-survivor developed severe clinical signs of enterocolitis. Right dorsal colitis associated with short or long-term administration of non-steroidal anti-inflammatory drugs does not appear to be common in donkeys, based upon clinical and postmortem examinations of donkeys at the author's clinic. Of note, the author has rarely seen ventral or limb oedema in donkey colitis cases with hypoalbuminaemia. This could be because of the often peracute nature of the disease process, but since ventral oedema is also not a finding in more chronic hypoalbuminaemic inflammatory bowel disease cases, the explanation remains unclear.

Differential diagnoses

Given that the general clinical presentation of a donkey with colitis is that of a dull donkey, there are numerous potential differential diagnoses. It is incumbent upon the attending veterinarian to rule out other key cause of 'dullness', including but not limited to:

- Colic
- Hepatopathies
- Primary hyperlipaemia
- Respiratory disease
- Laminitis.

Colitis may be comorbid with any of these.

Medical management

If the donkey can be successfully treated in their home environment, this will be beneficial in terms of minimising stress. However, many colitis patients deteriorate rapidly and will necessitate an inpatient stay. Remembering that many donkey patients have probably been unwell for some time before they are presented to the vet, it is wise to consider hospitalisation or referral sooner rather than later. On the other hand, transport to a clinic is not without complication. Of paramount importance is that any companion must accompany the donkey patient. Donkeys form strong bonds with their companions and separation is considered stressful and a risk factor for hyperlipaemia (Burden et al, 2011).

Provision of analgesia, restoration of normovolaemia and preventing secondary hyperlipaemia are the key features of medical management. It should be noted that there are few licensed veterinary medicines for donkeys and therefore any administration or prescription must be made following the cascade (UK Government, 2021). For initial analgesia and provision of anti-inflammatory medication, the use of flunixin meglumine 1.1 mg/kg bodyweight twice daily is recommended. For many non-steroidal anti-inflammatory drugs, including flunixin and phenylbutazone, evidence has indicated that donkeys metabolise these drugs faster than horses and twice daily dosing is always advised (Grosenbaugh et al, 2011). If there are concerns regarding renal function and hydration status, anti-endotoxic doses of flunixin can be used, but it is likely that further analgesia would then be required. In all instances, a multimodal approach to analgesia is likely to be of benefit. The author has used oral paracetamol at doses of 20–30 mg/kg bodyweight twice daily and opioids at standard equine doses, extrapolated to the donkey's weight. Concerns over the use of opioids and reduction of gut motility need to be balanced against the impact of ongoing uncontrolled pain on motility. Note that lidocaine constant rate infusions have been used in many donkey colitis patients, again using standard horse protocols for loading dose and maintenance. Anecdotally, the use of lidocaine has been associated with successful recovery but as multiple medications are used in any one case, it is so far impossible to comment on the efficacy. Use of other anti-inflammatory medications would follow the same guidelines as for horse patients and there are no peer-reviewed, donkey-specific studies.

On first presentation of an inappetent donkey, assuming that there is no reflux, administration of small volumes of fluid and nutrition can be provided by nasogastric intubation. The typical 150–200 kg sized UK donkey stomach holds an average of 3 litres. For initial support, the author gives 2–3 litres of isotonic solution, with added dextrose or glucose powder (1 g/kg) and supplementation with oat-based cereal products for short-term energy supply. In terms of quantity of the latter, the rule of thumb is to add as much to the bucket as you can, while ensuring that the resultant

concoction is not too thick to flow through the tube. If an infectious or toxic aetiology is suspected, then consideration should be given to the use of oral adsorbents. The author has used smectite at standard horse dose but would caution that the product will likely need to be administered by stomach tube multiple times to be effective, and repeated tubing in itself carries the risk of being a stressful procedure. If larval cyathostominosis is suspected then anthelmintic treatment with moxidectin may be made, once the patient is stable (Bell et al, 2021). As with horses, pre-treatment for 24–72 hours with corticosteroids is a worthy consideration, and continuing treatment until resolution of hypoalbuminaemia and/or restoration of normal intestinal wall thickness may be of merit.

