The feeding and management practices of Australian horse owners

Claudia Margaret Macleay

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School of Animal and Veterinary Science,
Faculty of Science,
Charles Sturt University

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Abstract

The horse’s anatomy, physiology and behaviours have evolved as a grazing animal on open grassland plains. Domestication has removed the horse from the environments in which they evolved so that horses could be managed in conditions that are convenient to people. Today in Australia horses are now used primarily for recreational riding, sport, competition and as companion animals, yet many feeding and management practices are often based on tradition, folklore, and misinformation. Inappropriate feeding practices have been linked to a number of health and welfare problems in horses.

The aim of this study is to investigate whether the current feeding and management practices of Australian horse owners are following the current scientific literature and recommendations. An online survey was designed to ascertain the following information: demographics, current feeding and management practices, and perceptions and knowledge of equine nutrition. Quantitative analytical methods included descriptive statistics, Pearson’s chi-square test and a multivariable analysis performed in IBM SPSS.

There were 4265 eligible surveys used in the statistical analysis; the majority of participants were female, aged between 18-54. Participants reported that most horses (58.5 %) were kept in paddocks that were overgrazed. Over half of all horses (57.8 %) were recorded by participants to be currently in work and/or training, with most horses in light work and used for pleasure riding. While only 20.4 % of participants recorded their horses to be obese when pasture intake estimates and reported rations were combined, the results of NRC (2007) nutritional analysis showed that 96.8 % of horses were receiving digestible energy above the recommendation and it is likely that many more animals were overweight. Australian horse owners are underestimating the nutritional content of pastures and overestimating the nutritional requirements of their horses, placing horses at risk of nutritional health problems. Australian horse owners need to recognise that well-managed pastures can provide horses with their daily nutritional requirements and is a long-term, cost-effective way of feeding horses, that also reduces health and behavioural problems.
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A literature review of past and present nutritional understanding and feeding practices in the horse
1.1 Introduction

The horse has evolved to be a grazing animal on open grassland; thus the horse’s anatomy, physiology, and natural feeding behaviours are orientated towards maximising grazing efficiency (Mills & Nankervis, 1999). To understand equine nutrition and feeding practices, it is important to first comprehend the anatomy and physiology of the equine digestive system and the natural behaviours of free-ranging horses. From observing the behaviour of wild and feral horses, recommendations can be made for what is regarded as the natural feeding behaviours of the horse (McGreevy, 2012). The domestication of the horse 6000 years ago was an event which catalysed momentous changes in human history, but it also involved removing horses from the environments in which they evolved, and managing them under conditions convenient to people (Goodwin, 2007).

Although some aspects of domestication, such as the provision of food, shelter, protection from predators and care during illness and injury, have undoubtedly benefited the horse, many of the constraints imposed on the domestic horse conflict with their evolutionary adaptive behaviour (Goodwin, 2007). In today’s society, the horse’s freedom to roam, choose food, shelter and social companions may all be restricted, depending on the purpose for which they are kept (Harris, 1999). Although the primary role of horses in less economically developed countries remains that of a working animal used for transportation and agriculture (Rahman & Reed, 2014) the role of the horse in countries with advanced economies has changed (Robinson, 1999). Horses are now used primarily for recreational riding, sport, competition and as companion animals (Endenburg, 1999). While Australia’s history with the horse commenced with the arrival of the first fleet in 1788, the management practices, knowledge, and understanding of the horse were built upon the western canons traditions of ancient warfare (Donaghy, 2012). Though traditional practices may have been appropriate for the hardworking war horse, such feeding methods today have been linked to a range of health problems including hindgut acidosis (Julliand, De Fombelle, & Varloud, 2006), colic (Hudson, Cohen, Gibbs, & Thompson, 2001; Tinker et al., 1997b), laminitis (United States Department of Agriculture, 2000) and gastric ulcers (Luthersson, Nielsen, Harris, & Parkin, 2009). While there is a growing body of international research into the feeding practices of horses, there have been few published studies which detail feeding practices in Australia.

This literature review aims to investigate the horses specialised grazing anatomy, physiology, and behaviours, as well as the literature surrounding both past and contemporary feeding practices, and how these practices impact on the health and welfare of the horse.
1.2 Anatomy and physiology of the Horse’s digestive system

1.2.1 The Mouth

The horse has been described as a ‘trickle feeder’ a term used to describe how the horse’s grazing behaviour allows for a constant trickle of feed to be passed through the digestive system. To allow grazing on grasses which contain abrasive silica, horses have long hypsodont teeth (Frandsen, Wilke, & Fails, 2009) which continuously erupt throughout the horse’s lifetime until they reach about 20 years of age (Nicholls & Townsend, 2016). This allows horses to graze on abrasive vegetation, which would otherwise wear the tooth surface away (Clauss, 2013). Correct mastication is an essential component of dental health (Bonin, Clayton, Lanovaz, & Johnston, 2007). The mastication cycle of the horse has three stages, the opening, closing and power strokes; the last being when the lower cheek teeth sweep across the upper cheek teeth to grind and crush feed (Baker, 2005). As horses chew saliva is produced, which in the horse is alkaline due to the inclusion of bicarbonate and plays a critical role in buffering stomach acid in the proximal region of the stomach (Al Jassim & Andrews, 2009; Merritt & Julliand, 2013). Due to the constant ingestion of food as the horse trickle feeds, large amounts of saliva are secreted; with horses producing 35-40 litres per day depending on the dry matter (DM) content of feed (Meyer, Coenen, & Gurer, 1985).

1.2.2 The Stomach

Due to the horse evolving as a trickle feeder, that continuously grazes and does not need to consume large meals, the horse’s stomach is small with a capacity of 7.5-15 litres, (Al Jassim & Andrews, 2009). The equine stomach has two distinct regions of cell tissue divided by a clear line; the margo plicatus (Merritt & Julliand, 2013) as shown in Figure 1. The most proximal region of the stomach is similar to the cells lining the oesophagus and contains no secretory glands while the lower regions of the stomach are glandular and contain secretory tissue that produces stomach acid and mucus to protect the region from gastric acid (Merritt & Julliand, 2013). It is the buffering action of saliva combined with the fibrous bolus that protects the proximal region of the stomach from gastric acid splashes (Luthersson et al., 2009). Andrews and Nadeau (1999) found that the mature horse secretes approximately 1.5 litres of gastric juices per hour into the stomach, containing 4-60 mmol of hydrochloric acid.
The buffering effect of salvia means that there are variable pH levels within the horse’s stomach, the normal pH range of the stomach contents at the oesophageal region is between pH 5-7, for horses on a roughage-based diets. The equine stomach increases in acidity towards the pylorus, with a pH range of 3-6 at the margo plicatus, while the glandular portion is consistently acidic at pH 2-3 (Frape, 2007; Luthersson et al., 2009; Merritt & Julliand, 2013). Understanding the sensitive anatomy of the horse’s stomach is vital in preventing such health problems as stomach ulcers.

Figure 1 A post-mortem specimen of the equine stomach depicting the anatomical regions (Sykes, Hewetson, Hepburn, Luthersson, & Tamzali, 2015)

1.2.3 The Small Intestine

Digested material passes from the stomach to the small intestine which has a total length of 21-25 meters (Frape, 2007). Ingesta travels through the small intestine at an average rate of 30 cm/min, with a total mean retention time of 5 hours on average (Van Weyenberg et al., 2006). Despite the fast passage of feed through the small intestine, it is the principal site for the digestion and absorption of hydrolysable carbohydrates, amino acids, fatty acids, minerals
and some vitamins (Jackson, 1998). The entry of digesta into the small intestine stimulates pancreatic and biliary secretions. Because the horse evolved to graze continuously its lacks a gallbladder for storing bile (Housset, Chretien, Debray, & Chignard, 2016). Instead, bile from the liver is secreted directly into the small intestine (Al Jassim & Andrews, 2009). Due to the horse being a ‘trickle feeder’, pancreatic secretions occur continuously, (Merritt & Julliand, 2013) with secretions of 20–25 L/day recorded in adult horses (Kitchen, Burrow, Heartless, & Merritt, 2000). Pancreatic and bile secretions are alkaline and raise the pH of digesta exiting the stomach from an acidic pH of 2.0-3.0 to a neutral range pH of 6.0-7.0 in the small intestine, protecting the internal mucosa from acidic damage (Mackie & Wilkins, 1988, p. 2155; Merritt & Julliand, 2013). The neutralisation of acidic chyme entering the duodenum allows for optimal enzyme function (Al Jassim & Andrews, 2009). The predominant digestive enzymes in equine pancreatic tissue are lipases which act on fats, and amylase which hydrolyses dietary non-structural carbohydrates (Lorenzo-Figueras, Morisset, Morisset, Lainé, & Merritt, 2007). However, the activity of α-amylase in the horse is low and highly variable when compared to other species (Kienzle et al., 1994), resulting in horses having a limit to the amount of non-structural carbohydrates that can be digested in the small intestine. Non-structural carbohydrates that reach the caecum and colon undigested can lead to health problems such as laminitis, colic and hindgut acidosis.

1.2.4 The Caecum and Colon of the Horse

The large intestine of the horse often referred to as the hindgut, is the largest and most complex of any domestic animal and is the primary site of fermentation and microbial digestion of structural carbohydrates (Frandson et al., 2009), hence the term hindgut fermenter. Structural carbohydrates contain material forming the plant cell wall including cellulose, hemicellulose, and lignin. Bacterial fermentation of structural carbohydrates is required in the hindgut before they can be utilised by the horse as they are resistant to the horse’s digestive enzymes (Pagan, 1998). The caecum of the horse is a comma-shaped sac, approximately 1 m long with a capacity of 25-30 L (Frape, 2007) as seen in Figure 2. The caecum contracts every 2-4 minutes to move digesta into the right ventral colon, (Merritt & Julliand, 2013; Van Weyenberg et al., 2006) creating an audible sound in the horses right flank (Jennings, Curtis, Burford, & Freeman, 2014). The large colon forms a double loop comprising of the right and left ventral colon and the left and right dorsal colon, connected by
bends known as flexures, (Frandsen et al., 2009). The colon has a length of 2-4 m with a capacity of approximately 150 L with a diameter of 25 to 30 cm (Al Jassim & Andrews, 2009).

1.2.5 Digestion and Absorption in the Caecum and Colon

The digestion of structural carbohydrates occurs in the caecum and colon and is facilitated by microbial fermentation (Al Jassim & Andrews, 2009). Microbial fermentation converts plant fibres into volatile fatty acids, principally acetic, propionic and butyric acids (Frape, 2007). The volatile fatty acids produced during microbial fermentation contributed to 70-80% of the energy absorbed by the horse (Al Jassim & Andrews, 2009). The purpose of fermentation is to break down the structural carbohydrates forming the plant cell wall including cellulose and hemicelluloses of which horses, like many other animals, lack the digestive enzymes for (Merritt & Julliand, 2013). The microbes in the horse’s caecum and colon also aid in synthesising B vitamins which can be absorbed and utilised by the horse (National Research Council (NRC), 2007). Hindgut microbes include numerous and various types of bacteria, protozoa, and fungi (Hsiung, 1930). Bacteria represent the majority of the hindgut microbial biomass and are classified into cellulolytic, proteolytic, lactate-using and glycolytic bacteria (Santos, Rodrigues, Bessa, Ferreira, & Martin-Rosset, 2011). To sustain a healthy fermentative process, the maintenance of a strict anaerobic environment, with limited changes in the pH and the rapid absorption of fermented by-products is required (Merritt & Julliand, 2013). Volatile fatty acids must be quickly absorbed through the luminal wall to maintain a suitable ecosystem for hindgut microbes. Volatile fatty acids are transported across the hindgut lumen with sodium chloride, while bicarbonate is secreted to maintain a pH fluctuating at around 7 (Frape, 2007). Any change in pH can severely alter the microflora and the digestive fermentation process (Merritt & Julliand, 2013).
1.3 Natural Feeding Behaviours of the Horse

1.3.1 Grazing

Horses are able to thrive on forages that are high in fibre and low in quality, not only because of their gastrointestinal anatomy but also because of their feeding behaviours. Grazing is the primary behaviour observed in herds of free-ranging horses. Over a 24 hour period horses will spend between 30-68 % of their time fulfilling this behaviour (Boyd, 1988; Lamoot & Hoffmann, 2004; Mayes & Duncan, 1986; Van Dierendonck, Bandi, Batdorj, Dügerlham, & Munkhtsog, 1996). Grazing periods may last up to 19 hours when forage is limited (Rubenstein, 1981) but often averages between 10-17 hours on good pasture (Gallagher & McMeniman, 1989). Seasonality effects time spent grazing and the voluntary dry matter intake (VDMI) due to changes in grass growth, quality and quantity (Carson & Wood-Gush,
In addition, seasonal effects of weather such as intense heat in summer, or wind or rain in winter also influence the time that horses spend grazing (Fraser, 1992).

### 1.3.2 Voluntary Intake
Voluntary dry matter intake is an essential consideration for the modern management of horses at pasture as excessive intake can lead to obesity (USDA, 2000) and/or laminitis (Sillence, 2012). The voluntary dry matter intake for adult horses grazing fresh forages has been estimated to average 2.3 % of body weight (BW) (Harris et al., 2016). Voluntary dry matter intake is often the highest for lactating mares that on average consume 2.8 % of BW in dry matter (DM), but can be as high as 5 % as recorded for grazing ponies (Longland, Barfoot, & Harris, 2016). While grazing horses can average up to 30 000 bites per day (Mayes & Duncan, 1986), voluntary intake is additionally influenced by sward height and palatability. Horses take fewer chews on higher sward (Edouard, Fleurance, Dumont, Baumont, & Duncan, 2009) in addition to grazing time decreasing with increased pasture availability (Arnold, 1984). As sward height and pasture availability declines horses increase their bite rate (Edouard et al., 2009) and time spent grazing (Rubenstein, 1981). Though irrespective of pasture height or thickness horses tend to graze areas of new pasture growth (Salter & Hudson, 1979) indicating palatability plays a significant role in voluntary intake. Understanding the changes in grazing behaviour and intake is an essential consideration for managing both horses and pastures, especially for horses at risk of excessive pasture consumption.

### 1.3.3 Locomotion
In a free-ranging environment, the primary function of locomotion is to allow horses to maximise their intake of the highest-quality feeds available (Duncan, 1983). Horses will take a bite followed by moving one or two steps forwards before another bite (Feist & McCullough, 1976) allowing horses to cover large areas as they graze. While Native Japanese ponies and Przewalski’s horses have been recorded to travel 3.5 to 4.32 km per day, other equids such as the Asiatic Wild Ass, and the Plains Zebra have been recorded to travel
8.3 km and 15 km per day respectively (Brooks, Bonyongo, & Harris, 2008; Kaczensky, Ganbaatar, Von Wehrden, & Walzer, 2008; Shingu et al., 2000). However, these distances travelled are short in comparison to feral horses in the Australian outback that have been recorded to cover 8.1-28.3 km per day and up to 55 km to a water source (Hampson, De Laat, Mills, & Pollitt, 2010). It is speculated that constant locomotion may assist in the normal movement of digesta through the gastrointestinal tract (Luthersson et al., 2009), which is critical for equine gastrointestinal health.

1.4 Nutritional Requirements of the Horse

As for all animals, horses have minimum dietary requirements for dietary energy (DE), crude protein (CP), macrominerals, microminerals, and vitamins. The current nutritional recommendations by the National Research Council (NRC, 2007) are formulated for horses at different stages of growth, pregnancy, lactation, exercise intensity and maintenance. There is, however, one presiding requirement that all equids have, the requirement for fibrous roughage and forages. Fibrous roughages and forage form the basis of the diet of wild equids, with a large body of literature reporting on numerous health and welfare problems caused by insufficient dietary roughage. Harris et al. (2016) recommends that the lowest daily roughage intake should be 15 g DM/kg BW for horses fed additional complementary concentrates, and that an absolute minimum recommendations of 12.5 g DM/kg BW be fed only to horses under exceptional clinical circumstances such as severe restriction for weight loss purposes, or post-surgery. Additionally, the NRC (2007) recommends that the equine diet should contain no less than 1 % BW as roughage DM per day. Therefore, while horses can be fed a large variety of feeds types, the horse's anatomy and physiology are designed for grazing on fibrous roughages (Frape, 2007), and the goal of all horse owners should be to supply this need adequately.

1.5 Historical Horse Feeding Practices

The first horses arrived in Australia in January 1788 with the First Fleet (Parsonson, 1998). Horses were vital to the settlement and development of Australia; for transportation, agriculture, and communication. However, the horse did not come alone. Accompanying the
horse, the British brought a discourse on horse husbandry spanning thousands of years. Horses were first domesticated six thousand years ago, in an area which today is described as Eurasia (Levine, 1999). Though initially maintained as a food source, people quickly established the horses ability to be ridden, pull carts and carry goods; and by the first millennium before the common era (BCE) the importance of the ridden horse in human culture had been established (Goodwin, 2007). Ancient Greek and Roman texts explain in detail how to care for horses that were required to carry out heavy work and be in peak physical fitness, especially in military endeavours (Donaghy, 2012). These horsemen of ancient times fed rations of barley, oats, bran, clover, and lucerne; which are as commonly fed today as they were then. Management practices including feeding twice daily, and the set ration size was essential for military logistics (Donaghy, 2012). The Ancient Romans, Persians, and Hittite fed rations of 2-4 kg of grains, and an equal amount of hay (Donaghy, 2012) are almost indistinguishable from current feed rations (Bourke, 1968; Southwood, Evans, Bryden, & Rose, 1993a, 1993b; Stubbs, 2001). The continuing influence of horse husbandry from Ancient Greece and Rome are evident throughout history in the written and archaeological records. Evidence from Medieval England and Europe show the continuum of horses being fed oats, barley, bran, and hay (Dejmal et al., 2014; Langdon, 1982). As more horses were kept in urban environments grains became a major component of the diet due to roughages being often poor in quality and difficult to transport (Donaghy, 2012; Herbert, 1859; Stewart, 1838). In the 1859 book ‘Hints to Horse keepers’ (Herbert, 1859), a horse in heavy work was recommended 8.0 kg of oats and 3.5-4.5 kg of hay. An article from the 1903 Queensland Agriculture Journal on “How British horses are prepared for exhibition” (“The horse: How British horses are prepared for exhibition ”, 1903) reflects oats as the feed of choice for horses, while the 1942 edition of “Diseases of the Horse” (Michener, 1942) still recommends feeding horses approximately 4.0-5.0 kg of hay and 8.0 kg of oats daily as best practice. Observations from examining the history of horse husbandry confirm that the feeding and management of horses are immersed in thousands of years of tradition. However, this does not mean that these traditions are best practice with many feed rations now being re-examined and proving to be detrimental to the horse health and welfare.
1.6 The Influence of Production Animals on Feeding Horses

Over the 20th Century, production animals transitioned from free-range grazing to confined housing, thus providing animals with a ‘nutritionally balanced’ diet became necessary (Coffey, Dawson, Ferket, & Connolly, 2016). The first use of ground grain for animal feed was recorded as early as 1813, but most grains for livestock came from production leftovers (Coffey et al., 2016). The first opportunity for the formula feed industry to be of service arose in the late 19th Century when horses supplied the main form of transportation and agricultural service. High-quality feed for horses was in demand, and early feed mills began mixing and selling their own ‘horse feeds’ with little to no scientific formulation involved (Schoeff, Fairchild, Bursiek, & Castaldo, 2005). Research into the nutrition of production animals increased markedly in the period following the world wars (Harris, 1998). It was the growing production animal industry which lead to the continuing advancements in improving grain processing; resulting in the development of a number of different methods for processing both dry and wet grains (Matsushima, 2006) see Figure 3 and Figure 4 for a chronological history. Squibb (1958) emphasised that there had been little advancement in horse nutrition over the early 20th Century. With only a few references to equine nutrition appearing in the Journal of Animal Science during the 1940’s to the 1960’s; Squibb noted that the lack of interest corresponded with the difficulties and the high cost of equine nutrition research (Squibb, 1958). The first edition of the National Research Council’s (NRC) book, *Nutrient Requirements of Horses* (1961) highlighted this lack of information in its opening pages stating that

*Data on maintenance requirements of horses are so limited that the energy requirements of cows have been used to a large extent in calculating the feed requirements of horses. Likewise, data on digestible nutrients of various feeds for horses are based largely on data obtained in digestion trials with ruminants...*

Nevertheless, over the last 20 years, there has been a huge interest in equine nutrition research resulting in hundreds of journal articles published, in addition with the establishment of international conferences and society’s devoted to equine nutrition (Harris, 1998).
1.7 Feeding Horses in Australia during the 20\textsuperscript{th} Century

1.7.1 Feeding Australian Racehorses

Over the 20\textsuperscript{th} Century, the role of the horse changed, as mechanisation occurred in the agricultural, military and transportation industries, the horse in the western world was deemed to have ‘lost its usefulness’ (Squibb, 1958), instead the horse became part of a growing leisure riding industry (Harris, 1999). Equine scientists at the time noted that future research would be related to the racehorse because that was the dominating industry at the time (Squibb, 1958). A survey by Bourke (1968), on 45 Victorian racing trainers found that the ration of racehorses averaged 5.7-8.16 kg of grain and 3.8-5.4 kg of chaff. The average ratio of concentrates to roughages was 60:40, but Bourke (1968) recorded ratios as high as 80:20. Whole oats were the most popular grain of choice, with cooked barley and linseed fed in the winter months. Bran is noted as being fed in small amounts (0.3 kg) but is interestingly
categorised as a roughage while today it is seen as a concentrate (NRC, 2007). Roughages of choice include oaten, wheaten and lucerne chaff, oaten and lucerne hay and fresh cut lucerne as a substitute for green pasture or an hour of daily grazing. Protein-rich concentrates included cottonseed meal, lucerne meal, skim milk powder, linseed meal, peas, beans and sunflower seed meal. Feed additives comprised of salt, glucose, wheat germ, dried kelp, molasses and vitamin and mineral mixtures. Horses were fed three to four times daily with hay available in the stable, though hay was recorded to be limited to only 4.5 kg to ensure horses consumed the grain ration (Bourke, 1968). A similar survey was conducted in 1992 on 50 racing stables in Sydney (Southwood et al., 1993a, 1993b). Changes in feeding practices were observed, with a majority of Thoroughbred (TB) owners only fed their horses twice daily, while Standardbred (SB) trainers only fed three times daily (Southwood et al., 1993a). The reduction in the number of daily meal feeding compared to 1968 was due to trainers having less time available for feeding their horses. Oats were still fed as the primary grain; due to oats being traditional, cheaper, higher in protein and more palatable than other grains. Rations also contained additional maize and commercial pellets which were not fed in the earlier study by Bourke (1968); the average amount of concentrates fed were 7.8 kg ± 1.6 kg for TB trainers and 7.7 kg ± 0.8 kg for SB trainers (Southwood et al., 1993b). The most substantial change was the amount of roughage fed had significantly declined from the 1968 survey, with TB trainers feeding 3.3 kg ±0.3 kg and SB trainers feeding 4.1 kg ± 0.3 kg (Southwood et al., 1993b) compared to 4.5 kg in 1968 with an additional hour of grazing/ or fresh forage. The reason for this change is linked to the belief that feeding hay would affect their horses racing performance, with 60% of trainers reducing or not feeding lucerne on race day; despite this assumption being disproved (Southwood et al., 1993a).

### 1.7.2 Feeding Non-Racing Horses Australia

In 1998 a postal survey of 196 owners with horses on small properties in New South Wales, South Australia, and Victoria, aimed at investigating feeding practices, pasture management and horse husbandry (Stubbs, 2001). Most respondents were members of either Pony Clubs and/or the Equestrian Federation of Australia. Surveyed horses where predominantly kept on pasture and allowed access to grazing, in addition to grazing access most horses were fed at least once daily. Roughages fed included lucerne hay/chaff, grass hay, and oaten chaff, and concentrates included bran, grain, premixed feeds and pellets as well as additional mineral
supplements. Results show that combinations of multiple feedstuffs where included in the ration. However supplementary feeding in 1998 accounted for nearly 50% ($800 per annum) of the annual cost of keeping a horse. With Stubbs (2001) concluding that most horses were being fed superfluous to the horse’s needs and that many horses in particular ponies could be adequately catered for with pasture and/or hay alone. Indicating that tradition took the place of necessity. Further investigation revealed that most owners were supplementary feeding because pastures mainly comprised of poorer grasses, a little clover, native plants, and weeds. Stubbs (2001) recommended that horse owners require further education on the value of pasture and pasture management, as pasture improvement offered economic benefits for horse owners as well as providing more sustainable use of horse pastures.

1.8 Current Feeding Practices of Horses in Australia

There are few published studies which detail contemporary feeding practices for horses in Australia. Recently published studies show a trend away from a sole focus on the feeding and management of racehorses, with studies conducted on the feeding of elite sports horses, recreational riders, and aged horses (Clarkson & Thompson, 2013; McGowan et al., 2010a; Owens, 2005; Richards, Hinch, & Rowe, 2006).

1.8.1 The Current Feeding Practices of Pony Club Horses in Australia

Pony Club is an organisation which allows young horse riders to engage in various equestrian activities, and is widely recognised as the grassroots for most other equestrian endeavours in this country, including racing, eventing, show jumping, dressage, polocrosse, western pleasure and other disciplines (Buckley, More, & Dunn, 2000). A longitudinal study by Buckley (2008) between June 2000 and July 2001 was conducted to describe the nutrition, body weight and body condition score of 84 pony club horses, kept within 100 km of the regional city of Wagga Wagga. Results found that the majority of horses were kept on pasture and that horses were fed additional roughage, grains or concentrates, often in excess of requirements, resulting in obesity. Roughage was the most commonly fed supplement typically contributing between 25-50% of the horse's daily DE requirements with
concentrates contributing to less than 25 % of the daily DE requirement. The study found little variation in supplemental feeding with the season, despite body weight and body condition score fluctuating with seasonal pasture growth curves. Therefore, the horse’s body condition score did not appear to influence the owners feeding decisions (Buckley, 2008).

1.8.2 The Current Feeding Practices of Sports Horses in Australia

A study conducted by the consulting nutritionist to the Australian Equestrian team, recorded feeding, and management practices over a period of five days for 22 elite horses, competing in Olympic level eventing, show jumping and dressage (Owens, 2005). The study aimed to compare feed rations with the NRC recommendations and ensure that horses were receiving adequate dietary requirements. Sixty-eight percent of horses were fed twice daily, 13 % fed three times daily, and 18 % fed four times daily. The feed ration included 40-50 % as roughage; all horses were fed chaff with their meals, either one or a mixture of wheaten, oaten and lucerne chaff. Horses also received lucerne and grass hays. Though horses received an adequate percent of roughage, hay was fed by volume rather than weight, resulting in considerable variations meaning roughage fed ranged from 2.1 kg to 6.91 kg (Owens, 2005). The remainder of the ration was made up of grain, pellets or a commercial sweet feed (Owens, 2005). Low roughage feed rates correlated with horses fed below the NRC (1989) recommendation for the feed intake of working horses. The NRC (2007) suggests the ration for working horses to be 2-3 % of their body weight (BW), overall only six out of the 22 horses were fed to the NRC recommendation. Eventing horses were fed 1.48-2.45 %/BW, dressage horses between 1.04 and 1.79 %/BW and show jumpers between 1.09-2.55 %/BW. Issues were raised in this study regarding the rider’s perceptions of feeding and nutritional management. Riders were unaware of their horse body weights and all but one fed by volume not weight. Riders who fed high grain diets or large meals twice daily were aware of the potential problems but were unwilling to make changes to their feeding practices. Another issue surrounding feeding was that when the feed was analysed, the lucerne hay was below the NRC stated levels for calcium and iron and one commercial extruded feed which claimed a digestible energy (DE) content of 16.9 MJ was found to only be 12.86 MJ. These are sources of inaccuracy to be considered for all persons involved in the equine industry. Furthermore, when the rations were analysed, 17 horses were found to be receiving suboptimal levels of vitamin E; nine horses were receiving low intakes of sodium, and four
horses were deficient in minor vitamins (Owens, 2005). The results of this study show that ingrained and inappropriate feeding practices persist even among elite competitors, who refuse to make changes to improve feeding practices and nutritional management due to a lack of a problem with their horses (Owens, 2005).

1.8.3 The Current Feeding Practices of Racehorses in Australia

In 2006 a postal survey was sent to the list of Thoroughbred trainers from the NSW Racing Magazine, with the aim of providing details of grain feeding practices and the impact on the hindgut environment. Seventy-two trainers took part in the survey, which was a response rate of 25 % (Richards et al., 2006), and information was collected on a total of 690 horses. Oats, corn, commercial premixed diets, and barley were the grains most commonly fed concentrates, with 80.6 %, 73.6 %, 73.6 % and 33.4 % of trainers feeding these grains respectively. The number of trainers feeding oats and corn was similar to the results found by Southwood et al. (1993b). However, the number of trainers feeding barley and commercial premixed diets had significantly increased from 12 % and 44% respectively. The total quantities of grain fed to horses per day ranged from 3.8 kg to 13.2 kg with a mean of $7.3 \pm 0.24$ kg and are comparable to the results found by Southwood et al. (1993b). When feeding grains, the majority of trainers indicated that the perceived ‘quality’ of grain (based primarily on subjective parameters such as colour and smell) was the most important factor that influenced their purchase. The remaining 22.2 % made decisions based on tradition (6.9 %), nutritional advice (5.6 %) and price (2.8 %) (Richards et al., 2006). Though only a small number of trainers made decisions based on tradition, it is still evidence of the continuous role of tradition in the horse industry. Fifty-eight percent of trainers fed according to the horse’s workload and made rations for each horse individually. Meal frequency was also comparable to the results of Southwood et al. (1993a) survey, with 84 % of trainers in 1993 and 82 % of trainers in 2006 feeding horses a large meal twice daily, 15.3 % of trainers fed three times daily and 1.4 % of trainers fed a grain meal four times daily. Trainers had a diverse range of responses for feeding hay from some never feeding hay to others allowing it to be continuously available to horses. Ninety-six percent of trainers mixed chaff with their grain diets, with an average of 0.77 kg/horse/day of lucerne chaff and 0.85 kg/horse/day of oaten or wheaten chaff added to the diets. The similarities of feed rations in 2006 to those feed over 20 years earlier suggest that trainers are reluctant to adapt to new research,
especially evident with only 1.4 % of trainers choosing grains based on scientific research (Richards et al., 2006).

