Feeding Practices in the Sport Horse Industry on the North Island of New Zealand

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Table of contents

Abstract……………………………………………………………….. 2

List of abbreviations……………………………………………………3

Introduction……………………………………………………........4

Literature review………………………………………………………6

- Nutrition……………………………………………………………….6

  Gastro intestinal tract……………………………………………….. 6

  Microbial fermentation ………………………………………………7

  Feeding management……………………………………………….. 7

  Nutrients………………………………………………………………8

  Feed requirements…………………………………………………... 10

  Pasture in New Zealand………………………………………………13

- Workload………………………………………………………………14

  Energy expenditure during maintenance………………………………..14

  Energy expenditure during exercise……………………………………15

Objectives……………………………………………………………18

Hypotheses………………………………………………………….. 18

Materials and Methods………………………………………………19

Results…………………………………………………………………21

Discussion and Conclusion……………………………………………28

References……………………………………………………………...33

Appendix I: The survey…………………………………...………40

Appendix II: Images used for rating body condition score……………44

Abstract

Nutrition is an important component of equine performance and health, and with higher demands on performance, nutritional management intensifies. The aim of this study was to quantify feeding practices in New Zealand among the competitive sport horse population of the North Island through a cross sectional face-to-face survey. Data were collected from 4 shows in the lower North Island of New Zealand during spring in September / October 2010. Three disciplines were compared: dressage, show jumping and eventing, and a total of 192 surveys were completed. There was a significant effect of discipline on the body condition score (BCS): being greater in show jumpers (5.7) and dressage horses (5.8) compared to eventers (5.3; p=0.006). The average DE uptake through feeds provided by the owner was 62.0 MJ, and average DM was 5.92 kg. Dressage horses had a significantly higher uptake of DE (42,6 MJ) and DM (5.2 kg) through roughage than the other disciplines (show jumpers 32.4 MJ and 3.77 kg; eventers 29.4 MJ and 3.44 kg). The majority of horses were fed twice a day. Information obtained concerning pasture access identified that 70.1 % of horses were turned out 24 hours a day and the majority of owners (78 %) identified their pasture as mixed grass, generally considered to be of good (53%) or fair (29%) quality. Processed feeds were more commonly fed than unprocessed grains, and pellets were less popular than sweet feed / muesli style mixes. The most popular unprocessed feed was barley. Roughage was generally provided as chaff and/or hay. Most (85.6%) horses were fed oral supplements with a median of 3 different supplements per horse. The most popular supplements were electrolytes, mineral mixes, magnesium, joint supplements, salt and garlic. The feeding practices were relatively heterogeneous, caused by the wide variation in the base population and differences in uptake through pasture. This makes it difficult to assess the total daily uptake of this population, but it was possible to identify significant patterns in the feeding practices. To obtain more valuable information on the daily intake in future studies, the uptake through pasture should be included.

List of abbreviations

ATP – Adenosine triphosphate

BW – Body weight

Cal – Calories

CP – Crude protein

DE – Digestible energy

DM – Dry matter

J – Joules

kJ – Kilojoules

Mcal – Megacalories

ME – Metabolisable energy

MJ – Megajoule

NSC – Non structural carbohydrates

NRC – National Research Council

TAG – Triglycerides

VFA – Volatile fatty acids

Introduction

The sport horse industry continues to grow in popularity and sport horses are increasingly intensively managed. There is great pressure to improve performance, especially in advanced levels, and nutrition plays an important role in maximizing performance. There are many sources of information on managing horses and feeding practices. However, there is little known about what is happening in the industry and feeding practices need to be quantified in order to understand what is going on. This will provide guidelines on what can be done to optimize feeding practices and to maximize performance.

The aim of this project was to examine the nutrition and workload of the competitive sport horses in New Zealand. Data were collected via a face-to-face survey with riders to assess the feeding practices and workload in this group of horses.

Currently there is no published information available on the feeding management of sport horses in New Zealand. Hoffman et al. (2009) reported a survey of feeding practices among a subpopulation of horses referred to a teaching hospital in New England, USA. The majority of owners were feeding a concentrate (96%) and at least one dietary supplement (84%): the most commonly used were chondroprotectives, electrolytes and multivitamins. Many owners' responses indicated they did not have a basic understanding of principles of equine nutrition. In a study of feeding management practices and supplement use in top-level event horses (3* horses), the average number of supplements fed on a regular basis was just above 4. The most widely used supplement was electrolytes, followed by plain salt and oral joint compounds. Most horses did not have any changes in feeding prior to the event, except that most horses had feed withheld 2-4 hours prior to the event (Burk and Williams, 2008).

There is limited literature on assessment of the workload of sport horses. In a study of heart rates of horses during dressage, the mean heart rate during warm up was 91 ± 10 BPM and 102 ±13 and 107 ±8 for competing at elementary and medium level respectively (Williams et al., 2009). There was no association between heart rate, warm up duration and score or placing. These findings suggest that competitive dressage at these levels is only moderately physically demanding. In another study that compared the workload of horses jumping a low level course of fences and cantering the same course without the fences mean heart rate, PCV and concentration of lactate were significantly higher, and the mean pH and HCO_3^- were significantly lower when jumping. This indicates that workload increases significantly during jumping, even at low level, compared to cantering (Sloet et al., 2006).

Hallebeek et al. (2000) compared the daily net energy intake over a period of 7 days with the net energy requirement and found that on average (N=15) the intake was 30% higher than the requirement. Jansen et al. (2001) assessed the net energy intake and net energy requirements of 93 horses and pony's from riding schools, and found that on average, the estimated energy intake was 14% higher than the estimated requirements in horses with assumed constant bodyweight.

Literature review

Nutrition

Primarily, the horse evolved as a browsing and grazing monogastric herbivore, spending most of the day and night on eating and moving, during which it selects a variety in forages. These forages contain a range of hydrolysable and structural carbohydrates. The structural carbohydrates are fermented in the hindgut, and provide the horse with its main source of energy. Nowadays, horses are supplemented with grains, rich in hydrolysable carbohydrates. This is convenient for the owner and provides a more efficient feed than fermentable carbohydrates, to facilitate the higher demands on the horse's performance (Hoffman, 2003; Frape, 2004).

Gastro-intestinal tract

The lips, tongue and teeth are suited for the ingestion of forage and the molars are used to reduce the particle size (Frape, 2004). Hay and grass particles are generally reduced to less than 1,6mm in length, and the majority of particles in the stomach are less than 1 mm across (Meyer et al., 1975). Menard et al. (2002) compared the daily food intake between horses and cattle, and it was 63% higher in horses (144 g DM/kg $BW^{0,75}$/day) than in cattle (88 g DM/kg $BW^{0,75}$). The presence of material in the mouth stimulates the secretion of saliva from the parotid gland and this lubricates the food bolus. The significant concentration of bicarbonate of 50mEq/l in the saliva functions as a buffer. The saliva doesn't appear to have any digestive enzymatic activity. The content of the mouth reaches the stomach through the esophagus (Frape, 2004).

The stomach is relatively small: the volume of the stomach is about 10 percent of the total capacity of the digestive tract, which would be approximately 18 litres (Frape, 2004; Dyce et al., 2010). It is divided into the saccus ceacus, oesophageal, cardiac, fundus and pyloric regions (Dyce et al, 2010). The fundus secretes gastric acids, hydrochloric acid, pepsinogen and lipase (Frape, 2004). The pyloric region secretes gastric acid and gastric juice continuously, even during fasting (Merrit, 1999). The main action is to hydrolyze protein and part of the carbohydrates (McDonald et al. 2002). Water passes directly through the stomach without diluting the digestive juices (Frape, 2004).

