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The importance of horses' senses in a nutritional context

Abstract. The horse's senses are very acute and geared to constantly analyse the stimuli coming from the environment. Their role in choosing the right feed is very important and often underestimated by their caretakers. Compared to their wild ancestors, nowadays horses are generally not free to choose the type and amount of feed. Instead, they are provided with feed selected and prepared by humans. It is not uncommon to encounter the phenomenon of so-called food neophobia, i.e. horses' refusal to eat feed with an unfamiliar taste or smell. This also applies to the consumption of supplements, medication and sometimes even water, which can be quite a problem for horse users and can even lead to health disorders for these animals. Therefore, this paper explores the topic of the role of horses' senses in terms of their nutrition.

Keywords: equids, sense organs, horse nutrition, diet selection, food preferences

INTRODUCTION

Horses were domesticated about 5,500 years ago [Orlando 2020]. Since then, their living conditions and the type and amount of food they consume have been dependent on humans. The diet of domesticated horses gradually changed because horses used by humans needed feed that was richer in nutrients. Nevertheless, their general nutritional needs, determined by the specific structure of their digestive system and fermentation mainly in

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the cecum and large colon, remained unchanged [Ralston 2021]. Nowadays, it is very rare to find horses living in the wild – this is generally in nature reserves and other conservation areas [Naundrup and Svenning 2015]. Through evolution, horses have adapted to selectively choose and consume a wide range of plant species [Van den Berg et al. 2016b]. Horses are herbivores with a constant secretion of acid in the stomach, so they need to eat regularly in small portions to avoid digestive problems [Roig-Pons et al. 2025]. They spend 16–20 hours a day grazing, which consists of taking a small amount of forage and then moving a few steps to the next feeding station [Sarrafchi and Blokhuis 2013, Van den Berg et al. 2015]. This natural foraging behaviour also occurs in stabled horses when they are offered a variety of feeds [Goodwin et al. 2005b]. This way, equines can select the best food source based on visual cues, odour, taste, texture, availability and variety [Goodwin et al. 2005a, Chodkiewicz 2020, Rørvang et al. 2020]. Van den Berg et al. [2016a] indicated that horses are primarily guided by nutritional value, followed by taste and smell, when choosing a food source. Previous studies have shown that free-roaming horses eat up to 50 different plant species [Van den Berg et al. 2015]. Because poisonous plants are an integral part of many horse pastures around the world, it is important that horses be able to make appropriate dietary choices to avoid fatal poisoning [Pfister et al. 2010]. Optimal feeding is crucial for survival and functioning of the organism and is shaped by both the characteristics of the available feed and the animal's selective feeding strategies [Culda and Stermin 2019, Sahu et al. 2020]. Therefore, gathering information about potential food using various sensory modalities makes them extremely important in equine nutrition.

Horses living in stable conditions consume a variety of plant-based fed, depending on the climatic zone, availability of different plant species and storage method: hay, haylage, oats, barley, corn, alfalfa and others [Murray et al. 2015, Harris et al. 2017]. The use of complete industrial feeds, feed concentrates and supplements is also becoming more widespread. Currently, horses consume roughage selected and prepared by humans, so they do not make full use of their ability to selective choose [Stegelmeier 2011]. Because of their natural feeding pattern, which involves foraging and feeding for most of the day, horses may become bored or frustrated if they are unable to perform this behaviour [Roig-Pons et al. 2025]. A lack of adequate daily forage provision can lead to behavioural disorders, and is one of the frequently mentioned reasons for a reduced rejection of toxic plants [Sarrafchi and Blokhuis 2013, Sroka et al. 2022]. In reality, limited free search in domesticated horses may be the reason for a gradual decline in the ability to recognise noxious or poisonous plants [Stegelmeier 2011].

Horses evolved as flight animals, which is why they are very sensitive to environmental stimuli [Marliani et al. 2021]. Their alertness allows rapid detection and identification of the stressor which was crucial to survive in the wild [Apfelbach et al. 2005]. Horses' cautiousness also manifests itself in neophobia, i.e. fear of novelty that can be associated with various stimuli, including tastes or smells [Lansade et al. 2008a]. This means that there are situations when horses refuse to eat feed with an unfamiliar odour or taste or when they prefer the taste of one feed and do not want to take another. Combined with additional individual preferences, this can lead to problems in keeping horses in an adequate nutritional state [Van den Berg et al. 2016b, Merkies et al. 2024]. For this reason, this article analyses the role of the various senses of horses in the processes of feed selection and consumption. Each sensory organ, due to its characteristic biological and neurophysiological conditions, has a different contribution to make in delivering the received stimuli to the brain [Narloch 2016]. Horses' willingness to consume feed is influenced by its taste, smell, texture and visual cues [Goodwin et al. 2005a, Chodkiewicz 2020, Krueger and Flauger 2011]. Therefore, the senses of taste, smell, touch, and sight play the most significant role in assessing the suitability of feed and are discussed in this article.

