

Behavioural mechanisms of diet selection by horses

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Abstract

Compared to ruminants little is known about how horses modulate food intake and link the sensory properties (e.g. smell, taste) of foods with its post-ingestive consequences (negative and positive). While it has been suggested that horse's foraging preference may be largely influenced by sensory input (e.g. volatiles, taste), because of hindgut fermentation, it has been established that horses are able to differentiate and select familiar foods (e.g. concentrates and hay) based on the nutritional content. However, there is a lack of knowledge of behavioural mechanisms related to olfaction, gustation and somatic sensory perception and their effects on diet selection by horses. In particular little is known of how these mechanisms may operate in pastured environments where horses are often exposed to a variety of plant patches, including familiar and novel species that may differ in flavour, nutrient concentrations and plant toxins throughout the year.

The aim of this thesis was to further develop an understanding of behavioural mechanisms influencing diet selection by horses and in particular to determine how they identify and select amongst a variety of foods (familiar and/or novel) using sensory perception and post-ingestive feedback. A series of experiments examined: (1) The selection of familiar and novel forages using a checkerboard design to simulate patch foraging conditions. As changes in dietary preferences are largely influenced by the nutritional requirements of the animal and palatability of a food, it was of interest to investigate the effect of the nutritional status (energy intake) on novel forage selection by horses; (2) The influence of orosensory (smell) stimuli and post-ingestive feedback in the recognition of novel foods by horses. This was achieved by assessing the acceptance of a novel food with a familiar odour or with contrasting crude protein levels; and (3) The influence of different food characteristics i.e. nutrients, odour and taste, on the voluntary intake and preferences of horses exhibited when a number of foods were offered simultaneously (i.e. Smörgåsbord). In each experiment between 11 and 16 horses of Thoroughbred, Standardbred or Australian Stock Horse breeds were used.

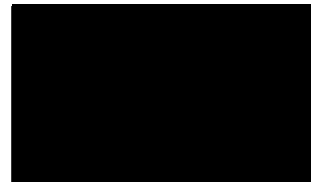
The findings of this thesis suggest that horses can respond to the nutritional content of foods, even if these are novel. There was a greater acceptance and intake of novel foods

that contained a higher level of crude protein, and energy intake seemed to have a lesser impact on the intake of novel foods. It was also observed that the acceptance and intake of a novel food was largely influenced by the orosensory characteristics (smell, taste, texture), and possibly an individual's experience. The thesis also shows that horses display patch foraging behaviour sampling from all foods on offer. When familiarised with diets horses clearly rank these based on nutrients, followed by taste and then odour. Further studies should assess the adoption of multiple-choice tests and nutritional geometric models to enhance our understanding of diet selection patterns by horses in different environments. In particular how individual animals may regulate the intake of multiple nutrients to meet dietary requirements. Whilst macronutrients may be the main driver for diet selection - the impact of the sensory perception on diet choice cannot be disregarded. This thesis highlights that familiar odour and taste cues could be applied in equine feeding management to increase food acceptance when forages/foods are scarce, during introduction of new foods or forage batches or when horses are moved to different environments.

Declaration

I hereby declare that this thesis is an original body of work produced as part of a Doctorate in Philosophy. The substance of this thesis has not already been submitted for any degree and is not currently being submitted for any other degree or qualification.

I certify that any help received preparing this thesis, and all sources used, have been acknowledged in the thesis.



Mariette van den Berg

29th of October 2015

This thesis is dedicated to all the horses



As he was drifting to sleep his thoughts were of horses and of the open country and of horses. Horses still wild on the mesa who'd never seen a man afoot and who knew nothing of him or his life yet in whose souls he would come to reside forever.

- McCarthy (1992)

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List of Abbreviations

ADF	Acid detergent fibre
APO	Apomorphine hydrochloride
BO-	Bamboo without lucerne odour
BO+	Bamboo with lucerne odour
BW	Body weight
Ca	Calcium
CCK	Cholecystokinin
CNS	Central nervous system
CO ₂	Carbon dioxide
CP	Crude protein
Cu	Copper
DE	Digestible energy
DM	Dry matter
DMI	Dry matter intake
ESC	Ethanol soluble carbohydrates
FF	Familiar forage
FO	Familiar odour
GLM	Generalised linear model
HE	High energy
HP	High protein diet
HP+	High protein diet with sweetener
LE	Low energy
LiCl	Lithium chloride
LP	Low protein diet
LP+	Low protein diet with sweetener
MJ	Mega Joules
NDF	Neutral detergent fibre
NF	Novel forage
NFC	Non-fibre carbohydrates
P	Phosphorus

PIF	Post-ingestive feedback
RDI	Recommended daily intake
REML	Residual maximum likelihood
SHP	Soybean hull pellets
VDMI	Voluntary dry matter intake
VFA	Volatile fatty acids
VNO	Vomeronasal organ
WSC	Water soluble carbohydrates
Zn	Zinc