The use of antimicrobials in treatment of colitis is always contentious and the donkey patient is no different. The choice to use antimicrobials should be made on a case-by-case basis (Weese, 2015). A donkey that is systemically unwell, with indicators of endotoxaemia, should have a lower threshold for starting antimicrobial therapy. In the author's experience, many acute presentations of colitis are associated with a profound neutropaenia and antimicrobials are more advisable in such scenarios. The next dilemma is which antimicrobial to select. In the first instance, broad spectrum therapy, such as combinations recommended in the BEVA ProtectMe guidance (BEVA, 2012) are appropriate starting points. Pharmacokinetics of antimicrobials in donkeys are sparsely covered in the literature. Penicillin and gentamicin combinations, with additional or sole use of metronidazole if clostridial disease is suspected, have been extensively used in donkeys in the author's clinic.

Fluid therapy guidelines in donkeys do not have major differences from horses (Shaw and Stämpfli, 2018). However, perhaps because of the general lack of diarrhoea, severe dehydration is rarely seen and aggressive crystalloid fluid therapy rates are rarely indicated. Hydration status should be monitored to avoid fluid overload, checking for urinary output and measuring urinary specific gravity alongside blood biochemistry, where feasible. Of note, significant mural oedema has been seen at post-mortem of non-survivors who were treated with high fluid therapy rates, although caution is needed as this association has not been proven. Provision of crystalloid fluid therapy at maintenance rates is useful for maintaining hydration, normovolaemia and the administration of any intravenous medications. In the field, fluid boluses may be useful but continuous infusions in the clinic setting are likely to more appropriate for the very unwell patient. In severely hypoproteinaemic cases, the use of colloidal infusions should be considered. If the companion is fit and well then they may be able to act as a plasma donor, otherwise commercial colloidal products are suitable for use in the donkey. Be aware that donkeys are inquisitive and playful creatures and perfectly well companions can delight in tampering with the fluid lines and catheters of their unwell friends. If bandaging of the neck is not enough to deter the companion, then physical separation of the pair, while maintaining visual contact over a set of hurdles or stable door may be needed to allow fluid therapy to continue. The use of parenteral nutrition is expensive and may not be readily available. Wherever possible, continued attempts should be made to encourage appetite and intravenous fluid therapy may need to be supplemented with nasogastric intubation as described previously.

Figure 2. Severe ulceration of the colon seen at post-mortem.

Figure 3. Necrotisation and ulceration of the colon seen at post-mortem.

Samples from post-mortem specimens (*Figures 2* and *3*) indicate that typhylocolitis can cause severe ulcerative lesions. Administration of protectants such as sucralfate would certainly seem pertinent but the efficacy is unknown. There appears to be a higher prevalence of gastric ulcer disease in severely unwell donkeys with colitis and/or hyperlipaemia (Thiemann and Sullivan, 2019). Currently, suspected colitis patients are given a combination of injectable omeprazole and oral sucralfate. Donkeys have delayed gastric emptying compared with horses and even after withholding food for 16 hours, the stomach can be quite full, presenting challenges for gastroscopy. As such, studies to determine the efficacy of the omeprazole/sucralfate regimen have not been performed.

The donkey gut microbiome is different to that of the horse (Edwards et al, 2020), so use of commercial horse probiotic products is not justified. Transfaunation does seem to be a useful technique to restore the microbiome of recovering colitis patients and has been tried in a small number of cases at the author's clinic. Identification of an appropriate donkey donor and preparation of the faecal liquid was performed following guidelines published for horses (Mullen et al, 2018).