This is a review article and aims to discuss the importance of taste, smell, touch and sight in the context of feed selection by horses. The paper refers to numerous scientific studies and other review articles, discussing the aspects of the functioning of the senses, nutrition, biology and the welfare of horses. The selection of scientific research for this paper was conducted with databases such as Google Scholar, Scopus, and Web of Science. The keywords applied included the expressions „horse senses”, „horse nutrition”, „feeding behavior of horses”, „sense of smell and taste in horses”, „touch in horses,” and „food selection by horses”.

Sense of taste and smell

Chemical senses, which include taste and the functionally related sense of smell, are considered one of the oldest forms of animal adaptation [Krueger and Flauger 2011]. They are closely related and much more acute than in humans. The sensory properties of feed are usually perceived by domestic animals in the following order: appearance, aroma, texture and taste. However, horses rely most on odour and taste, when selecting feed or plants in a pasture [Perry et al. 2024]. Horses perceive their environment differently than humans, and sensory abilities in humans and horses also differ [Stachurska et al. 2022]. The choice of feed for horses is largely based on olfactory and taste sensations, while for humans it is mainly based on visual sensations [Francis et al. 2020]. Taste is a sense that allows humans to evaluate the chemical properties of a substance in terms of its suitability for consumption. Taste information is received only in the oral area. However, most of the taste sensations experienced by horses while eating are simultaneously perceived as olfactory information from the nasal cavity area [Van den Berg et al. 2016b]. Horses usually smell before eating. This activity is due to the clear connection between taste and olfactory sensations. Before food reaches the mouth, the horse examines it thoroughly using its olfactory receptors and vibrissae [Perry et al. 2024]. The surface of the horse’s tongue is covered with numerous structures called taste buds, which are responsible for the sensation of taste. In the central part of the taste buds are taste receptors, which are equipped with special projections called microvilli. Taste nerve cells are concentrated in the taste buds of the mouth and throat. They react to food or drink mixed with saliva. These surface cells send taste information to nearby nerve fibres and then to the brain. In herbivorous mammals, i.e. also in equines, taste perception is better developed than in predators. Herbivores have a significantly higher number of taste buds than predators, which is related to the need to detect toxic substances in the plants they eat [Lunceford and Kubanek 2015].

Taste perception in horses is highly developed and plays a key role in their daily life, especially during food selection. Taste sensations provide the body with information about nutritional values and help to identify harmful or spoiled feed, protecting the horse from consuming poisonous or stale food [Tomczynski et al. 2002a, Rørvang et al. 2020]. Before domestication, horses used their sense of taste to select food rich in essential nutrients and to avoid eating poisonous plants. Nowadays, they are able to select vegetation in the pasture and forage provided by humans, thus rejecting what does not suit their taste preferences [Van den Berg et al. 2016b]. Horses can detect four out of five types of taste: sweet, sour, salty and bitter. There is currently very little information on whether horses can detect umami, known colloquially as meat or dry taste [Van den Berg et al. 2016a]. The vast majority of horses prefer sweet and salty tastes and avoid bitter and sour tastes [Janczarek et al. 2018]. The sweet taste of food often indicates the content of a simple source of energy, while a salty taste indicates the content of sodium and potassium cations. Food perceived as bitter may signal the presence of poisonous substances, while a sour taste may indicate possibly spoiled food [Van den Berg et al. 2016b]. Feed flavour is not limited to taste sensations alone, but is a combination of both taste, smell and texture [Tomczynski et al. 2002a]. Horses may avoid not only indigestible or poisonous plant species, but also those perceived by them as unpalatable [Janczarek et al. 2018].

The taste of feed affects horse's appetite, and thus the acceptance of feed by horses and the time of its consumption. Appetite is determined by so-called pre-gastric factors, which include the taste, smell and texture of the feed [Van den Berg et al. 2016b, Rørvang et al. 2020]. Horses often reject feed that doesn't match their individual taste preferences. As shown by Stachurska et al. [2022], moistening and sweetening feed has a potential to increase the horses' willingness to eat. Horse breeders often add various flavored supplements to the food (e.g. apple flavor) to encourage horses to eat. This is a very good solution when introducing a new feed to the diet or administer oral medications [Van den Berg et al. 2016a]. Masking tastes and odours that are unpleasant for horses (e.g. oral medications) increase the palatability and intake of feed. This method allows for „smuggling" medication in a feed when the horse refuses to take it [Stachurska et al. 2022]. Even if the nutritional value of a given feed seems to outweigh taste and smell in the horse's choice of food, individual taste preferences may be more relevant to horses [Van den Berg et al. 2016b, Merkies et al. 2024].