The small intestine is approximately 21-25 meters long in a 450 kg horse and consists of three regions: duodenum, jejunum and ileum. Pancreatic and bile secretion is continuous, but the secretion increases by four to five times in response to the presence of food in the stomach and gastric HCl in the duodenum. Both pancreatic and bile secretion will discontinue after fasting for 48 hours. Pancreatic secretion contains large quantities of fluids and ions (potassium, sodium, chloride and bicarbonate), and there is low enzymatic activity (trypsin) (Frape, 2004). Large quantities of non structural carbohydrates (NSC's) are not digested well in the equine small intestine, which results in the transfer of starch to the ceacum and colon. This may cause excessive fermentation and accumulation of D-lactic acid in the hindgut (Cuddeford, 2001).

The large intestine accommodates fermentation of digesta by microorganisms and consists of the caecum and colon. It also facilitates the absorption of volatile fatty acids (VFA's), water and electrolytes (Frape, 2004).

Microbial Fermentation

The diet highly influences the number of microorganisms and the species distribution of the microbial population in the hindgut. Carbon dioxide, methane and VFA's (acetate, proprionate and butyrate) are produced during fermentation of carbohydrates and proteins by the microorganisms (Hintz, 1994; Jackson, 2003). The VFA's are absorbed and the energy becomes available for utilization by the horse. Acetate, proprionate and butyrate are normally produced in a ratio ranging from 70:20:10 to 75:15:10, but when a large quantity of NSC is fed, the proprionate ratio increases (Hintz et al., 1971; Willard et al., 1977).

Feeding management

The sequence in which feeds are given can influence the metabolic outcome. Feeding the concentrate with or before the hay can depress the value of potential net protein intake (Cabrera et al 1992). Concentrates appear to be of more dietary value when fed after roughage, perhaps as a result of a slower passage rate through the small intestine. Larger feed quantities also result in a higher passage rate, as does commencing periods of work after feeding (Frape, 2004; Van Weyenberg et al., 2006).

Nutrients

Carbohydrates:

The main sources of dietary energy for horses are plant carbohydrates (NRC, 2007). They can be divided into two major groups: those hydrolyzed into sugars in the small intestine, and those that are fermented into VFA's in the hindgut. The difference in digestibility is due to the different linkage between the sugar molecules. The carbohydrates that are fermented in the hindgut are beta-1,4 linked molecules and are structural carbohydrates. The other group consists of alpha-1,4 linked molecules and are named the non-structural carbohydrates (NSC's) (Rowe et al., 1994; Hoffman, 2003). Diets high in roughage provide more VFA's, while cereals and grains contain large quantities of starch that are hydrolyzed into simple sugars (Hoffman, 2003; NRC, 2007). A small part of the NSC's are hydrolyzed in the stomach by gastric acid, but the main site for hydrolysis is in the small intestine by alpha-amylase, alpha glucosidase and beta-galactosidase. However, these enzymes are available in low and variable concentrations which results in a limited ability to process NSC's (Cuddeford, 2001; Hoffman, 2003).

Feed processing and the origin of the starch are two major factors that control the extent of prececal carbohydrate digestion. During feed processing, physical and biochemical changes occur, which can influence both the mean retention time of the feeds and the enzymatic activity in the foregut. Depending on the process used, the apparent digestibility of cereal starch can vary from 20% to 90% in the foregut. The prececal digestibility of cornstarch increases significantly through physical processes, but it only has a moderate effect on other cereals. Thermal and hydrothermal processes increase the starch digestibility of any botanical origin (Juliand et al., 2006). Meyer et al. (1993) increased the starch digestibility in horses by using exogenous amylase. Cereal processing like grinding or popping also increased prececal starch digestibility: preileal starch digestibility of whole corn was 28.9%, but popped corn reached up to 90.1%. Cell wall components are not digested in the small intestine.

Protein:

All tissues, enzymes, hormones and antibodies consist of proteins. These are built up from two types of amino acids: the essential and the non-essential amino acids. The essential amino acids for nonruminants are lysine, methionine, arginine, threonine, histidine, isoleucine, leucine, phenylalanine, tryptophan and valine. They cannot be synthesized in sufficient quantities by the body. The quality of protein in the diet is partially determined by the amino acid profile and if this fits the horse's demand of essential amino acids. The other factor determining the quality is the digestibility: the higher the digestibility (especially in the foregut), the more amino acids become available for the horse's amino acid pool (NRC, 2007).

The first step of protein digestion occurs in the stomach via pepsin, which breaks down specific bonds. The pancreatic proteases continue the break down process and the amino acids and dipeptides are absorbed in the small intestine. Non protein nitrogen (NPN) like urea is also absorbed at this site. Protein and NPN that is not digested and absorbed in the small intestine, becomes available for the microbes in the hindgut, and are used for the synthesis of microbial protein. There is no evidence that these amino acids can be absorbed in sufficient quantities to contribute to the amino acid pool. (NRC, 2007)

The digestibility of crude protein (CP) is correlated to its concentration and the dry matter (DM) intake. A higher CP concentration and DM intake increases the CP digestibility. Other factors that affect the digestion are feedstuff variation, site of digestion, biological value of protein, and transit time through the digestive tract (Potter et al., 1992). Prececal digestibility appears to be 25-30 percent in diets containing only forage, up to 70-75 percent when the diet contains protein supplement such as soybean meal. Compiling means from studies (N=17) resulted in an estimate of an apparent nitrogen digestibility for the total intestinal tract of 79 percent. Foregut N disappearance was used to evaluate apparent prececal nitrogen digestibility, and compiling means from four studies resulted in a digestibility of 51 percent when including all diets (NRC, 2007).

Fats:

Fats are triglycerides built up from three fatty acid units and a glycerol molecule. They undergo beta-oxidation to produce ATP and they contain 2,25 times more energy per unit weight than glucose energy sources (NRC, 2007). This can be used to increase the energy density in a horse's diet by the addition of fat. Fat supplementation has other benefits including diminished excitability (Holland et al., 1996; Redondo et al., 2009) and substituting NSC's in the form of cereal grains (Kronfeld, 1996). Dietary fats also supply the essential fatty acids (lineolic acid and alpha linolenic acid) and serve as carriers for the fat-soluble vitamins (A, D, E and K). Both animal and vegetable fats can be fed to horses, but vegetable fats are much more commonly used because they are more palatable. Holland et al. (1998)

examined the palatability of different oils, and corn oil was the most palatable: diets containing up to 15% of corn oil were readily accepted by horses.

There has been a lot of research on the effects of fat supplementation on athletic performance and it has been hypothesized that it is beneficiary. Possible explanations can be: 1) Less DM intake and bowel ballast can result in a better power-to-weight ratio (NRC, 2007); 2) Lower metabolic heat production from feeding and exercise (Kronfeld, 1996); 3) Less utilization of muscle glycogen which can result in increased stamina (Kronfeld et al., 1998; Sloet et al., 2001); 4) Better sprint performance because of increased energy transduction from anaerobic glycolysis (Oldham et al., 1990; Kronfeld et al., 1998); 5) decreased acidemia during high intensity exercise (Kronfeld et al., 1998). Results from studies that assessed the effect of fat supplementation on athletic performance are varying: several authors (Oldham et al., 1990; Harkins et al., 1992; Eaton et al., 1995) have reported improved performance, while others found no change (Topliff et al., 1985; Pagan et al., 1987; Hyyppa et al., 1999).

Feed requirements

Energy:

The apparent digestible energy (DE) is the most practical way to describe the available dietary energy from food sources and is calculated from the gross amount of energy (GE) from the food source minus the energy remaining in the fecal output. This includes the endogenous losses, undigested food and microbes so it is not the most accurate method (Grace, 1998). To calculate the true digestible energy the endogenous losses have to be known, and these are not routinely determined. DE is described in joules (J) or calories (1 cal = 4,18 J) (NRC, 2007). The equations used by the NRC to estimate the DE content of horse feeds are:

1. DE * (Mcal/kg) = 4.22 – 0.11 * (% ADF) + 0.0332 * (% CP) + 0.00112 * (% ADF^2) for dry forages and roughages, pasture, range plants and forages fed fresh
2. DE * (Mcal/kg) = 4.07 – 0.055 * (% ADF) for energy feeds and protein supplements

The efficiency of the conversion from DE to NE during exercise must be known in order to estimate the daily DE requirements. Pagan and Hintz estimated in 1986 that the efficiency of DE for exercise was 57%. However, several different studies (Webb et al., 1987; Freeman et al., 1988; Bullimore et al., 2000; Graham-Thiers et al., 2000) reported that when maintenance is estimated at 33.3 kcal/kgBW, it ranged between 20 and 50 %. Additional research is needed, but for now the efficiency of DE use is estimated on 30 % for horses that do strenuous exercise and 40 % or higher for horses that do moderate to mild exercise.

