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Equine Metabolic Syndrome: background & nutrition

Prof. dr. Myriam Hesta
DVM, PhD, Dip ECVCN
Labo Dierenvoeding, Universiteit Gent
myriam.hesta@ugent.be

Lab of animal nutrition

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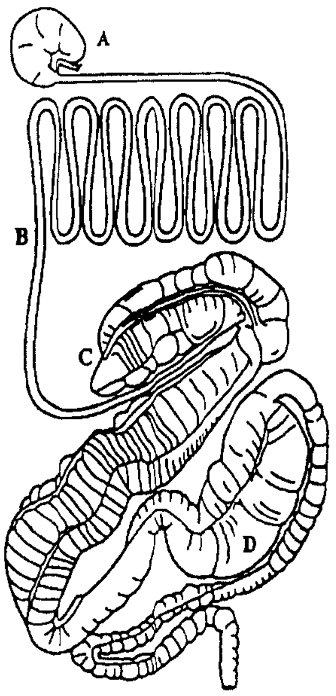
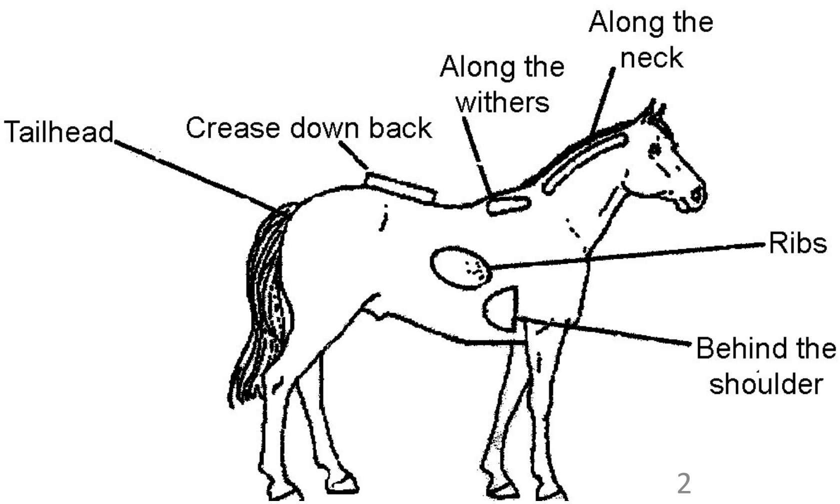
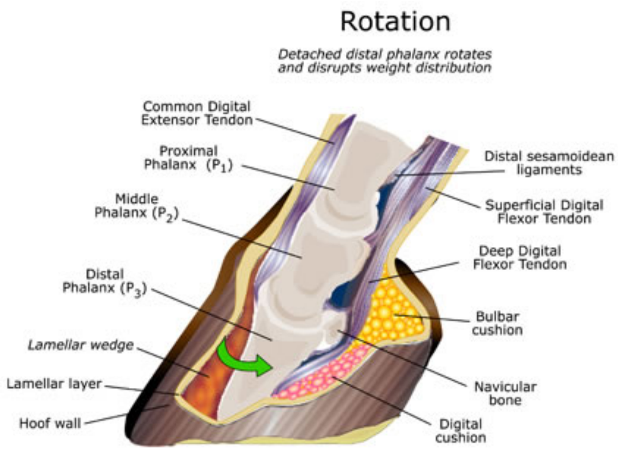
5 IR & supplements







Introduction

Laminitis

pasture associated form

(PAL)

EMS

Equine metabolic Syndrome

Obesity, IR, hyperleptinemia

Diet

non structural carbohydrates

NSC

sugars, starch, fructans

Equine Metabolic Syndrome

Obesity
general, regional

Hyperinsulinemia

EMS

Prelaminitic metabolic syndrome

IR

Hyperleptinemia

Milde hypertriglyceridemia

Laminitis
current or historical evidence

Equine Metabolic Syndrome: Breeds at risk

Pony >> horse breeds

- Welsh, Shetland, Dartmoor
- Morgan, miniature horse, Spanish mustang, Haflinger, Fjord, Arabic horse, warmblood
- Decreased risk: thoroughbred, standardbred

Insulin Resistance

Obesity

↓

chronic inflammatory status

Blood mRNA TNFa IL1b

Vick et al., 2008

↓

Diet rich in NSCs → IR

Table 2
A summary of findings related to obesity, regional adiposity, and endocrine or metabolic variables in published studies of the equine metabolic syndrome (EMS) phenotype.

	Treiber et al 2006[a]	Frank et al 2006	Bailey et al 2008	Carter et al 2009[a]
Breed(s)	Welsh and Dartmoor ponies	Six breeds	Mixed-breed ponies	Welsh and Dartmoor ponies
Sample size	160	12	80	74
Obesity (BCS) in EMS suspects	Yes	Yes	No	Yes
Regional adiposity in EMS suspects	Yes	Yes	No	Yes
Hyperinsulinemia in EMS suspects	Yes (21.6 vs. 10.7 mU/L)	Yes (50.5 vs. 9.1 mU/L)	Yes[b] (69.5 vs. 21.5 mU/L)	Yes (20.5 vs. 8.8 mU/L)
Insulin resistance in EMS suspects	Yes (RISQI)	Yes (CGIT)	Yes[b] (RISQI)	Yes (RISQI)
Fasting glucose	Not different	Higher in EMS (83.9 vs. 66.9 mg/dL)	Not different	Not different
Triglycerides	Higher in EMS (97.2 vs. 52.3 mg/dL)	Not different	Higher in EMS[b] (0.55 vs. 0.38 mmol/L)	Higher in EMS (53.0 vs. 39.0 mg/dL)
NEFAs	Not different	Higher in EMS (366.5 vs. 197.1 µmol/L	Not evaluated	Not evaluated

Abbreviations: BCS, body condition score; RISQI, reciprocal of the square root of the serum insulin concentration; CGIT, combined glucose-insulin tolerance test; NEFAs, nonesterified fatty acids.

[a] Data obtained from the same population of Welsh and Dartmoor ponies.

[b] Serum insulin and triglyceride concentrations and RISQI differed between ponies with and without a history of laminitis in summer but not in winter.