Like many other animal species, horses are characterised by variable and individual responses to specific tastes [Goodwin et al. 2005b]. It has been found that the taste preferences of horses depend on their breed and sex [Janczarek et al. 2018]. In the mentioned study, the greatest variation in individual taste preferences was found in purebred Arabian horses, while the mares perceived the selected treats as more palatable than the geldings. Taste and odour preferences during food selection change also with the age of the horse. Foals between 2 and 5 months of age readily accept feed with a milky taste and vanilla aroma. This preference was not observed in younger foals [Tomczyński et al. 2002b]. In adult horses, interest in feed enriched with flavour and aroma additives occurred only after four days of adaptation. It was also observed that the introduction of the scent of alfalfa and vanilla into the feed had a positive effect on the interest of adult horses in the feed [Tomczyński et al. 2002a]. According to the study conducted by Van den Berg et al. [2016b], a sweet taste or smell encourages horses to choose specific feed. The sense of taste is also important during horse training, especially in positive reinforcement. In horse training, reward (reinforcement) brings positive results and can positively influence the behavior of horses toward their trainers [Janczarek et al. 2018]. Popular treats include apples, carrots and special horse snacks. As shown by Janczarek et al. [2018], feeds with added apples or carrots were the favourite treats of all breeds studied, i.e. purebred Arabian, Anglo-Arabian, Polish Konik, and Polish cold-blooded horses. However, when introducing novel tastes and odours, the possibility of neophobia must be considered. In the study by Van den Berg et al. [2016b], most of the individuals studied showed aversion to smells that were new to horses, and consequently, to the food they were given. Considering the above, when choosing feed for horses or treats used during training, factors such as individual preferences, breed, sex and neophobia should be taken into account.

Humans are able to associate certain odours with a certain taste and vice versa, referring to the combined effect of smell and taste as taste sensations [Holcombe and Ducharne 2004]. Unlike humans, horses breathe only through the nostrils, and mouth breathing only occurs when the horse is physically deprived of the ability to breathe through the nostrils [Mellor and Beausoleil 2017]. In horses, the sense of taste is ontogenetically linked to the olfactory epithelium. During ontogenesis both organs develop from similar embryonic structures and thus share a common origin. The taste buds and the olfactory epithelium originate from the same germ layer – the ectoderm. However, it is not known whether horses can associate smell and taste and form a concept of a given taste, as is possible in humans [Goodwin et al. 2005a].

Olfaction is a key sense in most mammalian species and has a crucial role in their interactions with the environment, as well as in sexual and social behaviour [Rørvang et al. 2017]. Horses are very susceptible and sensitive to odours from their environment. Their olfactory organ consists of the olfactory epithelium which lines the inside of the upper part of the nasal cavity and connects via olfactory neurons in the nasal conchae, to the olfactory bulbs in the horse's brain [Rørvang et al. 2020]. In addition to the main olfactory system, horses have a highly developed accessory olfactory system [Rørvang et al. 2021]. It is called Jacobson's organ or the vomeronasal organ (VNO) and is located in the hard palate at the base of the nasal septum between the nasal and oral cavities, although in horses there is no connection between the VNO and the oral cavity. It enables the accurate analysis of volatile molecules (e.g. pheromones), commonly found in the body's bodily secretions. Jacobson's organ plays a key role in chemical communication [Buzek et al. 2022]. Such a highly developed olfactory apparatus implies that information from odours is relevant to horses [Rørvang et al. 2020].

The way horses respond to odours plays a key role in their daily lives, as they use olfactory cues in a variety of behavioral contexts, such as eating given food, forage search and grazing in the pasture, and aspects of herding behaviour and reproduction [Hothersall et al. 2010, Nielsen et al. 2015, Jezierski et al. 2018]. It also provides humans with valuable information regarding the welfare of the horses, for example by determining their response to food. Knowledge of horses' reactions to odours and the ability of humans to predict them are also essential to ensure safety when handling and training horses, especially when horses are exposed to many new odours [Sabiniewicz et al. 2023]. The presence of a familiar smell may increase the willingness to consume unknown foods, whereas novel odours may hinder feed intake [Stachurska et al. 2022]. For example, in the study conducted by Christensen et al. [2005], the horses had an increased number of eating bouts and became more vigilant towards their surroundings when eucalyptus oil (novel smell) was present. Horses can also be conditioned to associate a particular odour with positive stimuli, e.g. feeding, grooming. The same odour can then be used in stressful or fear-inducing situations, e.g. trailer loading or social isolation [Rørvang et al. 2021].