Crude protein:

Digestible crude protein (CP) is based on the apparent faecal digestibility of nitrogen, multiplied by a factor of 6.25. This is not the actual amount of protein in the diet (Kohnke et al 1999). Energy intake must be sufficient when protein needs are evaluated. When CP isn't adequate but energy intake is, this results in weight loss. The other way around, when CP is adequate and the energy intake is not, weight loss also occurs. The nitrogen balance through endogenous urinary and fecal nitrogen loss, can underestimate the true loss from the body because of losses from hair, skin and sweat or measurement errors. Different recommendations on maintenance CP have been presented by several studies. The NRC (1989) requirements for maintenance for a 500 kg horse are 656 g CP/day and this assumes a 46% digestibility and an all forage diet. The CP requirement for maintenance lies between 1.08 g CP/kg BW/day and 1.44 g CP/kg BW/day, based on the assumption that more active horses have more lean tissue to support. The average requirement would be 1.26 g CP/kg BW/day. The requirement for lysine is only based on the average lysine content in protein sources fed to horses, and the minimum would be 0.036 g/kg BW/day, while the optimum would be 0.054 g/kg BW/day. This results in the relationship of lysine being 4.3% of the CP requirement and that the utilized protein source should provide this. Bryden (1995) presented that, to match the maintenance protein requirement of a 500 kg horse, the feed should contain 85 g/kg DM/day.

Exercising horses might result in higher protein requirements for muscle development and repair and loss through sweat. The increase of DM intake for energy should compensate this, except when the increase in energy is provided by higher fat feeds. In that case there might not be an adequate increase in protein intake. The additional protein required for exercise varies from 0.089 g CP/kg BW/day for light exercise to 0.354 g CP/kg BW/day for very heavy exercise (moderate exercise requires half the amount needed for very heavy exercise). For intense work, CP is estimated to be 11.4% of DM (NRC, 2007)

Miller and Lawrence (1988) found no metabolic evidence for detrimental effects of high dietary protein levels on exercise, and Miller-Graber et al. (1991) concluded that dietary protein did not affect substrate utilization. However, Graham-Thiers et al. (2001) stated that excess protein may interfere with the acid base balance because it results in a lower blood pH during exercise. Meyer (1987) concluded that excess amino acids increase the formation of urea, which is accompanied by water loss through urine.

Roughage:

Feeding a diet high in fiber is beneficial because it allows more continual access to feed, which may result in less boredom and stress. When long stem fiber is restricted, stereotype behaviors may increase. Fiber adds bulk to the ration, so it slows intake time. Feeding a diet higher in fiber decreases the relative amount of NSC, which may reduce incidence of colic and laminitis (NRC, 2007). Some believe that feeding forage before exercise affects the performance negatively, but Pagan and Harris (1997) concluded this was not the case. However, a diet high in forage may increase the gut fill (Carroll and Huntington, 1988), which may increase bodyweight and compromise the performance (Ellis et al., 2002). Another possible disadvantage of feeding a diet high in fiber is that the energy density may be too low to provide the horse with the necessary energy intake. Lawrence (1990) presented that horses that perform light work should be fed with a diet that contains 80% roughage and 20 % concentrate, whereas horses performing heavy work might consume 33% roughage and 67% concentrate. The NRC (2007) guideline for minimal intake of long stem roughage is 1 percent of the bodyweight.

Minerals:

Minerals are metabolites that aid metabolism and homeostasis but do not produce any energy. Minerals are divided into two groups: macro minerals or major minerals, and micro minerals or trace elements. There are twenty-one different minerals that are required by the horse. The quantity of the individual minerals is not the only thing one should look at when evaluating a ration: the ratios of all minerals should be assessed, because minerals influence the absorption, metabolism or excretion of other nutrients (NRC, 2007). Of the major minerals, calcium, phosphorus, magnesium, potassium, sodium, chloride are considered by the NRC (2007) to be important enough to have a daily requirement; of the trace minerals these are selenium, copper, manganese, iodine, zinc, iron, fluoride and cobalt.

In this study the daily uptake of phosphorus and calcium is also assessed, so these are of more importance to this literature review. The endogenous loss of calcium has been estimated at 20 mg/day, and taking an estimated absorption efficiency of 50 % into account, the requirement for dietary calcium for horses is 0.04 g Ca/kg BW. If the calcium phosphorus ratio is less than one, the calcium absorption may be impaired. The endogenous loss of phosphorus has been estimated at 10 mg/day, and, taking an estimated absorption efficiency of 35 % into account, the requirement for dietary phosphorus for horses is 0.028 g P/kg BW (NRC, 2007).

Vitamins:

Vitamins are a group of complex unrelated organic compounds and are divided into two groups: the lipid soluble (A, D, E and K) and water soluble (C and B). They are essential to the metabolism and deficiency diseases can occur when they lack in the diet (NRC, 2007).

Pasture in New Zealand

There is a lack of information on the feeding value of pastures grazed by horses in New Zealand and the rest of the world. The New Zealand pastures are usually perennial ryegrass based and the feeding value appears high because the growth rates of thoroughbreds fed solely on pasture, are similar to the growth rates reported from the northern hemisphere where grain is fed in addition to pasture (Hoskin and Gee, 2004). The estimated pasture intake in 24 hours when no other source of DM is available, ranges from 1.5 – 3.3% of the horse's bodyweight. (Cuddeford, 2002). Grace et al. (2002, 2003) determined that the DM digestibility of perennial ryegrass based pastures was 60 – 65% for horses. The energy content of the pasture depends on the season and the type of the pasture. For the typical New Zealand ryegrass based leafy pasture (80-95 % perennial ryegrass and 5-20 % white clover) the DE ranged from 10.3 MJ DE/ kg DM in summer, to 12.0 MJ DE/ kg DM in spring (stalky summer grass 8.0 MJ DE/kg DM). The CP content ranges from 148 - 268 g/kg DM (stalky summer grass 100 g/kg DM). (Hunt, 1994; Grace et al., 2003; Grace et al., 2002). The Ca content of New Zealand pasture usually ranges from 2.0 to 6.0 g/kg DM (Fleming et al., 1973). Grace et al. (2003) found that uptake of calcium from pastures below NRC requirements did not limit bone development or growth.

A common disease in New Zealand associated with pasture is perennial ryegrass staggers, caused by the alkaloid lolitrem B. Other alkaloids may also reduce animal performance (Cross et al. 1995; Smith and Towers, 2002).