KEY POINTS

- The reported 'dull' donkey should be seen as a priority by a vet.
- Donkeys typically mask pain symptoms and may be more severely unwell than first realised.
- Diarrhoea is not commonly seen in acute colitis cases in donkeys.
- Donkeys metabolise many non-steroidal anti-inflammatory drugs faster than horses and will require twice daily dosing.
- Blood work should include triglyceride level measurement as co-morbidity with hyperlipaemia is a risk.
- If hospitalising a donkey colitis case, the donkey's bonded companion/s must accompany the patient.

Nursing care

Good nursing care is pivotal to good outcomes for colitis cases and this includes management of the donkey's companion, who can easily become bored and will benefit from stable enrichment and human interaction, including owner visits and attention from nurses, vet care assistants and grooms. Further enrichment ideas can be found online (The Donkey Sanctuary, 2024a). Many donkeys do not tolerate being stabled, and the colitis patient may need periodically to be taken off fluids and allowed short periods of time outside. In terms of nutrition, the aim is to replicate the donkey's normal diet, while ensuring that the burden on an inflamed colon is minimised.

The normal diet for a healthy adult donkey with good molar function should consist of a majority of straw (https://www.thedonkeysanctuary.org.uk/for-owners/food-for-donkeys/feeding-donkeys) but a period of acute illness is not the time to make major dietary changes. Owners should be encouraged to bring in routine feedstuffs from home if the practice does not have a regular supply. Appetisers, such as 'safe' hedgerow trimmings, including brambles and hazel and treats such as carrots or apples can help to encourage eating. Patients should be monitored for signs of developing laminitis and phlebitis as in horses.

Use of donkey-specific pain scales are valuable in monitoring acute pain. Acute colic pain was accurately recognised in one study using both facial expression-based and composite pain scales, although colitis specifically was not validated (van Dierendonck et al, 2020). Scoring using these systems can add objective data to assist in assessing the progress of the patient. Finally, attention to biosecurity is essential for human safety and minimising the risk to other hospital inpatients. Protective overalls and footdips outside the stable door are advisable.

Conclusions

The possibility of typhylocolitis should be considered as a differential for the dull donkey, and dull donkeys should be treated as emergencies. Cases can deteriorate rapidly and intensive clinic care may be needed. The prognosis for colitis is guarded and owners should be aware of the costs, risks and benefits of all treatment decisions. There is limited published information regarding therapeutics in donkeys and treatment needs to be based upon horse guidelines, while remaining aware of donkey-specific differences in colitis presentation and management. EQ

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Conflict of interest

The author declares that there are no conflicts of interest.

References

Barrio E, Rickards KJ, Thiemann AK. Clinical evaluation and preventative care in donkeys. Vet Clin North Am Equine Pract. 2019;35(3):545–560. https://doi.org/10.1016/j.cveq.2019.08.013

Bell N, Thiemann AK, Sullivan RJE (2021). Endoparasite control for donkeys in the UK. UK Vet Eq. 2021;5(2):84–89. https://doi.org/10.12968/ukve.2021.5.2.84

BEVA. Protect Me Toolkit. 2012. https://www.beva.org.uk/Protect-Me (accessed 4 March 2024)

Burden FA, Du Toit N, Hazell-Smith E, Trawford AF. Hyperlipemia in a population of aged donkeys: description, prevalence, and potential risk factors. J Vet Intern Med. 2011;25(6):1420–1425. https://doi.org/10.1111/j.1939-1676.2011.00798.x

Burden FA, Thiemann AK. Donkeys are different. J Eq Vet Sci. 2015;35(5):376–382. https://doi.org/10.1016/j.jevs.2015.03.005

Du Toit N, Burden FA, Getachew M, Trawford AF. Idiopathic typhlocolitis in 40 aged donkeys. Eq Vet Edu. 2010;22(2):53–57. https://doi.org/10.2746/095777309X480894

Edwards JE, Schennink A, Burden F et al. Domesticated equine species and their derived hybrids differ in their fecal microbiota. Anim Microbiome. 2020;2(1):8. https://doi.org/10.1186/s42523-020-00027-7