However, olfaction is of great importance in foraging, since it provides horses with first information about potential food before tasting it. Namely, horses often explore feed through olfactory investigation before ingestion. During such olfactory exploration, the horse sniffs and examines elements of the forage at close range, allowing it to assess chemical cues related to palatability and safety [Rørvang et al. 2022]. Wilk et al. [2024] showed that the horses' sense of smell has some potential for differentiating poisonous from non-poisonous plants without tasting, touching and seeing them. The authors observed that horses spent significantly more time on olfactory exploration of non-poisonous plants than poisonous plants. Poisonous plants might have elicited aversion in the horses and therefore they interacted with them less. The ability to recognise unpalatable, indigestible or poisonous plants by sense of smell alone without previous experience with them would be beneficial for horses. However, different food sensory characteristics (smell, taste and texture) and post-ingestive feedback (positive or negative) seems crucial in creating food aversion [Van den Berg et al. 2016a]. Horses can also recognise the scent of a predator, even if they have never encountered it before [Ahmadinejad et al. 2010]. Such skills increased the species' chances of survival in the wild and confirm how acute and well-developed sense of smell horses have [Nielsen et al. 2015, Sabiniewicz et al. 2023]. As studied by Rørvang et al. [2022], horses habituate to scent samples after repeated exposure to them, but presentation of a new odour restores an initial reaction. It shows that horses are vigilant to odours in their environment and that they recognise between them. The authors also concluded that horses naïve to the taste of a substrate may be able to link smell with taste, which is a new insight into the knowledge on horses' food intake. In the previous study Rørvang et al. [2021] observed that, similarly to the sense of taste, horses may have different odour preferences and that olfactory interest may vary with age and gestational status but not sex. Horse caretakers should therefore take these factors into account when offering new feed and treats to their horses.

Unfortunately, research on equine olfaction is sparse and primarily concerned with social recognition and reproduction [Rørvang et al. 2021, 2022]. As previously mentioned, horses are mainly guided by nutritional value, followed by taste and smell when choosing a food source. Horses can select the vegetation on the pasture and the feed given them by humans, rejecting what does not meet their taste preferences [Van den Berg et al. 2016a]. Taste sensations provide nutritional information to the body and protect the horse from consuming poisonous or spoiled food [Tomczyński et al. 2002a]. The sense of taste allows horses to assess the chemical properties of a substance in terms of its edibility. Taste information is only received in the oral cavity. However, the majority of the taste sensations that horses experience while eating are simultaneously perceived as olfactory information from the area of the nasal cavity [Van den Berg et al. 2016a]. The sense of smell and sight are the first to participate in the selection of plats that are to be eaten by horses. The appearance and smell of the plant are the first clues that are meant to encourage or discourage the animal from potential consumption. However, the taste and texture of the food determine whether the animal will continue to consume it or stop [Rørvang et al. 2021]. Toxic plants are usually characterized by a bitter taste and strong odour, and horses do not try to eat plats or other types of feed that have an unpleasant smell for them [Zeitler-Feicht 2014].

Sense of touch

From an evolutionary perspective, horses, as a species susceptible to predation, are animals with high tactile sensitivity. Horses vary in their tactile sensitivity, but individual levels of tactile sensitivity are relatively constant [Lansade et al. 2008b]. As a hunted species, horses are more sensitive to tactile stimuli, which was important for their survival. The horse's skin is equipped with many sensory receptors, and the most sensitive parts of the body are the head, neck, and withers. Delicate sensory receptors in these areas allow them to quickly respond to even subtle stimuli, such as an insect bite or a light touch from another animal, thus increasing their chances of escaping a predator in a natural condition [Saslow 2002]. Skin is the largest organ in both humans and horses. Therefore, considering the entire body, the skin is the largest sensory organ in horses. The most sensitive to touch are the snout, nostrils, and the area around the eyes, which is important for recognizing feed. Epidermal layer is thinner around the eyes, muzzle and nostrils, so sensitivity to tactile stimuli in these areas is particularly high [Rørvang et al. 2020].

The sense of touch in horses is important in the selection and intake of feed and plants [Saslow 2002]. As in many other mammalian species, horses have sensory hairs (vibrissae) around the muzzle and eyes [Mills and Redgate 2017]. These are long and stiff hairs that enable sensory evaluation of objects. Vibrissae have very different characteristics to follicles; they are thicker, do not undergo the moulting process and they are embedded in the nerves' endings. They are also a sensory organ, so their removal for aesthetic purposes is not compatible with welfare [Rørvang et al. 2020]. Vibrissae allow horses to select their feed, which helps them avoid prickly or contaminated plants in the pasture [Saslow 2002]. The horse's eyes are situated not at the front of the head, but more at the sides, its skull is quite long, so it cannot see the feed that is directly in front of its mouth. Therefore, the sensitive skin on the muzzle and the vibrissae on the lips and around the nostrils are very important when recognising feed [Rørvang et al. 2020].

Tactile perception of feed is inextricably linked to the sense of taste, because in order to know the taste of food, the horse must first take it into its mouth [Culda and Stermin 2019]. However, the decision to swallow the food placed in the mouth is also influenced by its texture, because in such a way the horses receive full information about the feed they are consuming [Janczarek et al. 2018]. Cairns et al. [2002] showed that horses had different preferences for pellets with different orosensory properties, e.g. in moisture content. The authors also state that other nutrients and overall taste and texture will change as the energy density of the food changes. Therefore, the orosensory characteristics (taste, odour, texture) of higher-energy pellets may have been perceived by horses as more palatable than lower-energy pellets.