Carrying capacity is used to express the number of livestock an area of land will support. One stock unit is equal to one average sized breeding ewe feeding her own lamb, and each different class of grazing animal has been given a stock unit (SU) based on its feed requirements. A small hack in light work is estimated to need 8 SU and a large hack in light work 12 SU. The number of stock units per property varies according to soil type, pasture quality and climate (Institute of Veterinary, Animal and Biomedical Sciences (2010) Equine production course material)

Workload

Energy expenditure during maintenance:

Relative to body weight, large horses require slightly less energy for maintenance than ponies in the same conditions. The NRC (1989) formulated the following equation to estimate the DE for maintenance of a normal nonworking horse weighing 600kg or less:

$$DE\ (MJ/day) = 5.9 + 0.13\ BW$$

Potter et al. (1987) found that heavy Belgian and Percheron horses had 10 – 20% lower energy requirements than predicted. This was attributed to the lower activity and slower acceleration and deceleration of heavy horses. The NRC (1989) made an adjustment for heavy horses:

$$DE\ (MJ/day) = 7.61 + 0.1602\ BW - 0.000063\ BW^2$$

Where BW is the body weight in excess of 600kg. The French use a different system: l'unité fouragère cheval (UFC) with the following equation:

$$DE\ (kcal/day) = 140\ BW^{0.75}$$

After several studies, the estimate for DE is considered to be 30.3 kcal/kg BW/day as average minimal requirement for a horse at maintenance. The estimates for maintenance have usually been made using sedentary animals, and athletic horses might have an elevated level of energy expenditure for maintenance. The DE for maintenance of horses with average voluntary activity and alert temperaments was obtained by increasing the minimum value with 10 % to 33.3 kcal/kg BW/day. For horses with high levels voluntary activity and nervous temperaments, an elevated requirement of 36.3 kcal/kg BW/day was estimated (NRC).

Many factors may influence the maintenance energy requirements, including body composition, gender, environmental temperature, being in work or not, age, breed, temperament and season (Harris, 1997).

Stabling factors that could influence the energy required for maintenance are turnout, activity in the stable or performing compulsive behavior, and possibly even comfort associated with ventilation, bedding, temperature or size (NRC, 2007).

Energy expenditure during exercise:

The energy expenditure of exercise is always added to the energy used for maintenance. It is dependent on time and many factors that influence the intensity. These include speed (Pagan & Hintz, 1986), ground resistance (Jones et al, 2006), terrain (Eaton et al 1995), weight carried or pulled (NRC), difficulty of movements performed (dressage) (Williams et al 2008) and number and height of jumps (Sloet van Oldruitenborgh-Oosterbaan et al. 2006), level of training, climate, and differences among individual horses (NRC). When assessing the energy expenditure of competition horses, one should also take into account that some horses are transported extensively and that this may add to the workload. Doherty et al. (1997) found that the energy expenditure and heart rate during transport had a strong correlation with the energy expenditure during walking (in Shetland ponies). Walters et al. (2008) assessed the training practices for UK dressage horses with a questionnaire-based study. This is relevant for this study, because in their pilot trial (N=50), they found that there was a low error rate in the owners'/riders' perceptions of how they exercise their horses.

Taken all the factors mentioned above into account, one expects to find significant differences in energy expenditure between the different disciplines like dressage, show jumping and eventing. This would reflect in the horse's diet.

Measuring the oxygen consumption can be used to estimate the energy expenditure (Pagan & Hintz, 1986). A strong relationship exists between heart rate and oxygen utilization so it may be possible to estimate the energy expenditure from the heart rate (Coenen, 2005) especially during sub-maximal exercise. Not the actual heart rate, but the percentage of the maximal heart rate is the closest related to the oxygen utilization. The maximal heart rate is different for every individual and dependant on factors like age and breed (NRC), so before estimating the percentage, the maximal heart rate itself should be known. However, it may be difficult to determine maximal heart rate, so using the actual heart rate to relate to the oxygen utilization is more practical. Eaton et al. (1995) derived an equation for this relation that produces reasonable estimates of oxygen utilization during high heart rates:

$$\text{Oxygen utilization (ml } O_2\text{/kg BW/min)} = 0.833 * (\text{HR}) - 54.7 \; (R^2 = 0.865)$$

Coenen (2005) derived an equation from 87 studies on oxygen consumption and this provides a better estimation of the oxygen utilization during lower heart rates than the equation of Eaton et al. (1995):

$$\text{Oxygen utilization (ml } O_2\text{/kg BW/min)} = 0.0019 * (HR)^{2.0653} \ (R^2 = 0.9)$$

When using the heart rate as an indication for workload, one should be aware of overestimation because of the heart rate being higher due to excitement. The heart rate drops rapidly after the exercise has stopped, so when the heart rate is measured then, this could lead to an underestimation.

DE requirements for exercise:

To calculate an estimate of the DE required for an individual horse, the NRC (2007) suggests four categories of work: light, moderate, heavy and very heavy. For the definitions of these categories, see table 1. The following equations can be used to calculate the required DE for the different categories:

Light work: DE (Mcal/d) = (0.0333 * BW) * 1.20

Moderate work: DE (Mcal/d) = (0.0333 * BW) * 1.40

Heavy work: DE (Mcal/d) = (0.0333 * BW) * 1.60

Very heavy work: DE (Mcal/d) = (0.0363 * BW) * 1.9

Table 1: different categories of exercise (NRC 2007)):

Exercise category	Mean heart rate	Description	Types of events
Light	80 BPM	1-3 hours/week; 40% walk, 50% trot, 10 % canter	Recreational riding, beginning of training, show horses
Moderate	90 BPM	3-5 hours/week: 30% walk, 55% trot, 10% canter, 5% low jumping, cutting, other skill work	School horses, recreational riding, beginning of training, show horses, polo, ranch work

Heavy	110 BPM	4-5 hours/week; 20% walk, 50% trot, 15% canter, 15% gallop, jumping, other skill work	Show horses, polo, ranch work, low/medium level eventing, race training
Very heavy	110-150 BPM	Various; ranges from one hour/week speed work to 6-12 hours/week slow work	Racing, elite 3 day event

Pagan and Hintz (1986) described the energy requirements for work differently:

Energy expenditure (cal/kg/min) = $e^{3.02 + 0.065x}$ (x = velocity in m/min)

Objectives

The aim of the project was to examine the feeding practices of competitive sport horses in New Zealand. Data was collected via a face-to-face survey with riders to quantify the relationship of feeding and workload in this group of horses.

Hypotheses

The hypotheses tested were:

There will be a significant effect of discipline on actual and desired body condition score.

There will be a significant effect of discipline on daily DE and CP fed.

The DE and DM intake of a horse will be positively associated with the desired body condition score of the horse by the owner.

Eventers will feed a lower ratio between concentrates and roughage than show jumpers and dressage riders

Significantly more prepared feeds will be fed than unprocessed grains, and sweet feeds will be more popular than pelleted feeds.

The majority of horses will be kept at pasture 24 hours a day, but feed provided by owner will provide greater than 50% of their estimated DE requirement

The estimated average crude protein, calcium and phosphorus provided in the daily supplementary feed will exceed the NRC requirements.

Materials and methods

- *Sample selection*

Data were collected from 4 shows in the lower North Island of New Zealand that were believed to provide a representative sample of the competitive equestrian population. The four shows sampled were:

- Feilding show jumping Show, Feilding; 25 September 2010 (1 star)
- Dunstan Horse Trial, eventing, Taupo; 16 – 17 October 2010 (up to 1* / novice)
- Hawkes Bay A&P show, Show jumping, Hastings; 20 – 22 October 2010 (3 star)
- Wellington Dressage Championship, dressage, Foxton; 30 – 31 October 2010 (regional show)

- *The horses:*

To permit comparison of technical / level of competition between disciplines the competition levels were stratified according to the criteria in Table 1.

Table 1: categories of levels of competition

Level category	Show jumping	Dressage	Eventing
Advanced	>1.30 m	Level 5 – 6	Advanced
Medium	1.20-1.30 m	Level 3 – 4	Intermediate
Low	<1.20 m	< level 2	Novice and below

- *The survey*

The data were collected as a face-to-face survey by 8 interviewers experienced with the sport horse industry. The survey consisted of 21 questions in 6 categories covering horse identification and competition experience, current feeding practices, and management of the horse at home (Appendix I). After completion of the survey the horses were weighed using customized Tru-test scales and were condition scored by the regular rider and the interviewer using the Henneke body condition score system (Henneke et al., 1983). The riders were asked to estimate the body condition score by comparing their horse's posture to a selection of images (Appendix II).

- *Pilot testing*

After development the survey was pretested on six riders at Massey University who ride their horses competitively in different disciplines. None of the riders had previous awareness of the survey and the pilot data was not included in the final analysis.