Grosenbaugh DA, Reinemeyer CR, Figueiredo MD. Pharmacology and therapeutics in donkeys. Eq Vet Edu. 2011;23(10):523–530. https://doi.org/10.1111%2Fj.2042-3292.2011.00291.x

Lawson AL, Malalana F, Mair TS. Larval cyathostominosis: clinicopathological data and treatment outcomes of 38 hospitalised horses (2009–2020). Eq Vet Educ. 2023;35(8):424–435. https://doi.org/10.1111/eve.13782

Lightbody KL, Davis PJ, Austin CJ. Validation of a novel saliva-based ELISA test for diagnosing tapeworm burden in horses. Vet Clin Pathol. 2016;45(2):335–346. https://doi.org/10.1111/vcp.12364

Lightbody KL, Austin A, Lambert PA et al. Validation of a serum ELISA test for cyathostomin infection in equines. Int J Parasitol. 2024;54(1):23–32. https://doi.org/10.1016/j.ijpara.2023.07.001

Matthews JB, Burden FA. Common helminth infections of donkeys and their control in temperate regions. Equine Vet Educ. 2013;25(9):433–486. https://doi.org/10.1111/eve.12018

McLean AK, Navas González FJ, Canisso IF. Donkey and mule behavior. Vet Clin North Am Equine Pract. 2019;35(3):575–588. https://doi.org/10.1016/j.cveq.2019.08.010

Mullen KR, Yasuda K, Divers TJ, Weese JS. Equine faecal microbiota transplant: current knowledge, proposed guidelines and future directions. Eq Vet Educ. 2018;30(3):151–160. https://doi.org/10.1111/eve.12559

Rendle DI. Diagnosis and treatment of cyathostominosis in horses. 2014. https://www.vettimes.co.uk/app/uploads/wp-post-to-pdf-enhanced-cache/1/diagnosis-and-treatment-of-cyathostominosis-in-horses.pdf (accessed 17 January 2024)

Shaw SD, Stämpfli H. Diagnosis and treatment of undifferentiated and infectious acute diarrhea in the adult horse. Vet Clin North Am Equine Pract. 2018;34(1):39–53. https://doi.org/10.1016/j.cveq.2017.11.002

The Donkey Sanctuary. Clinical examination of the donkey. 2018. https://www.thedonkeysanctuary.org.uk/sites/uk/files/2018-12/the-clinical-examination-20181214.pdf (accessed 29 September 2023)

The Donkey Sanctuary. Parameters: biochemistry and haematology. 2020. https://www.thedonkeysanctuary.org.uk/sites/default/files/2020-02/parameters-for-haematology-and-biochemistry.pdf (accessed 4 March 2024)

The Donkey Sanctuary. Environment enrichment. 2024a. https://www.thedonkeysanctuary.org.uk/for-owners/environment/environment-enrichment (accessed 4 March 2024)

The Donkey Sanctuary. Feeding donkeys. 2024b. https://www.thedonkeysanctuary.org.uk/for-owners/food-for-donkeys/feeding-donkeys (accessed 4 March 2024)

Thiemann AK, Sullivan RJE. Gastrointestinal disorders of donkeys and mules. Vet Clin North Am Equine Pract. 2019;35(3):419–432. https://doi.org/10.1016/j.cveq.2019.08.001

UK Government. The cascade: prescribing unauthorised medicines. 2021. https://www.gov.uk/guidance/the-cascade-prescribing-unauthorised-medicines (accessed 29 September 2023)

van Dierendonck MC, Burden FA, Rickards K, van Loon JPAM. Monitoring acute pain in donkeys with the equine Utrecht University scale for donkeys composite pain assessment (EQUUS-DONKEY-COMPASS) and the equine Utrecht University scale for donkey facial assessment of pain (EQUUS-DONKEY-FAP). Animals (Basel). 2020;10(2):354. https://doi.org/10.3390/ani10020354

Weese JS. Antimicrobial use and antimicrobial resistance in horses. Equine Vet J. 2015;47(6):747–749. https://doi.org/10.1111/evj.12469