Sense of sight

The vision of humans and animals is closely linked to their nature [Narloch 2016]. The biological structure of the visual organ plays a key role in determining the perception of the external environment [Sankey et al. 2011]. It is made up of the eyeball, optic nerve and accessory organs such as eyelids and eyelashes. Unlike the retina in the human eyeball, the equine retina has a so-called „visual stripe", which allows horses to see the entire horizon equally, but with a significantly smaller range at the top or bottom [Hanggi and Ingersoll 2009]. From an adaptive perspective, this had a huge advantage for horse living in open spaces, where they were not exposed to aerial predators. In order to sharpen a given object, the horse usually needs to raise or lower its head. Therefore, the position of the horse's head is crucial for their ability to see [Rørvang et al. 2020]. Horses also have many more rods in their retinas than humans, that allows them to see better at night [Roth et al. 2008].

During evolution, horses' sense of sight has developed significantly [Paul and Stevens 2020]. Life on the open steppes was quite challenging since horses were exposed to attacks from predators [Rørvang et al. 2020]. Horses' panoramic field of vision is due to the placement of their eyes on the sides of their skulls. As a result, horses have a very wide field of vision, approximately 330° [Ollivier et al. 2004]. Horses are characterised by a good scotopic vision, i.e., ability to see under low light conditions and have a color vision. Colour vision in horses is dichromatic, similar to that of people with red-green colour blindness.

Panoramic vision and the sharp eyesight of horses are a prime example of evolutionary adaptation to the conditions in which they lived before domestication [Paul and Stevens, 2020].

It is well known that the olfactory and taste systems play a large role in the selection of food by horses, while the visual system is less important [Van den Berg et. al 2016a]. However, research conducted by Culda and Stermin [2019] showed taking food into mouth does not mean it will be consumed. Findings showed that sight is the main sense in locating food, followed by the sense of smell involved in the choice of plants eaten and the sense of taste, which contributes less to the choice. However, in that study all four plants have been smelt and tasted, whereas only three of them were swallowed. The visual sense also played an important role in the orientation toward a certain species of the plant. These findings should be taken into account in horse nutrition since visual cues of a certain food may link to memory of prior experience. Consequently, they may reinforce the drive to seek food, or may result in food aversion [Van den Berg et al. 2016a, Fine and Riera 2019].

Unfortunately, scientific research on the importance of the sense of sight in horses in the context of food selection is scarce, previous research was conducted only by Culda and Stermin [2019]. However, the visual organ is one of the most frequently analyzed aspects in ethological studies on the senses and perception of horses [Ollivier et al. 2004]. Scientific research is primarily based on the way horses see color and perceive depth of field [Timney and Macuda 2001]. In the case of horses recognizing various objects or individuals, the horses' brain is able to integrate the cues from different sensory organs into unified information [Stone 2010]. All senses participate in processing information. When the sense of sight provides 90% certainty about the identify of a given individual, and the sense of smell confirms this information, the animal gains 99% certainty is a given situation [Breed 2010]. In study conducted by Próchniak et al. [2017], it was shown that the smell of a positively conditioned person had a more intense effect on horses than the sight of that person. Horses also showed more interest by touching, grasping, and licking the object that was the source of the smell. This indicates that during conditioning, the stimulus is more strongly associated with the smell of a human than their face.

According to the information available so far, sight is of least importance for horses when choosing food. Research and analysis on these topics are advisable. However, it should be remembered that horses use all their sensory organs in their daily functioning, which complement each other. It is likely that sense of smell, taste, and touch contribute more to the selection of food by horses. However, a better understanding of these mechanisms, and in particular a more precise knowledge of the role of the sense of sight in the selection of food, could in the future contribute to a more conscious diet for horses, which would promote their health and well-being.

SUMMARY

Horses' senses evolved to best adapt them to the environment in which they lived, to help them avoid danger from predators, and to facilitate their social life. They also play a key role in locating the source, choosing the right diet, appropriate for edibility, palatability and being non-poisonous. The senses of smell and taste, but also sight and touch, are particularly involved in food selection. Despite these facts, relatively little research has

addressed this topic. Horses are comprehensively utilised animals, so understanding the functioning of their senses and knowing how they react to new foods is important for their welfare and safe handling and use. Although horses currently have a limited ability to selectively ingest food, there are studies indicating that they have retained the ability to safely select an appropriate diet. The current state of knowledge would need to be completed with information on the relationship between the different sensory modalities in equine nutrition. Knowledge about how a horse's senses function in the context of feeding behaviour can help develop more effective strategies for introducing new feeds and reducing food neophobia. In practice, it is recommended to introduce new ingredients gradually, use methods to mask strong odours and monitor horses' reactions to changes in their diet. This approach can increase the effectives of feeding and facilitate the maintenance of proper health in horses.