- *The data*

The riders usually do not know the weight of the feed they are feeding, but usually measure feed as a volume such as dippers provided by commercial feed companies or other known units of volume such as ice cream containers. Because of this the riders were initially asked the quantity fed as a weight, and if not known were asked to describe the volume fed as measured by a commercial feed dipper or 2l ice cream container. These volumes were then converted to kg weight as fed using the following derived conversion factors. .

- A level dipper of sweet feed/textured feed contains 0.9 kg
- A level dipper of pelleted feed weighs 1.1 kg.
- A single handful of pelleted or sweet feed = 100g
- A level ice cream container = level dipper of feed
- Double handful sweet feed/pellets= ¼ dipper
- Double handful chaff = dipper
- Single handful chaff 1/3 dipper
- Typical slab weighs 2.25 ± 0.7 kg *(Williamson, 2007)*

For the complete feeds the composition data from the feed manufacturer were used. Feed compositions for forage were based on published data for New Zealand and for unprocessed feed NRC values were used (NRC, 1997, 2007).

- *Statistical analysis:*

Data were collected on pro forma recording sheets and manually entered into MS Excel. The Excel sheets were then loaded into a customized MS Access databases for manipulation and extraction of records for analysis. Parametric data were examined using a general linear model and non-parametric data were examined using a Kruskal-Wallis test. Categorical data were examined using Chi Squared tests. All data were tested within SPSS v18 with a significance level set at $p<0.05$. Data are presented as mean ± standard deviation unless otherwise stated.

Results

Table 1: Descriptive data of the Shows at which data were collected:

	Feilding show jumping event	Dunstan Horse Trial, Taupo	Hawkes Bay A & P show, Hastings	Wellington champs, Foxton
Discipline	Show jumping	Eventing	Show jumping	Dressage
Number of horses present	170	153	164	95
Number of horses surveyed	29	68	52	45
Number of different owners/riders surveyed	21	59	42	42
Response rate	17.1%	44.4%	31.7%	47.4%

Table 2: Description of sample population, according to discipline and level of competition:

	Show jumping *	Dressage	Eventing	Total
Number of horses	81	45	68	192
Advanced level horses	10	10	5	25
Medium level horses	24	10	5	39
Lower level	41	25	58	124
Horse gender				
Gelding	52	34	55	141
Mare	27	10	13	50
Stallion	0	1	0	1
Breed / type				
Warmblood	20	19	3	42
Stationbred**	18	7	1	26
Thoroughbred	12	11	39	62
Sporthorse	13	3	14	30
Pony	2	1	2	5
Other	14	4	9	27

**For six horses in the group of show jumpers, the level of competition was not known.*

***Stationbred (SB): the common name in New Zealand for a cross-bred between a cold-blood type horse (usually Clydesdale or Cleveland Bay) and a Thoroughbred.*

The majority of horses were geldings, especially in the eventing discipline. When looking at the different breeds of horses, more warmbloods were being used for show jumping and dressage than for eventing. Thoroughbreds were most commonly used for eventing and were the predominant breed across all disciplines.

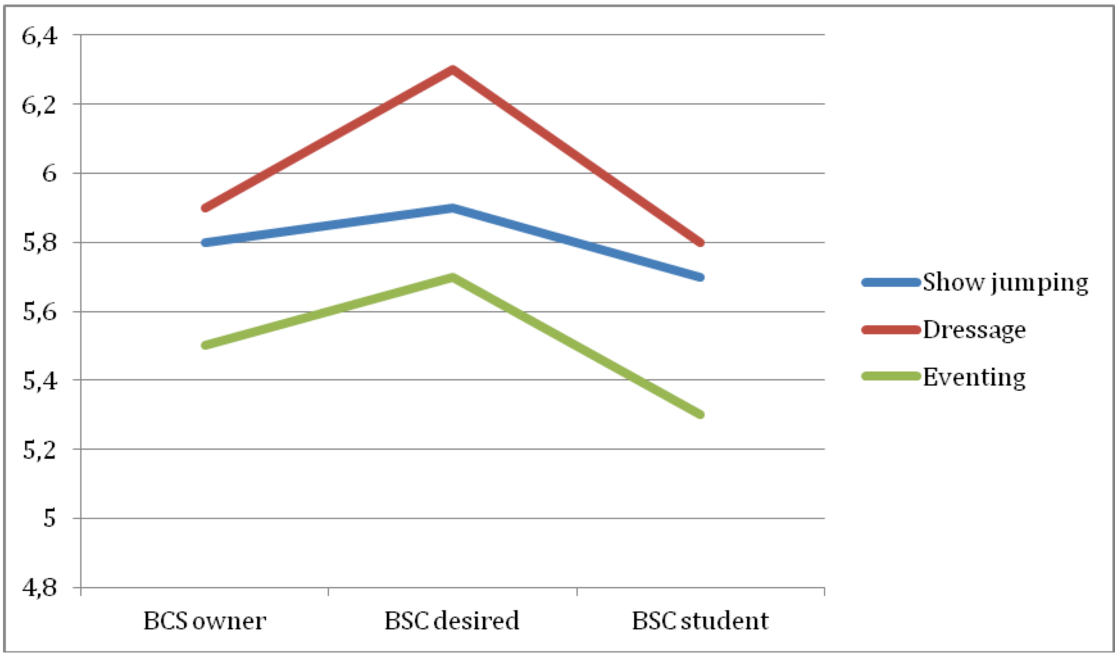
Table 3: descriptive characteristics of horses according to competition discipline:

	Show jumping	Dressage	Eventing	Total
Height (cm)	160.7 ± 8,2 (N=66)	163.8 ± 6.4 (N=45)	162.7 ± 7.0 (N=67)	162.2 ± 7.4 (N=178)
Weight (kg)	529.0 ± 67.8(N=55)	555.1 ± 65.3 (N=41)	522.8 ± 56.2 (N=61)	533.4 ± 63.7 (N=157)
Age (years)	9.4 ± 3.7 (N=80)	9.84 ± 4.5 (N=45)	9.51 ± 3.1 (N=68)	9.55 ± 3.7 (N=193)
Body condition scores				
BCS by owner	5.8 ± 1.05 (N=66)	5.9 ± 1.23 (N=45)	5.5 ± 1.41 (N=68)	5.7 ± 1.25 (N=179)
BCS desired by owner	5.9 ± 0.90 (N=67)	6.3 ± 0.94 (N=45)	5.7 ± 0.87 (N=68)	5.9 ± 0.93 (N=180)
BCS by student	5.7 ± 0.82 (N=62)	5.8 ± 0.80 (N=44)	5.3 ± 0.77 (N=66)	5.6 ± 0.82 (N=172)

The mean age of the horses that were surveyed was 9.6 ± 3.7 years. The mean weight and height were 533.5 ± 63.8 kg and 162.2 ± 7.4 cm respectively. There were no significant differences between the disciplines.

There was no significant difference between the disciplines in body condition as graded by the owner/rider of the horse. However there was a significant difference in desired BCS between dressage and eventing (p=0.002), and the desired BCS was greater than the horse's current BCS as graded by the students and the rider (respectively p=0.071 and p=0.001) (Figure 1). This trend was primarily driven by the discipline dressage. There was a significant difference in BCS judged by the student between eventing and dressage (p=0.006) and with show jumping (p=0.008).

Figure 1: Body condition score judged by owner, body condition score desired by owner, and body condition score judged by student, sorted by discipline:



<u>Pasture access</u>

When assessing the pasture access of the horses surveyed, 70.1 % were turned out 24 hours a day, while 16.7 % were at pasture less than 12 hours, and 12.5 % were turned out 12 hours or more, but boxed for part of the day. There is no statistical interaction between discipline and pasture access.