McCue et al., 2015

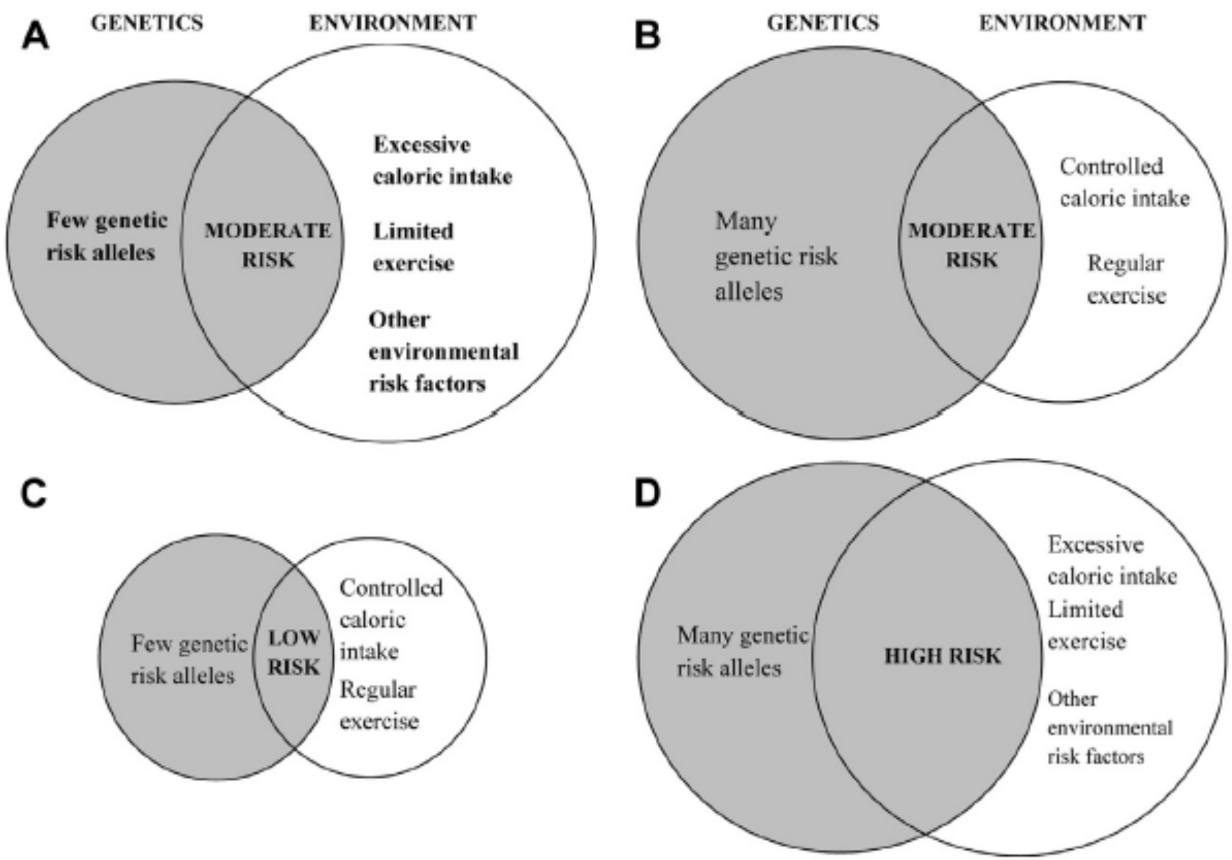


Fig. 2. Depiction of four scenarios where the contribution of genetic and environmental factors that sum to low, moderate, or high risk. A and B, Horses with moderate genetic risk. C, Horse with low genetic risk. D, Horse with high genetic. See text for discussion.

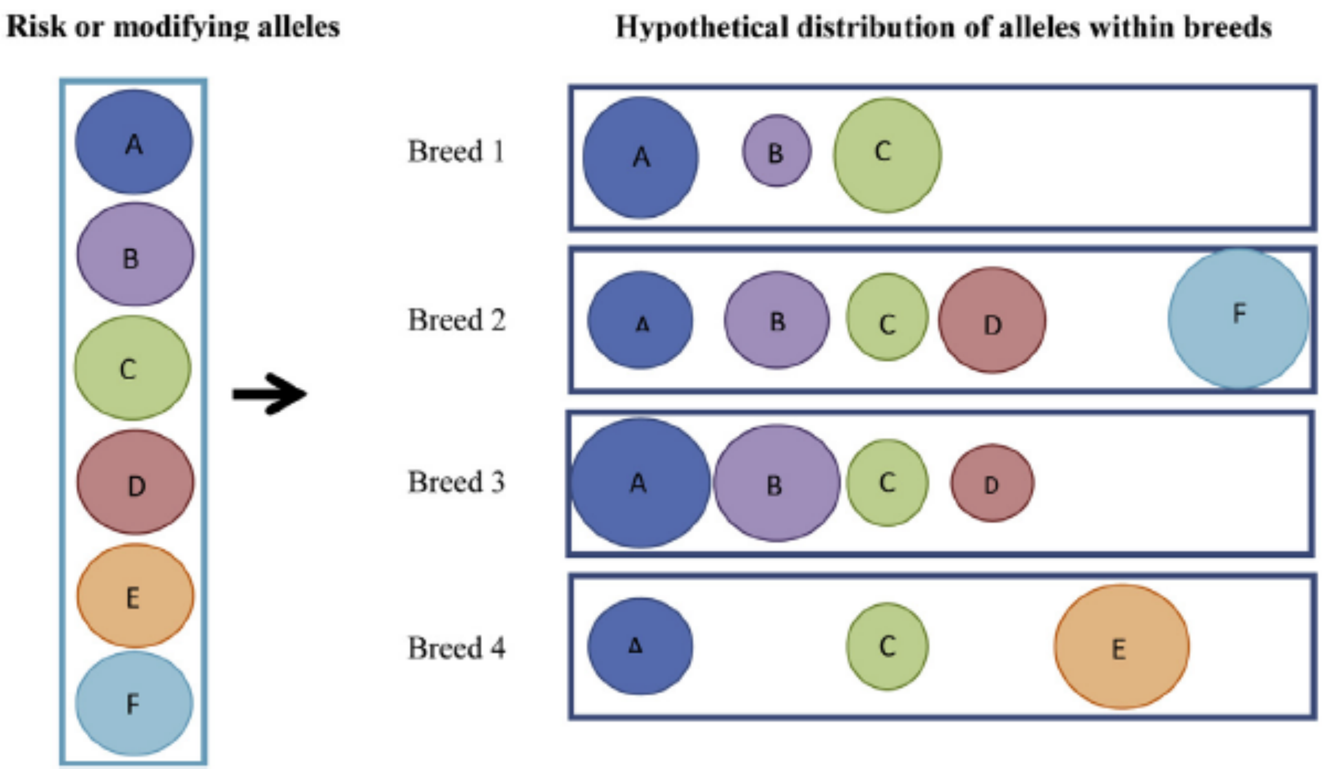


Fig. 3. Hypothetical polygenic genetic model explaining differences in breed means in measured metabolic traits.