REFERENCES

Ahmadinejad M., Hassani A., Kharazian F., 2010. The responses of horses to predator stimuli. Int. J. Vet. Res. 4, 5–9. https://doi.org/10.22059/IJVM.2010.20865

Apfelbach R., Blanchard C.D., Blanchard R.J. et al., 2005. The effects of predator odors in mammalian prey species: a review of field and laboratory studies. Neurosci. Biobehav. Rev. 29, 1123–1144. https://doi.org/10.1016/j.neubiorev.2005.05.005

Breed M.D., 2010. Social recognition. In: M.D. Breed, J. More, Animal behavior. Elsevier, 267–272.

Buzek A., Serwańska-Leja K., Zaworska-Zakrzewska A. et al., 2022. The shape of the nasal cavity and adaptations to sniffing in the dog (*Canis familiaris*) compared to other domesticated mammals: a review article. Animals 12(4), 517. https://doi.org/10.3390/ani12040517

Cairns M.C., Cooper J.J., Davidson H.P.B. et al., 2002. Association in horses of orosensory characteristics of foods with their post-ingestive consequences. Anim. Sci. 75, 257–265. https://doi.org/10.1017/S1357729800053017

Chodkiewicz A., 2020. Advantages and disadvantages of Polish primitive horse grazing on valuable nature areas – a review. Glob. Ecol. Conserv. 21, e00879. https://doi.org/10.1016/j.gecco.2019.e00879

Christensen J.W., Keeling L.J., Nielsen B.L., 2005. Responses of horses to novel visual, olfactory and auditory stimuli. Appl. Anim. Behav. Sci. 93, 53–65. https://doi.org/10.1016/j.applanim.2005.06.017

Culda C.A., Stermin A.N., 2019. Horses' senses involvement in food location and selection. Bul. Univ. Agric. Sci. Vet. Med. Cluj-Napoca, Anim. Sci. Biotechnol 76, 1843–536. https://doi.org/10.15835/buasvmcn-asb:0008.19

Fine L.G., Riera C.E., 2019. Sense of smell as the central driver of pavlovian appetite behavior in mammals. Front. Physiol. 10, 1151. https://doi.org/10.3389/fphys.2019.01151

Francis J.M., Neander C.R., Roeder M.J. et al., 2020. The influence of topically applied oil-based palatants on eating behavior in horses. J. Equine Vet. Sci. 91, 102995. https://doi.org/10.1016/j.jevs.2020.102995

Goodwin D., Davidson H.P.B., Harris P., 2005a. Selection and acceptance of flavours in concentrate diets for stabled horses. Appl. Anim. Behav. Sci. 95, 223–232. https://doi.org/10.1016/j.applanim.2005.04.007

Goodwin D., Davidson H.P.B., Harris P., 2005b. Sensory varieties in concentrate diets for stabled horses: effects on behaviour and selection. Appl. Anim. Behav. Sci. 90, 337–349. https://doi.org/10.1016/j.applanim.2004.08.013

Hanggi E.B., Ingersoll J.F., 2009. Long-term memory for categories and concepts in horses (*Equus caballus*). Anim. Cogn. 12, 451–462. https://doi.org/10.1007/s10071-008-0205-9

Harris P.A., Ellis A.D., Fradinho M.J. et al., 2017. Review: feeding conserved forage to horses: recent advances and recommendations. Animal 11(6), 958–967. https://doi.org/10.1017/S1751731116002469

Holcombe S.J., Ducharne N.G., 2004. Upper airway function of normal horses during exercise. In: K. W. Hinchcliff, A.J. Kaneps, R.J. Geor, Equine sports medicine and surgery. Elsevier, 541–558. https://doi.org/10.1016/B978-0-7020-2671-3.50030-1

Hothersall B., Harris P., Sörtoft L. et al., 2010. Discrimination between conspecific odour samples in the horse (*Equus caballus*). Appl Anim Behav Sci. 126, 37–44. https://doi.org/10.1016/j.applanim.2010.05.002

Janczarek I., Wilk I., Pietrzak S. et al., 2018. Taste preferences of horses in relation to their breed and sex. J. Equine Vet. Sci. 64, 59–64. https://doi.org/10.1016/j.jevs.2018.02.010

Jezierski T., Jaworski Z., Sobczyńska M. et al., 2018. Do olfactory behaviour and marking responses of Konik polski stallions to faeces from conspecifics of their sex differ? Behav. Proc. 155(1), 38–42. https://doi.org/10.1016/j.beproc.2017.09.015