1.8.4 The Current Feeding Practices of Aged Horses in Australia

A 2010 survey designed to describe the management practices, health and welfare of aged horses was posted to members of Equestrian Australia in Queensland, as well as being available to complete online for Queensland residents (McGowan et al., 2010a). A response rate of 30 % was achieved, and data was collected for 1185 horses classed as aged; being 15 years or older. The median age of surveyed aged horses was 20.7 years. Ninety-five percent of horses reported in the survey were at pasture either all or most of the time (68 %). The most common feed to all horses was lucerne hay, followed by stud mix, grass hay, oaten, wheaten chaff, and grain. A high number of respondents reported feeding additional supplements to aged horses such as minerals, oils/fats, vitamins, herbs, joint supplements and hoof supplements. Feeding practices varied by region, horse age, and if horses were retired or in work, with retired horses more likely to be fed only pasture and kept in rural areas. Horses owned in the Brisbane region or by members of Equestrian Australia Queensland (QEA) were more likely to receive supplements than horses in rural areas (McGowan et al., 2010a). The high percentage of horses fed a ration in addition to pasture indicates that horse owners are concerned about keeping aged horses in a good body condition. Despite being beyond their physiological prime, the authors note that aged horses are sort after for their temperament and safety as horses that have high levels of training and work well with inexperienced riders or horses (McGowan et al., 2010a). Older horses were more likely to be retired, but those in training work exercised on average for one hour, with three sessions per week. Twenty-six percent of horses were exercised at a low intensity, 68 % at medium intensity and 6 % at high intensity. Feeding-related disorders including laminitis, colic, and dental problems accounted for only 4 % of owner-reported known diseases, yet 30 % of owners recorded that their horses had shown clinical signs of feeding-related disorders within the previous 12 months (McGowan et al., 2010b). The overall results of the study found that 83 % of owners of aged horses reported that their horses had clinical signs of disease, but only 35.2 % of horses were reported to have a known or diagnosed disease or disorder. This discrepancy implies that horse owners are unaware of the underlying disease causing the visual clinical signs, and that overall there was a lack of veterinary influence within the group.
studied. These factors place the studied horse population at risk of being susceptible to both preventable and treatable diseases which can significantly impact on the welfare of the horse.

1.8.5 Current Demographics of Australian Horses

In Australia, little is known about recreational horse ownership, due in part to the lack of a compulsory registration system and the number of horse owners that are not members of any horse clubs, societies or organisations. Recent studies have been conducted to gain a greater insight into the demographics of Australian domesticated horses and ownership (Clarkson & Thompson, 2013; Hemsworth, 2012; Smyth & Dagley, 2015). Hemsworth (2012) found women, aged between 36-45 years to represent the largest group of horse owners and the majority of horses were kept in rural areas and on average. Though horse ownership across Australia is unknown, ownership in Victoria was recorded to be 3.5 % in 2012, and the average number of horses owned was four (Hemsworth, 2012). Horses were kept most commonly at pasture, with stabled horses representing between 9.2-18 % of surveyed responses (Hemsworth, 2012; Smyth & Dagley, 2015) at 70 % and 75 % respectively. Supplementary feeding in addition to horses having access to pasture was recorded to be 86 % by Hemsworth (2012) while Clarkson and Thompson (2013) reported that 79 % fed supplementary hay, 33 % fed concentrates and 28 % hand feeding as was seasonally required. These surveys show that feeding is an essential part of daily horse care for Australian horse owners. However, all three surveys omit to record the feedstuffs and quantities of rations, leaving a gap in the current understanding of Australian equine nutrition and feeding practices.

1.9 Comparing Australian Feeding Practices to Those of Other Countries

Internationally there is a growing awareness of the importance of equine nutrition, not only for racehorses and high-performance sports horses but also for pleasure and recreational riding horses. This is seen in the recent increase in scientific literature around the topics of equine nutrition with hundreds of articles on the topic published between 1991 and 2010, compared to less than 300 publications in the period 1970-1980 (Jansson & Harris, 2013).
Furthermore, the way horses are fed and managed reflects the purpose for which they are kept (e.g., racing Thoroughbred vs. pony club horses), their location (urban vs. rural), the time of year, the horse (breed & age) and the owner’s financial situation.

### 1.9.1 Comparing the Feeding Practices of Racehorses

The current global literature on the feeding of racehorses shows that while feedstuffs and feed frequency are similar to the feeding practices recorded in Australian studies, the ratio of roughage to concentrates being fed is changing. Grass and legume hays, oats, mixed grains and commercial feeds are recorded as the primary feedstuffs used (Jansson & Harris, 2013). Bibliometric analyses of international studies on TB and SB training stables from 1979 to 2007, found that forage feed was fed at 5.7±0.4 kg/day and 5.8±0.4 kg/day respectively and concentrates were fed at 7.4±0.3 and 6.8±0.4 kg/day respectively (Jansson & Harris, 2013). A study on racehorses in Chile had almost identical results to those recorded in a bibliometric analysis by Jansson and Harris (2013), with horses fed oats and lucerne hay, at 7.9± 2.0 kg/day and 3.2±1.3 kg/day respectively (Tadich, Weber, & Nicol, 2013). Compared to studies published on Australian racehorses (Bourke, 1968; Southwood et al., 1993a, 1993b), racehorses in Germany, Sweden, the United Kingdom (UK), the United States of America (USA) and New Zealand (NZ) were all fed higher levels of roughage and less concentrates (Gallager, Leech, & Stowe, 1992; Glade, 1983; Mullen, Hopes, & Sewell, 1979; Williamson, Rogers, & Firth, 2007; Winter, 1980). These studies on the feeding of racehorses show a trend from 1991-2007 for increases in the amount of roughage fed daily compared to 1979-1990; rising from 4.8±0.8 kg/day to 6.8±0.3 kg/day respectively. Simultaneously there is an overall trend for reducing the amount of concentrates fed, likely due to the inclusion of more roughage but also more energy dense feedstuffs being used, such as the increased inclusion of fat/oils. Jansson and Harris (2013) reported that in Europe the oil content in horse feeds for sports horses had increased from 3 % in 1970 to 5-6 % in 2010. Changes to feeding practices could be a result of trainers and managers becoming more aware of the health and welfare problems associated with traditional rations high in concentrates and low in roughages.
1.9.2 Comparing the Feeding Practices of Performance Sports Horses

The term ‘performance horse’ covers a wide range of equine disciplines, with the majority of studies focusing on the disciplines of eventing, show jumping, dressage, and endurance. The three main components of training are frequency, duration, and intensity (Marlin & Nankervis, 2002). The NRC (2007,) identified four levels of activity; light, moderate, heavy and intense work, with recent studies finding there is little difference between disciplines concerning ridden duration of each training session (30-40 minutes) or the number of weekly training sessions (6 per week), (Munsters, van den Broek, van Weeren, & Sloet van Oldruitenborgh-Oosterbaan, 2013; Verhaar, Rogers, Gee, Bolwell, & Rosanowski, 2014). Despite this, exercise intensity has rarely been recorded, leaving owners to create rations based on perceived workload together with body condition, which could lead to an inappropriate nutritional intake from over or underestimating the horse's nutritional requirement (Hale, Hemmings, & Randle, 2016).

Performance horses are most commonly fed two large meals daily. Studies showed that feeding twice daily was practised by 44.6 % of USA owners and 54 % of NZ owners, respectively (Burk & Williams, 2008; Verhaar et al., 2014) in comparison to 68 % of Australian owners who fed twice daily (Owens, 2005). In contrast, the majority of performance horse owners in Switzerland feed their horses three times daily (Brunner, Wichert, Burger, von Peinen, & Liesegang, 2012). Additionally, 76-87.5 % of performance horses were kept on pasture for over 6 hours per day (Brunner et al., 2012; Burk & Williams, 2008; Crandell, 2005; Verhaar et al., 2014). Globally performance horses were fed more roughage than what had been recorded being fed to performance horses in Australia, with a minimum of 5.64 ± 2.26 kg, to a maximum of 10.25 ± 3.25 kg being recorded, compared to only 2.1 to 6.91 kg fed to Australian performance horses (Brunner, Liesegang, Weiss, & Wichert, 2015; Brunner et al., 2012; Burk & Williams, 2008; Martin, 2010; Owens, 2005; Pratt-Phillips, 2016; Verhaar et al., 2014). Further investigation into each study reveals a wide range of feeding practices. Brunner et al. (2012) found 40-68 % of Swiss horse owners provided their horses with roughage ad lib, whereas polo ponies in the USA only received 30 % of their ration as roughages (Martin, 2010). Grass, lucerne hay and lucerne chaff were the most common roughage fed, though other roughages fed included haylage and sugar beet pulp as a fibre alternative (Brunner et al., 2015; Brunner et al., 2012; Crandell, 2005; Martin, 2010; Pratt-Phillips, 2016; Verhaar et al., 2014).
Feeding a commercial concentrate was practised by 89-100 % of performance horse owners, while other concentrates included grains and bran (Crandell, 2005; Pratt-Phillips, 2016; Verhaar et al., 2014). The total amount of concentrates fed ranged between a minimum of 1.45±0.45 kg to a maximum of 6.13 ± 3.34 kg (Brunner et al., 2015; Brunner et al., 2012; Pratt-Phillips, 2016; Verhaar et al., 2014). Global results are comparable to Australian performance which were fed a minimum of 2.98 ±0.27 kg, and a maximum of 7.09±0.61 kg, when assuming 50-60 % of their ration was concentrates (Owens, 2005). The addition of oil to the ration is becoming a more popular choice for owners wanting to ensure their horses are receiving the correct dietary energy without the need for increasing the amount of starch in the ration (Harris, 2009). The addition of oil to the ration was practiced by 32-54 % of endurance horse owners in the UK and the USA respectively (Crandell, 2005; Marlin & Sadler, 2015), 26.4 % of International show jumpers (Pratt-Phillips, 2016) and 32 % of Swiss performance horses (Brunner et al., 2012).

Studies of feeding practices of performance horses also indicate the high use of supplements in the feed ration. Joint supplements, electrolytes, salt, hoof supplements, vitamins and mineral mixes and gastrointestinal supplements were the most commonly reported to be used by performance horse owners, (Crandell, 2005; Marlin & Sadler, 2015; Pratt-Phillips, 2016; Verhaar et al., 2014). Agar, Gemmill, Hollands, and Freeman (2016) found that the main reasons for using supplements were ‘joints and mobility’, and ‘behaviour’ for dressage, and ‘electrolytes’, and ‘joints and mobility’ for eventing, with an average of two supplements given. Interestingly Australian performance horses were not recorded as being fed as many supplements as recorded in other studies (Owens, 2005).

The management of performance horses shows similarities despite the distance between studied horse populations. Concerned could be raised over the minimum roughage component being below recommendations (Harris et al., 2016). However, the high majority of horses were reported to be kept solely on pasture, suggesting that horses often would have had adequate roughage intake, so long as pasture was satisfactory.
1.9.3 Comparing the Feeding Practices of Recreational and Aged Horses

Current literature on equine demographics shows that the majority of horses kept in developed countries are used for recreational riding (Hoffman, Costa, & Freeman, 2009; Mellor, Love, Walker, Gettinby, & Reid, 2001; Murray, Bloxham, Kulifay, Stevenson, & Roberts, 2015; Wylie, Ireland, Collins, Verheyen, & Newton, 2013). Similar to the findings of McGowan et al. (2010a) 90-97 % of UK owners and 76 % of US owners kept their recreational or aged horses on pasture (Grimwood, Penaluna, & Brown, 2016; Hoffman, Costa, et al., 2009; Ireland, Clegg, McGowan, McKane, & Pinchbeck, 2011a; Wylie, Ireland, et al., 2013). Though during the winter 68.5-74.3 % of owners recorded that they stabled their horses at some point during the day, a practice not recorded in Australia primarily due to the difference in climate (Hotchkiss, Reid, & Christley, 2007; Ireland, Clegg, et al., 2011a). Supplementary feeding of roughages, predominantly grass hay, haylage and lucerne hay was practiced by 67-100 % of horse owners in the UK and USA, while 86.1-96 % of owners in the UK and USA fed additional concentrates (Grimwood et al., 2016; Hoffman, Costa, et al., 2009; Honoré & Uhlinger, 1994; Hotchkiss et al., 2007; Ireland, Clegg, et al., 2011a; Murray et al., 2015; Wylie, Ireland, et al., 2013). Furthermore, feeding supplements was not an uncommon practice with 60-77 % of horse owners from the UK and the USA feeding additional vitamins, minerals, joint and health supplements (Grimwood et al., 2016; Honoré & Uhlinger, 1994; Wylie, Ireland, et al., 2013). What is of concern is that most recreational and aged horses are fed in addition to pasture access, and with these horses in either maintenance, light or moderate work, it is possible that many horses are being fed in excess of dietary requirements (Ireland, Clegg, et al., 2011a; Mellor, Love, Gettinby, & Reid, 1999; Wylie, Ireland, et al., 2013).

1.10 Making Decisions and Sourcing Information on Feeding Horses

How owners make decisions on feeding their horses is a crucial component in understanding why horse owners feed the way they do. An owner's decisions on what, when and how horses are feed directly affects their horse’s health and welfare. Making these choices is not always easy, as today's horse owners are inundated with information on equine nutrition including books, magazines, social media, websites, feed companies, coaches, friends, veterinarians
and a growing body of scientific literature. It has been well documented that when people make decisions on buying food, there are numerous factors which affect the decision-making process, and that choice is not determined solely by physiological or nutritional needs. Price, availability, tradition, time constraints, product marketing, consumer attitudes, memories, emotions, and behaviour all play a significant part in decision making (Köster, 2009). It is likely that many of these factors play a similar roll in decisions regarding the feeding of horses. When asked how owners acquire information on equine nutrition, researchers found that the majority rely on their veterinarian for nutritional advice, followed by trainers, magazines, books, farriers, and other horse owners (Gemmill, Agar, Freeman, & Hollands, 2016; Hoffman, Costa, et al., 2009; Murray et al., 2015; United States Department of Agriculture, 1998). This statement appears to be at odds with other studies on how owners source equine nutritional information. Pony club owners in Australia reported that they would only call the vet as a “last resort”, while 19 % of owners learned about horse health through trial and error, and 56 % consulted a friend or knowledgeable horse person first (Buckley, Dunn, & More, 2004). In contrast, a recent study in the UK found that a horse owners level of equestrian experience did not increase their equine nutrition knowledge (Lewis, Coward, & Michaels, 2015), signifying owners may be receiving incorrect advice when they ask a ‘knowledgeable’ horseperson. A survey of veterinarians in Georgia, USA, revealed that one third questioned believed they were not sufficiently knowledgeable to provide equine nutritional advice (Roberts & Murray, 2013). Surveyed veterinarians reported to be the most confident giving advice on colic, and the least confident on less commonly seen equine nutritional disorders. It would also appear that where owners are receiving their information on nutrition from is not what is generating feeding choices. A study on the feed choices by horse owners found that lower product prices were the most significant determinant of feed choice, followed by a preference for green coloured horse muesli because owners assumed it contained more lucerne, with the least influencing factor being ‘supplier advice’ (Anders, 2013). A similar study on feeding horses supplements found that owners were mostly influenced by product research or from a personal recommendation by a friend (Gemmill et al., 2016). Another factor which plays a significant role in human nutritional decisions is a person’s level of education, with nutritional knowledge increasing in correlation with a person’s level of education (Hendrie, Coveney, & Cox, 2008). Gemmill et al. (2016) recorded that higher levels of education were significantly associated with the use of research papers as a source of information, though other studies on feeding practices found peer-reviewed scientific literature to rank low as a source of information (Buckley et al., 2004; Hoffman,
Costa, et al., 2009; Honoré & Uhlinger, 1994; Murray et al., 2015; Roberts & Murray, 2013, 2014). In a survey on the demographics of Australian horse owners, Smyth and Dagley (2015) found that horse owners had a higher educational achievement compared with the rest of the population, with bachelor degrees held by 22.5 % of horse owners compared to 16.5 % of the population, and postgraduate degrees had been gained by 5.3 % of horse owners compared to 4.4 % of the population. However, these findings may not be indicative of good welfare levels or correct feeding practices, as a Victorian study on the demographics of horse owners investigated for horse welfare problems found that though 20 % of ‘problem horse owners’ had tertiary degrees, problem horse owners all reported low levels of knowledge about equine nutrition and management (Pearson, 2003). In conclusion, though horse owners have been found to have a high interest in equine nutrition, there is juxtaposition between where owners source information and what owners are actually doing (Murray et al., 2015). Research indicates that horse owners frequently lack a basic knowledge of equine feeding and nutritional management (Hoffman, Costa, et al., 2009) which is likely to be a contributing factor in the prevalence of nutritional health problems in horses.

1.11 Health Problems Associated with Inappropriate Feeding Practices

1.11.1 Dental Health Problems

Dental diseases are a common oral disorder in horses, but left untreated can lead to weight loss, poor performance, pain, behavioural abnormalities, and illness (Anthony, Waldner, Grier, & Laycock, 2010). The most common dental disorders are of the cheek teeth, mainly due to gross abnormalities of wear (Dixon & Dacre, 2005). Sharp enamel points which were found to exist in 47.7 % and 68 % respectively of horses examined at Canadian abattoirs (Anthony et al., 2010) and Australian abattoirs (Chinkangsadarn, Wilson, Greer, Pollitt, & Bird, 2015). Sharp enamel points occur on the outer edges of the tooth and are a result of the upper and lower teeth being unable to completely wear against each other (Bonin et al., 2007). Uneven tooth wear can be accentuated by providing horses with diets high in soft concentrates which horses consume quickly, thus reducing chewing time and the grinding
motion of the check teeth (Bonin et al., 2007; Cuddeford, 2005; Dixon & Dacre, 2005). When comparing the duration of feed intake, horses took an average 8.4 minutes to consume 1 kg of pellets (Bochnia, Boesel, Bahrenthien, Wensch-Dorendorf, & Zeyner, 2017), while horses took an average of 16.6 minutes to consume 1 kg of lucerne chaff (Brüssow et al., 2005) and up to 35.2 minutes for horses to consume 1 kg of hay from a hay net (Ellis et al., 2015).

While all horses should have regular dental examinations to detect and treat dental disorders, owners need to consider that different rations will impact on the dental health of horses. A comparison of horses kept solely on pasture and horses stabled 24 hours/day found that the occurrence of abnormalities was higher in stabled horses (O’Neill, Keen, & Dumbell, 2010). Simple changes in feeding horses such as offering *ad lib* hay to the stabled horse increase in the time spent eating by horses; which is a readily adopted management strategy to aid horse owners in reducing dental abnormalities as well as other health problems caused from a reduction in the grazing time (Kiley-Worthington, 1987)

Figure 5 The time budgets of wild horses and horses housed in yards and stables (Kiley-Worthington, 1987)

**A:** Average time budgets for Camargue horses (Mayes & Duncan, 1986)

**B:** Time budgets for three horses in a yard with *ad lib* hay

**C:** Time budgets for horses individually stabled fed *ad lib* hay, able to touch and see other horses.

**D:** Time budgets for horses individually stabled fed restricted roughage (approx. 3 kg/day) unable to touch other horses and only able to see other horses over the stable door.
1.11.2 Equine Gastric Ulcers

Equine gastric ulcer syndrome is the ulceration of the stomach, which can occur in both the non-glandular and glandular regions of the stomach (Videla & Andrews, 2009). Though horses cannot directly inform us of their feelings, in human’s, gastric pain due to stomach ulcers is described as a sharp burning or gnawing pain located below the sternum with continuing burning discomfort (Drewes et al., 1997). The reported clinical signs of EGUS include poor appetite, poor body condition, weight loss, poor coat condition, bruxism, behavioural changes and poor performance (Sykes et al., 2015). The prevalence of horses with EGUS varies in populations from as high as 80-93 % for horses in race training (Hammond, Mason, & Watkins, 1986; Murray, Schusser, Pipers, & Gross, 1996) to as low as 11 % for horses in a university riding program (Chameroy et al., 2006). Gastric ulcers occur when the unprotected stomach is exposed to gastric acid (Sykes et al., 2015). Under natural circumstances, while horses are grazing the stomach has a constant flow of digesta. This digesta fills the stomach and reduces acid splashes. In addition, there is a continuous flow of saliva from the mouth into the stomach which buffers the stomach acid, causing stomach pH to rise and protects the stomach from acidic erosion (Luthersson & Nadeau, 2013). Gastric ulcers once treated can be managed with diet modification. By feeding a low starch, high fibre diet horses showed significant improvement in the severity of ulcers compared to horses which, after treatment, did not receive a modified diet (Luthersson et al., 2017). Horses at pasture have a lower prevalence of gastric ulcers than horses fed high concentrate diets due to the continuous flow of saliva that comes from the trickle feeding effect of grazing (Videla & Andrews, 2009). Horse owners need to be aware that simple changes in rations such as increasing the roughage in the diet and grazing access can aid in both preventing EGUS and offering a long-term strategy for horses being medically treated.

1.11.3 Equine Colic

Colic is the broad term given to abdominal pain in horses. Colic is a severe health problem and is frequently associated with death or euthanasia (Ireland, Clegg, McGowan, Platt, & Pinchbeck, 2011; Kaneene, Saffell, Fedewa, Gallagher, & Chaddock, 1997). Epidemiological studies from the UK and the USA have found that colic has a reported incidence rate of 3.5 to 26 colic episodes per 100 horses per year and a case fatality rate of 6.7– 11% (Kaneene et al.,
1997; Tinker et al., 1997b; Traub-Dargatz et al., 2001; Uhlinger, 1992). Incidence rates though can vary considerably, influenced by different variables in the management of horses. Tinker et al. (1997a) found between farm variations range from 0 to 30 episodes per 100 horse years. Feed-related factors which increase the risk of colic include feeding practices, changes to the feed ration and pasture access (Archer & Proudman, 2006). Studies have associated increased concentrate feeding with colic risk, due to the poor ability for horses to digest large amounts of high-starch diets (Durham, 2009). Tinker et al. (1997b) recorded that horses consuming 2.5-5 kg of concentrates had an increased risk of colic five times higher than grazing horses. Similarly, horses consuming 2.7 kg of oats per day were found to be five times at risk of developing colic (Hudson et al., 2001). Recent and rapid changes to the horse’s diet is also a significant risk factor for colic. Hudson et al. (2001) reported that 75.8% of horses presenting with colic had their feed ration changed within the previous two weeks, a finding also supported by Hillyer et al. (2002). Dietary changes resulting in colic are thought to be caused by changes occurring in the hindgut microbial population (Durham, 2009). Studies show pasture access has been found to decrease the risk of colic in horses. Hudson et al. (2001) found horses stabled 24 hours per day or horses which had recently reduced pasture access had a threefold increase colic risk, possibly due to reduced gut motility and a decrease in horses being able to continually consume feed as they do while grazing. Knowledge of the feeding risk factors can be used to formulate strategies to prevent colic from developing or recurring. Ensuring horses are not overfed concentrates to prevent starch overload, the slow introduction of new feeds to give microbes time to adjust and increase the time horses can spend grazing on pasture can aid in reducing the risk of colic in horses. Another important point for owners to consider is that the current commonly accepted recommendation of introducing new feeds over the course of two weeks may not be a long enough time frame for the hindgut microbes to adapt, or horse owners are not introducing feeds as gradually as possible.

1.11.4 Laminitis

Connecting the horse’s inner hoof wall and the distal phalanx are Velcro-like structures called laminae. During laminitis, the laminae become inflamed, and the connection between the hoof wall and the distal phalanx deteriorates; resulting in the distal phalanx rotating and/or sinking (Geor & Harris, 2013) as shown in Figure 6 and Figure 7. Laminitis
prevalence varies between horse populations, the United States Department of Agriculture estimates that at any given time 1 % of the equine population of the USA is affected by laminitis (USDA, 2000). In the UK, prevalence has been estimated to be 0.5 %, meaning that approximately 1 in every 200 horses evaluated had an active episode of laminitis (Wylie, Collins, Verheyen, & Newton, 2013a). Prevalence in Australia has been reported to range from 0.3 % in a study on 340 horses processed at an Australian abattoir (Doughty, 2008) to 23.8 % in a study on 84 pony club horses (Buckley, Morton, & Coleman, 2007). There are three primary types of laminitis; endocrinopathic (e.g., associated with insulin resistance, obesity &/or pituitary pars intermedia dysfunction), sepsis-related laminitis (e.g., gastrointestinal disease, septic metritis, pneumonia, starch overload and oligofructose overload) and mechanical overload (supporting limb laminitis) (Geor & Harris, 2013).

Figure 6 The healthy equine hoof (illustration by C. Macleay).
Figure 7 Laminitis in the equine hoof, with inflammation of the laminae and deterioration of the connection between the hoof wall and the distal phalanx (illustration by C. Macleay).

1.11.4.1 Endocrinopathic laminitis

Endocrinopathic laminitis is the most common type of laminitis accounting for 70-89% of all cases presented to equine practitioners (Donaldson, Jorgensen, & Beech, 2004; Karikoski, Horn, McGowan, & McGowan, 2011). Insulin resistance (IR) appears to be the common risk factor in endocrinopathic laminitis (Johnson, 2017). The body produces insulin when glucose is released into the bloodstream from the digestion of dietary carbohydrates. In a normal response, insulin causes glucose to be taken into body cells to be stored and used for energy rather than fat. This results in blood glucose decreasing and staying within the normal physiological range when carbohydrates are consumed (Burns & Toribio, 2017). However, IR is a condition where cells fail to respond normally to the hormone insulin, resulting in high blood glucose concentrations. The pancreases continues to increase insulin production, but with cells failing to respond it only contributes further to high blood insulin levels and glucose (Burns & Toribio, 2017), referred to as hyperinsulinaemia. Insulin resistance in horses with endocrinopathic laminitis is has been suggested to be caused by elevated corticosteroid levels, which are powerful inhibitors of the action of insulin. This link has been established in horses and ponies given a corticosteroid injection which resulted in insulin
resistance and hyperinsulinaemia (Bailey et al., 2007; Tiley, Geor, & McCutcheon, 2007). One study found that a single dose of triamcinolone acetonide (0.2 mg kg\(^{-1}\), intramuscular), a synthetic corticosteroid, led to elevated insulin levels for more than 150 hours and caused the appearance of ‘growth lines’ in the hoof, signifying changes in the laminae had occurred (French, Pollitt, & Pass, 2000). Research is continuing into this area, as currently the exact pathophysiology of endocrinopathic laminitis remains unknown.

### 1.11.4.2 Laminitis from Starch Overload

Horses have a limited capacity for prececal digestion of starch. When horses ingest a large amount of high starch grains, either by accident or from inappropriate feeding practices, there is a high risk that undigested starch will reach the caecum and colon (Geor & Harris, 2013). In the hindgut starch is rapidly fermented by lactic acid producing bacteria, causing the pH in the caecum and colon to drop as the lactic acid concentration rises. The rapid production of lactic acid overwhelms the buffering capacity of the large intestine, causing a decrease in anaerobic Gram-negative bacteria. As these bacteria die they release endotoxins (Eades, 2017). Endotoxins together with the increased acidity of the intestinal contents are capable of causing damage and necrosis of enterocytes (Weiss, Evanson, Green, & Brown, 2000). This process results in sepsis-related laminitis. An inflammatory response is activated, and changes in the laminae are similar to that of sepsis-associated organ injury, including proinflammatory cytokines, leukocyte and endothelial activation, as well as leukocyte adhesion and emigration through hoof capillaries (Belknap, Moore, & Crouser, 2009).

### 1.11.4.3 Laminitis from Oligofructose Overload

Laminitis can also occur in equids from the ingestion of pastures high in non-structural carbohydrates, including glucose, fructose, sucrose and starches (Longland & Byrd, 2006). When non-structural carbohydrates are digested enzymatically in the stomach and small intestine, they are absorbed as glucose and trigger insulin to be released. In the insulin resistant horse or pony the rise in blood insulin may exceed the known threshold and cause changes to the hoof laminae and subsequently, pasture-associated laminitis occurs (Pollitt & Milinovich, 2017). Alternatively, pasture-associated laminitis can occur from oligofructose overloading of the hindgut. When a large amount of undigested oligofructose reaches the
equine hindgut, it has been suggested that a similar reaction to starch overload occur in the equine hindgut and laminitis results, although there are some questions to the validity of the results obtained (Geor & Harris, 2013). Further research in this area needs to be conducted before conclusively stating oligofructose overload of the hindgut can cause equine laminitis.