Major Alleles resulting in
A=> hyperinsulinemia
C=> Hypertriglyceridemia

Modifying Alleles: B=> altered insulin release or clearance,
D => altered tissue utilisation or lipolysis
E=> enhanced insulin sensitivity
F=> elevated NEF's

McCue et al., 2015

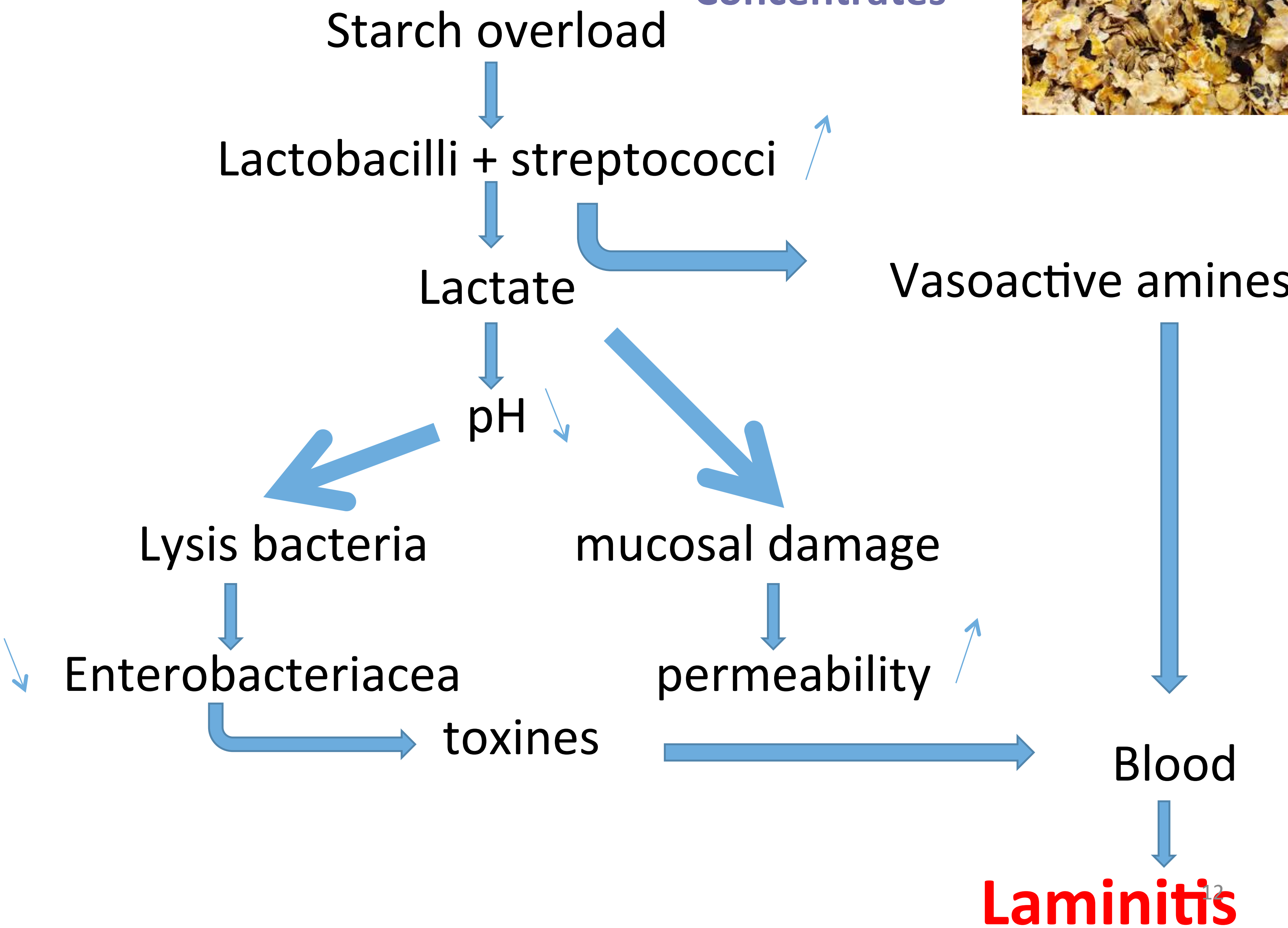
Content

Obesity – IR – Laminitis: diet

Diet

- Summer pasture -> insulin concentration ↑
- Fructans -> " " ↑
- High starch diet -> insulin sensitivity ↓
- Disturbed fermentation large intestine: lower threshold in case of IR

Concentrates



Starch overload

- Overload: 3.5-4g starch/kg BW
- Cecal pH ↓: 2-3g starch/kg BW
- ↓glu en insulin response < 1.1 <-> 1.1-2g starch/kg BW

⇒ **RECO: < 1.1g starch/kg BW per meal**

or 0.3kg concentrates (30-40% starch) per 100kg BW per meal

Grains: type & treatment

	Starch%	**Crude fiber %**	
corn	62	2	
barley	51	5	
oats	37	10	
Pre-cecale VC	Intact grain	milled	puffed
corn	30%	45%	90%
oats	83%	98%	

		EWpa	Starch + sugar
Pavo	Basic +	0.79	25%
	kruidenmelange	1.05	43%
Equifirst	Fiber all in one	0.68	17%
	Sport cube	0.89	35
Cavalor	Performix	0.80	35%
	Basefeed essential	0.70	25%
	Fiber force	0,63	8%
Krafft	Groove 60		16%*