Krueger K., Flauger B., 2011. Olfactory recognition of individual competitors by means of faeces in horse (*Equus caballus*). Anim Cogn. 14, 245–257. https://doi.org/10.1007/s10071-010-0358-1

Lansade L., Bouissou M.F., Erhard H.W., 2008a. Fearfulness in horses: a temperament trait stable across time and situations. Appl. Anim. Behav. Sci. 115 (3), 182–200. https://doi.org/10.1016/j.applanim.2008.06.011

Lansade L., Pichard G., Lecote M., 2008b. Sensory sensitivities: components of a horse's temperament dimensions. Appl. Anim. Behav. Sci. 114 (3), 534–553. https://doi.org/10.1016/j.applanim.2008.02.012

Lunceford B.E., Kubanek J., 2015. Reception of aversive taste. Integr. Comp. Biol. 55, 507–517. https://doi.org/10.1093/icb/icv058

Marliani G., Sprocatti I., Schiavoni G. et al., 2021. Evaluation of horses' daytime activity budget in a model of ethological stable: a case study in Italy. J. Appl. Anim. Welf. Sci. 24, 200–213. https://doi.org/10.1080/10888705.2020.1857252

Mellor D.J., Beausoleil N.J., 2017. Equine welfare during exercise: an evaluation of breathing, breathlessness and bridles. Animals 7, 41. https://doi.org/10.3390/ani7060041

Merkies K., Visneki M., Danel J. et al., 2024. Taking the bitter with the sweet – a preliminary study of the short – term response of horses to various tastants in solutions. Int. J. Equine Sci. 3, 12–20.

Mills D., Redgate S., 2017. Behaviour of horses. In: P. Jensen, The ethology of domestic animals: an introductory text, modular texts. CABI Publishing, 137–150. https://doi.org/10.1079/9781845935368.0137

Murray J.A., Bloxham C., Kulifay J. et al., 2015. Equine nutrition: a survey of perceptions and practices of horse owners undertaking a massive open online course in equine nutrition. J. Equine Vet. Sci. 35(6), 510–517. https://doi.org/10.1016/j.jevs.2015.02.005

Narloch A., 2016. Postrzeganie i kategoryzacja barw (świat ludzi i zwierząt). Scrip. Neophil. Posn. 16, 69–80. https://doi.org/10.14746/snp.2016.16.04

Naundrup P.J., Svenning J.C., 2015. A geographic assessment of the global scope for rewilding with wild-living horses (*Equus ferus*). PloS one, 10(7), e0132359. https://doi.org/10.1371/journal.pone.0132359

Nielsen B.L., Jezierski T., Bolhuis J.E. et al., 2015. Olfaction: an overlooked sensory modality in applied ethology and animal welfare. Front. Vet Sci. 2(69). https://doi.org/10.3389/fvets.2015.00069

Ollivier F.J., Samuelson D.A, Brooks D.E. et al., 2004. Comparative morphology of the tapetum lucidum (among selected species). Vet. Opthalmol. 7, 11–22. https://doi.org/10.1111/j.1463-5224.2004.00318.x

Orlando L., 2020. Ancient genomes reveal unexpected horse domestication and management dynamics. BioEssays 42(1), 1900164. https://doi.org/10.1002/bies.201900164

Paul S.C., Stevens M., 2020. Horse vision and obstacle visibility in horseracing. Appl. Anim. Behav. Sci. 222, 104882. https://doi.org/10.1016/j.applanim.2019.104882

Perry E.B., Handlos G.C., Fenton J.M., 2024. Impacts of olfactory cues on equine feeding behavior. J. Equine Vet. Sci. 138, 105096. https://doi.org/10.1016/j.jevs.2024.105096

Pfister J.A., Garder D.R., Cheney C.C. et al., 2010. The capability of several toxic plants to condition taste aversions in sheep. Small Rumin. Res. 90, 114–119. https://doi.org/10.1016/j.smallrumres.2010.02.009

Próchniak T., Rozempolska-Rucińska I., Petrykowska M. et al., 2017. Zdolności poznawcze koni w zakresie percepcji wzrokowej i węchowej. Med. Weter. 73, 48–52. https://doi.org/10.21521/mw.5623

Ralston S., 2021. Nutritional requirements of horses and other equids. https://www. msdvetmanual.com/management-andnutrition/nutrition-horses/nutritional-requirements-of-horses-and-other-equids [date of access 15.07.2025]

Roig-Pons M., Bachmann I., Briefer Freymond S., 2025. Impact of feeding strategies on the welfare and behaviour of horses in groups: an experimental study. PLoS One 20(6), e0325928. https://doi.org/10.1371/journal.pone.0325928

Rørvang M.V., Jensen M.B., Nielsen B.L., 2017. Development of test for determining olfactory investigation of complex odours in cattle. Appl. Anim. Behav. Sci. 196, 84–90. https://doi.org/10.1016/j.applanim.2017.07.008