1114.4 Managing laminitis

In the case of laminitis, the phrase “prevention is better than cure” is an appropriate method to follow, especially as other studies have indicated that between 33.5-89 % of horses or ponies with laminitis will go on to develop subsequent episodes of the disease. Horses or ponies with endocrinopathic laminitis commonly develop laminitis unexpectedly, due to owners often missing the earlier signs of laminitis risk (Belknap & Durham, 2017). Excessive weight gain has been associated with a four-fold increase in laminitis risk (Wylie, Collins, Verheyen, & Newton, 2013b). Several studies have found that owners poorly recognise high body conditions scores (Stephenson, Green, & Freeman, 2011; Wyse, McNie, Tannahill, Love, & Murray, 2008). Furthermore, a recent study found that 45.5 % of horse owners did not recognise the signs of laminitis when horses were brought to veterinary clinics for diagnoses due to lameness (Pollard, Wylie, Verheyen, & Newton, 2017) indicative of the need for educating horse owners on recognising the signs and risk factors of laminitis. The prevention of starch overload laminitis requires horse owners to be aware that undigested starch can reach the hindgut when horses are fed above 2 g starch/kg BW in a single meal (Kienzle et al., 1994; Meyer et al., 1995). In horses at risk of laminitis, the level of starch reaching the hindgut able to cause a disturbance can be as little as 0.3 g NSC/kg BW/meal (Hoffman, Haffner, Crawford, Eiler, & Fecteau, 2009). Common horse feeds contain varying amounts of starch, with oats, barley and corn containing 392, 492 and 647 grams of starch per kilo respectively while roughage alternatives such as sugar beet pulp only contain 0.97 grams of starch per kilo (FeedXL, 2016). This translates to 1 kg of starch being fed to a horse receiving 2.5 kg of oats, 2 kg of barley or 1.5 kg of corn, quantities which are known to be commonly fed to Australian racehorses (Richards et al., 2006). Owners need to be aware of the amount of starch present in common feedstuffs and how they interact with the horse’s digestive system.
Pasture-associated laminitis requires owners to be aware of changing conditions which increase pasture non-structural carbohydrates and how to manage their horse’s intake of pasture at these times. Pastures high in non-structural carbohydrates are commonly ‘lush’ (actively growing) or stressed (when environmental conditions are suboptimal for growth) and often comprise of temperate C3 grasses due to the way these plants store NSC (Agne, 2010; Geor, 2009; Geor & Harris, 2013). Keeping at-risk horses on these pastures requires owners to manage pasture intake. Restricted grazing time can reduce intake, though with ponies this will need to be in conjunction with a grazing muzzle as there is evidence that ponies can ingest 1% of their body weight as dry matter during three hours of grazing (Longland et al., 2016). Another method of restricting pasture is removing a horse or pony from pasture, by keeping at-risk animals in dirt paddocks, or pasture free areas. Rather than total confinement, the horse or pony still has the opportunity for exercise while feed intake is controlled. Alternatively, strip grazing can be used so that at-risk animals only graze pastures which have been already grazed by other stock, meaning the total available pasture has been reduced (Harris, 2017). In conclusion, laminitis is a debilitating disease in horses which if not corrected leaves euthanasia as a last resort to relieve suffering (Laskoski, Araújo Valadão, Dittrich, Deconto, & Faleiros, 2016). However, it is a preventable condition, and for owners, appropriate feeding, pasture management, vigilance and surveillance are the best defence.

11.1.5 Obesity

Just as there is a human obesity epidemic, there is increasing recognition of obesity occurring in many domestic animal species, including horses (Johnson, Wiedmeyer, Messer, & Ganjam, 2009). Overweight and obese horses are classed as having a body condition score (BSC) of four or five out of six, (Cumming, 2009) as shown in Figure 8. Overweight and obesity in horses are at high risk of developing IR and laminitis. When a horse presents with all three conditions (obesity, IR and laminitis) the term Equine Metabolic Syndrome (EMS) is given (Morgan, Keen, & McGowan, 2015; Trieber et al., 2006). A 2015 survey found that equine obesity rates appear to be rising with 23.2% of horses and/or ponies in the UK assessed to be overweight, compared with 16.9% the previous year and 7.8% in 2013 (National Equine Health Survey, 2015). Research indicates that while owners perceive BCS to be a key indicator of horse health (Buckley et al., 2004), owners frequently underestimate their horses own BCS (Ireland, Clegg, et al., 2012; Wyse et al., 2008). One study put the
rising obesity level in horses down to inappropriate feeding practices, owners not recognising an appropriate BCS, improved pastures, the absence of seasonal shortages in feed, better insulation from the winter cold, and obesity becoming normalised (Sillence, 2012). These factors now provide horses with year-round energy, in excess of their metabolic needs. In most cases managing the overweight or obese horse or pony requires a combination of an increase in exercise, a decrease in dietary energy and owner education regarding the nutrient content of feeds and the notion of appropriate exercise intensity (Sillence, 2012). However, owners need to be aware that sudden dieting and increased exercise can cause a condition called hyperlipidemia. It is a normal physiological response for the body to mobilise fat as an energy reserve, but in periods of negative energy balance and physiologic stress this response can become exaggerated, leading to increased fat concentrations in the blood (McKenzie, 2011). Excessive fat mobilisation may overwhelm the capacity of the liver and kidneys leading to hepatic and renal lipidosis (McKenzie, 2011). The most effective preventive approach is to avoid situations of stress and negative energy balance in animals likely to be susceptible. Instead, owners with overweight and obese equids will need to work slowly over many months to bring their animals back to a correct BCS and weight.

Figure 8 The equine body condition scoring six-point scale (Carroll & Huntington, 1988), illustration by C. Macleay.
1.11.6 Emaciation

Starvation and partial starvation lead to loss of body weight and condition, which are accompanied with poor dental health, poor hoof health, intestinal parasites, cancer, and several chronic diseases (Kronfeld, 1993). Prevalence of emaciation is an area that has been less researched than obesity. A USA study base in California found that out of an estimated equine population of over 1 million horses, only 0.2 % were estimated to be severely malnourished (witham, Stull, & Hird, 1998). However, a higher prevalence of 3.0 % was recorded by Grandin, McGee, and Lanier (1999) in horses that arrived at US abattoirs. A recent press release by the RSPCA Victoria stated that over the 2015/16 period, of the 12,022 reports received, with 2020 reported being related to horses. Reports of insufficient food, water or insufficient shelter accounting for 47 %, while underweight animals accounted for another 25 % of the cruelty reports (RSPCA Victoria, 2017). Domesticated horses suffer starvation and malnutrition for reasons that can be avoided by management, planning and education. In a review of horse welfare, Hemsworth, Jongman, and Coleman (2015) it appears that the majority of the investigated horse welfare cases were primarily due to the result of horse owner ignorance or lack of knowledge regarding horse husbandry and management practices. Pearson (2003), reported similar findings from owners investigated for horse welfare problems, with owners stating a range of beliefs ranging from horses requiring little commitment to care for, to horses being difficult to care for. These statements confirm a need for the public promotion of education on horse ownership and the realities of horse ownership. One of the major concerns for emaciated horses is the ‘refeeding syndrome’; a potentially lethal condition caused by severe electrolyte and fluid shifts (Crook, Hally, & Panteli, 2001). When feed intake is decreased, the horse first relies on its body stores of energy in the form of glycogen and fat. After 72 hours of starvation, metabolic pathways shift and take energy from ketone production, eventually the body will utilise proteins from skeletal muscle and organs for energy (Wortinger & Burns, 2015). During starvation, the body maintains extracellular concentrations of electrolytes at the expense of intracellular concentrations. However, when food is reintroduced to the patient, blood glucose rises, and the body releases insulin which pumps glucose and electrolytes intracellularly, resulting in low blood levels of electrolytes and hypokalaemia, hypophosphatemia, hypomagnesemia can occur (Wortinger & Burns, 2015). Recent research recommends that for initial refeeding of the starved horse, frequent small amounts of high-quality lucerne had the best results due to it being high in protein, phosphorus, and magnesium and its
carbohydrate content, created minimal effects regarding insulin response (Stull, 2003). Over 10-14 days, the size of the meal is gradually increased while the number of feedings decreased until the horse is able to eat as much as possible. With a healthy weight achieve after three to five months (Stull, 2003).

1.12 Conclusion

This literature review has aimed to determine the current scientific literature on the feeding practices used by horse owners in Australia. Feeding horses is a practice which has occurred for thousands of years; from when the success of empires depended on the marching warhorse, to the heavy pulling cart horse and the labouring farm horse to the pleasure companion horse of today. Throughout the last 2000 years, there is historical and archaeological evidence to support that feeding practices have remained constant, with the traditions of feeding a large twice daily ration of oats or barley emerging from the Ancient Greek and Roman empires and continuing from the medieval knight to the Georgian squire. Indeed, it has only been in the last 100 years that the horse’s roll in military, transport and agriculture has come to an end and the horse has instead found a place in sport and recreation. Today’s research on equine nutrition has become a global area of interest, even though during the early 20th century equine nutritional recommendations were generated from research on ruminants. Recently traditional feeding practices have come under scrutiny, as traditional high concentrate, low roughage diets have been linked to a number of health problems in horses. Equine nutrition, and the importance of implementing correct diets for horses is becoming increasingly significant to ensure good health and welfare. However, past research indicates that many Australian horse owners still feed based on tradition, folklore, and misinformation. The aim of this study is to investigate the current feeding and management practices of horse owners in Australia, as an indication of the current knowledge and understanding that owners have regarding equine nutrition and nutritional management.
2 Survey on the feeding practices and supplement use amongst Australian horse owners
2.1 Introduction

Horses have evolved as a grassland grazer, with their anatomy, physiology and natural feeding behaviours orientated towards the near continual intake of high fibre roughages (Mills & Nankervis, 1999). In contemporary Australia, horses are kept in a range of husbandry systems, selected to provide the basic requirements to the animal in a setting convenient to the people who own them. Although some aspects of domestication, have benefited the horse, the way we keep horses and the tasks we expect of them often conflict with their evolutionary behaviour (Goodwin, 2007). This often results in management practices that are suboptimal for the horses’ health and performance (McGreevy, 2004). There is growing concern that nutritional-related disorders such as obesity, colic, laminitis, and equine metabolic syndrome are increasing due to lack of nutritional knowledge among horse owners (Honoré & Uhlinger, 1994; Murray et al., 2015). There have been few studies published on the practices of feeding horses in Australia, with most surveys focused on racehorses (Richards et al., 2006; Southwood et al., 1993a, 1993b). The aim of this study was to describe the management, training and feeding practices of Australian horses and to analyse the horses daily nutritional intake based on the owner reported ration and pasture available at the time of the study.
2.2 Research methods and methodology

2.2.1 Participants
Because social research involves the study of humans, society and social phenomenon, the ethical implications of the research must be considered throughout all stages of the research project from the beginning of the research up until the write up of results. To maintain a high standard of ethical integrity research was only conducted after receiving approval from the Charles Sturt University, Ethics in Human Research Committee, (Protocol number 400/2017/16).

2.2.2 Questionnaire design
The survey questionnaire commenced with questions on owner demographics, followed by questions on six categories of horse modelled from the NRC computer program which is accessible online (http://nrc88.nas.edu/nrh/). The categories of horse included weanlings (under 1-year-old), young horses (1 to 2.5 years old), pregnant mares, lactating mares, mature horses (2.5 to 20 years old) and aged horses (over 20 years old). Participants were instructed to only record information for one of their horses in each category. Thus the maximum number of horses’ data could be collected on from each survey was six. Within each category, there were five sections: horse information, housing management, pasture composition, training workload and current feeding practices. Participants were asked to record a detailed account of what feeds and supplements were in the ration, the amount of feed and supplements feed in kilograms and grams respectively and the reason why participants choose those feedstuffs and supplements. The survey mainly consisted of multiple choice and short answer questions. A number of questions were similar to those asked in previous surveys on equine feeding practices (Hoffman, Costa, et al., 2009; Murray et al., 2015). The Charles Sturt University (CSU), Spatial Data Analysis Network (SPAN) formatted the survey questions into an online questionnaire using the web-based survey software Survey Monkey. The online survey was programmed with skip logic which allowed participants to skip a later page, or a specific question on a later page, based on their answer.
to a previous closed-ended question. A printed version of the survey was also made available if requested, to reduce bias for participants who lacked internet access.

### 2.2.3 Survey participation

The only criteria required to take part in the survey for participants was that participants were current horse owners or currently cared for horses and lived in Australia. The survey front page provided participants with information about the research project, and what would be expected of them if they chose to partake. Participants were informed that the questionnaire was anonymous and that names, phone numbers, addresses or emails would not be collected. Participants were given the researchers contact details if further information was required about the details of the study and the details for contacting the Faculty of Science Human Ethics Committee. All participants were asked to be over 18 years of age and asked for consent before completing the survey. In the online survey participants that selected that they were under 18 years of age or chose not to consent were redirected away from the online survey (See Appendixes).

### 2.2.4 Focus group

On the 05/04/2017, a focus group session was held at Belisi Equine Park, a local riding school near Wagga Wagga. Five people of different ages, gender and horse industry involvement, completed a written survey. The focus group was then asked to discuss the survey and comment on any questions which they did not understand or were poorly phrased. The main question identified as needing further explanation was the question on horse body condition score. The images were based on the 6-point BCS scale developed by Carroll and Huntington (1988), group members found it difficult to distinguish between images that were close together on the scale, especially between fat and obese horses. This was recertified in the final survey by including a written description alongside each image.
2.2.5 Pilot survey
A pilot survey was sent out via email and Facebook on the 19/05/2017, to students and lecturers from the Charles Sturt University, School of Animal and Veterinary Sciences. The pilot survey received 20 responses and participants were asked to give feedback on the survey questions and online access. Some participants noted the difficulties in recording feedstuffs for multiple horses when such horses were vastly different from each other regarding weight, height, breed and age. The survey was altered to ask participants to provide information for only one horse in each category instead of multiple horses, thus ensuring the data gathered was more accurate.

2.2.6 Media release and email distribution
A press release written by CSU media was published on the 27/06/2017 correlating with the survey being released. The press release outlined the research aims and the purpose of the study. The press release was included as an attachment in all recruitment emails, which were sent to numerous Australian equine industry organisations, breed societies, and riding associations, as well as various equine magazines. The email invited organisations to include the survey in their next e-newsletter, webpage or Facebook pages. Organisations that had not responded to the original email request were sent a follow-up email on the 24/07/2017.

2.2.7 Facebook distribution
Facebook was chosen as a social media distribution method due to its large number of users, with 17 million active users in Australia and 2 billion users globally (Cowling, 2017). Before distribution began Facebook groups, and pages had to be selected that would reach the required audience. Facebook groups are an online place for group communication and for people to share their common interests, express their opinion, discuss issues, post photos and share related content (Hicks, 2010). Facebook groups were found by searching on Facebook for keywords such as horse, show jumping, endurance riding, dressage and equine nutrition. Joining groups was first required to access and begin discussions. Facebook allows for users to share posts allowing for survey snowballing. Facebook distribution began on the 03/07/2017. Posts included a small paragraph about the survey with an attached image of a
horse to gain viewer attention (Figure 9). Comments were frequently monitored and replied to when survey participants were experiencing difficulty or confusion with the survey. A new post was created weekly during the online survey period. The new post and image were uploaded on to the selected group pages to ensure group users would see the post first when opening Facebook rather than scrolling past the survey post. Survey posts were addressed to the group, to gain more view attention, e.g. “Dressage riders needed”. The interval between posts was to prevent disinterest and over saturation of the survey leading to Facebook users ‘scrolling’ past the survey posts. The online survey was closed on the 31/8/2017.

![An example of a Facebook post used for survey recruitment](image)

**2.2.8 Analysis**

Data was gathered by Survey Monkey and downloaded into an Excel spreadsheet. The data on the nutritional composition of feedstuffs was gathered from internet searches, feed company websites, and personal communication with feed companies if the nutritional information was not disclosed on their websites. All survey responses had the feed names formatted to be the same as the product trading name and the name of the brand and variety,
allowing for feedstuffs to be correctly identified during computer analysis. Survey responses which were incomplete or completed incorrectly were removed from the analysis. Due to the survey monkey skip logic participants did not have to complete every question, meaning each question had a varying number of responses. Descriptive statistics were only analysed for participants that responded to the question being analysed. Demographic data were analysed based on the unique identification code given to each respondent.

Before information on individual horses was analysed, responses were grouped into the six categories of horse that as has been previously mentioned. Mature and aged horses that were not selected by participants to be in work or training were classed as being retired or spelling. The exercise intensity of horses in work or training was based on the total duration of weekly exercise. Horses in light work were exercised for under three hours per week, horses in medium work were exercised between three to four hours per week, horses in heavy work were exercised for four to five hours per week while horses in heavy work were exercised for over five hours per week. Information on current feed and product prices were gathered from internet searches, feed company websites, livestock produce websites, and personal communication with feed companies or livestock produce companies if feed prices were not disclosed on their websites. All feed prices were based on an average price for the product; hay showed the greatest variation in prices with some differing from the average by ± $10.00 depending on the region.

Data on pastures used in the pasture digestible energy analyses came from the MLA Feed demand calculator, while data on the content of crude protein and mineral composition was sourced from the NSW Department of Primary Industries. Pasture intake was based on the NRC (2007) estimation of intake at 2%/BW and pasture digestibility at 80 %. Pasture digestibility was based on pasture growth estimates sourced from the PrograZe manual (Graham, 2006). Pasture digestible energy, crude protein and mineral content were then included in the NRC (2007) nutrition analysis. The NRC (2007) formulas were coded into Excel to form part of the statistical analysis of dietary nutrients. Horses were only selected for the NRC nutritional analysis if participants had given information on the horse age (for growing horses only), month of pregnant or month of lactating (for breeding mares), the horses body weight, the horses exercise intensity, the type of feedstuffs fed in the ration and the weight of each feed component in the ration. The age of yearlings for the NRC nutritional analysis was based on the average age in months of the yearlings, except for yearlings.
between 2-2.5 years of age which were set at 26 months old. Quantitative data were analysed for descriptive statistics, with the confidence interval set to 95%, univariable analyses were conducted using Pearson’s chi-square test. The multivariable analysis was performed in IBM SPSS, with a binary variable of obese or not obese set as the outcome. Since the response variable was binary and the predictor variables were a mixture of categorical and continuous variables, a logistic regression model was applied to fit the data. Nine variables were used in the final model these included the categories of horse, breed, turn out duration, feed measuring method, activity level, daily pasture access, pasture ground cover, stocking rate and ration DE. Participants had the option of giving an open-ended question when asked their reason for choosing feedstuffs. Responses were managed using NVivo thematic analysis software, from this common word frequencies were identified and categorised into themes. Participant responses from the raw data were used, but the spelling was corrected to ensure that the software could correctly identify responses.
3 Results

Completed surveys n= 4512

Excluded surveys

Participant below 18 years old n= 97
Did not consent to participate n= 8
Incomplete and blank surveys n= 142

Total participant surveys included in analysis n= 4265

Yielded data for analysis of Australian horse owner demographics

Participant gender and age n= 4255
Geographical information n= 4121
Experience with horses n= 4113
Equine industry involvement n= 4190

Total horses enrolled from eligible surveys n= 5646

Yielded data for analysis of management practices

Housing n= 5449
Pasture ground cover n= 5014
Pasture height n= 5013
Pasture species n= 4052
Paddock size n= 4535
Shared grazing n= 4277
Exercise/Training n= 2455

Training discipline n= 2357
Exercise intensity n= 2455

Yielded data for analysis of Australian domestic horse population demographics

Breed n= 5623
Body condition score n= 4528

Feeding frequency n= 4365
Pasture access n= 5120
Measuring feed n= 3811
Ration composition n= 4395
Ration quantity n= 3998
Figure 10 Flow chart of eligible survey responses and responses used in the analysis

3.1 Demographics of Australian horse owners

3.1.1 Response rate
A total of 4512 people responded to the questionnaire. Responses that were not eligible included eight participants who did not consent and 97 participants below 18 years of age. The remaining 142 surveys were found to be only partially completed or blank (Figure 10.) A total of 4265 survey responses were able to be used in further analysis. Increases in daily survey participation increased in association with the upload of a new Facebook post (Figure 11).
Figure 11 Survey response rate and upload of new Facebook posts from the 26/06/17 until the 31/8/17

3.1.2 Participant gender and age

A total of 4255 people responded to the questions on participant gender and age. Participants were 95.0% female ($n=4044$) and 4.4% male ($n=187$), while 0.6% chose not to disclose their gender ($n=24$). The majority of participants were between 18 to 54 years old (86.3%, $n=3671$), with 64.9% ($n=2759$) of participants between 18-44 years old Figure 12.

Figure 12 Age range of survey participants
3.1.3 Participant experience with horses

A total of 4113 people responded to the question on the number of years of experience participants had with horses. The number of years of experience ranged from 1 to 70 years (Figure 13), with the majority of participants having more than six years of experience with horses (93.4%, n = 3843).

![Number of participant-reported years of horse experience](image)

Figure 13 Number of participant-reported years of horse experience

3.1.4 Participant involvement in the equine industry

Participants were asked to describe their involvement in the equine industry in a multiple answer question (Figure 14), with a total of 4190 participants responding. The majority of participants reported that they were horse owners (n=3661), pleasure riders (n = 2187) or riding competitively (n=2103). Overall only 106 participants responded that they had horses currently in flat, harness jumps race training; of those only 38 were horse trainers (35.8 %). Responses for the category of ‘other’ (n=399) included being a stable hand or groom, the parent of a young rider, riding horses for stock work, track rider, being an equine acupuncturist, masseuse or physiotherapist and other miscellaneous equine industry-related occupations.
3.1.5 Geographical distribution of horse owners

A total of 3845 people responded to the question on the participant's residential postcode. Participants were predominantly from New South Wales (34.8%, n=1337) and Victoria (27.4%, n=1055). Twenty percent of participants reported to living Queensland (n=766), while 8.7% lived in Western Australia (n=335), 5.3% lived in South Australia (n=204), 1.1% in the Australian Capital Territory (n=44), 2.2% lived in Tasmania (n=83), and 0.5% lived in the Northern Territory (n=21).

3.1.6 The distance of horses from participants place of residence

A total of 4121 people responded to the question on the location of horses to the participant's place of residence. The majority of owners kept their horses within 0 to 5km of their place of residence (74.3%, n= 3159). While 8.9%, of owners kept their horses within 6 to 10km (n=380), 5.2% within 11 to 15km (n= 220), 4.5% within 16 to 20 km (n=191). Six percent (n=299) of participants recorded that their horses were kept more than 21 km away from their place of residence.
3.1.7 Horse ownership in Australia
The total number of horses owned by all participants was 17,655. The average number of horses owned or cared for was 7; though the most common number of horses owned was 2. The number of horses owned ranged from 1 to 104 horses. The total number of horses individually described in the questionnaire by participants was 5646.

3.2 Demographics of the Australian domestic horse population

3.2.1 The density of the domestic horse population in Australia
A total of 3436 participants provided information on their residential postcode and the total number of horses that they owned. The geographical spread and density of horses based on the number of horses owned in each postcode found that the highest concentration of horse ownership occurred on Australia’s East coast. High-density horse ownership areas (>100 horses per postcode) identified in Queensland included the local government areas of Livingstone, Rockhampton and Central Highlands. In New South Wales High-density horse ownership areas included the local government areas of Kempsey, Nundle, Scone, Tamworth, Gosford, Wyong, Greater Argyle, Shoalhaven, Yass Valley, Wagga Wagga, Junee and the Northwestern Sydney metropolitan area. High-density horse ownership areas identified in Victorian included the local government areas of the Casey, Moorabool, Golden Plains and Warrnambool. In Western Australia, the Northeastern Perth metropolitan area was recognised as high-density horse ownership locality (Figure 15).
Figure 15 Distribution and density of horse ownership in Australia as reported by 3436 survey participants
3.2.2 Gender of the surveyed equine population

A total of 5630 horses had their gender recorded by participants. The study population comprised of 44.2 % mares/fillies ($n=2488$), 47.5 % geldings ($n=2675$), and 8.3 % stallions ($n=467$) as shown in Figure 16. Of those horses that were classed as mature horses in work ($n=2068$) 67.8 % were geldings ($n=2068$), 30.5 % were mares ($n=631$) and 1.7 % were stallions ($n=35$).

![Figure 16 The gender, age and use of participant-reported horses](image)

3.2.3 Age range of growing horses

Growing horses were categorised into weanlings between 5 and 12 months old, and yearlings between 1 year old to 2.5 years old. Participants recorded owning a total of 915 weanlings and 835 yearlings. Just over half of all weanlings recorded were between 8 and 10 months old ($n=487$) (Figure 17), while 48.8 % of yearlings were between 2 to 2.5 years old ($n=407$) (Figure 18).
Broodmares were categorised as mares being pregnant or lactating at the time of the survey. A total of 377 participants recorded owning a pregnant mare, while 79 participants recorded owning a mare that was currently lactating. The mares in their 8th and 9th months of gestation accounted for 47.2% of pregnant mares ($n=178$) (Figure 19). The majority of lactating mares were recorded to be in their 6th month of lactation (58.2%, $n=46$) (Figure 20). *Early
pregnancy was defined as the first 5 months of pregnancy, while the 6th to 8th months of gestation were termed mid-pregnancy and late pregnancy was recorded for mares in their 9th, 10th and 11th months of gestation. Mares in early lactation were classes as being in their 1st and 2nd month of lactation, mares in their 3rd and 4th month of lactating were classes as in mid-lactation, while mares in their 5th to 6th month of lactation were defined as being in late lactation.

![Figure 19 Reported month of gestation for pregnant mares](image1)

![Figure 20 Reported months of lactation for lactating mares](image2)
3.2.5 Horse breeds
A total of 5623 horses had their breed recorded by participants. Thoroughbred horses represented the largest breed category accounting for 20.5 % of all reported breeds (n=1151). Whilst Australian stock horses represented 12.1 % (n=681), Quarter horses 11.3 % (n=633) and Warmbloods 9.7 % (n=546). Breeds reported by participants in the category of ‘other’ (14.5 %, n=818) included Andalusians/Andalusian cross, Friesians/Friesian cross, Brumbies, Irish Sports horses and other miscellaneous pure breeds, pony breeds, cross breeds and horses of unknown breeding.

3.2.6 Body Condition Score
A total of 4528 horses had their current body condition score recorded by participants, which was adapted from Huntington’s six-point scale (Figure 8, page 33). The majority of participants recorded their horses to be in a ‘good’ BCS (65.0 %, n=2954), while 18.9 % of horses were recorded as ‘fat’ (n=860), 13.5 % were in a ‘moderate’ BCS (n=613), and 1.4 % were in a ‘very fat’ BCS (n=63). Horses in a ‘poor’ and ‘very poor’ BCS represented 1.0 % (n=48) of responses and were more likely to be aged horses (Figure 21).

Figure 21 Participant-reported body condition score as a percentage of study horses
3.2.7 Multivariable logistic regression model

Using the statistical software SPSS; six predictor variables were entered into a multivariable logistic regression model of which the outcome was the likelihood of obesity (BCS ≥4) based on the participants reported body condition score for horses (Table 1). The predictor variables included, the categories of horse, breed, turn out duration, feed measuring method, activity level, daily pasture access, pasture ground cover, stocking rate and ration DE. On average mature horses in work were 1.6 times more likely to be reported as obese by participants compared to horses in maintenance; however, results were not statistically significant due to sampling variation.

Cob type ponies and Shetland ponies were 1.6 times and 1.3 times respectively more likely to be reported as obese by participants compared with the reference category Welsh ponies, however results were not statistically significant due to sampling variation. In contrast Standardbreds, Thoroughbreds and Warmbloods were 3.1 times, 4.4 times and 2.5 times respectively less likely to be reported as obese by participants compared with the reference category Welsh horses; these results were considered statistically significant. Increasing turn out duration was found to have a preventative effect on reported obesity. With every 1-hour increase in turn out time, there was a 3% increase in the likelihood of participants reporting horses being reported as not obese; this result was statistically significant. While horses kept in individually in a paddock were 1.4 times less likely to be reported as obese by participants compared with the reference category of horses sharing paddocks with other horses and/or stock; this result was statistically significant. The most notable finding of the analysis was that participants were 1.9 times less likely to report their horses as obese when their horses received DE in the ration above the NRC recommended level; this result was statistically significant.
<table>
<thead>
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<th>Variable</th>
<th>Odds ratio</th>
<th>Confidence interval</th>
<th>p-value</th>
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</thead>
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<td></td>
<td></td>
</tr>
<tr>
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<td></td>
<td></td>
</tr>
<tr>
<td>maintenance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<tr>
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<td></td>
<td></td>
</tr>
<tr>
<td>Ref= Welsh ponies</td>
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</tr>
<tr>
<td>Appaloosa</td>
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<td>0.141</td>
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<td>Arab</td>
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<td>0.588</td>
</tr>
<tr>
<td>ASH</td>
<td>0.548</td>
<td>0.27 – 1.10</td>
<td>0.093</td>
</tr>
<tr>
<td>Cob/large pony</td>
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<td>Draft horse</td>
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<td>(hours)</td>
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<td>0.51 – 0.98</td>
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<tr>
<td><strong>Ration DE</strong></td>
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<td>recommendation</td>
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<td>0.32 – 0.80</td>
<td>0.004</td>
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<tr>
<td>Ration DE over NRC recommendation</td>
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<td>0.32 – 0.80</td>
<td>0.004</td>
</tr>
</tbody>
</table>
3.3 Management of Australian horses

3.3.1 Management of stabled horses

A total of 5449 participants responded to the question about stabling horses. Only 2.1% of horses were reported by participants to be stabled all of the time \((n=113)\) (Figure 22). Half of all stabled horses were mature horses in work \((n=57)\), while young horses in work represented 20.4% of all stabled horses \((n=23)\). Fifty-five horses stabled all the time were given daily turn out \((48.7\%)\). The duration of turn out ranged from 15 minutes to more than 6 hours, with most horses being given more than 6 hours of turn out daily \((n=27)\). Turn out in areas included, arenas \((n=2)\), day yards \((n=22)\), and pasture \((n=30)\). Twenty-eight stabled horses were not given any weekly turn out time \((24.8\%)\), while a further 30 horses were recorded as receiving some weekly turn out time but not given daily turn out \((26.5\%)\).