*Only starch

RECO

- Healthy: < 1.1g starch/kg BW per meal
- EMS: <0,3 “ “

- High energy req. => oil supplementation

Content

Pasture management

1. Environmental factors
2. Growth stage
3. Plant species

=>Combination

'Warm season' grass <-> 'cold season' grass different reaction to cold °C

Pasture management
Environmental factors

- Temperature

NSC x 3 at 10 en 5°C versus 25-15°C

Species effect: cool <-> warm season grass

- Place

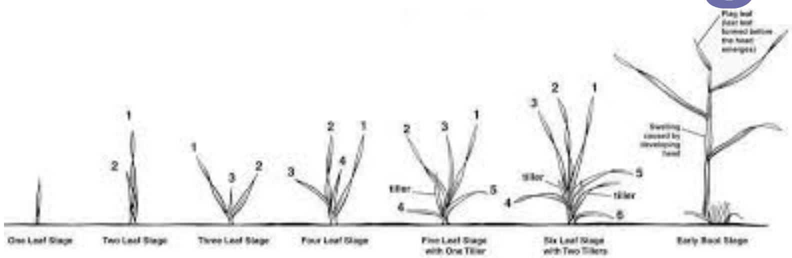
Light intensity -> sugar production

Grass in shadow: lower NSC

Taraxacum officinalis

Pasture management

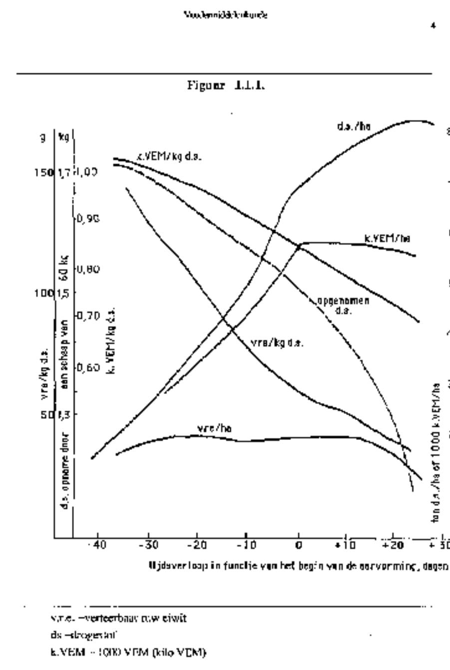
age



- Harvest: embryonal seeds

though also max. NSC

- Sometimes selective eating of seeds

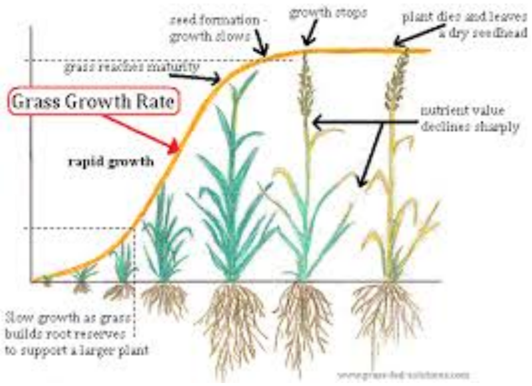


Growth after mowing: lowest in NSC <-> overgrazed

Advice to mow or rotate with other species in case of sensitive equines

Pasture management

2. Growth stage



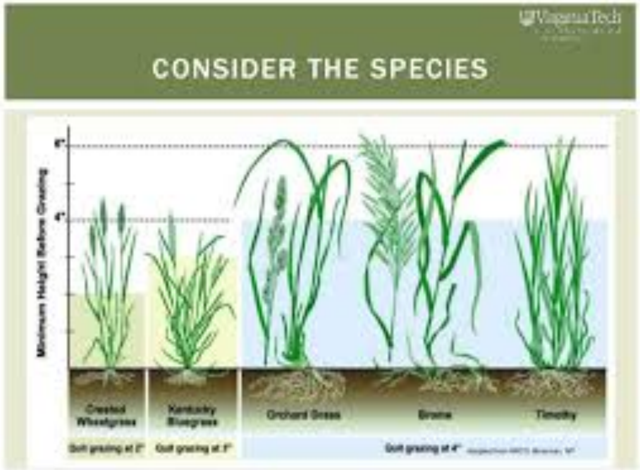
- Growth speed

NSC concentration ↓ in case of fast growth after grazing or mowing: transfer NSC -> fiber, N & energy

Often N limiting factor for fast growth

Nutrient def. -> stress -> increased NSC

Pasture management
3. Species



- Native species

Often lower in NSC!

Though

Expensive

Long duration until pasture can be used (up to 2 years)

Lower resistance towards overgrazing

Over Pavo Paardengraszaad

Veel weides zijn ingezaaid met rundvee graszaadmengsels. Deze grassoorten zijn minder geschikt voor paarden, omdat die meer structuur en minder eiwit nodig hebben. De paardenweide heeft sterke grassoorten nodig, die tegen vertrapping kunnen en bestand zijn tegen de manier waarop paarden grazen. Paarden grazen de plant namelijk veel korter af dan koeien. Graszaad van Pavo geeft een dichte zode en bevat gezonde kruiden met veel structuur en is daarmee ideaal voor de paardenweide.

Samenstelling Pavo GrassSeed

Welke gras heb je nodig voor paarden?

- Omdat paarden het gras zo kort af-eten is het belangrijk rassen te kiezen in een mengsel die een laag groeipunt hebben. Als namelijk het groeipunt van gras wordt opgegeten, dan stopt de groei van het gras. Normale (rundvee) grassen hebben een wat hoger groeipunt. De rassen in

Lees verder

Belangrijke eigenschappen

- laag groeipunt dus beter bestand tegen kort afweiden
- extra structuur dus gezondere spijsvertering
- hoge resistentie tegen kroonroest(schimmel) dus extra smakelijk
- dichte zodevormend
- zeer geschikt voor weides die met minder stikstof(bemesting) verzorgd worden
- met speciale kruiden die de gezondheid van het paard (luchtwegen, spijsvertering, vitaliteit) en de smakelijkheid van het gras verbeteren
- lage fructaan index

Toepassing

Zakken van 15 kg
Nodig per hectare:

- opnieuw inzaaien 45-60 kg/ha,
- doorzaaien 30 kg/ha

Pasture management

4.Practice

- Laminitis season : variable

- <5°C at night for 2 à 3 weeks + possibility to overeat => laminitis

Late spring

Summer dry period => stress

Autum

Marine climate + mild winter: NSC mid winter

RECO regarding roughage

- No pasture acces during ‘laminitis season’
- Roughage < 10% NSC

- Grass silage: lower NSC compared to hay from the same batch

Analysis: NSC

- By difference

NSC = 100- (CP% +NDF%+ moisture%+CFat%+ CA)