The majority of owners (78 %) identified their pasture as mixed grass, 18 % ryegrass clover, and 4% of the owners had a special horse grass mix. The quality of the pasture was generally considered to be good (53%) or fair (29%), very few identified their pasture as excellent (10%) or poor (7%). The median sward height was 5cm (IQR 3- 10cm). The median paddock size was 1 acre (IQR 0.5-2acres).

The majority of horses were the only horse in the paddock (44.5 %) or with one other horse (34.6 %). The remaining were in groups of three (12.0 %), or more than three horses per paddock(8.9%)(up to a maximum of 11 horses). The derived horse density (number of acres divided by number of horses in the paddock) was 0.5 acre / horse (IQR 0.33 to 1 acre / horse).

Feeding practices

The majority of horses were fed twice a day, and very few owners feed three feeds per day (Table 4). The feeds were a combination of roughage (generally chaff) and concentrate, with most owners providing concentrate as a complete feed rather than unprocessed grains (Table 5).

Table 4: The number of meals fed per day:

Feeding frequency	Count	Percentage
0 times/day	1	0.5
Once/day but not every day	1	0.5
Once/day	75	38.7
Twice/day	106	54.6
Three times/day	5	2.6

Table 5: variation in types of feeds:

Type of feed	Number of horses	Percentage of horses
Concentrate	188	96.9
Roughage	188[1]	96.9
Pellets	67	34.5
Sweet feeds	96	49.5
Unprocessed grains	66	34.0

[1] *Not the same horses as the ones fed concentrates.*

Processed feeds were more commonly fed than unprocessed grains and pellets were less popular than sweetfeed / muesli style mixes. The most popular unprocessed feed was barley (49 /179 horses), followed by pollard and oats, which were fed to 12 and 11 horses respectively. Roughage was generally provided as chaff and hay. 74 out of 179 horses were fed Lucerne chaff, 21 oats chaff, and 20 were fed meadow chaff. Approximately a third of the horses (68/179) were fed sugar beet. The most commonly fed forage was meadow hay, which was fed to 116 of the horses.

There was a great variety in the brands that were fed, but there were some brands much more popular than others. Seventy-six of the horses were fed with a Fiber Fresh product, of which Fiber Pro was by the far the most popular: 54 of the horses were fed that. The most popular pelleted feed was NRM's LowGIsport (fed to 20 horses), followed by Dunstan's Eezymix (fed to 14 horses). The most popular sweet feeds were NRM's Coolade and Dunstan's Coolfeed, which were fed to 17 and 11 horses respectively. When looking at most popular brand for processed feeds, NRM's pellets and sweet feeds were fed most frequently (fed 56 times). Overall, Dunstan's horse feeds were most commonly used (fed 124 times), partially because of the popularity of sugar beet. Other reasonably popular brands were Mitavite (fed 44 times) and Fisken (fed 18 times).

When looking at how many different feeds each horse was fed, the median was 2 (IQR 1-2) different concentrates per feed and a similar trend for roughages. The total of different feeds fed to one horse had a median of 4 (IQR 3-5).

<u>Daily intake:</u>

Table 6: Uptake of DE and DM through concentrates, roughages and total fed in a population of sport horses

	Show jumping	Dressage	Eventing	Total
DE from concentrate (MJ)	33.1 ± 19.7	28.1 ± 20.2	28.0 ± 17.4	30.2 ± 19.1
DE from roughage (MJ)	32.4 ± 24.9	42.6 ± 25.1	29.4 ± 23.9	33.7 ± 25.0
Total DE (MJ)	65.1 ± 34.6	68.1 ± 33.0	54.4 ± 30.4	62.0 ± 33.2
DM from concentrate (daily) (kg)	2.29 ± 1.38	1.99 ± 1.45	1.96 ± 1.16	2.11 ± 1.33
DM from roughage (daily) (kg)	3.77 ± 2.87^{ab}	5.20 ± 3.08^{a}	3.44 ± 2.94^{b}	3.97 ± 3.01
Total DM (daily)	6.03 ± 3.39	6.91 ± 3.53	5.16 ± 3.21	5.92 ± 3.41
Total DM per meal	3.74 ± 2.04	4.64 ± 3.12	3.50 ± 2.68	3.87 ± 2.59
DM(concentrate)/ DM(roughage)	Median 0.58 IQR 0.32-1.51	Median 0.35 IQR 0.6- 0.71	Median 0.70 IQR 0.38-2.23	Median 0.51 IQR 0.31-1.49

The uptake of DE through roughage by the dressage horses is significantly higher (p=0.023) than that of the eventers and there is a trend towards it being higher than in the show jumpers (p=0.096). There is no significant difference between the disciplines in uptake of DE through concentrates or the total of feeds, though there was a trend for dressage horses to have a greater total DE (p=0.095). Dressage horses had a significantly higher uptake of DM through roughage than both eventing horses (p=0.009) and show jumping horses (p=0.035). There was a significant difference between total uptake of DM of the dressage horses and the eventers (p=0.023) and a trend towards the dressage horses receiving more DM per meal than the eventers (p=0.066). There was also less variation of the concentrate roughage ratio in dressage horses than in the other disciplines. There was no significant relationship between the amount of concentrates and roughage fed across the disciplines.

Within this project the effect of competition level was not compared. There was no significant association of DE uptake and body weight or body condition scores.

Table 7: Daily CP intake from concentrate and roughage within a population of sport horses:

	Concentrate	Roughage	Total
CP (kg/day)	0.293 ± 0.21	0.288 ± 0.36	0.566 ± 0.43

The mean of the daily CP uptake is 566 g and the mean uptakes from concentrates and roughage were similar. The mean daily calcium uptake was 0.04 ± 0.035g and the phosphorus uptake was 0.02 ± 0.016g. The mean of the calcium phosphorus ratio was 2.08 ± 1.04. Only 6.3 % of the horses had a ratio lower than 1 based on the data derived from the surveyed feeds.

<u>Supplements</u>

The majority of horses 166 / 194 (85.6%) were fed one or more supplements. Of the horses that were fed supplements, the number of different supplements per horse had a median of 3 (IQR 2 - 4). The maximal number of different supplements fed to one horse was 8 (N=1). Across the disciplines, the mean of the number of different supplements fed to one horse was significantly higher in the show jumpers than in the dressage horses (p=0.024). The number of supplements fed was not associated with the amount of different concentrates and roughages fed to one horse.

The most popular supplements were electrolytes, mineral mixes, magnesium, joint supplements, salt and garlic, which were fed to 57, 54 52, 46, 44 and 38 horses respectively. All of the other supplements like seaweed and toxin binders (for ryegrass staggers) were fed 20 times or less.

Discussion and conclusion

Representative survey and response rate

The sample is believed to be representative of the sport horse population in the lower North Island of New Zealand. The relative response rate across the shows was consistently high, and may in fact be higher than that reported as many riders may ride 2 or more horses and the response rate was calculated based on a per horse basis. The shows sampled also had riders from a broad geographical area and in some cases could be considered representative of competitive riders in the North Island of New Zealand. The spread of horses sampled across the disciplines represents the spread of use as recorded by Equestrian Sports New Zealand (ESNZ) and the greater representation from the lower levels also reflects the demographic spread of horse competition levels.

Possible limitations

Eight different people administered the survey, which could lead to differences in asking or possibly interpreting the responses to the questions. This could also affect the scoring of the body condition. However bias due to these points was minimized as students were well instructed on how to do the survey, and the body condition scoring system according to Henneke was used after the students had a group training session on the scale, as well as the use of standardized guide sheets.

Many feeds were weighed, or information was provided by the feed company, but for some this was not possible. Weighing the feeds revealed a small difference in content between an ice cream container and a dipper, but this was variable and for most of the feeds not significant (<5%), so it was decided to assume both units have the same content. For the weight of a slab or a biscuit of hay, the data of a previous study were used after validation with a random bale of hay. Another potential problem could be the variation in the dippers used. However, the owners that were asked specifically about the size of the dipper they used, all confirmed they used the standard dipper (provided by NRM or Mitavite). For calculating DM per meal, the assumption was made that all feeds where evenly distributed over the different meals.