![Figure 22 Percentage of horses kept stabled, stabled sometimes or never stabled as recorded by participants at the time of the survey](image)
3.3.2 Management of horses stabled some of the time

Of the 5449 horses that had their housing recorded a total of 17.5 % \((n=956)\) of horses were stabled some of the time (Figure 22). Mature horses in work represented the largest group of horses stabled some of the time (44.8 %, \(n=428\)). Overall 916 horses were recorded to be given turn out time, with 86.9 % \((n=790)\) of horses stabled some of the time given daily turn out on pasture. Horses were also given daily turn out in arenas (0.33 %, \(n=3\)) and day yards (10.5 %, \(n=95\)), while responses for the category of ‘other’ (3.1 %, \(n=28\)) primarily included in paddocks with no pasture. The duration of turn out time was answered for 896 horses, with 89.4 % of horses given more than 6 hours of turn out daily \((n=801)\) and 9.0 % of horses given 2 to 5 hours of turn out time daily \((n=81)\). The remaining horses were recorded as receiving less than two hours of turn out daily \((n=14)\).

3.3.3 Management of horses never stabled

Of the 5449 horses that had their housing recorded 80.4 % of horses were never stabled (Figure 22). A total of 4331 horses had their pasture access recorded, with 87.0 % of horses that were never stabled having access to pasture all the time \((n=3768)\), while 9.4 % had pasture access sometimes \((n=410)\) and 3.5 % had no pasture access \((n=153)\).

3.4 Pasture management

3.4.1 Pasture ground cover

Overall 5014 horses had their pasture ground cover recorded (Figure 23). Most horses grazed pasture with 75% ground cover (42.7 %, \(n=2142\)), while 37.7 % \((n=1889)\) of horses were on pasture with 100 % ground cover. Thirteen percent of horses were on pasture with 50 % ground cover \((n=665)\), 3.3 % on pasture with 25 % ground cover \((n=170)\), and a further 2.9 % reported pasture to have less than 25 % ground cover \((n=148)\).
Pasture ground cover as recorded by participants at the time of the survey

### 3.4.2 Pasture height

The number of horses which had the height of pasture recorded was 5013 (Figure 24). Thirty percent of horses were kept in unevenly grazed paddocks that contained patches of tall and short grass \((n=1529)\). Pastures above 10 cm high accounted for 11.7\% of pastures \((n=588)\), while pastures between 5 to 10 cm high represented 29.3 \% \((n=1466)\), and pastures below 5 cm high represented 28.5 \% \((n=1430)\).
3.4.3 Pasture species

A total of 4052 participants recorded the pasture species in their horse's paddocks. Participants were able to select multiple pasture species. Tropical grass species were the most commonly reported pasture species (59.9%, \( n=2429 \)), followed by temperate grasses (46.6%, \( n=1890 \)), temperate legumes (30.5%, \( n=1237 \)) and native grasses (13.7%, \( n=557 \)). However, almost a third of participants did not know what pasture species were growing (34.4%, \( n=1392 \)). Responses for the category of ‘other’ (17.6%, \( n=713 \)) included barley grass, cocksfoot, buffalo grass, capeweed and various grasses that were native to the area where participants kept their horses (Figure 25).

Figure 25 Pasture species grazed by study horses as identified by participants

3.4.4 Distribution of high oxalate pastures

Several pasture species in Australia have been identified as being high oxalates including buffel grass, panic grass and kikuyu grass. Of the 4052 participants that recorded the pasture species in their horse's paddocks, 18.4% (\( n=748 \)) reported pastures containing buffel grass,
panic grasses and kikuyu grass. The distribution of these pasture species is mapped in Figure 26. High oxalate pastures were reported primarily across Eastern and Northern Australia, with the highest density of reported high oxalate pastures in the Northern Sydney metropolitan areas.

3.4.5  Paddock Size

A total of 4535 participants recorded the size of the paddock that their horses were kept in. Mean paddock size for horses sometimes stabled and never stabled was reported as 14.9 ha (36.8 acres), with 0.4 ha (1 acre) the most common paddock size recorded. Horses that were never stabled were found to be kept on larger paddocks than horses reported to be sometimes stabled. The average paddock size for horses fed in addition to pasture access was less than for horses not fed in addition to pasture, and that horses kept individually had smaller paddocks than horses kept with horses or other stock animals.

Table 2 The average paddock size in hectares of horses never stabled receiving supplementary feeding in addition to pasture.

<table>
<thead>
<tr>
<th>Paddock size (ha)</th>
<th>Paddock size of (ha)</th>
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<tr>
<td>Paddock size of (ha) horses not fed</td>
<td>Paddock size of (ha) horses fed</td>
</tr>
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<td>Grazing with other horses only</td>
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<td>Grazing with cattle/sheep/goats/alpacas or lamas</td>
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</tbody>
</table>
Figure 26 Distribution of high oxalate pastures in Australia
3.4.6 Shared grazing

The sharing of pastures with other domestic stock was recorded for 4277 horses. Overall 62.0 % of horses grazed with horse’s other domestic stock animals all the time (n=2652). Of those 96.1 % grazed with other horses (96.1 %, n= 4110), 13.5 % with cattle (n=577), 9.2 % with sheep (n=393), 3.5 % with goats (n=150), and 1.7 % with alpacas or lamas (n=73). The remainder of horses only grazed with other horses or domestic stock some of the time (22.6 %, n=968), while 15.4 % of horses were kept in individually (15.4 %, n=657).

3.5 Management of horses in work and training

3.5.1 Exercise intensity

Horses in work and/or training included yearlings, mature and aged horses. Of the 4245 yearlings, mature and aged horses recorded, 57.8 % of horses were recorded to be currently in work or training (n=2455). Young horses in work represented 11.1 % of all horses in work (n=273), while mature horses represented 82.6 % (n=2028), and aged horses represented only 6.3 % (n= 154) of all horses in current exercises or training. Exercise intensity was recorded for 2357 horses, with most horses in work or training were found to be in light work (55.9 %, n=1317), while 18.1 % were in moderate work (n=427), 12.0 % in heavy work (n=284) and 14.0 % in intense work (n=329) (Figure 27). Of those horses not in work 66.8 % were yearlings (n=549), 26.3 % were mature horses (n=724) and 77.0 % were aged horses (n=517).
Figure 27 The total percentage of all horses (n=2455) in light, moderate, heavy and intense exercise as recorded by participants at the time of the survey.

Figure 28 The total percentage of yearlings, mature and aged horses (n=2455) in light, moderate, heavy and intense exercise as recorded by participants at the time of the survey.
### 3.5.2 Weekly training sessions

The number of weekly training sessions ranged from 1 to 14, while the duration of training sessions ranged from 5 minutes to 6 hours. The average number of training sessions as reported by participants and the average session duration is contained in Table 3 and Table 4. The average time participants reported their horses spent in walk, trot, canter and gallop during a training session is recorded in Figure 29. Whilst the average duration of a training session decreased for aged horses in intense work compared to aged horses in heavy work, aged horses in intense work had an average of six exercise sessions per week compared to aged horses in heavy work which only had an average of four sessions per week. Though some horses in light work were recorded to have up to seven training sessions per week, for these horse’s session times were between 5-10 minutes of walk only.

<table>
<thead>
<tr>
<th>Yearlings</th>
<th>Light</th>
<th>Moderate</th>
<th>Heavy</th>
<th>Intense</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3 (1-7)</td>
<td>5 (2-6)</td>
<td>6 (3-7)</td>
<td>6 (3-14)</td>
</tr>
<tr>
<td>Mature</td>
<td>3 (1-7)</td>
<td>4 (1-7)</td>
<td>5 (2-8)</td>
<td>5 (2-12)</td>
</tr>
<tr>
<td>Aged</td>
<td>2 (1-5)</td>
<td>4 (2-6)</td>
<td>4 (2-5)</td>
<td>6 (3-12)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Light</th>
<th>Moderate</th>
<th>Heavy</th>
<th>Intense</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yearlings</td>
<td>27</td>
<td>43</td>
<td>46</td>
</tr>
<tr>
<td>Mature</td>
<td>40</td>
<td>40</td>
<td>57</td>
</tr>
<tr>
<td>Aged</td>
<td>42</td>
<td>56</td>
<td>71</td>
</tr>
</tbody>
</table>
The total number of responses collected regarding the current disciplines that yearlings, mature and aged horses were trained in was 2357. The majority of participants were typically engaged in more than one equestrian discipline; principally recreational riding and dressage (Figure 30). Though a smaller number of participants selected only one discipline, recreational riding and dressage remained the most popular equestrian activities. Responses for other included barrel racing, cutting, stock work, polocrosse, team penning, and various other miscellaneous riding activities. Participants that selected only one discipline were furthered examined for differences in workload, training sessions and training duration. Pleasure horses represented the largest percentage of horses in light work, while endurance horses represented the largest percentage of horses in intense work (Figure 31). All disciplined showed an increase in pace duration as work intensity increased. Pleasure horses spent the longest duration in walk, while dressage and endurance horses were worked in canter the least. The number of training sessions per week and the duration of sessions for each discipline increased with workload, as did on average the time spent in each pace (Table 5).
Figure 30 Riding disciplines reported for yearlings, mature and aged horses were trained in horses in current exercise/training (total responses $n= 2357$).

Figure 31 The total percentage of horses in light, moderate, heavy and intense exercise based on participants who selected a single discipline.

*See Figure 32., for the total number of horses in each category*
Figure 32 Average time participants reported that their horses spent in walk, trot, canter and gallop during a typical training/exercise session based on participants who selected a single discipline

(Flat Racing light work n=19, moderate work n=6, heavy work n=5, intense work n=8, Harness Racing light work n=11, moderate work n=12, heavy work n=9, intense work, Dressage light work n=78, moderate work n=68, heavy work n=28, intense work n=17, Eventing light work n=25, moderate work n=20, heavy work n=14, intense work n=7, Show Jumping light work n=30, moderate work n=12, heavy work n=6, intense work n=6, Endurance light work n=4, moderate work n=3, heavy work n=10, intense work n=19, Camp Drafting light work n=32, moderate work n=8, heavy work n=5, Pleasure Riding light work n=172, moderate work n=26, heavy work n=14, intense work n=6)
Table 5 Average duration and range of weekly training sessions (minutes) and the number of weekly sessions based on participants who selected a single discipline for mature horses.

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Work load</th>
<th>Sessions per week</th>
<th>Session duration (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dressage</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light</td>
<td>4 (1-6)</td>
<td>36 (20-60)</td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>5 (2-6)</td>
<td>48 (35-110)</td>
<td></td>
</tr>
<tr>
<td>Heavy</td>
<td>5 (3-6)</td>
<td>51 (40-80)</td>
<td></td>
</tr>
<tr>
<td>Intense</td>
<td>6 (4-10)</td>
<td>65 (40-110)</td>
<td></td>
</tr>
<tr>
<td><strong>Eventing</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light</td>
<td>4 (2-7)</td>
<td>37 (25-60)</td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>4 (3-6)</td>
<td>46 (37-70)</td>
<td></td>
</tr>
<tr>
<td>Heavy</td>
<td>5 (4-7)</td>
<td>51 (40-70)</td>
<td></td>
</tr>
<tr>
<td>Intense</td>
<td>6 (5-7)</td>
<td>61 (50-110)</td>
<td></td>
</tr>
<tr>
<td><strong>Show Jumping</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light</td>
<td>4 (2-6)</td>
<td>33 (10-55)</td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>5 (4-6)</td>
<td>41 (30-65)</td>
<td></td>
</tr>
<tr>
<td>Heavy</td>
<td>5 (4-6)</td>
<td>50 (40-65)</td>
<td></td>
</tr>
<tr>
<td>Intense</td>
<td>6 (4-9)</td>
<td>73 (60-85)</td>
<td></td>
</tr>
<tr>
<td><strong>Endurance</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light</td>
<td>3</td>
<td>49 (45-52)</td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>3 (2-5)</td>
<td>76 (47-105)</td>
<td></td>
</tr>
<tr>
<td>Heavy</td>
<td>3 (2-5)</td>
<td>99 (55-150)</td>
<td></td>
</tr>
<tr>
<td>Intense</td>
<td>4 (2-5)</td>
<td>165 (90-&gt;300)</td>
<td></td>
</tr>
<tr>
<td><strong>Harness racing</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light</td>
<td>7 (5-7)</td>
<td>23 (5-35)</td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>6 (6-7)</td>
<td>32 (30-37)</td>
<td></td>
</tr>
<tr>
<td>Heavy</td>
<td>7 (6-7)</td>
<td>37 (35-40)</td>
<td></td>
</tr>
<tr>
<td>Intense</td>
<td>6 (6-7)</td>
<td>65 (50-95)</td>
<td></td>
</tr>
<tr>
<td><strong>Flat racing</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light</td>
<td>6 (5-6)</td>
<td>23 (22-25)</td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>6</td>
<td>34 (32-37)</td>
<td></td>
</tr>
<tr>
<td>Heavy</td>
<td>6</td>
<td>47</td>
<td></td>
</tr>
<tr>
<td>Intense</td>
<td>7 (6-7)</td>
<td>60 (47-70)</td>
<td></td>
</tr>
<tr>
<td><strong>Camp drafting</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light</td>
<td>3 (1-6)</td>
<td>37 (20-57)</td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>4 (3-5)</td>
<td>49 (37-70)</td>
<td></td>
</tr>
<tr>
<td>Heavy</td>
<td>4 (3-6)</td>
<td>60 (40-95)</td>
<td></td>
</tr>
<tr>
<td>Intense</td>
<td>5 (3-10)</td>
<td>106 (42-245)</td>
<td></td>
</tr>
<tr>
<td><strong>Pleasure riding</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light</td>
<td>2 (1-5)</td>
<td>43 (5-110)</td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>4 (2-7)</td>
<td>54 (30-110)</td>
<td></td>
</tr>
<tr>
<td>Heavy</td>
<td>4 (2-6)</td>
<td>71 (40-135)</td>
<td></td>
</tr>
<tr>
<td>Intense</td>
<td>4 (3-6)</td>
<td>100 (60-182)</td>
<td></td>
</tr>
</tbody>
</table>
3.6 Feeding practices

3.6.1 Feeding frequency
The number of times horses were fed daily was recorded for a total of 4365 horses. Just over half of all horses fed twice daily (54.6 %, \(n=2383\)), whilst 35.7 % of horses were fed once daily \((n=1558)\), and 4.4 % of horses were fed three times daily \((n=192)\). Overall only 4.2 % of participants recorded that their horses had feed constantly available, which included horses stabled all the time, sometimes and never \((n=183)\). Of the 4365 horses, 83 horses were recorded as being stabled (1.9 %). Feeding twice daily was recorded for 55 of these stabled horses, while 11 were fed three times daily and nine horses were recorded as being fed only once per day. Only eight stabled horses were recorded as having access to feed constantly available.

3.6.2 Feeding in addition to pasture access
A total of 5120 horses had information collected on the practice of feeding in addition to pasture access. Overall 90.4 % of horses were fed in addition to grazing access \((n=4629)\). Of the 1544 mature horses which were fed in addition to pasture access by their owners, only 3 horses were fed a supplement with no additional roughages, commercial concentrates or grains. Horses which were not fed in addition to grazing were kept at pasture and never stabled or sometimes stabled.

3.6.3 Measuring feed quantity
A total of 3811 participants recorded how they measured the quantity of their horses’ daily feed ration. Most participants used a feed scoop (43.8 %, \(n=1669\)), whilst 31.0 % weighed their horse’s feed \((n=1181)\). A container of known capacity was used by 16.7 % \((n=636)\), 5.2 % visually guessed their horses feed measurement \((n=198)\), and 0.3 % of participants used a 20-litre bucket \((n=11)\). Responses for the category of ‘other’ (3.0 %, \(n=114\)) included using multiple methods, filling hay nets, or weighing the amount of feed in one scoop (Figure 33).
Methods of measuring feed as reported by participants

### 3.6.4 Feed Composition

Information on the composition of feeds in the daily ration was collected for 4395 horses, and the daily ration quantity in kg was recorded for 3598 horses. Feed composition was explored for differences in the feeding of roughages, concentrates and supplements depending on how horses were housed, workload, pasture and regional climate.

### 3.6.5 Roughages

A total of 96.5% of horses were fed one or more types of roughage in their daily ration. Most rations contained two different types of roughages, with 42.3% of horses fed a ration containing both hay and chaff \( (n=1859) \). The five most popular roughages fed to horses included lucerne hay, lucerne chaff, grass hay, oaten hay and oaten chaff, which were fed to 28.9% \( (n=1270) \), 26.8% \( (n=1178) \), 20.3% \( (n=892) \), 10.0% \( (n=440) \) and 14.5% \( (n=637) \) of horses respectively. Lucerne and oaten chaff were fed at a daily average of 1.2 kg, lucerne hay was fed at an average of 2.7 kg, oaten hay at an average of 3.4 kg and grass hay at an average of 4.3 kg. Other roughages came from various cereal, legume and pasture hays and silages. Sugar-beet pulp and soybean hulls were the most popular alternative roughages fed to horses; which were fed to 12.3% \( (n=540) \), and 4.6% \( (n=202) \) of horses respectively. The
average amount of sugar-beet pulp and soybean hulls fed to horses was 1.0 kg and 0.9 kg respectively.

![Diagram showing average kg fed of different roughages](image)

**Figure 34** The average daily ration weight (kg) recorded by participants of common roughages fed to horses

### 3.6.6 Concentrates

Concentrates included commercial pellets/premixes, grains, co-products and pulses. Overall, 80.0% of rations included one or more type of concentrates \( (n=3516) \). While most horses were fed only one concentrate in their ration (46.1%, \( n=2026 \)), 34.9% were fed two concentrates \( (n=1534) \), 12.1% were fed three concentrates \( (n=536) \), 5.5% were four concentrates \( (n=242) \), and 1.4% of horses were fed five concentrates in their daily feed ration \( (n=62) \).

Commercial pellets/premixes were fed to 64.7% of horses \( (n=2843) \). The average amount of commercial pellets/premixes fed to horses ranged from 1.1 kg - 2.5 kg (Figure 35). Grains were fed to 21.7% of horses \( (n=954) \). The average amount of grains fed to horses ranged from 0.7 kg to 2.8 kg. The most popular grains were oats and barley, which were included in 15.3% \( (n=673) \), and 10.2% of rations \( (n=448) \), respectively. Other grains in feed rations included wheat, millet and grain mixes which were fed to 0.2% \( (n=9) \), 0.7% \( (n=31) \) and 1.2% \( (n=53) \) of horses respectively.
Concentrate co-products included bran, pollard, copra meal, rice bran and mill mix. Concentrate co-products were fed to 18.6 % \((n=818)\) of horses, with the average amount fed ranging from 0.5 kg – 1.6 kg. Copra meal was the most popular co-product included in feed rations and was fed to 12.5 % of horses \((n=550)\). Other co-products such as bran, pollard and rice bran were only fed to 2.6 % \((n=114)\), 1.9 % \((n=84)\) and 1.4 % \((n=62)\) of horses respectively. Pulses were fed to 9.4 % of horses \((n=413)\), with lupins the most commonly recorded \(8.1\%\), \(n=356\). The average amount of pulses fed to horses ranged from 0.5 kg – to 3.1 kg. Figure 35 contains the average weight in kg of concentrates fed to horses from each category.

![Figure 35 The average daily ration weight (kg) recorded by participants of common concentrates fed to horses](image)

### 3.6.7 Supplements

Supplements were classed as additional ingredients in the ration which were not roughages or concentrates; these included such products as vitamins, minerals, herbal supplements and oils. Of the 4330 participants that responded to the question on feeding supplements, 35.0 % \((n= 1516)\) of participants did not feed their horse any supplements. Of those horses fed supplements 42.1 % were fed a single supplement \((n=1188)\), 25.5 % \((n=721)\) were fed two supplements, 15.6 % \((n=441)\) were fed three supplements, 10.0 % \((n=282)\) were fed four supplements and 6.7 % \((n=189)\) rations contained five supplements \((n=238)\). As shown in
Figure 36, combined vitamin-mineral supplements were the most popular supplements included in the ration and were fed to 30.5 % of horses (n=1340), with 8.8 % of horses fed two or more vitamin-mineral supplements (n=119). Mineral supplements were fed to 29.1 % of horses (n=1279), with 25.8 % of horses fed two or more mineral supplements (n=330). Salt accounted for just over half of all recorded mineral supplements (58.2 %, n=744), while only 15.9 % (n= 204) of horses were recorded to be given magnesium. Herbal supplements were fed to 13.3 % of horses (n=583), with 3.5 % of horses fed two or more herbal supplements (n= 154). Turmeric, rose hips, garlic and apple cider vinegar were the most commonly reported herbal supplements and accounted for 24.9 % (n=1094), 18.4 % (n=809), 13.9 % (n=611) and 24.7 % (n=1085) respectively, of all herbal supplements used. Other popular supplements included hoof and coat supplements, gastrointestinal supplements, ration balancers, oils and oilseeds such as linseeds and sunflower seeds.
Figure 36 The number of horses fed supplements in their daily feed ration and the types of supplements fed (n=2814)
3.6.8 The influence of housing management on ration composition

The influence of housing management on ration composition was examined for young, mature and aged horses in maintenance, light, moderate, heavy and intense work. The overall average amount of roughage fed to stabled, sometimes stabled and never stabled horses increased with activity level; the exception being stabled horses in moderate work (Figure 37). Whilst the ratio of roughage: concentrates in the ratio was the highest for mature horses in maintenance and lowest for yearlings in work (Figure 38).

Figure 37 The average daily ration weight (kg) recorded by participants of roughages and concentrates fed to stabled, sometimes stabled and never stabled horses in maintenance and at varying activity levels.

(*Stabled (Maintenance n= 11, light work n= 42, moderate work n= 13, heavy work n= 10, intense work n=13). *Sometimes stabled (Maintenance n= 159, light work n= 204, moderate work n= 114, heavy work n=64, intense work n=65). *Never stabled (Maintenance n= 1082, light work n= 846, moderate work n= 229, heavy work n=167, intense work n=165)).
The average ratio of roughage to concentrates in the rations of stabled horses

(Weanlings n=13, yearlings n=5, yearlings in work n=23, pregnant mares n=4, mature horses in maintenance n=6, matures horses in work n=57, aged horses in work n=4)

3.6.9 The influence of feed measuring method on the amount feed

A comparison between the four methods of feeding was conducted to examine the difference between the reported kilograms fed and the method of ration measurement. Participants that recorded using a feed scoop are likely to be guessing the weight of their hay as hay cannot be ‘scooped’. Overall it shows that the reported rations weights were similar for each category regardless of how participants measured their feed (Figure 39).
3.6.10 The influence of riding disciplines on feed composition

The feed composition and quantity fed to horses in work and training varied between disciplines and activity levels. Results were gathered from horses that had only one riding discipline selected. Of those participants with horses 693 recorded how their horses were housed. In total 71.6 % (n= 502) of horses in work were kept permanently on pasture, with a further 24.1 % (n= 171) recorded as stabled sometimes, resulting in the majority of horses having daily access to pasture.

3.6.10.1 Racing

A total of 38 Thoroughbred horses (TB) in flat race training had their ration composition examined. The majority of horses were fed twice daily. In comparison to horses’ training in other disciplines, TB in training were fed the highest ratio of concentrates to roughage, at a ratio of 60:40 (Figure 40). The average daily roughage intake for TB horses was 4.5 kg (Figure 41), though this ranged from a low of 3.6 kg for TB in moderate race training to 5.1 kg for TB horses in light race training. The average daily hay intake for TB horses was 2.1 kg, while chaff was 1.6 kg. Most trainers (87.0 %) fed both chaff (oaten or wheaten) and lucerne hay. Total quantities of concentrates in the ration ranged from 3.0 kg to 9 kg, with a mean daily ration quantity 4.5 kg. Commercial concentrates were fed by 76.3 % of trainers and were fed at an average of 2.2 kg daily, 77.7 % of trainers fed more than one commercial concentrate. Grains were fed by 55.2 % of trainers. Oats were the most popular grain, fed by 34.2 % of trainers at an average of 1.5 kg daily. Barley was fed by 29.0 % of trainers at an average of 1.3 kg daily. Maize (corn) was only fed by 18.4 % of trainers at an average of 1 kg daily, while 13.1 % of trainers fed lupins at an average of 1.0 kg daily. Supplements were fed by 57.9 % of trainers, with mineral, vitamin and mineral, hoof and coat supplements, oil, gastrointestinal and herbal supplements the most popular. Only 13.2 % of TB were recorded as being kept on pasture, while the majority were permanently stabled.

3.6.10.2 Harness racing

Forty-one Standardbred (SB) horses had their ration composition examined. Standardbred horses were more less likely to be stabled compared to TB race horses, with 51.2 % kept on
pasture and 46.3 % stabled sometimes. Horses that were stabled sometimes were often recorded as kept in day yards. The average amount of roughage fed to SB horses was 5.7 kg, ranging from 5.0-6.0 kg depending on work level (Figure 41). In total 61.2 % of trainers fed hay, those that didn’t either fed chaff or recorded horses to have daily pasture access. The average amount of hay was fed to SB horses was 3.1 kg, oaten and lucerne hay were the most popular types of hay fed to SB horses. Chaff was fed by 68.3 % of trainers, with lucerne chaff in combination with oaten or wheaten chaff the most popular combination fed. Chaff was fed at an average of 2.2 kg daily. Concentrates were fed to SB horses at an average of 4.7 kg daily, varying from 3.3 kg fed to horses in moderate work to 5.1 kg fed to horses in heavy work. Commercial concentrates were fed by 78.9 % of trainers at a daily average of 2.4 kg. Grains were fed by 48.7 % of trainers. Oats were the most popular grain fed and were used by 39.4 % of trainers at an average of 1.6 kg daily. Barley was fed at a daily average of 2.3 kg, by 23.6 % of trainers. Mazie was fed by 15.7 % of trainers at an average of 1.6 kg daily. Unlike TB horses in race training, 13.1 % of SB horses were fed bran, pollard, copra meal at a daily average of 0.9 kg. In total 76.3 % of SB horses were fed a supplement in their daily feed ration. Supplements were fed to 74.3 % of Sb horses in training. Mineral supplements, vitamin and minerals, oilseeds and herbal supplements were the most popular supplements fed to SB horses in harness race training.

### 3.6.10.3 Dressage

The rations compositions of 191 dressage horses were further examined. Just over half of all dressage horses in work were kept permanently at pasture (59.2 %), and a further 36.7 % recorded as sometimes stabled with daily pasture access of ≥6 hours. Dressage horses were fed an average of 5.2 kg of roughage daily. Eighty-three percent of horses were fed hay, at a daily average of 3.5 kg. Chaff was fed at a daily average of 1.5 kg. Lucerne hay was the most popular roughage fed to dressage horses fed by 46.9 % of owners, followed lucerne chaff (40.3 %), almost of quarter of dressage horse owners fed both lucerne hay and lucerne chaff to their horses (23.7 %). Grass hay was fed by 27.0 % of owners and oaten hay by 12.1 %. Concentrates were fed to dressage horses at a daily average of 2.0 kg, though dressage horses in heavy work were fed on average 0.4 kg more than horses in light and moderate work (Figure 41). Commercial concentrates were fed by 80.1 % of owners, at a daily average of 1.8 kg. Grains were only fed by 9.4 % of owners, with lupins fed by 8.2 % of owners.
Supplements were fed by 64.7 % of owners. The most popular supplements fed were combined vitamin and mineral supplements, mineral supplements and herbal supplements.

### 3.6.10.4 Eventing

A total of 75 eventing horses had their feed ration composition further inspected. The average daily roughage intake for eventing horses was 5.7 kg, though horses in heavy work were only fed an average of 4.6 kg daily, while those horses in moderate work were fed 7.7 kg daily. Hay was fed at an average of 3.4 kg daily by 69.0 % of owners, while chaff was fed by 66.1 % of owners at an average of 1.7 kg daily. The most popular hay fed was grass hay which was fed by 44.6 % compared to lucerne hay which was only fed by 29.2 % of owners. Lucerne chaff was the most popular followed by cereal chaffs. Alternative roughages were fed by 29.2 % of owners at an average of 0.7 kg daily. Concentrates were fed at an average of 2.5 kg daily. Though horses in moderate and heavy work were fed similar level of concentrates the reduction in roughage decreased the ratio of concentrates to roughages from 26:74 to 37:63 respectively (Figure 41). In total 81.5 % of horses were fed a commercial concentrate, at a daily average of 1.9 kg. Grains were fed to 16.9 % of horses, similarly lupins were also fed to 16.9 % of eventing horses. Supplements were fed by 72.9% of owners, with vitamin and minerals, mineral supplements the most common recorded supplements used. In total 81.3 % of eventing horses were kept on permanently on pasture. The remaining 18.7 % of horses were recorded a sometimes stable were kept on daily pasture for ≥6 hours, with one horse kept on pasture for only 3-4 hours daily.