⇒ starch, sugars + fructans but also pectines, gumms, mucilages

- By analysis

NSC => water soluble carbohydrates + starch

NSC => ethanol soluble carbohydrates + starch

http://www.paardnatuurlijk.nl/ — Paard Natuurlijk

Bestand Bewerken Beeld Favorieten Extra Help

Weer | Chat | Nieuws | Bestelling | Scan | Logo | Fructaan | Webcam

Paard Natuurlijk

Reeds 3980131 bezoekers

HoefNatuurlijk | Interactief | Pers | Over ons | Shop | Home | Onderzoek | Kennis

Beginpagina's

- Hoofdpagina
- Het laatste nieuws
- Sitemap

Andere menu's

- Natuurlijke kennis: bekapping, verzorging, voeding, omgang, etc.
- Onderzoek en Testen
- WebWinkel: Cursussen en producten
- Over ons en onze paarden
- Natuurlijk Interactief
- In de pers

Diversen

- Advertenties
- Gastenboek

De fructaan-index

- Alles over fructaan
- Wat is de fructaan-index?
- De tabel
- Verantwoording
- Het algoritme
- De fructaan-index op je eigen website
- Waar kun je de fructaan-index vinden?

Fructaan-index van 6 december 2012

Plaats	Weer	Tijd	Trend	Risico	
Groningen	-2°C	13:25	stijgend	**hoog**	26
Amsterdam	3°C	12:55	stijgend	**hoog**	24
Enschede	1°C	12:20	stijgend	**hoog**	22
Eindhoven	2°C	13:25	stabiel	**hoog**	24
Antwerpen	2°C	13:20	stijgend	**hoog**	20
Luik	0°C	13:20	stabiel	**hoog**	22

Gras kan, afhankelijk van de weersomstandigheden, fructaan produceren en dit kan hoefbevangenheid veroorzaken.

Informatie over de fructaan-index. De fructaan-index op je eigen homepage? Lees hier meer.

Hoef Natuurlijk

Wat is de fructaan-index?

Fructaan is een stof die **hoefbevangenheid** kan veroorzaken. Fructaan wordt door gras geproduceerd, en wel in een mate die afhankelijk is van de weersomstandigheden.

De fructaan-index wordt samengesteld aan de hand van de actuele weersinformatie. Hierdoor is gemakkelijk te zien of er een risico op een hoog fructaangehalte bestaat, waardoor je het graastijdstip en de duur van het grazen kan aanpassen.

> ! *Deze pagina gaat uitsluitend over de fructaan-index. We raden dringend aan om, voor meer informatie over fructaan zelf, en waarom het gevaarlijk is voor paarden, de pagina over **fructaan** te raadplegen. Je kan dan beter gebruik maken van de informatie die de fructaan-index biedt.*

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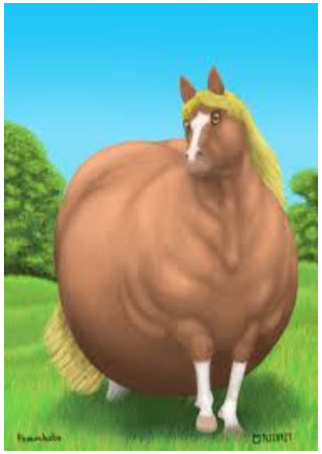
Content

Prevalence



1. Overweight & obesity: 19-51%

Thatcher et al., 2008; 2012; Wyse et al., 2008; Robin et al., 2015

2. Evolution over time?

2013: 7.8%

2014: 16.9%

2015: 23.2%

Anonymous, 2015

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Predisposing factors

1. Breed
2. Exercise
3. Poor nutrition
4. Environmental factors

Hitchens et al., 2016; Robin et al., 2015; Giles et al., 2014

=> PREVENTION

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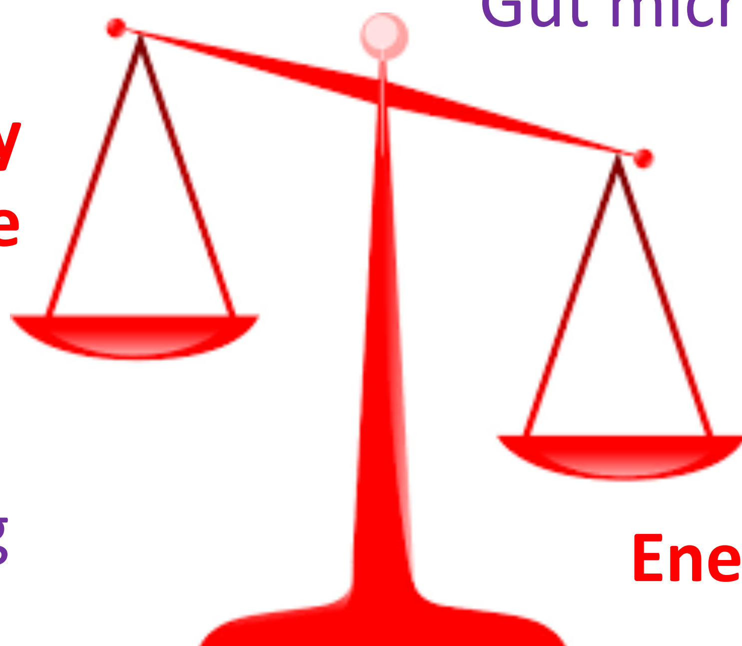
Pathogenesis

Gut microbiota

Energy expenditure



Genes

Early life feeding

Energy intake

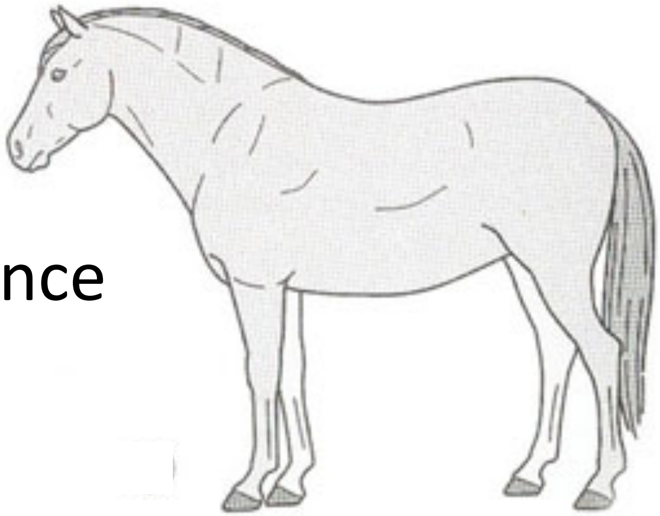
Other?