Assumptions had to be made about the nutritional composition of the forages and pasture and the best average estimates were used for calculations. The estimates were generally based on information from a domestic forage provider or on reference values from the University.

There was a significant effect of discipline on body condition score for desired body condition score and body condition score judged by student. Eventing was the discipline that differs most from the others. This could be explained by the fact that the workload for an eventing horse is higher and that excess body weight could negatively affect its performance, while this would not be the case for the dressage and show jumping horses. Studies of endurance and racehorses have observed the negative relationship between higher body condition score and the investigated performance levels (Lawrence et al., 1992; Kearns et al., 2002). Especially dressage horses are desired to be fatter than what they are now, which might be driven by the difference in breeds used and the fact that dressage is more about the show and the image than eventing. Possibly, the horses are easier to ride when they are heavier, or appear to be more muscled.

There was no significant difference between the body condition score judged by the owner and judged by the student, which indicates that the method used, based on a reference, was relatively consistent.

The variety and quantity of feeds given to a horse are dependant on many different factors and this explains the large variation in many of the parameters measured. Dressage horses had a significantly higher uptake of DE, and DM through roughage than both other disciplines and also a lower concentrate to roughage ratio. All these differences are driven by the fact that dressage horses were fed more roughage than the other disciplines. An explanation may be a difference in pasture access: if the dressage horses are boxed more, they would have less DE and DM uptake from pasture, which would have to be compensated by feeding more roughage. However, there was no inter-disciplinary effect on the pasture access, so this cannot explain the differences in DE intake through roughage. However, other factors such as the quality of pasture and sward height could possibly have some influence. Another reason for feeding dressage horses more roughage would be that high fat and forage diets are associated with calmer behavior, a desirable trait for dressage.

Possibly one could explain the greater amount of roughage fed to dressage horses with the higher desired body condition for this discipline. However, there was no association between total DE uptake, body weight or body condition scores. This could indicate that the horse related factors play a greater role in determining how the DE intake affects the body weight.

It was proposed that eventers will feed a higher ratio between concentrates and roughage than show jumpers and dressage riders to provide their horse with sufficient energy for the workload. Results show that the ratio is significantly lower for dressage horses than for the other disciplines driven by the fact that the dressage horses were fed significantly more roughage.

There was no relationship between the amount of concentrates and roughage fed. When more roughage is fed, the amount of concentrates does not increase. The lack of relationship between these two could be attributed to not being able to quantify the roughage uptake from pasture, making the determination of true roughage intake impossioble.

Assuming 97.5 MJ/day as the energy requirement for a 500 kg horse doing moderate work, more than half of the energy requirement was met with the concentrate fed (mean of 62.0 MJ). The mean daily uptake from concentrates is 30.2 MJ, which is approximately 30 % of the daily requirement. This makes sense when looking at what Lawrence (1990) presented: horses that perform light work should be fed with a diet that contains 80% roughage and 20 % concentrate, whereas horses performing heavy work might consume 33% roughage and 67% concentrate. The ratio between concentrates and roughage found in this study differs from results from studies in the racing industry. In a study on management of young thoroughbreds, the horses received 79% and 81% of the National Research Council recommendation for energy from concentrate feed alone at 5 and 12 months old respectively (Stowers et al., 2009). In racing Thoroughbreds Southwood et al. (1993) found a weight of the concentrate component of the daily diet of 7.8 kg with roughage accounting for 3.3 kg per day. The relative amount of concentrates fed to racehorses was much higher than the roughage component, compared to the results found in this study for sport horses. This can be explained by the fact that the workload for racehorses is higher, so the energy uptake must be optimal to maximize performance.

Presuming the daily minimum requirement for a horse of 500 kg in moderate work is 745 g, the mean daily CP uptake of 566 g is lower than the minimum requirement. Because we cannot quantify the uptake of CP from pasture, no conclusions can be made if the daily requirements are met or not. However, the feeds offered by the owners accounted for around 60% of normative daily energy intake. The other 40 % would come from pasture. When extrapolating this to the CP uptake from offered feeds, which is around 75% of the necessary daily uptake, it is plausible that if the pasture will provide the 40% of remaining energy requirement, it will also provide the 25% of remaining CP requirement.

The mean daily calcium uptake of 40 g was twice as high as the minimum requirement of 20 g for a 500 kg horse. The phosphorus uptake was 20 g and the minimum requirement is 14 g, so the daily minimum requirements for both minerals were already met through uptake from feeds supplied by the owner. The calcium phosphorus ratio was higher than one in 93.7% of the horses, which is appropriate for mature horses. One has to take into account that for certain commercial feeds the values for calcium and phosphorus were not available. Because of this, the calculated values for daily uptake per horse may be somewhat lower than they are in reality. However, both factors are affected, so the effect on the ratio should be minimal, especially when one takes into account that all of the commercial feeds of which the values were known, contain more calcium than phosphorus, so this would not influence the ratio negatively.

As expected, the prepared feeds were much more popular than unprocessed grains, and sweet feeds were more popular than pelleted feeds. The first finding may be explained by the fact that the riders think that prepared feeds are balanced better, so by feeding it there would be no chance of any deficiency in nutrients. The popularity of sweet feeds may be attributed to the fact that it appeals to the owner more when they imagine their horse having to eat it.

Within the horse industry there are many different oral supplements available, which are widely used. In this study, 85.6% of the horses was fed with one or more supplements, with a median of 3 different supplements per horse. This is very similar to the reports of a survey of feeding practices amongst horses referred to a teaching hospital in New England, USA: 84 % of the horses received some type of dietary supplement with a median of 3 different supplements per horse (Hoffman et al., 2009). The owners do not always know what the possible effect of the supplement might be and there is a possibility of over-supplementation of certain nutrients or nutrient interactions. It was shown that horses receiving some kind of dietary supplement were twice as likely to have excess dietary levels of at least one nutrient compared to unsupplemented horses (Honore, 1994). Improper supplement use can lead to health problems through imbalances in vitamins and minerals (Poppenga, 2001).

A wide range in the results was found, caused by the wide variation in the base population. This makes it difficult to assess the general situation, but nevertheless it was possible to identify significant patterns in the feeding practices in this population. This information is relevant for the veterinary practice because nutrition and management are key elements to equine performance, and better advise by the veterinarians can lead to improvement. Moreover could this prevent malpractices such as over-supplementation. To obtain more accurate information on the daily intake, the uptake through pasture should be included and more carefully assessed in future studies. When this is known, the intake can be compared to the nutritional requirements for individual horses in relation to their workload, and more valuable conclusions can be drawn on the efficiency and benefits of the current feeding practices.

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Appendix I

Equine workload and feeding questionnaire

(First) Name owner:___________________________

Cellphone number:____________________________

I) Identification Horse:

Name: ______________________ Color*: ChN / Bay / Bl / Gr/Other*

Age:_____

Sex: *Mare* *Gelding* *Stallion*

Breed: *WB* *SB* *TB* *SH* *Other*_______

II) Activities: Competition

Discipline & level:

- *Dressage* ______
- *Eventing* *training/novice/intermediate/advanced/young rider/*_____
- *Showing* ___________
- *Show jumping* ____________

How many competitions per month?__________

III) Body condition

Weight:_________Kg *Constant/changing*

Approximate height:___________hands

Condition score:
By owner:_______ Desired:________ By student:___
___

IV) feeding

- *Consistent / Changes* before or after competition
- Feeding frequency: How many times a day do you feed your horse?____________
- Daily ration: how much did you feed your horse on a typical day in the last week?