### 3.6.10.5 Show jumping

Fifty-five horses recorded to be used only for show jumping had the composition of their feed ration examined. There were no show jumping horses recorded as being permanently stabled, with 67.9 % kept on pasture. The remaining horses which were recorded as sometimes stabled (32.1 %) all had daily access to pasture for ≥ 6 hours. The average amount of roughage fed daily was 5.6 kg, though this varied depending on the activity level with horses in moderate fed the highest average of roughage at 7.6 kg daily. Hay was fed at an average of 3.9 kg per day by 76.4 % of owners, while chaff was fed at an average of 2.3 kg
by 54.5% of owners. Lucerne hay was fed by 51.8% of owners, with grass hay the next most popular choice fed by 24.0% of owners. A number of owners fed both lucerne hay and lucerne chaff (16.6%). Cereal chaffs were fed by 38.9% of owners. The average amount of concentrates fed to show jumping horses was an average of 2.7 kg daily, which was consistent across all levels of activity (Figure 41). Commercial concentrates were fed to 81.5% of show jumping horses at an average of 1.6 kg daily, while 24.0% of horses were fed grains. Oats were the most popular grain of choice fed at a daily average of 0.8 kg. Supplements were included in the daily ration to 72.2% of horses, with vitamin and minerals, mineral supplements, herbal supplements, and ration balancers the most common recorded supplements used.

3.6.10.6 Endurance
There were only 40 horses which recorded as being used solely for endurance riding. Endurance horses were fed an average of 4.7 kg of roughage daily (Figure 41). Hay was fed at a daily average of 3.2 kg, with lucerne hay the popular choice fed by 41.6% of owners, followed by grass and cereal hays. Chaff was fed at a daily average of 1.0 kg with lucerne and cereal chaffs the most popular combination fed. Concentrates were fed by 75.0% of owners at a daily average of 2.1 kg; though endurance horses in light work were fed an average of 3.5 kg daily in comparison to endurance horses in heavy work that were fed an average of 2.0 kg of concentrates daily. The ratio of concentrates to roughages ranged from 40:60 to 30:70, depending on activity level (Figure 40). Only 25.0% of endurance were fed grains, with oats the most popular grain of choice fed at an average of 0.8 kg daily. Supplements were included in the daily ration to 75.6% of horses, with mineral supplements, vitamin and minerals, and electrolytes the most common recorded supplements used. The average amount of oil fed in the ratio to endurance horse was 0.25 litres. The majority of endurance of endurance horses were recorded to be kept at permanently pasture (89.7%).

3.6.10.7 Camp drafting
There were 54 camp drafting horses which had their ration composition examined. Camp drafting horses were fed an average of 4.2 kg of roughage daily, though horses in heavy work
were fed an average of 4.9 kg daily. Hay was fed to 78.4 % of horses, with horses fed a daily average of 3.2 kg. Lucerne hay and chaff were the most popular roughages and were fed by 49.0 % and 23.5 % of owners respectively. A quarter of owners (25.4 %) fed both lucerne hay or chaff in combination with a and oaten or wheaten hay or chaff. As workload increased the amount of concentrates in the ration increase (Figure 41) with horses in heavy work fed almost an additional 1 kg of concentrates daily. In total 76.4 % of owners fed a commercial concentrate, the total average daily amount of concentrates fed was 1.7 kg. Only three out of the 51 owners of camp drafting horses fed grains. Supplements were fed by 65.4 % of owners. Combined vitamin and minerals supplements and ration balancers were the most popular supplements fed to horses used for camp drafting. There were no camp drafting horses recorded to be kept permanently stabled, all horses were either at pasture (81.4 %) or sometimes stabled (19.6 %) with daily pasture access of ≥6 hours.

### 3.6.10.8 Recreational riding

Horses used solely for pleasure and reactional riding represented the largest category of horses, with 88.2 % of horses kept permanently on pasture. The remaining 11.0 % of horses were sometimes stabled but kept on pasture for ≥6 hours daily. As workload increased, the ratio of concentrates to roughages also increased, as seen in Figure 40. The average daily roughage intake was 4.0 kg and was similar for all horses regardless of the level of exercise intensity (Figure 41), hay was fed at an average of 3.1 kg daily. Lucerne hay was fed by 34.3 % of horse owners, while grass hays were fed by 34.2 % of owners and a small proportion of owners fed both (9.2 %). In total 38.4 % of horses were cereal chaffs, while 30.2 % were fed lucerne chaff and 40.0 % of horses were fed both hay and chaff. Chaff was fed at an average of 1.4 kg daily. Alternative roughages were used by 28.0 % of horse owners and were fed at an average of 0.9 kg daily. The average intake of ration concentrates 1.8 kg daily, though it can be seen from Figure 41. that total daily intake of concentrates increased with the workload. Commercial concentrates were fed by 57.4 % of owners at a daily average of 1.2 kg. Only 10.9 % of horses were fed grains; a more popular option was by-products such as copra meal which was fed by 23.6 % of owners. Supplements were fed by 69.7 % of owners, with vitamin and minerals, mineral supplements and herbal supplements, the most commonly recorded supplements used.
Figure 40 The ratio of roughages to concentrates in the rations of horses in work/ training as a percentage of the average amount fed to horses in each riding discipline as reported by participants.

*horses in heavy and very work combined.

(Flat Racing light work n=19, moderate work n=6, heavy work n=13, Harness Racing light work n=11, moderate work n=14, heavy work n=16, Dressage light work n=70, moderate work n=65, heavy work n=56, Eventing light work n=29, moderate work n=22, heavy work n=24, Show Jumping light work n=30, moderate work n=12, heavy work n=13, Endurance light work n=4, moderate work n=3, heavy work n=33, Camp Drafting light work n=34, moderate work n=9, heavy work n=126, Pleasure Riding light work n=172, moderate work n=26, heavy work n=30)
Figure 41 The average daily ration weight (kg) recorded by participants of roughages and concentrates in the rations of horses in each riding discipline.

* Horses in heavy and intense were combined. Refer to Figure 41 for the total number of horses in each category.
3.6.10.9  Feeding broodmares

The majority of broodmares were kept permanently at pasture. Pregnant mares were fed an average of 4.3 kg of roughage and 2.7 kg of concentrates daily. Lucerne hay and chaff the most commonly fed roughages, followed by grass hay and oaten hay. In total 81.4 % of owners fed their pregnant mares concentrates, with 71.2 % feeding a commercial concentrate at an average of 1.7 kg per day. Grains were fed by 23.9 % of owners, at an average of 1.6 kg daily. Though there were slight differences between the average quantity of concentrate and roughage fed during pregnancy, the ratio of concentrates to roughages remained similar. Supplements were fed by 59.5 % of owners, with combined vitamin and minerals supplements and mineral supplements the most commonly recorded supplements used.

Lactating mares were fed a 5.2 kg of roughage daily. Hay and chaff was fed at a daily average of 4.1 kg and 1.7 kg respectively, with lucerne hay and chaff the most commonly fed roughages, followed by grass hay and oaten hay. Similar to pregnant mares 81.4 % of lactating mares were fed concentrates, at a daily average of 3.3 kg. Mares in mid-lactation were fed the lowest ratio of concentrates to roughages (Figure 43). Just over half of all owners (55.5 %) fed their pregnant mares a commercial concentrate at a daily average of 2.0 kg. A third of owners (33.3 %) fed their lactating mares grains at an average of 1.6 kg daily. Supplements were fed by only 43.1 % of owners, with mineral supplements and combined vitamin and minerals supplements the most commonly recorded.
Figure 42 The average daily ration weight (kg) recorded by participants of roughages and concentrates in the rations of broodmares.

(*Pregnant mares early n=11, mid n=99, late n=95, *Lactating mares early n=11, mid n=10, late n=26).

Figure 43 The ratio of roughages to concentrates in the rations of broodmares as a percentage.
3.6.10.10 Feeding weanlings

Seventy-five percent of weanlings were kept at pasture, with 22.6 % of weanlings stabled sometimes. Of those weanlings recorded as sometimes stabled 81.2 % had daily access to pasture for ≥6 hours. Weanlings were fed an average of 3.7 kg of roughage and 2.0 kg of concentrates daily (Figure 44). Though the amount of roughages and concentrates varied depending on the age of weanlings, the ratio of concentrates to roughages remained similar (Figure 45). Hay was fed to 75.9 % of weanlings at an average of 2.8 kg daily, while chaff was fed to 53.7 % of weanlings at an average of 1.3 kg. Lucerne hay and chaff were the most commonly fed roughages, followed by grass hay and oaten hay. In total 80.4 % of weanlings were fed concentrates in the ration. Commercial concentrates were fed by 66.4 % of owners at an average of 1.7 kg daily, only 14.4 % of owners fed grains at 1.2 kg daily. Supplements were fed to just half of all weanlings (52.5 %), with mineral supplements and combined vitamin and minerals supplements the most commonly recorded.

![Figure 44 The average daily ration weight (kg) recorded by participants of roughages and concentrates in the rations of weanlings. (*Weanlings 5 months n=22, 6 months n=62, 7 months n=69, 8 months n=119, 9 months n=115, 10 months n=120, 11 months n=43, 12 months n=86).]
The ratio of roughages to concentrates in the rations of weanlings as a percentage.

**3.6.10.11 Feeding mature horses in maintenance**

A total of 464 mature horses in maintenance had their feed ration composition recorded. A total of four horses were recorded as stabled, with 87.5% of horses kept at pasture and a further 10.5% of horses stabled sometimes but with daily pasture access of ≥6 hours. Out of the 464 horses in maintenance that had their feed composition recorded only 12 were not fed any additional roughage in the feed ration. Horses in maintenance were fed an average of 4.0 kg of roughage and 1.7 kg of concentrates daily (Figure 46). Seventy-six percent of owners fed their horses hay, and a further 58.2% of owners fed their horses chaff. Horses were fed a daily average of 2.9 kg of hay and 1.4 kg of chaff. Lucerne hay and chaff were the most commonly fed roughages, followed by grass hay and oat hay. The majority (75.0%) of all owners fed their mature horses in maintenance concentrates; commercial concentrates were fed by 60.3% of owners at an average of 1.7 kg daily. Only 18.1% of owners fed their horses grains, with oats and barley the most popular grains fed. Supplements were fed by 63.5% of owners, with combined vitamin and minerals, mineral supplements and herbal supplements the most commonly recorded supplements in the feed ration.
3.6.10.12 Feeding aged horses in maintenance

A total of 344 aged horses had their ration composition recorded. Only one aged horse in maintenance was recorded to be permanently stabled, 86.9% of horses were kept at pasture, and a further 11.9% of horses were stable sometimes but had daily access to pasture of ≥ 6 hours or more. Aged horses in maintenance were fed an average of 2.1 kg of roughage (Figure 46). Hay was fed at a daily average of 4.0 kg by 66.8% of owners, while 75.8% of owners fed their aged horses’ chaff at an average of 1.4 kg daily. Lucerne hay and chaff were the most commonly fed roughages, followed by grass hay and oaten hay. Only 19.7% of aged horses received sugar beet pulp or soybean hulls in their ration. Eighty percent of owners fed their aged horses concentrates, at a total average of 2.6 kg daily. Commercial concentrates were fed by 70.9% of owners, the average amount fed was 2.3 kg (Figure 46). Only 17.7% of owners fed grains, with oats and barley the most popular grains fed. Supplements were fed by 62.7% of owners, with mineral supplements combined vitamin and minerals supplements and herbal supplements, the most commonly recorded supplements used in the feed ration.

![Figure 46 The average daily ration weight (kg) recorded by participants of roughages and concentrates in the rations of mature and aged horses in maintenance.](image)

(*Mature horses in maintenance n=464, Aged horses in maintenance n= 344)

3.6.11 The influence of climate and pasture on feeding practices

Australia is a geographically diverse country; to analysis in the influence of climate on feeding practices horses recorded as never stabled were categorised by postcode into climatic zones based on the Bureau of Meteorology climate classifications (Figure 47). A total of
3166 participant responses were used to examine how horses were kept in different climate zones across Australia. The survey recorded that participants owned horses across various climatic zones in Australia; ranging from desert to equatorial to cool temperate zones. While Australia has six major climate zones, the majority of horses were kept in temperate zones (73.1 %, n= 2314), 18.9 % (n= 597) of horses were kept in subtropical zones, 6.8 % (n= 215) of horses were kept in Grassland zones and 1.1 % (n=37) of horses were kept in tropical zones. Only 0.2 % (n= 5) of horses were kept in dessert and equatorial zones.

Horses kept permanently on pasture in Grassland, Subtropical and Temperate Zones were further examined for variations in feeding practices. Overall, the amount of roughage differed by 0.5 kg depending on climate zone, while concentrates did not show any variation (Figure 48).

![Figure 47 Map of the Bureau of Meteorology climate classifications](image_url)
The amount of available pasture (DM/kg/ha) depends on both ground cover and pasture height. While the height of pasture was found to be significantly related to BCS (p=0.02), pasture ground cover and BCS was not (p=0.11), suggesting participants looked more at the height of the pasture in the paddock than at the ground cover. Closer investigation of the pasture biomass available to horses showed that horse owners in grassland and subtropical climates did make changes in the amount of roughage fed to horses; with increasing pasture kg/DM/ha corresponding to decrease in the amount of roughage fed, though concentrates varied less. Whereas horse owners in temperate climates showed only a small change in feeding for horses on 500 kg/DM/ha, while pasture kg/DM/ha at higher levels recorded no changes to the amount of roughage or concentrates fed to horses regardless of pasture biomass on offer.

Figure 48 The average daily ration weight (kg) of roughages and concentrates fed to horses kept in grassland, subtropical and temperate climate zones.
Figure 49 The average daily ration weight (kg) of roughage fed to horses based on pasture biomass (kg/DM/ha) for horses kept in grassland, subtropical and temperate climate zones.

Figure 50 The average daily ration weight (kg) of concentrates fed to horses based on pasture biomass (kg/DM/ha) for horses kept in grassland, subtropical and temperate climate zones.
3.7 NRC Ration Analysis

A total of 2892 horses were included in the NRC ration analysis, which compared rations to the NRC recommendations for daily dry matter dietary intake (DMI), digestible energy (DE), crude protein (CP), macrominerals, and microminerals. Calculations were based on the current NRC formulas for weanlings, yearlings, yearlings in work, pregnant mares, lactating mares, mature horses in maintenance and mature horses in work.

3.7.1 Ration analysis of dietary dry matter intake

The NRC calculates recommended dry matter intake (DMI) to be between 2.0%-2.5% body weight, depending on the current age and use of the horse. Dry matter intake was calculated for the entire ration and did not include pasture intake. A total of 19.3% (n=557) of all rations were found to be in excess of the NRC recommendation daily DMI (Figure 51). The remaining 1.3% (n=29) of rations were equal the NRC recommendations. Further investigation revealed that 14.1% (n=407) of rations were within 1 kg of the NRC recommendation for total kilograms of daily DMI.

![Figure 51](image)

Figure 51 The overall percentage of rations above or below the NRC recommendation for daily dry matter intake.
(Pregnant mares n=65, lactating mares n=44, weanlings n=460, yearlings n=262, yearlings in work n=117, mature horses in maintenance n=347, mature horses in work n=1142, aged horses in maintenance n=258, aged horses in work n=82)

3.7.2 Comparing housing method to daily dry matter intake

Daily DMI was compared between horses stabled all of the time (n=62), sometimes stabled (n=541) and never stabled (n=2289). The majority of all horses were fed a ration below the NRC recommendation for daily DMI, with 61.3 % (n= 38) of stabled horses, 72.5 % (n=392) of horses sometimes stabled and 82.0 % of horses never stabled (Figure 52).

![Figure 52 The percentage of horses stabled, sometimes stabled and never stabled receiving rations above or below the NRC recommendation for daily dry matter intake.](image)

*Rations do not equal 100 % as some rations were equal with the NRC recommendations. See Figure 51 for the total number of horses in each category.

Overall 19.4 % (n= 12) of stabled horses, 17.4 % (n=94) of horses sometimes stabled and 12.8 % (n=292) of horses that were never stabled received a ration within 1 kg of the NRC recommendation. Rations >5 kg above the recommendation for DMI accounted for 14.5 % (n= 9) of stabled horses, 7.4 % (n= 40) of horses sometimes stabled and only 3.0 % (n=61) of horses that were never stabled. While 11.3 % (n= 7) of stabled horses, 27.7 % (n= 150) of horses sometimes stabled and 38.2 % (n=875) of horses that were never stabled, received a ration >5 kg below the NRC recommendation for DMI.
### 3.7.3 Ration analysis of daily digestible energy intake

A total of 23.6 % \( (n=658) \) of owner-reported rations was found to be above the NRC recommendation for daily digestible energy (Figure 53). Within each category of horse over half of all lactating mares were fed DE above requirement, while only 14 % of working horses were fed over the NRC recommendation. Overall only 18.5 % \( (n=536) \) of all rations were found to be within 10% of the NRC recommendation for total MJ of daily DE.

![Figure 53 The percentage of rations above the NRC recommendation for daily digestible energy](image)

*See Figure 51 for the total number of horses in each category.*

### 3.7.4 Ration analysis of excess daily digestible energy intake

The NRC estimates that 67 MJ is the amount of excess DE required for 1 kg of weight gain in horses. In total 2.3 % \( (n=63) \) of horses received a ration that contained \( \geq 67 \)MJ above the horses recommended daily intake of DE (Figure 54).
The percentage of rations providing ≥67MJ of DE above NRC recommendation for daily digestible energy

* See Figure 51 for the total number of horses in each category.

### 3.7.5 The inclusion of pasture consumption and daily digestible energy intake

A closer inspection of pasture composition and its contribution to the horses daily digestible energy intake was conducted for 192 horses. These horses were recorded as never stabled and kept individually thus giving a stocking rate of one horse per paddock. Horses also had pasture ground cover, height, location and pasture species recorded. If horses were only given pasture access and no additional supplementary feeding, based on pasture DM intake at 2.0 %/BW and 80 % digestibility, only 48.9 % (n=94) of horses would have received DE below the NRC recommendation, and no horses had DE in excess of ≥67MJ. Weanlings, yearlings and pregnant mares were the categories most likely to have a digestible energy shortfall if on pasture alone. Increasing pasture DM intake to 2.3 %/BW, resulted in only 20.3 % (n=39) of horses receiving DE below the NRC recommendation, while 21.8 % (n=42) of horses received DE excess in excess of ≥67MJ. When pasture based on intake of 2.0 %/BW and the recorded rations was combined only two horses received daily digestible energy below the NRC recommendation, while 96.8 % (n=186) were receiving a daily digestible energy intake in excess of ≥67MJ (Figure 56).
A closer inspection of horses in work revealed that at the NRC estimate intake of 2%/BW, pasture would have met the nutritional requirements of only 44.6% of horses. Raising pasture intake to 2.3%/BW resulted in pasture meeting the DE requirements for 83.5% of horses. Those horses that could not meet their nutritional requirement from pasture alone were predominantly mature horses in intense work.

Figure 55 A comparison of mature horses in current work on pasture receiving daily digestible energy over the NRC recommendation from pastures at intakes of 2%/BW and 2.3%/BW.

*(mature horses in light work n=53, mature horses in moderate work n=16, mature horses in heavy work n=12, mature horses in intense work n=9,)*
Figure 56 A comparison of 192 horses on pasture receiving daily digestible energy over the NRC recommendation from the owner-reported ration, pastures at intakes of 2%/BW and 2.3%BW and the ration DE combined with pasture intake at 2%/BW.

*(Pregnant mares n=7, lactating mares n=4, weanlings n=16, yearlings n=14, yearlings in work n=6, mature horses in maintenance n=32, mature horses in work n=90, aged horses in maintenance n=16, aged horses in work n=7)*
3.7.6 Comparing housing method to daily digestible energy intake

Daily digestible energy intake was compared between horses stabled all of the time \( (n=62) \), sometimes stabled \( (n=541) \) and never stabled \( (n=2289) \). Forty percent \( (n=25) \) of stabled horses, 32.9 % \( (n=178) \) of horses sometimes stabled and 23.2 % \( (n= 532) \) of horses that were never stabled, received a ration above the NRC recommendation for DE (Figure 57). The percentage of horses that received a ration within 10 % of the NRC recommendation for DE was found to account for 12.9 % \( (n= 8) \) of stabled horses, 13.9 % \( (n=75) \) of horses sometimes stabled and 9.6 % \( (n=219) \) of horses that were never stabled. Furthermore, 4.8 % \( (n= 3) \) of stabled horses, 6.7 % \( (n= 36) \) of horses sometimes stabled and only 3.2 % \( (n=73) \) of horses that were never stabled received a ration of \( \geq 67 \) MJ above the NRC recommendation for daily digestible energy intake.

![Figure 57](image)

Figure 57 The percentage of horses stabled, sometimes stabled and never stabled receiving rations above or below the NRC recommendation for daily digestible energy.

*Rations do not equal 100 % as some rations were equal with the NRC recommendations.*
### 3.7.7 Comparing exercise intensity to daily digestible energy intake

Digestible energy intake was compared between yearlings, matured and aged in maintenance \((n=867)\), light work \((n=747)\), moderate work \((n=254)\), heavy work \((n=180)\) and intense work \((n=175)\). Just over a quarter of all horses in maintenance received a ration containing DE above the NRC recommendation. The percentage of horses receiving DE above requirement decreased as exercise intensity increased (Figure 58). Horses in light work were statistically more likely to be fed a ration with DE above the NRC recommendation \((p=0.000123)\), than horses in moderate, heavy or intense work.

![Figure 58](chart.png)

**Figure 58** The percentage of rations for horses at varying exercise intensities above the NRC recommendation for daily digestible energy

### 3.7.8 Comparing body condition score to daily digestible energy intake

Digestible energy intake was compared between horses in a poor \((n=31)\), moderate \((n=312)\), good \((n=1641)\), fat \((n=433)\) and very fat \((n=22)\) body condition scores (Figure 8, page 33). Figure 59, showed a trend towards an increase of owners reporting rations with a lower DE as horses reached a higher BCS. There was a significant correlation with owners feeding a ration which provided DE above the NRC recommendation \((p=0.000092)\) and not reporting their horses as obese \((BCS \geq 4)\).
Figure 59 The percentage of rations for horses in varying body condition scores providing DE above NRC recommendation for daily digestible energy

3.7.9 Ration analysis of crude protein

NRC ration analysis revealed that in total 49.9 % \( (n=1442) \) of rations recorded by owners provided crude protein (CP) in excess of the NRC recommendation (Figure 60). Almost all yearlings in work, and the majority of pregnant mares received a ration with CP below the recommendation. Rations containing total CP over 14% of the total ration are considered to be high in protein based on the NRC recommendations, a total of 12.8 % \( (n= 369) \) of the owner reported rations provided horses with excessive amounts of protein.
Figure 60 The percentage of rations above or below NRC recommendation for daily crude protein intake.

*Rations do not equal 100 % as some rations were equal with the NRC recommendations. See Figure 51 for the total number of horses in each category.

### 3.7.10 The inclusion of pasture consumption in the ration analysis of crude protein

A closer inspection of pasture composition and its contribution to the daily crude protein (CP) intake was conducted for 150 horses; all horses were kept individually and permanently on pasture with pasture ground cover, height, location and pasture species recorded. If horses were only given pasture access and no additional supplementary feeding, based on pasture DM intake at 2.0 %/BW and 80 % digestibility, only 10.0 % (n=15) of horses would have received CP below the NRC recommendation. When the pasture CP content was included in the ration analysis, all horses received CP over the NRC recommendation (Figure 61).
Figure 61 A comparison of 150 horses on pasture receiving daily crude protein over the NRC recommendation from the owner-reported ration, pastures at an intake of 2%/BW and the ration DE combined with pasture intake at 2%/BW.

*(Pregnant mares n=7, lactating mares n=3, weanlings n=11, yearlings n=11, yearlings in work n=6, mature horses in maintenance n=25, mature horses in work n=67, aged horses in maintenance n=14, aged horses in work n=6)*
3.7.11 Ration analysis of lysine

Half of all rations analysed were found to be below the NRC recommendation for lysine (50.4%, n=1457), with only 9.2% (n=266) of all rations providing lysine within 10% of the recommendation (Figure 62). Further ration analysis found that the categories with the highest percentage of horses receiving a ration below the NRC recommendation for lysine were young horses in work (97.0%, n=128) and lactating mares (75.0%, n=33) (Figure 62).

![Figure 62](image)

Figure 62 The percentage of horses fed lysine above or below the daily NRC recommendation.

*Rations do not equal 100% as some rations were equal with the NRC recommendations. See Figure 51 for the total number of horses in each category.*

3.7.12 Ration analysis of macrominerals

Owner-reported rations were analysed for macrominerals which included calcium, phosphorus, magnesium, potassium, sodium, and chlorine. The majority of rations were found to provide macrominerals in excess of the NRC recommendation (Figure 63), with 65.9% (n=1906) of rations above in calcium, 53.3% (n=1542) above in phosphorus, 59.9% (n=1731) above in sodium, 38.8% (n=1123) above in chlorine, 77.8% (n=2249) above in
magnesium and 91.6 % (n=2649) above in potassium. Less than 10.0 % of all rations were found to balance macrominerals within 10% of the recommended daily intake.

Figure 63 The total percentage of horses receiving ration macrominerals above or below the daily NRC recommendation.

*Rations do not equal 100 % as some rations were equal with the NRC recommendations.

### 3.7.13 Magnesium in the ration

The NRC currently estimates that the maximum tolerable range for magnesium is 0.8 % of daily DMI; in total 8.6 % (n= 247) of owner-reported rations were found to provide horses with magnesium in excess of the maximum tolerable range (Figure 64).
The total percentage of horses receiving a ration containing magnesium above the recommended maximum tolerable range.

*See Figure 51 for the total number of horses in each category.*

### 3.7.14 Ration analysis of the calcium-phosphorus ratio

Further analysis of the calcium and phosphorus content found that 23.4% \( (n=678) \) of rations had an unbalanced calcium-phosphorus ratio which was below the NRC recommended ratio (Figure 65). A total of 969 horses were identified from the nutritional analysis as grazing pastures which contained buffel grass, blue and green panic grass and kikuyu, known to be high oxalate pastures. Only 8.8% \( (n=85) \) of horses on high oxalates pastures had a Ca:P ratio above the recommended ratio of 3:1, while 86.6% \( (n=839) \) horses had a Ca:P ratio below 3:1. The majority of horses with the exception of yearlings were found to have a Ca:P ratio below the minimum ratio of 3:1 (Figure 66).
Figure 65 The total percentage of horses receiving a ration with a calcium-phosphorus ratio above or below the daily NRC recommendation.

*Rations do not equal 100 % as some rations were equal with the NRC recommendations.

Figure 66 The total percentage of horses receiving a Ca:P ration above or below the ratio of 3:1 recommendation.

* Rations do not equal 100 % as some rations were equal with the NRC recommendations.
3.7.15 Ration analysis of microminerals

Ration microminerals included cobalt, copper, iodine, iron, manganese, selenium and zinc. The majority of rations were found to provide macrominerals above the NRC recommendation (Figure 67), with 65.6 % \((n=1898)\) of rations above in cobalt, 62.7 % \((n=1812)\) above in copper, 83.6 % \((n=2418)\) above in iron, 55.0% \((n=1590)\) above in manganese and 68.4 % \((n=1978)\) above in selenium. Whilst iodine and zinc were only recorded to be above the recommendation in 36.2 % \((n=1048)\) and 48.6 % \((n=1406)\) of rations respectively. Except for iron in the ration \((11.4 \%, n=117)\), less than 10.0 % of all rations were found to balance microminerals within 10% of the recommended daily intake.

![Figure 67](image)

The total percentage of horses receiving ration microminerals above or below the NRC recommendation.

*Rations do not equal 100 % as some rations were equal with the NRC recommendations.*

3.7.16 The impact of ration supplements on the analysis

To assess the impact of adding supplements to the ration, the analysis was conducted again with all ration supplements removed. The only ration minerals which differed by more than 10 % with the removal of ration supplements was copper and zinc (Figure 68). The percentage of horses with a Ca:P ratio above 3:1 did not significantly alter.
Figure 68 The total percentage of horses receiving ration macrominerals and microminerals above the NRC recommendation with ration supplements included in the analysis and with ration supplements removed.

*Rations do not equal 100 % as some rations were equal with the NRC recommendations.*
3.7.17 The impact of pasture minerals on the analysis

A closer inspection of pasture composition and its contribution to the horses daily mineral intake was conducted for 448 horses, kept permanently on pasture. The analysis was only applicable for horses on pastures that contained clover, lucerne, rye grass, oats, kikuyu, paspalum, and panic grass species. When pasture and rations were combined, almost all horses received >100 % of their daily mineral intake. Furthermore, pasture alone would have met the daily calcium, phosphorus, magnesium, potassium, iron and manganese requirements of all horses. Bases on the nutritional content of the pasture species included in the analysis sodium, copper and zinc would have only met the requirements of 81.0%, 46.8 % and 70.9 % of horses respectively.