Ley et al., 2005, 2006, Turnbaugh et al., 2006, Ridaura et al., 2013;
Reilly et al., 2005; Serisier et al., 2013

Co-morbidities

Insulin resistance

Reduced reproduction



Benign lipoma's

Reduced performance

Laminitis

Equine Metabolic Syndrome

=> Negative effect on animal welfare

Johnson et al., 2009; Geor & Harris, 2009; Hitchens et al., 2016

Effect of increased adiposity on insulin sensitivity and adipokine concentrations in different equine breeds adapted to cereal-rich or fat-rich meals

CrossMark

N.J. Bamford [a], S.J. Potter [a], C.L. Baskerville [a], P.A. Harris [b], S.R. Bailey [a,*]

[a] Faculty of Veterinary and Agricultural Sciences, The University of Melbourne, Werribee, Victoria, Australia
[b] Equine Studies Group, WALTHAM Centre for Pet Nutrition, Melton Mowbray, Leicestershire, UK

A R T I C L E   I N F O

Article history:
Accepted 3 February 2016

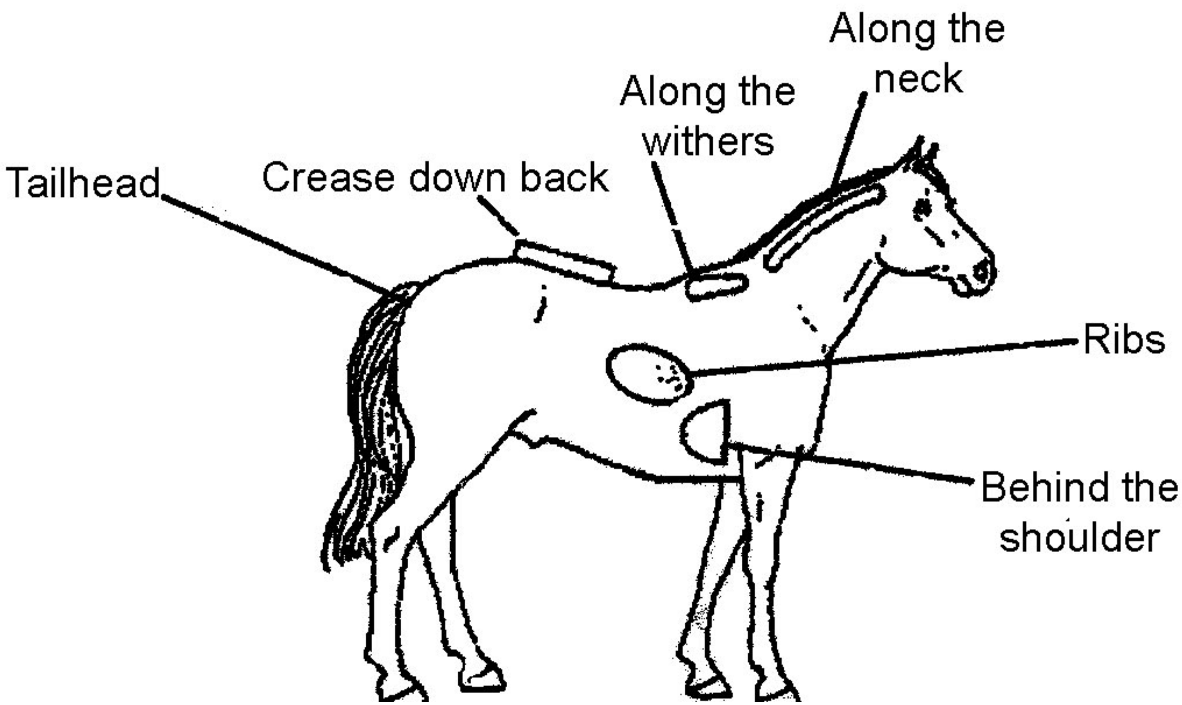
Keywords:
Nutrition
Equine
Hyperinsulinaemia
Insulin resistance
Laminitis
Obesity

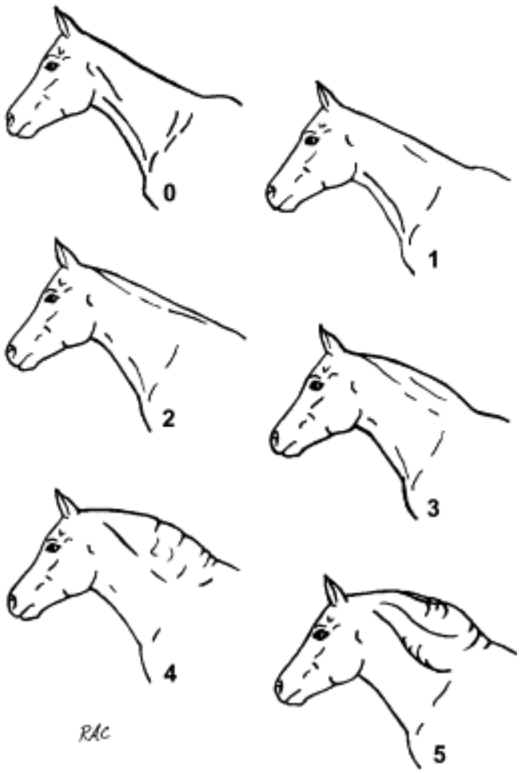
A B S T R A C T

The relationships between diet, obesity and insulin dysregulation in equids require further investigation due to their association with laminitis. This study examined the effect of dietary glycaemic load and increased adiposity on insulin sensitivity and adipokine concentrations in different equine breeds. Equal numbers of Standardbred horses, mixed-breed ponies and Andalusian horses were provided with ad libitum hay plus either cereal-rich (CHO; $n = 12$), fat-rich (FAT; $n = 12$) or control (CON; $n = 9$) meals over 20 weeks. The isocaloric CHO and FAT diets were fed to induce obesity by gradually increasing the supplementary feeds to provide 200% of daily digestible energy requirements by Week 20. The CON group were fed a basal ration only and maintained moderate body condition.