(next page)

Feeds (daily quantity)

Dunstan

1. Coolfeed
2. Coolfeed extra
3. Maintenance mix
4. Sporthorse hi performance
5. Eezymix
6. Polo mix
7. Racemix
8. Show conditioner
9. Grass balancer
10. Extruded rice
11. Extruded barley
12. Extruded soya
13. Extruded maize
14. EezyBeet
15. Molassed Sugar Beet Pellets
16. Broodmare mix
17. Staggers Nuggets

Fiber fresh

18. Fiberpro
19. Fibermix
20. Fiberezy
21. Fibersure

Prydes

22. Easifeed three
23. Easiperformance
24. Stamina
25. Easiresponse
26. Easisport
27. Easiresult
28. Power Pak

Mitavite/Vitamite

29. Power on
30. Cool performer
31. Breeder
32. Extra cool
33. Economix
34. Prosport
35. Gumnuts
36. Promita

NRM

37. Lite brew
38. Coolade
39. Horse & pony
40. Performa
41. LowGLsport
42. Equi-jewel
43. Equine balancer
44. Sweetfeed

Hygain

45. Honey B
46. Equine senior
47. ICE
48. Grand prix premium
49. Balanced
50. Showtorque
51. Allrounder
52. Zero

McMillan

53. Cool feed
54. Manetane
55. Performance pellets
56. Protein plus
57. Total rapid gain
58. Sporthorse

Other

59. Sugarbeet (mollassed?)
60. Lucerne chaff
61. Rice (extruded/crushed)
62. Barley (extruded?)
63. Soya
64. oats (extruded?)
65. maize (grain)
66. Bran
67. Pollard
68. Fiscans sweet feed
69. Molasses
70. Peas
71. Oat chaff
72. Lucerne&oat chaff
73. Fiskens Horse Ballancer
74. Fiskens Parole
75. Fiskens Yearling Mix
76. Coprice nutririce #2
77. Meadow chaff
78. Fiskens Maintenance mix
79. Copra
80. Annandale Allrounder??
81. Coprice stamina&perf
82. Coprice allrounder

Other:_________________

Supplements

1. Salt
2. Mineral mix (like equilibrium)
3. Mineral mix + extra magnesium
4. Electrolytes
5. Magnesium
6. Joint supplement (like glucosamine)
7. Soybeen oil
8. Seaweed
9. Garlic
10. Linseed oil
11. Coat conditioner
12. Ranvet 500
13. Mitavite performance 3 oil
14. Copper
15. Rice brent oil
16. Selenium
17. Yeast
18. Cider Vinegar
19. Probiotic
20. Against staggers (like equigard)
21. Hoof supplement
22. Muscle supplement
23. Minerals + extra iron
24. Airways
25. Oil

Other:_________________

Forage/Hay

1. Baillage
2. Meadow hay
3. Clover hay
4. Lucerne hay
5. Pea vine

Other:_________________

Units: gram (g), kilogram (kg), cup (c), tablespoon (ts), double handful (dhf), single handful (shf), dipper (d), icecream container (=2L) (ic), slabs (s)

V) **Pasture:**

a. What is the typical size of paddock your horse is in?______acre(s)

b. What is the sward height of the grass?____________cm

c. How many horses are in the paddock?____________

d. What type of pasture best describes the paddock of your horse:

1. *Mixed grass (sheep pasture)*
2. *Ryegrass clover (equine dairy pasture)*
3. *Horse grass (special mix)*
4. *Other:* _______________

- What is the quality of the pasture? *Excellent* *Good* *Fair* *Poor*

(Excellent = 100%, good=75%, fair=50%, poor=25% proportion of grass density)

- On average how many hours does your horse spend at pasture?____Hrs

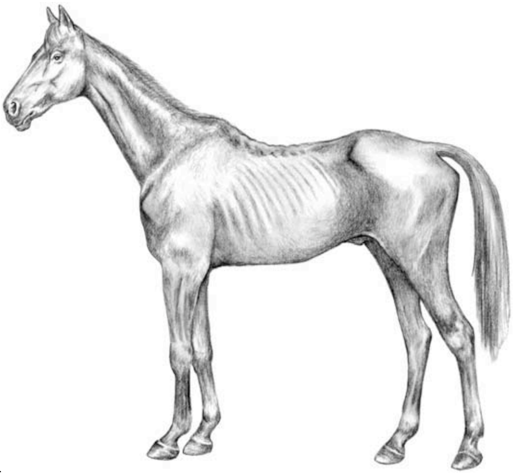
VI)

Workload during the previous 7 days

Workload (<u>minutes</u>)	*Day 1*	*Day 2*	*Day 3*	*Day 4*	*Day 5*	*Day 6*	*Day 7*	Day of Competition
Flatwork								
Advanced dressage movements								
Jump schooling								
Lunging								
Hack out (relaxed/ intense)								
Rest day								
Other (Treadmill etc.) Specify:								

Appendix II

Images used for rating body condition score by owner/rider



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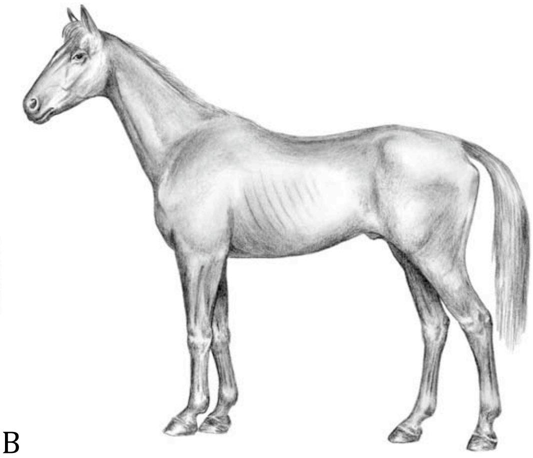

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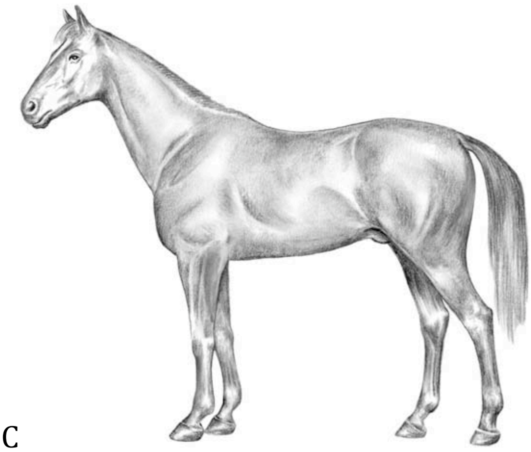

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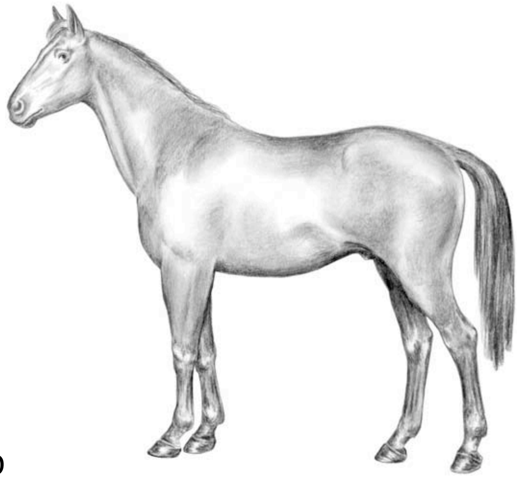

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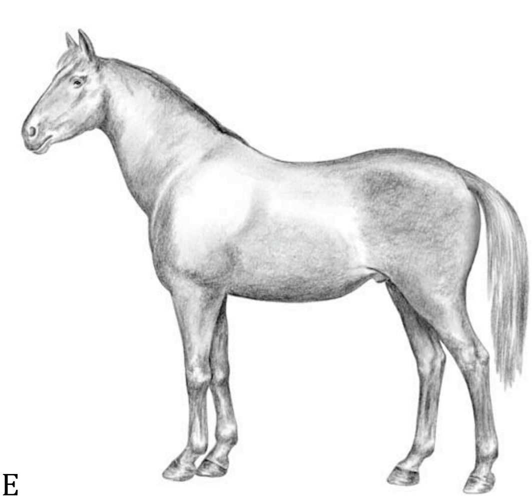

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