3.7.18 The economics of feeding horses in Australia

A total of 2875 rations were used in a cost analysis; rations which were not used contained feed products which prices could not be found be for. The average daily cost of roughage in the ration was estimated at $3.50. Ration concentrates included premixes, grains and grain by-products and was found to have an average daily cost of $2.30, and ration supplements had an average daily cost of $0.95. The average ration costs for all horses is shown in Figure 69. Overall the average daily, weekly and monthly cost of the given feed ration is contained in Table 6; if there was no change to the ration, the average yearly cost was calculated to be approximately $2,280 per horse. Keeping horses stabled and increased daily ration costs (Figure 70). Stabled horses had an average daily ration costing $9.30, whilst horses stabled sometimes had a daily ration average of $8.30 and horses never stabled had a daily ration average of $6.35.
Figure 69 The average daily cost of a feed ration for horses.

Table 6 The average daily, weekly and monthly cost of the feed ration for all horses

<table>
<thead>
<tr>
<th></th>
<th>Daily</th>
<th>Weekly</th>
<th>Monthly</th>
<th>Yearly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pregnant</td>
<td>$ 5.50</td>
<td>$ 38.53</td>
<td>$ 154.11</td>
<td>$ 1,849.27</td>
</tr>
<tr>
<td>Lactating</td>
<td>$ 5.67</td>
<td>$ 39.70</td>
<td>$ 158.81</td>
<td>$ 1,905.76</td>
</tr>
<tr>
<td>Weanlings</td>
<td>$ 7.10</td>
<td>$ 49.69</td>
<td>$ 198.76</td>
<td>$ 2,385.18</td>
</tr>
<tr>
<td>Yearlings</td>
<td>$ 6.81</td>
<td>$ 47.66</td>
<td>$ 190.64</td>
<td>$ 2,287.73</td>
</tr>
<tr>
<td>Yearlings in work</td>
<td>$ 7.46</td>
<td>$ 52.21</td>
<td>$ 208.85</td>
<td>$ 2,506.20</td>
</tr>
<tr>
<td>Mature</td>
<td>$ 6.20</td>
<td>$ 43.38</td>
<td>$ 173.52</td>
<td>$ 2,082.26</td>
</tr>
<tr>
<td>Mature in work</td>
<td>$ 7.68</td>
<td>$ 53.77</td>
<td>$ 215.07</td>
<td>$ 2,580.86</td>
</tr>
<tr>
<td>Aged</td>
<td>$ 6.63</td>
<td>$ 46.40</td>
<td>$ 185.64</td>
<td>$ 2,227.15</td>
</tr>
<tr>
<td>Aged in work</td>
<td>$ 6.92</td>
<td>$ 48.45</td>
<td>$ 193.78</td>
<td>$ 2,325.39</td>
</tr>
</tbody>
</table>
3.8 Making decisions on the feeding and management of horses

3.8.1 Feeding and management decisions

Participants were asked to record who made the majority of decisions about the feeding management of horses. A total of 3810 responses were received, with 93.3% of participants identifying themselves as being primarily responsible \((n=3556)\). Feeding decisions made by stud/ stable managers accounted for 1.4% \((n=55)\), as did equine nutritionists 1.4% \((n=55)\), and trainers 1.4% \((n=54)\), while veterinarians represented 0.5% \((n=20)\). Responses to the category of ‘other’ included a combination of the horse owner, trainer, coach and/or veterinarian \((1.8\%, n=70)\).

3.8.2 Information on Equine Nutrition

Participants were asked to rank their source of nutritional information from most to least important. A total of 3423 participants ranked their topmost sources of equine nutritional

![Figure 70 The average daily cost of a feed ration for horses always, sometimes and never stabled](image-url)
information as independent equine nutritionists (33.1 %, n=625), scientific literature (29.4 %, n=610), veterinarians’ (24.0 %, n=563) and other horse owners (17.5 %, n=443). Radio, television, newspapers (1.0 %, n=9), horse association meetings / newsletters (1.0 %, n=11), saddlery/ equestrian supplies stores (2.0 %, n=24) and celebrity endorsements (2.8 %, n=25) received the lowest number of responses for ‘most important source’ (Figure 71).

### Figure 71
'Most important' source of equine nutritional information as ranked by 3423 participants

<table>
<thead>
<tr>
<th>Source of Equine Nutritional Information</th>
<th>Number of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Veterinarian</td>
<td>563</td>
</tr>
<tr>
<td>Stable / Stud manager or staff</td>
<td>55</td>
</tr>
<tr>
<td>Social media (Facebook, Twitter, etc.)</td>
<td>106</td>
</tr>
<tr>
<td>Scientific literature</td>
<td>610</td>
</tr>
<tr>
<td>Saddlery / Equestrian supplies store</td>
<td>24</td>
</tr>
<tr>
<td>Riding instructor / trainer</td>
<td>137</td>
</tr>
<tr>
<td>Radio / TV / newspaper</td>
<td>9</td>
</tr>
<tr>
<td>Other horse owners / friends</td>
<td>443</td>
</tr>
<tr>
<td>Manufacturer's feed rep, nutritionist or consultant</td>
<td>239</td>
</tr>
<tr>
<td>Independent equine nutritionist / consultant</td>
<td>159</td>
</tr>
<tr>
<td>Horse magazines / reference books</td>
<td>300</td>
</tr>
<tr>
<td>Horse association meetings / newsletters</td>
<td>11</td>
</tr>
<tr>
<td>Feed store / Stock and station agency staff</td>
<td>70</td>
</tr>
<tr>
<td>Farrier</td>
<td>47</td>
</tr>
<tr>
<td>Equine dentist (other than veterinarian)</td>
<td>25</td>
</tr>
<tr>
<td>Celebrity endorsements</td>
<td>25</td>
</tr>
</tbody>
</table>

3.8.3 **Reasons for choosing ration components**

Participants were asked to record the reason for choosing roughages ($n=4437$), commercial concentrates ($n=3177$), grains/co-products ($n=1839$) and supplements ($n=3354$). Overall the most participants selected nutritional content as the main reason for choosing roughages (36.8 %, $n=1589$), commercial concentrates (49.8 %, $n=1583$), grains/co-products (46.3 %, $n=851$) and supplements (30.1 %, $n=1011$) (Figure 73). Ease of feeding was recorded by 17.2 % of participants as the second most common reasons for selecting a roughage ($n=745$), while 18.2 % and 13.8 % of participants selected the category of ‘other’ as the main reason for
choosing grains \((n=339)\) and commercial concentrates \((n=440)\) respectively; while 28.7 \% \((n=962)\) of participants fed a supplement based on the belief that it was needed by their horse (Figure 72).

![Figure 72 Percentage of responses for choosing ration feedstuffs](image1)

![Figure 73 Percentage of responses for choosing ration supplements](image2)
3.8.4 ‘Other’ reasons for choosing ration components

Further analysis of comments in the open-ended category of ‘other’ found seven main themes from the qualitative data. There were 1721 responses for ‘other’. These were categorised as (1) feed recommended (2) the horse's physical appearance, (3) personal experience, (4) grows own hay/grain to feed, (5) did not feed commercial concentrates or grains, (6) disease prevention and (7) research and testing.

Participants reported that feeds were recommended predominantly by equine nutritionists, farriers, friends, previous owners of the horse, coaches and trainers. Overall a recommendation by an equine nutritionist was reported for 55 feedstuffs; farriers accounted for 23 recommendations while a feed recommended by a veterinarian only was reported 12 times.

“Equine Nutritionist recommended the diet.”
“Friend recommended it a few years ago, and the horses seem to do well on it.”
“Leased horse was being fed this diet at horse owners property before being leased to us; owner recommended we kept diet.”

The physical appearance and behaviour of the horse was an area identified as a prominent reason for the use of the selected feeds, with examples including;

“What seems to work for the horse- holds weight, doesn't go silly, still has energy for exercise.”
“Good results with friends mature horse, working well on my 17 yo gelding.”
“It works. Why change it. He looks healthy, he is fit, coat glowing.”
“Maintains good weight on my horse.”
“…Visually assess and would add sups as needed. Assess coat, hooves and body score.”

A number of participants reported the reason for feeding based on prior experience with feeding horses and that they had used the same feed for many years, examples included;

“Because it has worked well for the last 15 years.”
“It has worked for me and my horse for years.”
“Preferred on personal experience.”
“Research has shown the benefits of these additives and personal experience has proven their efficacy....”
“Experience and knowledge of what concentrates are good for young horses.”
“It was what my father used to do.”

A smaller number of responses were received by participants who grew their own hay and grains to feed to their horses, responses included;

“We grow our own oats, cut chaff from whole plants (not headed)”
“We grow all our hay ourselves”

One of the predominate responses recorded by participants was that they did not feed commercial concentrates or grains, examples of the responses include;

“I don’t feed grain ever.”
“Cannot eat hay & intolerant to grains including oats & wheat chaffs.”
“no grain at all, she is a very good doer.”
“I do not feed any grains or concentrates. Horses are grass eaters.”
“I don’t like premixed feeds, I don't trust the manufacturer to use the best quality products, and the labels are so vague they can substitute proteins.”

The prevention of laminitis and ulcers were the most common responses for disease prevention, other preventative measures were recorded for dental health especially in aged horses, examples include;

“Hay creates longer chewing time releasing more saliva combined with lucerne creates a barrier over stomach acid to help reduce ulcers.”
“Horse is ulcer-prone, so much (better too) have a grain free, low sugar/starch diet.”
“Previous founder/laminitis issues, no flare-ups on this roughage.”
“Keeps laminitis away.”
“Horse is 37 and lacks the teeth to chew most things.”
“Horse has almost no teeth and struggles to eat, although he is enthusiastic.”

Research by participants such as tests performed on soil, pasture and horse hair was one of the most commonly reported other reasons given by participants for feeding supplements. Yet only two participants stated that they specifically used scientific literature.

Participants responses included;

“Years of research.”
“Recommended by independent equine nutritionist after pasture ‘n feed testing.”
“Known deficiency of magnesium in him, and salt replacement during hot and humid weather.”

“Recommendations following hair testing.”

“Research has shown the benefits of these additives and personal experience has proven their efficacy. I can tell if my horse misses a few doses of the Turmeric mix as he is stiffer and more arthritis, symptom wise.”

“Symptom and result based management and scientifically backed ingredients from my own research in nutrition.”

“Internet research and trial/ error to keep the horse healthy.”
4 Discussion

4.1 Introduction

The aim of this study was to describe the feeding and management practices of Australian horse owners and compare the results to the current scientific literature; as inappropriate nutrition, feeding and management practices have been linked to health, welfare and behavioural problems in the horse. This study has provided a detailed cross-sectional overview of the current demographics, housing, exercise and feeding practices of the domestic equine population of Australia.

4.2 Using social media in research

Compared to previous studies involving horse owners which had relied upon postal surveys or face to face questionnaires, the primary form of recruitment used in this study was online e-newsletters and Facebook (Buckley et al., 2004; Buckley et al., 2000; McGowan et al., 2010a; Southwood et al., 1993a, 1993b) (Buckley, Dunn, & More, 2004; Buckley, More, & Dunn, 2000; McGowan et al., 2010; Owens, 2005; Southwood, Evans, Bryden, & Rose, 1993a, 1993b). Recent years have seen the development and growth of social media to a point where it is now regarded as ubiquitous in contemporary culture and society (Cooper et al., 2016). Using an online and social media platform allows for data to be obtained from a large number of horse owners located across Australia. Survey distribution also benefited from online snowball sampling through Facebook with users ‘liking’ ‘sharing’, ‘tagging’ and ‘commenting’ on survey links and posts. The response rate is difficult to determine from online surveys as it is not possible to know how many people viewed the survey link but chose not to respond; though similar online surveys on equine topics have yielded comparable response rates (Boden, Parkin, Yates, Mellor, & Kao, 2013; Smyth & Dagley, 2015). Interestingly this study collected a significantly higher number of responses than a study on Hendra virus released earlier in 2017, despite both studies using Facebook as the primary distribution and recruitment method (Manyweathers et al., 2017). When the methods were compared, the survey by Manyweathers et al. (2017) only posted on the Facebook pages of 26 veterinary hospitals and made three postings on their own Facebook page. In contrast,
the current study made over 80 Facebook postings during the 10 weeks that the survey was open for and posted on over 30 Facebook pages which had member numbers ranging from 2000-30,000. In addition, the survey was included on the websites and e-newsletters of several equine societies and organisations. Signifying that a continual social media and online presence is effective in achieving higher survey response rates.

Future research projects which intend to use social media should consider having a larger social media presence with research content and progress on various social networking sites, blogs, microblogs, and content communities. Social media platforms can be used to inform the public and participants on the progression of research, new scientific developments and create a greater interest in scientific research within the community. An additional recommendation of this study is that future researchers should consider establishing their research study as separate social media account to their own personal social media account; allowing for the researchers to create a boundary between their work, study, and personal lives.

4.3 Demographics of Australians horse owners

The demographics of Australian horse owner’s in the current study were comparable to previous research from Australia and studies from the United Kingdom (UK) and the United States of America (USA). The higher number of female respondents as horse owners involved in the equine industry concurs with the results reported previous equine-related surveys (Boden et al., 2013; British Equestrian Trade Association, 2015; Murray et al., 2015; Wickens, Waite, Garey, & Fraze, 2011). The age range of participants was also similar to the results recorded by Murray et al. (2015) in a global survey; this differed from a survey by the American Horse Publications (2012), which recorded an older age demographic, though this may be due to the survey being distributed online. Participant reported experience with horses, varied from less than one year to more than 60 years with the majority of survey participants reporting more than six years of experience with horses, which was similar to the results found by Murray et al. (2015). The majority of survey participants were themselves horse owners and many identified as both pleasure and competition riders, which is consistent with other research (Australian Horse Industry Council, 2015; Boden et al., 2013). Many
participants selected more than one area of equine industry involvement, highlighting the diversity of the Australian equine industry. As other authors have noted the Australian horse industry can be divided into the horse racing industry and the recreational horse population (Hemsworth, 2012), however, this survey only captured a small representation of the racing industry.

4.4 Distribution and density of the Australian domestic equine population

The distribution of participants’ horses was consistent with previous studies on horse ownership in Australia (Gordon, 2001; Thompson, Clarkson, Riley, & Van den Berg, 2017). Horse ownership followed the geographical distribution of the general population (Australian Bureau of Statistics, 2017). The distance between where horses were kept and their owner’s place of residence was similar to other surveys (Boden et al., 2013; Wylie, Ireland, et al., 2013), indicating that a high percentage of horses would have been kept at the participant's own residence. The density of the Australian domestic horse population has previously been described by the NSW Rural Lands Protection Board (RLPB) and various studies after the 2007 outbreak of Equine influenza (Australian Bureau of Statistics, 2006; Moloney, 2011; Moloney, Sergeant, Taragel, & Buckley, 2011). The results of this study showed a high-density equine population in the NSW Hunter Valley, as expected due to the high concentration of Thoroughbred studs based on previously collected data. However, the high-density horse populations in the Queensland local government areas of Livingston, Rockhampton and Central Highlands was unexpected. The primary concern for horse owners in this area is that it overlaps with reported cases of Hendra Virus (Business Queensland, 2018) and at the time of writing a current outbreak of Kunjin virus; the Australian strain of West Nile Virus (WNV_KUN) (Australian Horse Industry Council, 2018). Overlapping Hendra virus outbreak areas and high-density horse ownership are populations of feral horses (Csurhes, Paroz, & Markula, 2016). Feral horses have been deemed be a potential to be a disease reservoir for the Australian domestic horse population (Dobbie, Berman, & Braysher, 1993; Gilchrist & Sergeant, 2011). A disease outbreak in these areas would cause significant impacts on the Australian equine industry and is a health risk for all equines.
4.5 Demographics of the Australian domestic horse population

The demographic characteristics of the Australian Equine population reported in this study were similar to those from previous surveys (Cole, Hodgson, Reid, & Mellor, 2005; McGowan et al., 2010a; Smyth & Dagley, 2015; Thompson et al., 2017). The uneven distribution of mature geldings in the equine population has been reported in other studies both in Australia and the UK (Clarkson & Thompson, 2013; Hayek, 2004; Hotchkiss et al., 2007; Ireland, Clegg, et al., 2011a; McGowan et al., 2010a). This skew is likely due to a higher proportion of mares used for breeding rather than riding (Cole et al., 2005). The age of weanlings and yearlings reflected that the majority were born between November to January; following the seasonal polyestrus breeding cycle of the mare (Brinsko et al., 2011). This seasonal trend is reflected in the reported months of gestation and lactation for breeding mares, which confirms that the majority of mares were joined between September to November the previous year. The low survey responses for lactating mares was probably due to the survey being released in winter when the majority of foals would have already been weaned. Participants with lactating mares reported that most mares were in their last month of lactation, corresponding to foals born in late summer. This study also inquired into the feeding and management practices of aged horses. There is no current consensus as to what categorises horses as old, geriatric or aged (Kohnke, n.d.). Previous studies have categorised aged horses as ≥15 years old (Ireland, Clegg, et al., 2011a; McGowan et al., 2010a) or ≥ 20 years old (Ralston, Squires, & Nockels, 1989), while a survey of horse owners found many considered horses ≥22 years old as aged horses (Brosnahan & Paradis, 2003). For the purposes of this study, a horse aged ≥ 20 years old was considered to be aged due to age-associated anatomical (e.g. dental) and physiological changes that impact prehension, mastication, digestion, and absorption of feed (Jarvis, 2009; Ralston et al., 1989). This study reported that only 12.0 % of the equine population was ≥20 years of age, which was similar to the findings of Thompson et al. (2017) and Ireland, Clegg, et al. (2011a), who recorded that respectively 10.0 % and 11.0 % of horses were ≥20 years of age. The demographics of the Australian domestic horse population appear to be stable and similar to that of other advanced economies including the UK and USA.
4.6 Reporting body condition score

Obesity is emerging as one of the most common health problems affecting domesticated horses. Obesity is defined as a body condition score (BCS) of ≥4 on a scale of 0-5 (Carroll & Huntington, 1988); Obesity increases the risk of horses developing a number of health problems including laminitis, insulin resistance, equine metabolic syndrome, reduced fertility, reduced athletic performance and increasing the risk of misbehaviour (Buckley, Morton, Buckley, & Coleman, 2013; Frank, 2011; Karikoski et al., 2011; Morley & Murray, 2014; Webb, Potter, Evans, & Webb, 1990; Wylie, Collins, et al., 2013b). In this study, 20.3% of horses were recorded to be obese. This is lower than in other reports, including 45% reported for riding horses in Scotland (Wyse et al., 2008), 27-35% in a population of UK leisure horses during winter and summer respectively (Giles, Rands, Nicol, & Harris, 2014), 51% of mature horses in a study in the USA (Thatcher, Pleasant, Geor, & Elvinger, 2012) and 24.5% in Australian pleasure horses (Potter, Bamford, Harris, & Bailey, 2016). From the previously stated research, it is likely that the percentage of obese horses in Australia is higher than what was reported in this study. Horse owners often underestimate their horse's current body condition, with one study finding only 11% of owners could correctly score their horses’ body condition (Morrison et al., 2017), whereas a separate study that used trained assessors to measure BCS recorded 62% of horses were found to be overweight (Harker, Harris, & Barfoot, 2011). Horse owner’s underestimating their horse's current body condition are placing horses at risk of developing preventable obesity-related diseases. A multivariable logistic regression model was designed to examine the risk factors associated with obesity. Though horses reportedly in work were more likely to be obese than horses in maintenance, the ration analysis found that only 1.0% of horses in work were fed digestible energy above the NRC (2007) recommendation, compared to 27% of horses in maintenance. The owners of horses in work are likely to be spending more time with these horses and therefore more aware of changes in body condition. The breed of the horse also had an impact on the risk of obesity. Large Cob/pony breeds and Shetland ponies were more likely to be reported as obese, which agrees with previous research (Potter et al., 2016). On the other hand, Standardbred, Thoroughbred and Warmblood horses were less likely to be reported as obese. Past studies have found that the perception of body condition score is biased by the breed of the horse, with sports horses more likely to be given lower score than Draught, Cob and pony type breeds (Morrison et al., 2017). This study also found that as turnout time increased participants were less likely to report their horses as obese. This is
juxtaposed to the results of the ration analysis, which found that the majority of horses on pasture received daily digestible energy above the NRC (2007) recommendation and would have been gaining weight over the duration of the study period. In addition, horse owners who fed a ration that was over the NRC (2007) recommendation for digestible energy were 1.9 times less likely to report their horses as obese. The perception of an appropriate or “ideal” body condition varies between horse owners and equestrian disciplines (Morrison et al., 2017). The misperception of body condition score is often linked to horse owners underestimating body condition, and the owners of fat and obese horses have been found more likely to underestimate their horses body condition score (Jensen, Danielsen, & Tauson, 2016; Potter et al., 2016; Stephenson et al., 2011; Wyse et al., 2008). Furthermore, it has been reported that in one survey only 46 % of horse owners regularly used body condition scoring, while 24 % did not use body condition scoring at all and a further 10 % did not know what body condition scoring was (Murray et al., 2015). Body condition scoring is evidently an area of difficulty for horse owners, and owner education on how to correctly score a horse’s current body condition should be given priority to decrease the rate of obesity among domestic horses.

4.7 Management of stabled horses

This study recorded 2.1 % of horses were permanently stabled. These results were similar to those found by Thompson et al. (2017), who also recorded that 2.0 % of Australian horses were permanently stabled, though slightly below the findings of McGowan et al. (2010a) who recorded that 5 % of horses in Queensland aged ≥15 years old were stabled. The low percentage of horses kept stabled likely reflects the mild climate of Australia with the majority of horses being kept in semi-rural, rural and regional areas where space to provide paddocks is available. This contrasts with horses kept in highly urban environments; a study on horses kept in Brazil, found 90.0 % of horses kept in cities were permanently stabled (Leme, Parsekian, Kanaan, & Hötzel, 2014). Whilst stabling provides a controlled environment, horses kept stabled for prolonged periods had a higher risk of developing gastric ulcers (Luthersson et al., 2009), colic (Archer & Proudman, 2006), increased stereotypic behaviours and a restricted opportunity to self-exercise. The first three of these factors have been linked to ration composition and feeding practices; specifically, the lack of
ad lib access to roughage for continual grazing (Cooper & McGreevy, 2007; Harris et al., 2016; Luthersson et al., 2017; Luthersson et al., 2009; Williams, Tucker, Green, & Freeman, 2011). This study found that 66.3% of stabled horses were fed a ration twice daily and 61.0% of stabled horses were fed below the NRC recommendation for daily dry matter intake. Based on evidence of confinement related health problems, the majority of stabled horses in this study were at risk of developing gastric ulcers, colic, and developing stereotypic behaviours. However, horse owners could minimise these risks by increasing the roughage component of the ration, providing horses with continual access to roughage and/or using a slow-feeder hay net which increases hay consumption duration and decreases intake rate (Glunk, Hathaway, Weber, Sheaffer, & Martinson, 2014). Another concern raised in this survey was that just over half of all stabled horses were recorded to have no daily turnout. Research from the UK has recorded that 60.1% of UK horses were kept stabled with daily turn out (Wylie, Ireland, et al., 2013), compared to only 23.9% of stabled horses in this survey. Post inhibitory rebound in locomotor behaviour has been recorded in horses kept stabled and is an indicator that horses were responding to a behavioural deprivation (Chaya, Cowan, & McGuire, 2006; Houpt, Houpt, Johnson, Erb, & Yeon, 2001; Pessoa et al., 2016; Werhahn, Hessel, & Van den Weghe, 2011). Freire, Buckley, and Cooper (2009) recommended that one hour/day of exercise as the minimum amount of exercise to reduce rebound behaviours in horses. However, only 4 out of the 83 stabled horses were exercised for ≥60 minutes, while no young horses in work were exercised for longer than 40 minutes. The results of this study indicate that though locomotor behavioural deprivation is common in the stabled horse, improved horse welfare could be met by increasing turn out, exercise duration and/or the provision of additional hand walking.

4.8 The management of horses at pasture

The majority of Australian horses were kept at pasture and never stabled, which agrees with previous studies on Australian horse ownership (McGowan et al., 2010a; Smyth & Dagley, 2015; Stubbs, 2001; Thompson et al., 2017). Therefore, pasture management is an integral part of horse keeping in Australia. However, the results of this study indicate that the majority of horse owners did not manage their pastures appropriately, which is likely why almost all horses were fed a ration in addition to pasture access. Horse owners reported 58.5% of horses were kept on overgrazed pastures, including those that contained patches of tall
and short grass; a typical sign of what is described as ‘horse sick pasture’. Similar results have been recorded in Australian equine pasture studies over the past 20 years, indicating little has changed in pasture management and that horse owners still have a lack of understanding on how to correctly manage their pastures (Stubbs, 2001; van den Berg, Brown, Lee, & Hinch, 2015; Wheatley, Stallard, & Woodward, 1998). These results indicate that many horses are kept on pastures that are under high grazing pressure, which could force horses to graze on potentially poisonous herbage (Avery, 2006). Of concern is that just over a third of surveyed horse owners did not know what pasture species were growing in their horses’ paddocks. So even a well-intentioned owner may be placing their horses at risk of preventable diseases, such as pasture-associated laminitis, obesity, plant poisoning and nutritional disorders (Watts & Pollitt, 2010); of these conditions laminitis and obesity are the most common, the prevalence of laminitis in Australia ranges from 1.6 % (Cole et al., 2005) to 23.8 % (Buckley et al., 2007). However, a recent study in the UK found that almost half of all owners who brought their horses to veterinary clinics due to lameness did not recognise that their horses had laminitis (Pollard et al., 2017), suggesting the frequency of laminitis in Australia could be higher than estimated. Poor pasture management during periods of high pasture production typically spring and autumn in temperate Australia results in excessive weight gain in horses (Thatcher et al., 2012) which in turn increases the risk of horses developing laminitis (Wylie, Collins, et al., 2013b). Horse owners need to understand which environmental conditions can increase the risk of horses developing laminitis, and how to manage at risk horses (Watts & Pollitt, 2010). Furthermore, pasture management can influence equine behaviour, with misbehaviour in ridden pony club horses more likely in overweight animals kept on actively growing (green) pastures (Buckley et al., 2013). Well managed pastures reduce feed costs and keep horses healthy, yet this study has found many horse owners have poor pasture management which inadvertently increases the risk of horses developing preventable diseases. Horse owners need to see pastures as a valuable resource and therefore owner education in this area should be a priority.

4.9 Exercise management of Australian horses

Determining a horse’s level of exercise intensity is a crucial prerequisite in the NRC (2007) nutritional formulas. Yet, previous research has found horse owners frequently overestimated
their horse's workload when asked to choose if their horses were in light, moderate, heavy or intense work (Hale et al., 2016). This study required participants to record the average number of exercise sessions per week and the time spent in each pace during a typical training session; horses were grouped into their levels of exercise intensity, thus preventing owners from overestimating workload. The majority of horses were found to be in light work, this was consistent with leisure riding being the most popular pursuit for horse owners, and is similar to the reported use of horses in the UK and USA (Hoffman, Costa, et al., 2009; Hotchkiss et al., 2007; Ireland, Clegg, et al., 2011a; Murray et al., 2015; United States Department of Agriculture, 2016; Wylie, Ireland, et al., 2013). The amount of exercise horses receive is an essential factor in managing obesity. Research from the UK has recorded that horses used for leisure riding are more likely to be at risk of obesity than horses ridden in competition (Robin et al., 2013). Signifying that horse owners need to be aware that merely having a horse in work does not prevent obesity. The workload of horses in moderate, heavy and intense exercise intensities were comparable to previous studies on competition dressage horses in the UK (Walters, Parkin, Snart, & Murray, 2008) and New Zealand competition horses (Verhaar et al., 2014), suggesting that most horses working at higher intensities are used for competition. A significant finding of this study was that though racehorses are often perceived as being the typical horse in intense work, there were horses used for endurance, eventing, camp drafting and show jumping worked for both longer durations and at higher intensities. However, it should be noted that unlike racehorses, sports horses were predominately kept at pasture. It is a recommendation of this study that horse owners require more resources and further education to aid in accurately categorising workload and exercise intensity; which would further aid horse owners in formulating the correct rations for their horses and reduce the health problems associated with overestimating nutritional requirements.

4.10 Measuring feed quantity

Feeding by weight warrants that the amount of feed is accurate and ensures that horses are fed an appropriate ration. However, this study recorded that only 31 % of participants weighed their horse’s feed ration, which was consistent with previous studies by Murray et al. (2015) and Hoffman, Costa, et al. (2009) who also recorded 29 % and 30 % of horse owners
weighed their horses feed ration respectively. Such findings indicate that overall many horse owners are not weighing their horses feed rations. Feeding by volume instead of weight, disregards the variation in density between feedstuffs. This variation is highlighted on the webpage of one Australian feed company which recorded a difference of 0.45 kg between its feed products even though the same 2L feed scoop was used ("Hygain Equine Senior," 2016; "Hygain Ice," 2016). Feeding by volume and not weight is endemic in all levels of the Australian equine community with a past study on the Australian equestrian Olympic team recording hay was often fed by volume and not weight, leading to significantly daily variances (Owens, 2005). Horse owners need to understand that inappropriate feeding practices lead to a number of diseases and behavioural issues, which are easily preventable and manageable through correct feeding that starts with accurately measuring the ration.