At Week 20, the CHO and FAT groups demonstrated significantly increased body condition score, bodyweight, total body fat mass and plasma leptin concentrations compared with the CON group ($P < 0.001$). The CHO group had lower insulin sensitivity (SI; $P < 0.001$) and higher acute insulin response to glucose ($P = 0.002$) than the CON group. In contrast, the FAT group was no different to the control group. Ponies and Andalusians had lower SI values compared with Standardbreds, regardless of diet group ($P = 0.001$). Adiponectin concentrations were similar between the FAT and CON groups, but were significantly lower in the CHO group ($P = 0.010$). The provision of cereal-rich meals appeared to be a more important determinant of insulin sensitivity than the induction of obesity per se. Whether hypoadiponectinaemia is a cause or consequence of insulin dysregulation warrants further investigation.

Diagnosis





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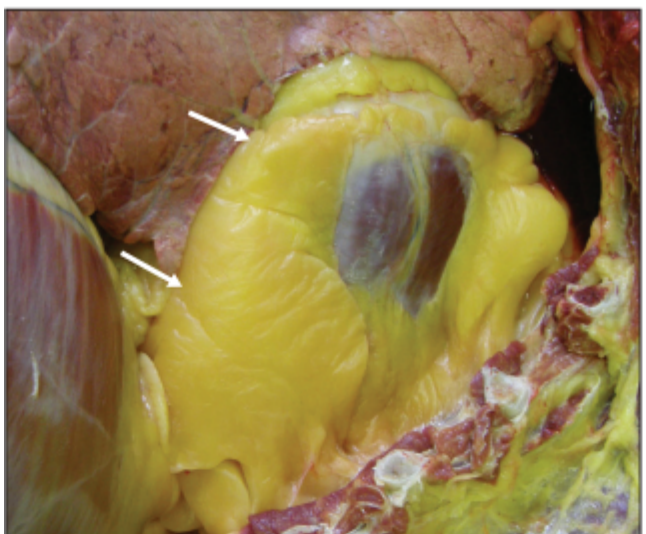
Raymond et al., 2013



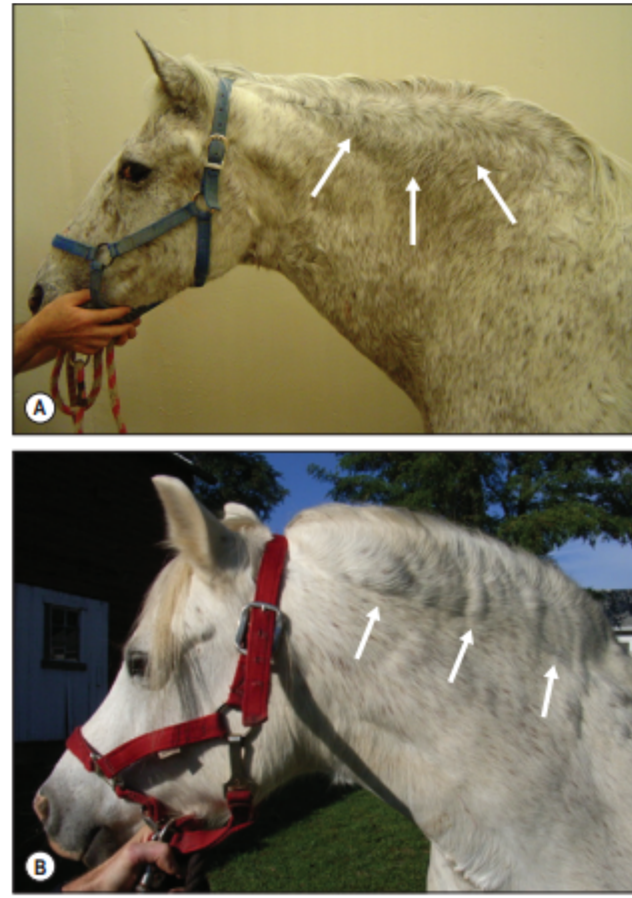


Figure 28.2 Images of a horse A) and pony B) with prominent nuchal crest subcutaneous fat deposition ("cresty neck").

clustering of cardiometabolic abnormalities (Wildman et al 2008). Although mechanisms underlying differences in these phenotypes have not been fully elucidated, it is apparent that people with "metabolically benign" obesity have lower visceral, liver and muscle fat content when compared to normal weight or obese individuals with insulin resistance and other metabolic abnormalities (Karelis 2008, Stefan et al 2008). These observations highlight the need for more

Treatment

Several Methods

Decreasing Energy Intake
Decreasing Dry Matter Intake
Current or ideal Body weight

Van Weyenberg et al.,2008; Geor and Harris, 2009; Dugdale et al., 2010; CVB 2013

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Treatment: Psychology

- Convince owner => overweight/obesity
- Convince owner => treatment
- Give very specific & detailed advice
- Take into account the individual situation => individual advice
- Follow –up and adaptation if necessary

Treatment: Diet

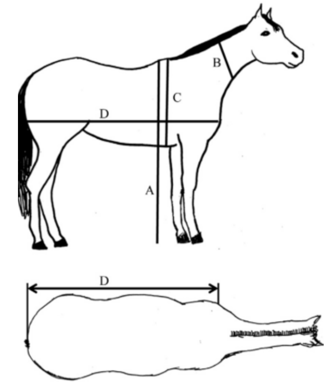
- 30% reduction of energy intake
- Based on Ideal BW
- Starting point although more severe reduction may be necessary

    evaluation current energy intake

    follow up over time

Van Weyenberg et al.,2008; CVB 2013

Treatment: Diet



1. Estimation of current weight?

Girth (cm)$^{1.486}$ × length (cm)$^{0.554}$ × height (cm)$^{0.599}$ × neck (cm)$^{0.173}$]/3,596, 3,606, and 3,441

for Arabians, ponies & stock horses

Martinson et al., 2014

2. Estimation Ideal BW in light breed horses?

Predicted optimal BW (kg)

= starting BW- ((Starting BCS - desired BCS) * 22.5kg))

Becvarova and Pleasant, 2012

Treatment: Diet

- Estimation Ideal BW in light breed horses?

Predicted optimal BW (kg)

= starting BW- ((Starting BCS - desired BCS) * 22.5kg))

Becvarova and Pleasant, 2012

=> each incremental increase in BCS is associated with 4-5% increase in BW

⇒ More variable with higher BCS

Witzel et al., 2014

Treatment: Diet

1. Reduction of energy intake by 30%
2. Full fill all other nutrient req.!
3. Full fill minimal dry matter intake!

<-> behavioural problems

Late cut roughage + supplement: protein, minerals, vitamins

Straw => dry matter intake

No pasture access

Treatment: Activity

1. Gradual increase
2. Realistic

Standard Article
J Vet Intern Med 2016;30:1732–1738

Sustained, Low-Intensity Exercise Achieved by a Dynamic Feeding System Decreases Body Fat in Ponies

M.A. de Laat, B.A. Hampson, M.N. Sillence, and C.C. Pollitt

Background: Obesity in horses is increasing in prevalence and can be associated with insulin insensitivity and laminitis. Current treatment strategies for obesity include dietary restriction and exercise. However, whether exercise alone is effective for decreasing body fat is uncertain.