Rørvang M.V., Mikulášková K., Yngvesson J., 2021. Testing olfaction in equids: age and gestational stage affects olfactory interest. Res. Square. https://doi.org/10.21203/rs.3.rs-957361/v1

Rørvang M.V., Nicova K., Yngvesson J., 2022. Horse odor exploration behavior is influenced by pregnancy and age. Front. Behav. Neurosci. 16, 941517. https://doi.org/10.3389/fnbeh.2022.941517

Rørvang M.V., Nielsen B.L., McLean A.N., 2020. Sensory abilities of horses and their importance for equitation science. Front. Vet. Sci. 7, 633. https://doi.org/10.3389/fvets.2020.00633

Roth L.S., Balkenius A., Kelber A., 2008. The absolute threshold of colour vision on the horse. PLoS ONE, 3, e3711. https://doi.org/10.1371/journal.pone.0003711

Sabiniewicz A., Borowicz H., Geminiani G. et al., 2023. Behavioral responses of horses (*Equus ferus caballus*) vary in response to potentially threatening odor condition and aversive social odor stimuli. Appl. Anim. Behav. Sci. 266, 106023. https://doi.org/10.1016/j.applanim.2023.106023

Sahu B.K., Parganiha A., Pati A.K., 2020. Behavior and foraging ecology of cattle: a review. J. Vet. Behav. 40, 50–74. https://doi.org/10.1016/j.jveb.2020.08.004

Sankey C., Henry S., Andre N. et al., 2011. Do horses have a concept of person? PLoS ONE 6, 4–7. https://doi.org/10.1371/journal.pone.0018331

Sarrafchi A., Blokhuis H.J., 2013. Equine stereotypic behaviors: causation, occurrence, and prevention. J. Vet. Behav. 8, 386–394. https://doi.org/10.1016/j.jveb.2013.04.068

Saslow C.A., 2002. Understanding the perceptual words of horses. Appl. Anim. Behav. Sci. 78, 209–224. https://doi.org/10.1016/S0168-1591(02)00092-8

Sroka L., Müller C., Hass M.L. et al., 2022. Horses' rejection behaviour towards the presence of *Senecio jacobea* L. in hay. BMC Vet. Res. 18, 1–9. https://doi.org/10.1186/s12917-021-03124-0

Stachurska A., Tkaczyk E., Różańska-Boczula M. et al., 2022. Horses' response to a novel diet: different herbs added to dry, wet or wet-sweetened oats. Animals 12, 1334. https://doi.org/10.3390/ani12111334

Stegelmeier B.L., 2011. Pyrrolizidine alkaloid-containing toxic plants (*Senecio*, *Crotalaria*, *Cynoglossum*, *Amsinckia*, *Heliotropium*, and *Echium* spp.). Vet. Clin. North Am. Food Anim. Pract. 27(2), 419–428. https://doi.org/10.1016/j.cvfa.2011.02.013

Stone S.M., 2010. Human facial discrimination in horses: can they tell us apart? Anim. Cogn. 13, 51–61. https://doi.org/10.1007/s10071-009-0244-x

Timney B., Macuda T., 2001. Vision and hearing in horses. J. Am. Vet. Med. Assoc. 218, 1567–1574. https://doi.org/10.2460/javma.2001.218.1567

Tomczyński R., Minakowski D., Kuleta Z. et al., 2002a. Studies on the use of flavour preparations in the feed mixtures for adult horses. Pol. J. Nat. Sci. 12(3), 187–196.

Tomczyński R., Minakowski D., Kuleta Z. et al., 2002b. Studies on the use of flavour preparations in the feed mixtures for foals. Pol. J. Nat. Sci. 13(1), 135–141.

Van den Berg M., Brown W.Y., Lee C. et al., 2015. Browse – related behaviors of pastured horses in Australia: a survey. J. Vet. Behav. 10, 48–53. https://doi.org/10.1016/j.jveb.2014.11.001

Van den Berg M., Giagos V., Lee C. et al., 2016a. The influence of odour, taste and nutrients on feeding behaviour and food preferences in horses. Appl. Anim. Behav. Sci. 184, 41–50. https://doi.org/10.1016/j.applanim.2016.08.015

Van den Berg M., Giagos V., Lee C. et al., G.N., 2016b. Acceptance of novel food by horses: the influence of food cues and nutrient composition. Appl. Anim. Behav. Sci. 183, 59–67. https://doi.org/10.1016/j.applanim.2016.07.005

Wilk I., Wnuk E., Stachurska A. et al., 2024. Explorative behaviour in horses when presented with unfamiliar poisonous and non-poisonous plants. Appl. Anim. Behav. Sci. 277, 106352. https://doi.org/10.1016/j.applanim.2024.106352

Zeitler-Feicht M.H., 2014. Zachowania koni. Przyczyny, terapia i profilaktyka. Świadome Jeździectwo, Warszawa.

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