4.11 Ration composition

A balanced ration should provide a horse with the appropriate quantities of energy, protein, minerals and vitamins to perform optimally and remain healthy. The horse has adapted to be an efficient high fibre grazer, thus the main component of the equine ration should be roughages (Mills & Nankervis, 1999). Historically, working horses could not have their nutritional need met by roughage alone, due to high energy demands and limited time for feeding (Harris et al., 2016). In addition, roughages were often poor in quality, and difficult to transport; leading to the use of grains as a major component of the diet (Donaghy, 2012; Herbert, 1859; Stewart, 1838). Inappropriately feeding concentrates to the horse can adversely affect the health, welfare and behaviour of the horse. The horse requires a minimum of 1.5 %/BW as roughage dry matter per day (Harris et al., 2016), meaning the roughage to concentrate ratio should be 75:25, if intake is based on the NRC recommendation of 2%/BW (NRC, 2007). Most rations in this study had a roughage to concentrate ratio below the current recommendation. However, the majority of horses were kept at pasture, and this would have added to the daily roughage intake. Stabled horses were identified as those horses at risk of health problems from a roughage: concentrate ratio imbalance and these horses were predominantly Thoroughbred and Standardbred harness racehorses. Thoroughbred horses in race training were fed the lowest ratio of roughages: concentrates followed by Standardbred horses in harness race training. Furthermore, the ratio recorded in this study for Thoroughbred horses in heavy work (40:60) was identical to the ratio recorded by Bourke
(1968) and Southwood et al. (1993b). The practice of reducing roughages while increasing the amount concentrates fed to racehorses is most likely the product of the 1989 publication of the NRC Nutrient Requirements of Horses which recommended a roughage to concentrate ratio of 35:65 for horses in race training. The practice of reducing roughage in the ration for the racehorse has been further fuelled by the belief that roughage provides a weight handicap to racehorses caused from an increase in gut weight and water consumption, (Ellis, Hollands, & Allen, 2002). Research into the roughage intake of racehorses has found a difference of only 3 kg in body weight between horses fed a roughage only ration compared to a ration of 50: 50 roughage to concentrates (Connysson, Essén-Gustavsson, Lindberg, & Jansson, 2010). Furthermore, racehorses fed 100% roughage diets were found to have no difference in performance to compared to horses fed traditional diets (Jansson & Ringmark, 2014). The results of these studies show that the current ration of the racehorse is still based on the high concentrate tradition, yet feeding high-energy forage-only diets can produce equal results whilst reducing the health and welfare problem of the high concentrate diet. Horse owners need to be aware that the majority of the horse's ration, even in elite equine athletes must to be roughage to ensure horses have optimal digestive health, optimal performance and are able to fulfil their natural grazing behaviours.

4.12 Hay verse chaff feeding

Most participants provided their horses with a daily feed ration that contained one or more roughages. While feeding stabled horses various types of roughage provides environmental enrichment (Thorne, Goodwin, Kennedy, Davidson, & Harris, 2005), the majority of horses in this study were kept in paddocks with access to pasture which allowed for natural grazing behaviours. Many owners fed their horses both hay and chaff, which is unnecessary for most horses. Feeding chaff in the ration comes from the long-held tradition that, the inclusion of chaff will slow down the rate of intake of concentrates in a ration. While the addition of 35% chaff to a pellet mix led to more than double the time spent on feed intake (from 147 g/min intake to 64 g/min) (Ellis, Thomas, Arkell, & Harris, 2005), feeding ad libitum hay before a ration of cracked corn resulted in an average intake of 55.5 g/min (Vervuert, Brüssow, Bochnia, Cuddeford, & Coenen, 2013). While some horses with poor dentition such as aged horses, are unable to adequately chew hay or pasture (Ralston et al., 1989), for the majority of
horses feeding hay is more beneficial. Feeding horses hay increases the duration of mastication and jaw motion which aids in promoting correct dental (Bonin et al., 2007). As horses are required to masticate for longer there is an increase in salvia production that buffers stomach acid and protects the stomach from gastric ulcers (Luthersson & Nadeau, 2013). Furthermore, horses allowed to graze on hay have fewer stereotypical behaviours (Dezfouli, Tavanaeimanesh, Naghadeh, Bokaei, & Corley, 2014; McGreevy, 2012). Most horses kept on pastures do not require additional feeding, but for those horses that require additional roughage, hay should be feed instead of chaff as it provides a greater number of health benefits for the horse.

4.13 Alternative roughages

Roughage plays a vital role in the equine diet, but if feeding hay or chaff is not a viable option horse owners should consider using alternative sources of roughage. Alternative roughages are often industry by-products, for example, sugar beet pulp is a by-product from the sugar refining industry (Kelly, 1983) while soybean hulls are a by-product of soybean oil production ("What are soybean hulls?," 2008), other by-products include citrus pulp, almond hulls and oat hulls. These products are often high in fibre and extensively fermented in the equine hindgut and are well suited as a replacement for starch-rich feedstuffs (Lindberg, 2013). These products have been made available to horse owners in Australia over the last 17 years (Huntington, 2001), though the use of alternative roughages by horse owners has not been extensively studied. Horses have been fed rations consisting of 45-55 % sugar beet pulp without any adverse effects on overall nutrient utilization and performance (Harris & Rodiek, 1993; Warren, Lawrence, Brewster-Barnes, & Powell, 1999). Other studies have found that sugar beet pulp was comparable to oats for digestibility, crude protein, neutral detergent fibre and energy (Lindberg & Karlsson, 2001; Palmgren-Karlsson, Jansson, Essen-Gustavsson, & Lindberg, 2002). Mature horses have been fed rations of up to 75 % soybean hulls, and results on nutritional analysis have found soybean hulls comparable to a lucerne/grass hay (Coverdale, Moore, Tyler, & Miller-Auwerda, 2004). Such studies suggest sugar beet pulp and soybean hulls should be considered as a viable alternative to hay, chaff and even oats. Horse owners in drought-affected areas can use alternative roughages as part of the feed ration when hay is of limited supply. Additionally, the low starch content of sugar beet pulp
and soybean hulls means that these feeds are a suitable alternative to hay and pasture for horses and ponies prone to laminitis. Finally, these by-products are a suitable feed for older horses that may struggle to chew and digest hay due to a lack of teeth, as these feeds are able to be softened with water. Alternative roughage sources are well utilized by horses and provide horses with fibre while preventing a range of health problems associated with traditional high grains diets or diets lacking in fibre.

4.14 Overfeeding supplements

Supplements for horses include a range of vitamins, minerals, oils, joint, protein, herbal and gastrointestinal supplements as well as many others, they are fed by many horse owners with the intention of improving their horse’s health and performance. However, this study found horse owners had little understanding of the role of supplements in the diet, resulting in many horses being unnecessarily over supplemented. The large variety of supplement products on the market for Australian horse owners highlights their popularity. Supplement use in this study was lower than past research and Australian horse owners preferred mineral supplements, over joint supplements (Agar et al., 2016; Burk & Williams, 2008; Demirel, 2006; Gemmill et al., 2016; Hoffman, Costa, et al., 2009; Ireland, Clegg, et al., 2011a; Kaya-Karasu, Huntington, Iben, & Murray, 2018; McGowan et al., 2010a; Murray, Hanna, & Hastie, 2018; Verhaar et al., 2014). Most horse owners in this study as in past research fed supplements based on a personal belief that their horse needed the supplement (Swirsley, Spooner, & Hoffman, 2017). This is interesting given, the limited research on the efficacy of supplements, and that many supplements have not been scientifically evaluated (Elghandour et al., 2018; Harris, Coenen, & Geor, 2013; Murray et al., 2018). Additionally, while owners may feel their horses will encounter a nutritional deficiency without supplements, dietary deficiencies in horses are in fact very rare (National Research Council, 2007; Stewart, 2011; Toribio, 2011), with this study finding only a small percentage of horses required an additional mineral supplement to correct a ration imbalance. Research indicates that for the most part horses in maintenance and light work do not require nutritional supplements in the ration, as the addition of supplements only resulted in horses being fed excess of NRC requirements (Neustädter, Kamphues, & Ratert, 2018; Ramey & Duren, 2011). This was confirmed in the NRC (2007) ration analysis, which found that almost all horses received minerals in excess of requirements. Feeding supplements superfluous to the horses
requirement is an unnecessary financial cost to the horse owner. When supplements were
removed from the ration, the number of rations providing minerals in excess showed only a
slight decrease; this was likely due to many commercial concentrates including vitamin and
mineral mixes in their products thus reaffirming that feeding additional supplements to horses
fed commercial feeds is unnecessary. Excess mineral intake appears to be a more significant
issue than a mineral deficiency in Australian horses. Many horse owners had little
understanding about the suitability of supplements in the ration with most owners
overestimating their horse’s nutritional requirements and underestimating the nutritional
content of pastures.

4.15 Dietary calcium: phosphorus ratio

A diet where the phosphorus content exceeds the calcium content, even if both minerals are
within the NRC recommendation, will result in the bioavailability of calcium being reduced
(Hathaway, n.d). A calcium: phosphorus ratio (Ca:P) imbalance can occur from feeding large
amounts of cereal grains and/or from high oxalate pastures (NRC, 2007), in this study the
latter is of more concern as grains in most rations were not fed at the quantities required to
impact on the Ca:P ratio. The NRC (2007) recommends a Ca:P ratio of approximately 1.5:1,
yet an imbalance in the calcium to phosphorus ratio was found in the rations of many horses
on high oxalate pastures. The implication of a ration in which phosphorus exceed calcium is
nutritional secondary hyperparathyroidism. A metabolic bone disease, caused from a decrease
in dietary calcium absorption, resulting in bone demineralization, lameness, stiffness, sore
joints, disruption of the articular cartilage and tearing of tendons and ligaments (NRC, 2007).
Tropical grasses such as buffel grass, blue and green panic grass and kikuyu, are known to be
high oxalate grasses in Australia. The availability of dietary calcium is reduced by the
presences of oxalates in the pasture (Allan, 2007). For many horses, the addition of a
supplement is unnecessary, however, when specific nutritional supplementation is needed
horse owners should select nutritional supplements for specific deficiencies rather than to rely
on a complete product (Ramey & Duren, 2011). Horse owners need to be guided as to when
supplements are and are not necessary in the ration based on the knowledge of what their
pastures are already providing or not. It is a recommendation of this study that horses on high
oxalate pastures require additional calcium, either from a high calcium roughage such as
lucerne hay (Dairy One, 2016) or a calcium supplement.
4.16 Overfeeding crude protein

Nearly half of all horses in this study were fed a ration that provided crude protein in excess of the NRC (2007) requirements. Overfeeding protein to horses can have negative impacts on both health and performance. The highest source of protein in the diet of most participants’ horses came from concentrates. The metabolism of excess protein creates excess nitrogen that must be excreted through urine. Increased urine output in horses on a high protein diet has been found to increase calcium and phosphorus loss in young horses (Glade et al., 1985). In humans high proteins diets have been linked to decreased mineralization of bone from renal calcium losses (Delimaris, 2013). Demineralization of bone results in bone with lower densities; a serious side effect of this is that racing Quarter horses with lower bone densities had an increase in stress fractures (Nielsen et al., 1997). Recent research has also found that feeding horses crude protein above requirements results in excess nitrogen excretion; while urea is not volatile when combined with faeces it is rapidly hydrolysed into ammonia (Weir, Li, Warren, Macon, & Wickens, 2017). For the stabled horse excess nitrogen excretion results in high level of ammonia, one study found that ammonia levels inside the stable were 100-200 ppb higher than pastures (Whittaker, Love, Parkin, Duz, & Hughes, 2009). Ammonia inhalation has been found to cause coughing, nasal discharge and degenerative changes to the tracheal epithelium (Katayama, Oikawa, Yoshihara, Kuwano, & Hobo, 1995). Metabolic acidosis can be caused by high protein diets as protein contains both sulphur and phosphorus that alters the dietary cation-anion balance. Researchers feeding high protein diets have been able to cause exercise-induced acidosis in horses (Graham-Thiers, Kronfeld, & Kline, 1999) and has been found to interfere with the oxidation of amino acids and an overall amino acid imbalance in horses at maintenance (Graham-Thiers & Kronfeld, 2005). Horse owners would benefit from a guideline to assist in understanding the differences in quality and quantity of protein in feeds, as the undesirable effects of excess protein can cause multiple health problems in horses.

4.17 Feeding the young horse

Correct nutrition for the growing horse is essential for optimal growth and allows for maximum health and performance later in life. In growing horses, the optimal growth rate is not the maximum growth rate, as the optimum integrates the objectives of athletic
performance, longevity, and soundness, while the maximum is the most rapid rate of gain (Williams et al., 2011). This study found many horse owners provided rations high in digestible energy and low in crude protein and lysine. Indicating that overfeeding digestible energy is a more significant horse health concern than underfeeding in Australia. This study found that pasture alone could not provide young growing horses with the recommended digestible energy intake. However, when pasture intake estimates and rations were combined all, but one young horse received digestible energy above the NRC (2007) recommendation. High concentrations of dietary energy will increase the rate of growth up to the genetic potential and can place growing horses at risk of developmental orthopaedic diseases (DOD) (NRC, 2007; Williams et al., 2011). Developmental orthopaedic diseases manifests in a number of ways including; metaphyseal enlargements; cervical compressive myelopathy-induced “wobblers syndrome,” angular leg deformities, flexure leg deformities, osteochondritis dissecans, subchondral bone cysts, juvenile arthritis, developmental degenerative joint disease (DJD) and/or osteoarthritis (Lewis, 1995). Developmental orthopaedic disease is a significant cause of economic loss in the horse industry and has been found to significantly compromise the future careers of horses in racing and performance (Robert, Valette, & Denoix, 2006). Research into DOD has found that other nutritional risk factors for the disease have also included feeding a low Ca:P ratio to young growing horses (Lepeule et al., 2011). This study recorded that 35 % of weanlings, 30 % of yearlings and 30 % of yearlings in work were fed a Ca: P ratio below the NRC (2007) recommendation; indicating that almost a third of weanlings, young horses and young horses in work are at risk of developmental bone disorders. Whilst many horse owners overfed digestible energy, this study found that the majority of young horses received rations below the NRC (2007) recommendation for lysine and crude protein. Lysine is one of the 20 amino acids essential to horses, and the NRC (2007) currently states that lysine is the first limiting amino acid in typical equine diets. Crude protein is required by growing horses for enzyme function, metabolism and tissue development such as collagen. Recent research suggests that other amino acids are influenced by lysine intake, and lysine may not be the only limiting amino acid in the horse (Mastellar, Coleman, & Urschel, 2016; Tanner, 2014). This study found that 55 % of weanlings, 48 % of yearlings and 97 % of yearlings in work received a ration below the NRC recommendation for lysine, while 34 % of weanlings, 55 % of yearlings and 52 % of yearlings in work received crude protein below requirements. For many young horses, pasture alone was able to provide crude protein above the NRC recommendation, indicating that young horses on pasture do not require additional protein supplementation. However, the
majority of yearlings in work were stabled racehorses with little to no pasture access. The trainers of stabled young horses should supplement their horse's diets with a high quality protein and lysine source ideally from high protein roughages such as lucerne. For the owners of young growing horses kept on pasture, rations should contain mineral supplements to rectify any Ca:P imbalance whilst providing adequate digestible energy to complement the current nutritional content of pasture without providing energy in excess of requirements.

4.18 Feeding the aged horse

As horses age, some will experience physiological changes that necessitate a change in feeding practices. One of the most common problems found in older horses is dental abnormalities. Previous research has found that between 70-100 % of aged horses and donkeys had dental abnormalities when examined (Du Toit, Burden, & Dixon, 2009; Ireland, McGowan, Clegg, Chandler, & Pinchbeck, 2012), though dental disease in older horses is often under-reported by owners (Ireland, McGowan, et al., 2012; McGowan et al., 2010b). Horses possess hypsodont teeth which erupt throughout the horse’s life, until approximately 20 years of age, by which time the tooth has been worn down or shed completely (Nicholls & Townsend, 2016). Changes to dentition can lead to older horses having difficulties chewing feed (Lowder & Mueller, 1998). For all horses, including aged horses with severely compromised dentition, the ration should be based on roughage and/or high fibre feeds. A positive finding of this study was that the majority of aged horses were kept on pasture providing aged horses with an easy to digest source of roughage, requiring little chewing if dentition is compromised (Nicholls & Townsend, 2016). Alternative roughages such as sugar beet pulp and soybean hulls are another excellent source of fibre and dietary energy for older horses as these can be soaked and softened, though only a small percentage of aged horses were fed these products (Jarvis, Paradis, & Harris, 2017). It would be a recommendation of this study that alternative roughages should replace grains in the rations of older horses as those with dental abnormalities are likely to swallow grains without complete mastication meaning they are not fully digested and are likely to be excreted whole. Furthermore, high fibre roughage alternatives could easily replace concentrates in the ration, which for older horses with equine pituitary pars intermedia dysfunction (Cushing’s disease) or a history of laminitis would prevent large quantities of glucose entering into the bloodstream (NRC, 2007). For many aged horses with dental problems chaff is an excellent source of roughage.
due to its reduced fibre length. However, owners must ensure that horses fed chaff do not have diastemata (gaps between the teeth) as this can lead to feed becoming lodged between the teeth resulting in periodontal disease (Du Toit & Rucker, 2013). When the rations of aged horses were analysed using the NRC (2007) formulas, it became apparent that while only 37.4% of aged horses were receiving rations above the NRC recommendation for digestible energy, all aged horses on pasture would have consumed digestible energy above their daily requirement. Research on aged horses has found that many owners reported their aged horses to be in a good body condition (Brosnahan & Paradis, 2003; Ireland, Clegg, Mcgowan, Mckane, & Pinchbeck, 2011b). Indicating most aged horses have no problem with maintaining weight and that obesity in the older horse can be as much of a problem as it is general equine population (Giles et al., 2014). While a loss of muscle mass was reported by 20% of owners of with aged horses reported in a UK survey (Ireland, Clegg, et al., 2011a, 2011b), research in other species has recorded that a decrease in physical activity is a primary factor in muscle loss (Harper, 1998). Only 29.8% of aged horses were reported to be in work in this study, which concurs with the findings of McGowan et al. (2010a). In comparison, a US survey found 63.8% of aged horses were recorded to be in work (Brosnahan & Paradis, 2003). While feed products may be marketed towards aged horses, the majority of healthy older horses with good body condition and normal dentition seldom require a different diet from that of a younger adult horse to remain healthy.

4.19 Feeding the broodmare

Broodmares have specific nutritional requirements that must cater for both the growing foetus and foal while still providing the mare with adequate nutrition for maintenance. It has been established that insufficient intakes of energy and low protein results in weight loss in the adult horse, reduced fertility in the broodmare, foetal loss in the pregnant mare and decreases milk production in the lactating mare (Gentry & Thompson, 2002; Henneke, Potter, & Kreider, 1984; Morley & Murray, 2014; Pagan, Hintz, & Rounsaville, 1984). Pasture alone at the time of the study was able to meet the daily digestible energy and crude protein requirements of all pregnant and lactating mares based on the NRC estimation of intake at 2% body weight (NRC, 2007) and pasture digestibility at 80% (Graham, 2006). As pasture plants mature, digestibility declines. This means that if kept on pasture with a digestibility below 60%, pregnant mares in their last month of gestation and lactating mares will
encounter a digestible energy and crude protein deficiency (Graham, 2006) and will require supplementary feeding. However, for most of Eastern Australia high pasture quality and digestibility occurs in late winter and early spring (McDonald, 1996, 1998, 1999, 2004) which corresponds to the final month of gestation and the first month of lactation; when the energy requirements for the broodmare are at their highest (NRC, 2007). Overfeeding broodmares increases the risk of mares becoming obese and developing insulin resistance, laminitis and equine metabolic syndrome (Galantino-Homer & Engiles, 2012). Furthermore, recent research has found that maternal obesity has been linked to increased insulin resistance in foals and higher incidences of osteochondrosis lesions, compared to mares in a good body condition that were not overweight (Robles et al., 2018). While the broodmare requires a rising plane of nutrition during pregnancy to early lactation, horse owners need to consider the nutritional composition of pasture when formulating a ration. Thus, ensuring mares are kept in a good body condition without detrimental changes to body weight.

4.20 Feeding the horse in maintenance

A horse in maintenance is one that is not growing, pregnant, lactating, in training, gaining or losing weight. This study found that just over a quarter of all mature horses were currently in maintenance, which was similar to a recent study on Australia equine demographics (Smyth & Dagley, 2015). Horses in maintenance have the lowest nutritional requirements, when compared to breeding, growing and working horses, yet 90.0 % of mature horses in maintenance were fed a ration daily. The digestible energy, crude protein and mineral content of pastures at the time of the study based on the average grazing intake at 2.3% body weight (Harris et al., 2016) and pasture digestibility at 80 % (Graham, 2006), would have met the nutritional requirements for almost all horses in maintenance kept on pastures in temperate, grassland and subtropical zones. These findings indicate that additional feeding of the horse in maintenance is often unnecessary when pasture is available and the majority of horses in this study would have gained weight unless rations and pasture access were altered. Furthermore, mature horses can be maintained on pastures until digestibility decreases to 50 %, when plants enter into the late flowering stage (Graham, 2006). It also indicates that the use of supplements was mostly unnecessary, except for horses kept on high oxalate pastures where a calcium supplement will aid in correcting a calcium: phosphorous imbalance. Previous research has found that the seasonal bodyweight and body condition score of Pony
Club horses closely follow seasonal pasture biomass (Buckley, 2008). However, horse owners were found not to alter their feeding patterns, despite unrestricted pasture access, resulting in horses losing weight during periods of low pasture growth, while then gaining weight excessively during periods of high pasture growth (Buckley, 2008). This suggests that, the horse’s body condition score did not appear to influence the owners feeding decisions. This has significant health implications, as the risk of obesity-related diseases are likely to be increased due to excessive body condition. Australian horse owners are underestimating the nutritional content of pastures and disregarding seasonal increases in pasture quality and quantity, resulting in unmanaged weight gain in horses and risking horses developing obesity-related diseases.

4.21 Feeding the mature horse in work

The ration for the horse in work needs to vary in accordance with the level of exercise intensity and the current management of the horse. From the results of this study mature horses in work can be grouped into those in light and moderate work used for pleasure riding, horses in heavy and intense work kept on pasture and horses in heavy and intense work permanently stabled. Each group of horses has their own nutritional and management requirements which allow for the optimal health of the horse. The majority of mature horses in work were in light work and used for pleasure riding. This study found that 87% of mature horses in light work would have received digestible energy above their nutritional requirement from pasture alone based on an average pasture intake of 2.3% body weight (Harris et al., 2016), yet almost all horses in light work were fed an additional ration. Horses receiving a daily intake of digestible energy above requirement will begin to gain weight (NRC, 2007) and many pleasure horses in light work are already likely to be obese or at risk of obesity based on the finding of the ration and pasture analysis. As in other horse categories, obesity increases the risk of mature horses developing health problems such as laminitis, insulin resistance, equine metabolic syndrome as well as negatively affecting athletic performance and increasing the risk of misbehaviour (Buckley et al., 2013; Frank, 2011; Karikoski et al., 2011; Webb et al., 1990; Wylie, Collins, et al., 2013b). An additional concern in Australia is that fat/obese horses may also suffer from heat stress. Past research has found that overweight and obese horses worked in hot weather (temperature 32 °C and 44% humidity), had higher heart and respiratory rates and increased difficulty in heat...
dissipation compared to horses in a good body condition (BCS = 3) due to the increase in thermal load (Webb et al., 1990). Well managed pasture, can for most of the year, provide the basis of an adequate and low-cost diet for horses in light to moderate work. Furthermore, overweight and obese horses in work would benefit from a reduction in digestible energy as a preventative method in reducing the possibility of obesity-related diseases and ensuring horses remained fit and healthy. Horses in heavy and intense work represented just under a third of all mature horses in work. While sports horses were worked at intensities similar to racehorses, the management of sports horses was considerably different to that of racehorses. Nearly all racehorses were kept permanently stabled compared to the majority of sports horses which were kept permanently on pasture or stabled with daily pasture access of ≥6 hours. Ration composition and feedstuffs were similar between riding disciplines, and similar to other global studies on the feeding of sports horses (Brunner et al., 2015; Brunner et al., 2012; Burk & Williams, 2008; Verhaar et al., 2014). However Australian sports horses were fed less roughage in the ration than eventing horses in the United States and sports horses in Switzerland (Brunner et al., 2012; Burk & Williams, 2008). While feeding lower amounts of roughage is suitable to horses on adequate pasture, this study found that horse owners did not alter their feeding to account for changes in pasture, with horses on low pasture biomass fed a similar daily amount of roughage to those horses grazing on pastures with a high biomass. As pasture biomass fluctuates so too must the ration. With all of NSW and a large proportion of Queensland drought affected at the time of writing this study (Bureau of Meteorology, 2018), there is a concern that the amount of roughage in the ration of drought affected horses will not be adequate.

At the time of this study pasture alone would have sufficiently met the nutritional needs of 92% horses in heavy work, this was not the case for horses in intense work. Only 11% of horses in intense work would have been able to meet their nutritional requirements from pasture alone, thus requiring an additional ration to prevent a deficiency in digestible energy. A concern raised in this study was that all working horses grazing on high oxalate pastures had a ration Ca:P balance below the NRC (2007) recommendation, indicating many horses in work had a calcium deficiency. These horses should be fed a specific calcium supplement, or a high calcium roughage such as lucerne (Dairy One, 2016). For those horses not grazing on high oxalate pastures, some horses may require mineral supplements during summer when high temperatures and high humidity increase sweat production and pasture quality reduces; supplements though should be seasonally adjusted and decreased over the winter period to prevent the wastage of costly mineral supplements from urinary excretion.
Sports horses on pasture received the benefit of daily grazing, providing additional nutrition, aiding in reducing gastric ulceration (Luthersson & Nadeau, 2013; Luthersson et al., 2009), promoting natural dental wear (O’Neill et al., 2010), reducing colic risk (Hillyer et al., 2002), and a decrease in stereotypical behaviours (Cooper & McGreevy, 2007). Stabled horses, however, do not receive the benefits of daily grazing. Stabled horses in heavy and intense work were predominantly Thoroughbred racehorses, though horses used in all disciplines were recorded as being in intense work and stabled. This study found that stabled racehorses were fed less roughage and more concentrates than stabled horses used in other disciplines, despite all horses being worked at the same exercise intensity. It appears from this study that the feeding practices of Thoroughbred racehorses have differed little since the 1993 survey conducted by Southwood et al. (1993a, 1993b). In contrast, Standardbred racehorses in this study received more roughage and less concentrates than had been previously recorded (Southwood et al., 1993b); with hay fed at an average of 3.1 kg daily, compared to an average of 1.6 kg as was reported by Southwood et al. (1993b). While concentrates provide a source of energy for racehorses, research indicates that overfeeding concentrates is linked to an increase of hindgut starch fermentation, changing the hindgut microbiome which increases the risk of associated health problems (Julliand & Grimm, 2017; Richards et al., 2006). Even if racehorses are fed supposedly ‘safe grains’ (Richards et al., 2006) which are those that have been processed to increase digestibility, the horse still has a limited capacity for starch digestion in the small intestine (Kienzle et al., 1994; Meyer et al., 1995). Recent research has indicated that horses fed rations containing medium levels of starch had a similar level of muscle glycogen recovery to that of horses fed a high starch ration (Mesquita, Pagan, Valberg, Waldridge, & Whitehouse, 2014). There appears to be misconceptions within the racing industry regarding optimal digestive health and athletic performance. For the majority of Australian horses in work, kept on pasture, a ration is only required when pasture quality is low. As exercise intensity increases some horses will require a ration to prevent a shortfall in digestible energy though this should be primarily roughage to ensure optimal horse health.

4.22 The cost of feeding horses in Australia

For livestock owners, feed typically represents the single largest cost in animal care (Pendell & Herbel, 2015). This study found that feeding horses costs an average of $2,280 per annum / per horse, and with the majority of survey participants owning two or more horses, the cost of
feeding quickly escalates. The results of this study show that the cost of feeding horses has more than doubled over the last 20 years (Stubbs, 2001). Horse owners appear to lack the feed budgeting knowledge of the livestock industry, in which the aim of additional feeding is to feed as little as possible while still achieving the required production levels and lowest production costs (McFarland, Curnow, Hyder, Ashton, & Roberts, 2006). The source of this mismanagement amongst horse owners comes from a lack of understanding around the nutritional content of pasture and poor pasture management (Stubbs, 2001). Meat & Livestock Australia (Meat & Livestock Australia, 2015) calculate that pasture costs on average 4c/kg dry matter (DM), compared to hay at 15c/kg DM and concentrates at 38c/kg DM. Reducing feed expenditure through pasture improvement would allow for a greater reliance on pasture as a nutrient source for horses, and reduce the costs associated with supplemental feeds. Only when pasture quality drops below 60 %, digestibility should owners then consider supplementary feeding (Graham, 2006). The aim of feeding a ration is to help match feed demand to feed supply, allowing owners to control dietary intake during times of pasture surpluses and deficits (Meat & Livestock Australia, 2016). Australian horse owners would reduce their annual feed expenditure by better utilising pastures. Well-managed pastures are low cost option for feeding horses and for most of the year, pastures contain sufficient nutrients to meet the requirements of almost all horses.