Hypothesis: Our hypothesis was that twice daily use of a dynamic feeding system for 3 months would induce sustained, low-intensity exercise thereby decreasing adiposity and improving insulin sensitivity (SI).

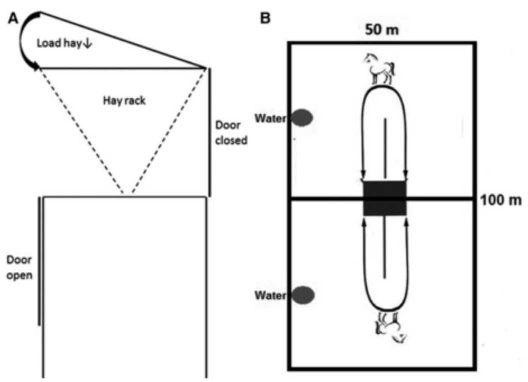
Animals: Eight, university-owned, mixed-breed, adult ponies with body condition scores (BCS) ≥5/9 were used.

Methods: Two treatments ("feeder on" or "feeder off") were administered for a 3-month period by a randomized, cross-over design (n = 4/treatment). An interim equilibration period of 6 weeks at pasture separated the 2 study phases. Measurements of body mass (body weight, BCS, cresty neck score [CrNS], and morphometry), body fat (determined before and after the "feeder on" treatment only), triglycerides, and insulin sensitivity (SI; combined glucose-insulin test) were undertaken before and after treatments.

Results: The dynamic feeding system induced a 3.7-fold increase in the daily distance travelled (n = 6), compared to with a stationary feeder, which significantly decreased mean BCS (6.53 ± 0.94 to 5.38 ± 1.71), CrNS (2.56 ± 1.12 to 1.63 ± 1.06) and body fat (by 4.95%). An improvement in SI did not occur in all ponies.

Conclusions and Clinical Importance: A dynamic feeding system can be used to induce sustained (daily), low-intensity exercise that promotes weight loss in ponies. However, this exercise may not be sufficient to substantially improve SI.

Key words: Equine metabolic syndrome; Horse; Insulin; Obesity.



Treatment: Management

1. Gradual transition (10 days)
2. Way of feeding => increasing time eating

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Treatment: Management

1. Gradual transition (10days)
2. Way of feeding => increasing time eating
3. Follow up!

⟹ gradual reduction in energy intake to 35% MER to achieve a constant weight loss of 1% per week

Van Weyenberg et al., 2008

What after reaching ideal BW?

- Gradual increase in energy intake

- Maintain good habits

- Life long!

Feed management

- Equiball
- Automatic concentrate distributors

Success or failure?

1. 53% of dogs that start weight loss programme, follow it for 6 months
2. +/-50% of dogs/cats that reach ideal BW, regain weight afterwards => “jojo effect”

German et al., 2016

3. Overweight dogs with osteoarthritis losing 6-9% of weight have significant reduction in limping

Marshall et al., 2010

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To strong reduction in energy

⇒ More IR!!!

⇒ Risk for hyperlipidemia

- Moderate energy restriction:

daily 1.5% ideal BW as low NSC roughage

- 80-60% MER: no negative effect on ulcers &, behaviour (Bruynsteen et al. 2015)

Conclusion

1. Obesity

   => chronic disease

   => incurable

   => but manageable

2. Prevention easier than cure

Content

Insulin sensitivity & activity

- Many studies:

+++ effect of activity on insulin sensitivity (Gordon et al., 2007; Powel et al., 2002; Stewart-Hunt et al., 2006; Treiber et al., 2006; ...)

- Light activity though regular (daily?)

- Gradual increase in intensity after complete recovery of laminitis

IR & supplements
Magnesium

- Humans: Mg def ~ diabetes type 2

- Equines: no publication on Mg status in IR, laminitis, obese equines

=> Meet requirements: 7.5g Mg/day adult warmblood horse

IR & supplements
Chromium

- Humans: + effect via insulin receptor

- oral starch test hyperinsulinemic obese ponies: +effect

⇒Supplement 2.5-5mg Chromium per day?

(Vervuert et al. 2006)

- Need for more studies

Other factors to consider

Original Research

Comparison of the Fecal Microbiota in Horses With Equine Metabolic Syndrome and Metabolically Normal Controls Fed a Similar All-Forage Diet

Sarah E. Elzinga[a], J. Scott Weese[b], Amanda A. Adams[a,*]

[a] Department of Veterinary Science, M.H. Gluck Equine Research Center, University of Kentucky, Lexington KY
[b] Ontario Veterinary College, University of Guelph, Ontario, CA

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Equine metabolic syndrome (EMS) is an ever-increasing problem in the equine industry, especially considering that it is a risk factor for the development of laminitis. Equine metabolic syndrome is similar to metabolic syndrome in humans, which has been associated with alterations in intestinal microbiota. However, no work to date has been published to characterize the fecal microbiota in the EMS horse to determine differences, if any, from the metabolically normal animal. Therefore, our objective was to characterize the fecal microbiota of horses with EMS compared with non-EMS controls. Ten horses were classified as having EMS, and 10 non-EMS controls were selected for this work. Equine metabolic syndrome was determined as: insulin resistance, general or regional adiposity, and a history of or predisposition to laminitis. Blood collection via jugular venipuncture was performed, along with an oral sugar challenge. Concurrent with blood collection, phenotypic measurements and fecal grab samples were taken. Fecal samples were used to extract DNA for next generation sequence-based analysis of the bacterial microbiota. Equine metabolic syndrome horses exhibited a decrease in fecal microbial diversity, and there were differences in overall community structure between EMS horses and controls. The operational taxonomic unit with the highest linear discriminant analysis effect size in association with EMS horses was a member of subdivision 5 of Verrucomicrobia incertae sedis (uncertain classification). Interestingly, the control group had an overrepresentation

Summary

- IR

Obesity

feed: glycemic index

activity

- NSC

concentrates

roughage