4.23 Factors affecting horse owners’ ration and feed choices

How horses are fed and managed reflects their owner’s current level of knowledge and understanding of equine nutrition. While this study had mainly focused on the feeding practices recorded by horse owners, understanding the behaviour of owners and the reasons behind the choices they make when feeding their horses is central to ensuring horses are fed and managed appropriately. The results from this study and past research indicate that many horse owners have a poor understanding of equine nutrition, and decisions regarding nutritional management are often based on tradition, folklore, and misinformation (Hoffman, Costa, et al., 2009; Martin, 2010; Murray et al., 2015; Owens, 2005). This study found that there was a discrepancy between where owners sourced their nutritional information versus the actual behaviour of including a feedstuff in the ration. Participants in this study indicated that equine nutritionists, scientific literature and veterinarians were the most important source of information on equine nutrition. However, when asked as to why owners selected feeds in
the ration less than 4% of participants recorded that their feeds were based on the recommendations of a veterinarian, while only 3.2% participants used a feed based on the advice of an equine nutritionist and only 0.1% participants recorded that they included a feedstuff in the ration based on the scientific literature. Past research has recorded that when horse owners seek information on nutritional advice, the first point of contact and the primary source of information is likely to be other horse owners and knowledgeable horse people (Buckley et al., 2004; Gemmill et al., 2016). However, a recent UK study has found that though a horse person may have a high level of equestrian experience, this did not equate to a higher level of knowledge on equine nutrition (Lewis et al., 2015). Misinformation on feeding practices is probably a common occurrence, as shown by the findings of this study. It is a recommendation of this study that horse owners require up to date, easily accessible information on equine nutrition from reliable scientific sources.
5 Conclusion

Assessing the feeding and management practices of a large population of horse owners has provided a unique insight into the nutritional management of horses in Australia. The demographics of Australian horse’s owners is comparable to that of owners in similar advanced economies such as the United Kingdom, Ireland and the United States. However, many management practices have not changed over the past 20 years, despite advances in the scientific literature surrounding equine nutrition and management. Throughout the survey period, pasture alone would have provided almost all horses with their daily nutritional requirements. During this period feeding an additional ration was unnecessary and expensive. However, over the course of this study, much of Eastern Australia has experienced drought conditions which will result in a need for many owners to provide an additional ration. It is a concern raised in this study that horse owners did not alter their feed rations based on pasture variations, which suggests many horses would be receiving inadequate amounts of roughage. This increases the risk of horses developing health and behavioural problems associated with low roughage intake. It is a recommendation of this study that horse owners require better resources and information to formulate rations promoting high roughage diets to improve the health of horses. In conclusion, this study found Australian horse owners would benefit by knowing that well-managed pastures are able to provide horses with their daily nutritional requirements, while reducing gastric ulceration, promoting natural dental wear, reducing colic risk, and decreasing stereotypical behaviours, as well as providing a long-term cost-effective way of feeding horses.
6 References


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Longland, A. C., Barfoot, C., & Harris, P. A. (2016). Effects of grazing muzzles on intakes of dry matter and water-soluble carbohydrates by ponies grazing spring, summer, and autumn swards, as well as autumn swards of different heights. *Journal of Equine Veterinary Science, 40*(Supplement C), 26-33. doi:https://doi.org/10.1016/j.jevs.2015.09.009


Glossary

Blog: A website or web page, containing user-created entries updated at regular intervals and/or user-submitted content that was investigated outside of traditional media (OECD, 2007).

CCI: Concours Complet International (CCI) is the rating of difficulty given to eventing levels in equestrian sports by the Fédération Équestre Internationale (FEI), levels are ranked with a star rating (*) from 1 star as an introductory level to 5 stars as an Olympic level.

Concentrate: Concentrates include feeds such as grains and legumes, they are feeds which contain a high density of digestible nutrients but have a low in crude fibre content (< 18 % DM) (Hendy, Kleith, Crawshaw, & Phillips, 1995).

Content communities: Content communities share photos, videos, presentations or text media content between users. Popular content communities include YouTube, Flicker, Bookcrossing and SlideShare.

Crude Protein: The base unit of protein contained in the feed before it is digested and utilised by the horse.

Dry matter: The organic and mineral components of the plant after removal of water by drying at 84°C for 24 hours in a forced draught oven. The dry matter represents the net results of photosynthesis and mineral uptake by the plant, it is a standard method of comparing feedstuffs.

Facebook Comment: A Facebook comment is when a user submits a comment on a piece of content on Facebook.

Facebook Fans: Users who Like your Page

Facebook Friends: Other users who Like an individual’s Profile

Facebook Like: When a user clicks the Like button, the action appears on the users Timeline. Liking a page connects the user to that Page so that the user will see its Posts on their News Feeds. The Page will also appear on the user’s Profile, and the user will appear on the Page as a person who Likes that Page.

Facebook News Feed: A constantly updating list of status updates, photos, videos, links, App activities, and Likes from the Friends, Pages, and Groups the user is associated with.

Facebook Page: A Facebook page is a public profile specifically created for businesses, brands, celebrities, causes, and other organizations.

Facebook Post: An uploaded comment, status update, photo, video, link, or other activity on the users own Timeline, a friend’s Timeline, a Facebook Page.

Facebook Profile: A personal account on Facebook. It includes the user's Timeline, profile picture, biography, and personal information. It can be public or private but is only for non-commercial use.
Facebook Share: Sharing allows for users to upload a Post, photo, video, link or other activity from another Facebook Profile or Page to their own Timeline, a friend’s Timeline or in a private message.

Facebook Status: A Facebook status is an update feature which allows users to discuss their thoughts, whereabouts, photos, videos or other activity and information with their Facebook friends.

Facebook Tag: A tag links a person, Page, or place to a user’s post, status update or photo.

Facebook Timeline: Is a display of the user’s Profile page which shows Facebook activity in chronological order.

International Unit: Is a unit of activity or potency for vitamins, defined individually for each substance in terms of the activity of a standard quantity. Vitamin A: 1 IU is the biological equivalent of 0.3 mcg retinol, or of 0.6 mcg beta-carotene. Vitamin D: 1 IU is the biological equivalent of 0.025 mcg cholecalciferol or ergocalciferol. Vitamin E: 1 IU is the biological equivalent of 0.67 mg d-alpha-tocopherol, or 0.9 mg of dl-alpha-tocopherol (USDA, 2017)

Macromineral: A mineral required by the horse in amounts of more than 1 gram daily.

Megajoule: Is the standard unit of energy used in Australia to describe the energy content of feeds. One megajoule (MJ) of energy is equivalent to 1 million watts of heat energy.

Microblogs: A blog style application limited to the exchange of text-based messages of 140 characters or less (Kaplan & Haenlein, 2011). Twitter is an example of a popular microblog.

Micromineral: A trace mineral required by the horse at less than 1 gram daily.

Roughage: Roughages come from the leaf, sheath and stem of the plant and depending on the stage of growth may contain the seed head or flower (NRC, 2007), and contain a crude fibre content over 18 % of DM (Hendy et al., 1995).

Social networking sites: A social networking site is an online platform that allows users to create a public profile and interact with other users on the website. Popular social networking sites include Facebook, Myspace, VKontakte and Qzone.
Appendix 1: Survey ethics approval

Miss Claudia Macleay
SAVS
CSU
8 Cooper Court
Rutherglen VIC 3685

13 June 2017

Dear Claudia,

The Faculty of Science Human Low Risk Ethics Committee has reviewed your variation request for "Survey on the feeding practices and supplement use amongst Australian horse owners" 400/2017/16 and has approved your proposal changes from 8 June 2017.

Please note the original conditions of approval apply:

- All consent forms and information sheets are to be displayed on CSU letterhead. Students should liaise with their Supervisor to arrange to have these documents printed where necessary.
- You must notify the Committee immediately in writing should your research differ in any way from that proposed;
- You must notify the Committee immediately if any serious or unexpected adverse event or outcomes occur associated with your research, that might affect the participants and therefore ethical acceptability of the project;
- Amendments to the research design must be reviewed and approved by the Faculty Human Ethics Committee or if no longer minimal risk research will be referred to the University Human Research Ethics Committee before commencement.
- **You are required to submit a final report by 9 May 2018**:
  - If an extension of the approval period is required, a request form must be submitted to the Faculty Human Ethics Committee one month prior to the above date;

The Committee wishes you well in your research and contact the Executive Officer on telephone 02 6338 6168 or email FOS-PHEC@csu.edu.au if you have any questions.

Yours sincerely,

Dr. Philip Rudzit
Chair Faculty of Science Low Risk Human Ethics Committee
Senior Lecturer Biomedical Science

www.csu.edu.au
Appendix 2: Survey information sheet

Feeding Practices and Supplement Use Among Australian Horse Owners

SCHOOL OF ANIMAL
AND VETERINARY
SCIENCES
FACULTY OF SCIENCE

Locked Bag 500
Boorooma Street
Wagga Wagga NSW 2650
Tel: +61 2 6933 4479
Fax: +61 2 6933 2991
Email: surv@csu.edu.au
www.csu.edu.au/vet

Invitation

You are invited to participate in a research study to record what feeds and supplements you are currently feeding to your horses and your current feed management practices. The study is being conducted by Claudia Macleay who is currently enrolled as an honours student from the School of Animal and Veterinary Science at Charles Sturt University.

Chief Investigator: Claudia Macleay, BEqSc,
Student of Bachelor of Science (Hons)
Email: cmacleay05@postoffice.csu.edu.au
Phone: 0435 302 501

Project Supervisor: Petra Buckley,
Senior Lecturer,
School of Animal and Veterinary Sciences,
Faculty of Science,
Charles Sturt University
Email: pbuckley@csu.edu.au
Phone: 02 6933 2426

Project Co-Supervisor: Dr Mark Barnett,
Independent Equine Nutritionist
MTB Equine Services
Email: barnettEquins@outlook.com
Phone: 0428 233 896

Before you decide whether or not you wish to participate in this study, it is important for you to understand why the research is being done and what it will involve. Please take the time to read the following information carefully and discuss it with others if you wish.

1. What is the purpose of this study?
The findings of this survey will be used to examine current equine nutrition trends in Australia. People involved in the equine industry, from stud managers to pleasure riders, understand that nutrition is a key element to good horse care and management. While there has been research into the area of what we should feed our horses there is very little research on how we are feeding our horses. The aim of this survey is to collect data that will help us understand what feeds and supplements horse owners and managers across Australia are using, and how that relates to the horses' current use, housing, pasture and workload or training.
Feeding Practices and Supplement Use Among Australian Horse Owners

2. Why have I been invited to participate in this study?
Anyone involved in the feeding and management of horses, from horse owners to managers and trainers, is invited to participate.

3. What does this study involved?
Participation involves completing this survey which should take 10-20 minutes. Owners of multiple horses are requested to complete several sections which may take a little longer. Sections are based on horses of similar ages, in similar training, or fed a similar diet. For example, if you had 5 horses of the same age and fed a similar diet, they could be answered as one group. The survey is voluntary and all participants will be anonymous. Results will be published once the research project is finalised and will be available online, or a printed copy can be requested.

4. Are there risks and benefits to me in taking part in this study?
The survey is designed to minimise any possible risks for participants. Should you feel uncomfortable in completing the survey, please do not participate. It is important to stress that the survey is voluntary.

5. How is this study being paid for?
As the survey is a key component, Claudia Macleay’s research activities at Charles Sturt University, all costs have been subsidised by the university. No external or third-party person is involved or has contributed any resources to the project.

6. Will taking part in this study cost me anything and will I be paid?
There will be no financial costs for any of the participants, nor will there be any payment for participating.

7. What if I don’t want to take part in this study?
Participation in this research is entirely your choice. Only those people who give their informed consent will be included in the project. Whether or not you decide to participate is your decision and will not disadvantage you.

8. What if I participate and want to withdraw later?
All participants are anonymous, you can choose to withdraw from the survey at any time. Responses are recorded as you move through the questions so, due to anonymity, your answers are not identifiable and will not be able to be removed.

9. How will my confidentiality be protected?
No personal details or information which might identify you will be collected by the researchers, all participants and data will be anonymous.

10. What will happen to the information that I give you?
The data that is collected will be reported and presented as a dissertation to be submitted to the Charles Sturt University honours examination committee. Data collected may be further published in relevant scientific journals. Please note that all data presented will remain anonymous.

11. What should I do if I want to discuss this study further before I decide?
If you would like to request further information please contact the researchers:

12. Who should I contact if I have concerns about the conduct of this study?
Charles Sturt University’s Human Research Ethics Committee and the Faculty of Science has approved this project. If you have any complaints or reservations about the ethical conduct of this project, you may contact the Faculty of Science Human
Feeding Practices and Supplement Use Among Australian Horse Owners

Ethics Committee:
Email: FOS-FHEC@csu.edu.au
Address: C/- School of Exercise Sciences,
Bathurst Campus,
Charles Sturt University,
Pancrama Ave, Bathurst, NSW 2795.

Any issues you raise will be treated in confidence and investigated fully and you will be informed of the outcome.
Appendix 3: Survey consent form

Feeding Practices and Supplement Use Among Australian Horse Owners

Consent Form

Note: Participants must be 18 years of age or over.

Please read the following statements:

- I agree to participate in the above research project and give my consent freely.
- I understand that the project will be conducted as described in the Participant Information, a copy of which I have retained.
- I understand that the survey is voluntary and all participants will remain anonymous.
- I understand I can withdraw from the project at any time and do not have to give any reason for withdrawing.
- I have had the opportunity to have questions answered to my satisfaction.

1. Are you 18 years of age or over?
   - Yes
   - No

2. Do you give your consent to:

   Participating in this survey on what your horses are fed and how they are managed; and

   Answering all the questions truthfully and as accurately as possible.

   - Yes, I consent
   - No thanks, I do not wish to participate

If you would like to request further information please contact the Chief Investigator:

Chief Investigator: Claudia Macleay, BEqSc,
Student of Bachelor of Science (Hons)
Email: cmacleay@csu.edu.au
Phone: 0438 302 501

Charles Sturt University's Human Research Ethics Committee and the Faculty of Science has approved this project. If you have any complaints or reservations about the ethical conduct of this project, you may contact the Faculty of Science Human

Ethics Committee:
Email: FOS-HREC@csu.edu.au
Address: CI: School of Exercise Sciences,
Bathurst Campus,
Charles Sturt University,
Panorama Ave, Bathurst, NSW 2795.

Any issues you raise will be treated in confidence and investigated fully and you will be informed of the outcome.
Appendix 4: Survey
Feeding Practices and Supplement Use Among Australian Horse Owners

Demographic questions

1. Please indicate your gender:
   o Female
   o Male
   o Prefer not to say

2. Please indicate your age group:
   o 18 - 24
   o 25 - 34
   o 35 - 44
   o 45 - 64
   o 55 - 64
   o 65 - 74
   o 75 and over

3. What is your residential postcode?

4. How far away from your residence is your horse/s located?
   o 0 - 5 km
   o 6 - 10 km
   o 11 - 15 km
   o 16 - 20 km
   o 21 - 30 km
   o 31 - 40 km
   o 41 - 50 km
   o More than 50 km

5. How many years’ experience with horses have you had?
Feeding Practices and Supplement Use Among Australian Horse Owners

6. What is your involvement in the equine industry?

(Please indicate all that apply)

- Breeder
- Competitive Rider
- Equine Nutritionist / Consultant
- Equine / Animal Scientist
- Farrier
- Horse Owner
- Horse Trainer
- Manufacturer, Distributor or Sales of equine products / services
- Pleasure Rider
- Researcher
- Riding Instructor
- Stud / Farm / Stable Manager
- Veterinarian
- Veterinary Technician / Nurse / Assistant
- Other (please specify)

-
7. Where do you get information about horse nutrition?

(Please rank from 1-16 all that apply according to their importance)

- Celebrity endorsements
- Equine dentist (other than veterinarian)
- Farrier
- Feed store / Stock and station agency staff
- Horse association meetings / newsletters
- Horse magazines / reference books
- Independent equine nutritionist / consultant
- Manufacturer's feed rep, nutritionist or consultant
- Other horse owners / friends
- Radio / TV / newspaper
- Riding instructor / trainer
- Saddlery / Equestrian supplies store
- Scientific literature
- Social media (Facebook, Twitter, etc.)
- Stable / Stud manager or staff
- Veterinarian
Feeding Practices and Supplement Use Among Australian Horse Owners

General horse owner / manager questions

8. Who makes the majority of feeding decisions for the horse/s you own or manage?
   - Stud / Farm / Stable Manager
   - Equine Nutritionist
   - Horse owner / You
   - Trainer
   - Veterinarian
   - Other (please specify)
   - _______________________________________________________________________

9. How do you normally measure your horse’s feed?
   - By weight (scales)
   - Feed scoop
   - 20 litre bucket
   - Container of known capacity
   - Visual guess
   - Other (please specify)
   - _______________________________________________________________________

Feeding Practices and Supplement Use Among Australian Horse Owners

Weanlings (5 - 12 months old)

If you have more than one weanling, please choose one and answer the following questions for that one.

1. Do you own or manage any weanlings (5 - 12 months old)?
   - Yes
   - No – continue to next section “Young Horses 1-2 ½ years old” page 16

2. How many weanlings do you own and/or manage in total?

3. What age (in months) is this weanling?
   - 5 months
   - 6 months
   - 7 months
   - 8 months
   - 9 months
   - 10 months
   - 11 months
   - 12 months

4. What gender is this weanling?
   - Filly
   - Colt (gelded)
   - Colt (entire)

5. What breed is this weanling?
   - Appaloosa
   - Arab
   - Australian Stock Horse
   - Clydesdale/ Shire /Percheron /Heavy Draft Horse
   - Large Cob/ Pony
   - Miniature Horse
   - Paint Horse
   - Quarter Horse
   - Shetland Pony
   - Standardbred
   - Thoroughbred
   - Thoroughbred Cross
   - Waler
   - Warmblood
   - Welsh Pony
   - Other (please specify)

6. If you know or can estimate, please record your weanling’s weight _________________ kg
Feeding Practices and Supplement Use Among Australian Horse Owners

Weanlings - Stabling, agistment and pasture management

7. Is your weanling currently stabled?
   - Yes, stabled all of the time
   - Yes, stabled some of the time
   - No, never stabled – please go to question 12

8. Do you give your stabled weanling turn out time?
   - Yes
   - No – please go to question 12

9. What type of area is your weanling turned out into?
   - Arena
   - Day yard
   - Pasture
   - Other (please describe) ______________________________________________________

10. How often is your weanling turned out into this area?
    - Daily
    - A few times per week
    - Once a week
    - Less than once a week

11. For approximately what length of time are they in the turn out area?
    - 15 - 30 minutes
    - 31 - 60 minutes
    - 1 - 2 hours
    - 2 - 3 hours
    - 3 - 4 hours
    - 4 - 5 hours
    - 6 hours or more

12. Does your weanling have access to pasture?
    - Yes, all the time
    - Yes, some of the time
    - No – please go to question 19 on page 9
Feeding Practices and Supplement Use Among Australian Horse Owners

13. What is the size of the pasture paddock? (Please specify in either hectares or acres below)
   - Hectares _______________________________
   - Acres ________________________________

14. Using the above images for comparison, what is the average grass cover in the pasture?
   - Less than 25%
   - 25%
   - 50%
   - 75%
   - 100%

15. How would you describe the length of the pasture?
   - Even and Short - cropped close to ground
   - Even and Medium - around hoof level
   - Even and Long - taller than hoof level
   - Uneven - patches of tall and short grazed

16. Please indicate the predominant pasture species if known: (Please indicate all that apply)
   - Biserrula
   - Bluegrass
   - Buffel grass
   - Clover (white or strawberry)
   - Couch grass
   - Fescue
   - Kangaroo grass
   - Kikuyu
   - Lucerne
   - Oats
   - Panic grass species
   - Paspalum
   - Phalaris
Feeding Practices and Supplement Use Among Australian Horse Owners

- Plantain
- Rye grass
- Salt bush
- Snow grass
- Spear grass
- Subterranean clover
- Wallaby grass
- Wheat grass
- Mainly weeds
- Don’t know
- Other (please specify) _______________________________

17. Does your weanling graze with other domestic stock animals (including horses)?
   - Yes, all the time
   - Yes, some of the time
   - No

18. What other domestic stock animals does your weanling graze with?
   (Please select all that apply)
   - Other horses
   - Cattle
   - Sheep
   - Goats
   - Alpacas / Llamas

Weanlings – Feeding

19. Do you feed your weanling in addition to their access to grazing?
   - Yes
   - No – continue to next section on Young Horses on page 13

20. How many times a day do you feed your weanling?
   - 1
   - 2
   - 3
   - 4
   - 5
   - 6
   - Feed Constantly Available
### Feeding Practices and Supplement Use Among Australian Horse Owners

21. **What type of roughage / fibre do you feed your weanling?**  
*Please list*

<table>
<thead>
<tr>
<th>Roughage/Fibre 1</th>
<th>Amount of feed in kg</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Roughage/Fibre 2</td>
<td>Amount of feed in kg</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Roughage/Fibre 3</td>
<td>Amount of feed in kg</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Roughage/Fibre 4</td>
<td>Amount of feed in kg</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Roughage/Fibre 5</td>
<td>Amount of feed in kg</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Roughage/Fibre 6</td>
<td>Amount of feed in kg</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

20. **What is the main reason for choosing this type of roughage / fibre?**

- Cost
- Ease of feeding
- Trusted manufacturer
- Ready availability
- Recommended by trainer / coach
- Recommended by veterinarian
- Nutritional content
- Palatability and minimal waste
- Visual appearance
- Other (please specify) ____________________________

21. **What complete / pre-mixed feed do you feed your weanling?**  
*Please list the brand and variety*

<table>
<thead>
<tr>
<th>Complete/Pre-mixed feed 1</th>
<th>Amount of feed in kg</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Complete/Pre-mixed feed 2</td>
<td>Amount of feed in kg</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Complete/Pre-mixed feed 3</td>
<td>Amount of feed in kg</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Complete/Pre-mixed feed 4</td>
<td>Amount of feed in kg</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Complete/Pre-mixed feed 5</td>
<td>Amount of feed in kg</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Complete/Pre-mixed feed 6</td>
<td>Amount of feed in kg</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
22. What is the main reason for choosing this complete / pre-mixed feed?
   - Cost
   - Ease of feeding
   - Trusted manufacturer
   - Ready availability
   - Recommended by trainer / coach
   - Recommended by veterinarian
   - Nutritional content
   - Palatability and minimal waste
   - Visual appearance
   - Other (please specify) _________________________________

23. What grains and/or concentrates do you feed your weanling?
   (Please list)

<table>
<thead>
<tr>
<th>Grains and/or Concentrates</th>
<th>Amount of feed in kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

24. What is the main reason for choosing these grains and/or concentrates?
   - Cost
   - Ease of feeding
   - Trusted manufacturer
   - Ready availability
   - Recommended by trainer / coach
   - Recommended by veterinarian
   - Nutritional content
   - Palatability and minimal waste
   - Visual appearance
   - Other (please specify) _________________________________
25. What supplements and/or feed additives do you feed your weanling?
(Please list and enter amount in grams)

<table>
<thead>
<tr>
<th>Supplement and/or Additives</th>
<th>Amount of feed in g</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
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<td>5</td>
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</tbody>
</table>

26. What is the main reason for choosing these supplements and/or feed additives?

- I don't feed any supplements
- I believe my weanling/s need these supplement/s
- Recommended by trainer / coach
- Recommended by veterinarian
- Recommended by feed supplier
- Nutritional content
- Trusted manufacturer
- Other (please specify)______________________________________________________________
Feeding Practices and Supplement Use Among Australian Horse Owners

Young Horses (1 – 2½ years old)

If you have more than one young horse, please choose one and answer the following questions for that one.

1. Do you own or manage any young horses (1 – 2½ years old)?
   - Yes
   - No – continue to next section “Pregnant Mares” page 26

2. How many young horses do you own and/or manage in total?

3. How old is your chosen young horse?
   - 1 – 1½ years
   - 1½ - 2 years
   - 2 – 2½ years

4. What gender is this young horse?
   - Filly
   - Colt (gelded)
   - Colt (entire)

5. What breed is this young horse?
   - Appaloosa
   - Arab
   - Australian Stock Horse
   - Clydesdale/ Shire /Percheron /Heavy Draft Horse
   - Large Cob/ Pony
   - Miniature Horse
   - Paint Horse
   - Quarter Horse
   - Shetland Pony
   - Standardbred
   - Thoroughbred
   - Thoroughbred Cross
   - Waler
   - Warmblood
   - Welsh Pony
   - Other (please specify) _________________________________________________
Feeding Practices and Supplement Use Among Australian Horse Owners

Young horses - Exercise and training

6. Is your young horse currently in work / training?
   - Yes
   - No – continue to question 13 on page 19

7. What discipline/s are you working / training your young horse in? (Please indicate all that apply)
   - Camp Drafting
   - Dressage
   - Driving
   - Endurance
   - Eventing
   - Flat Racing
   - Harness Racing
   - Jumps Racing
   - Pleasure Riding
   - Polo
   - Pony Club
   - Reining
   - School Horse
   - Show Horse
   - Show Jumping
   - Trail Riding
   - Western Pleasure
   - Other (please specify) __________________________________________________________

8. How many sessions per week do you work / train your young horse?
   - 1
   - 2
   - 3
   - 4
   - 5
   - 6
   - 7
   - 8
   - 9
   - 10
   - 11
   - 12
Feeding Practices and Supplement Use Among Australian Horse Owners

9. How long do you walk your young horse in a session?
   - 0 minutes
   - 5 minutes
   - 10 minutes
   - 15 minutes
   - 20 minutes
   - 30 minutes
   - 45 minutes
   - 1 hour
   - 1.5 hours
   - 2 hours or more

10. How long do you trot your young horse in a session?
    - 0 minutes
    - 5 minutes
    - 10 minutes
    - 15 minutes
    - 20 minutes
    - 30 minutes
    - 45 minutes
    - 1 hour
    - 1.5 hours
    - 2 hours or more

11. How long do you canter your young horse in a session?
    - 0 minutes
    - 5 minutes
    - 10 minutes
    - 15 minutes
    - 20 minutes
    - 30 minutes
    - 45 minutes
    - 1 hour or more

12. How long do you gallop your young horse in a session?
    - 0 minutes
    - 2 minutes
    - 5 minutes
    - 10 minutes
    - 15 minutes
    - 20 minutes
    - 30 minutes
13. From the descriptions shown above, which condition score best fits your young horse?

- 0: Very poor
- 1: Poor
- 2: Moderate
- 3: Good
- 4: Fat
- 5: Very fat

14. If you know or can estimate your young horse's weight, please record _____________________ kg

Young horses - Stabling, agistment and pasture management

15. Is your young horse currently stabled?

- Yes, stabled all of the time
- Yes, stabled some of the time
- No, never stabled – please go to question 20 on page 20

16. Do you give your stabled young horse turn out time?

- Yes
- No - please go to question 20 on page 20

17. What type of area is your young horse turned out into?

- Arena
- Day yard
- Pasture
- Other (please describe) __________________________________________________________
Feeding Practices and Supplement Use Among Australian Horse Owners

18. How often is your young horse turned out into this area?
   ○ Daily
   ○ A few times per week
   ○ Once a week
   ○ Less than once a week

19. For approximately what length of time are they in the turn out area?
   ○ 15 - 30 minutes
   ○ 31 - 60 minutes
   ○ 1 - 2 hours
   ○ 2 - 3 hours
   ○ 3 - 4 hours
   ○ 4 - 5 hours
   ○ 6 hours or more

20. Does your young horse have access to pasture?
   ○ Yes, all the time
   ○ Yes, some of the time
   ○ No – please go to question 27 on page 22

21. What is the size of the pasture paddock?
   (Please specify in either hectares or acres below)
   ○ Hectares _________________________________________
   ○ Acers ____________________________________________

22. Using the above images for comparison, what is the average grass cover in the pasture?
   ○ Less than 25%
   ○ 25%
   ○ 50%
   ○ 75%
   ○ 100%
Feeding Practices and Supplement Use Among Australian Horse Owners

23. How would you describe the length of the pasture?
   - Even and Short - cropped close to ground
   - Even and Medium - around hoof level
   - Even and Long - taller than hoof level
   - Uneven - patches of tall and short grazed

24. Please indicate the predominant pasture species if known:
(Please indicate all that apply)
   - Biserrula
   - Bluegrass
   - Buffel grass
   - Clover (white or strawberry)
   - Couch grass
   - Fescue
   - Kangaroo grass
   - Kikuyu
   - Lucerne
   - Oats
   - Panic grass species
   - Paspalum
   - Phalaris
   - Plantain
   - Rye grass
   - Salt bush
   - Snow grass
   - Spear grass
   - Subterranean clover
   - Wallaby grass
   - Wheat grass
   - Mainly weeds
   - Don't know
   - Other (please specify) __________________________________________________________

25. Does your young horse graze with other domestic stock animals (including other horses)?
   - Yes, all the time
   - Yes, some of the time
   - No
Feeding Practices and Supplement Use Among Australian Horse Owners

26. What other domestic stock animals does your young horse graze with? 
(Please select all that apply)
  ○ Other horses
  ○ Cattle
  ○ Sheep
  ○ Goats
  ○ Alpacas / Llamas

Young Horses – Feeding

27. Do you feed your young horse in addition to their access to grazing?
  ○ Yes
  ○ No – continue to next section on Pregnant mares on page 26

28. How many times a day do you feed your young horse?
  ○ 1
  ○ 2
  ○ 3
  ○ 4
  ○ 5
  ○ 6
  ○ Feed Constantly Available

29. What type of roughage / fibre do you feed your young horse? 
(Please list)

<table>
<thead>
<tr>
<th>Roughage/Fibre</th>
<th>Amount of feed in kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roughage/Fibre 1</td>
<td></td>
</tr>
<tr>
<td>Roughage/Fibre 2</td>
<td></td>
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<tr>
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<tr>
<td>Roughage/Fibre 5</td>
<td></td>
</tr>
<tr>
<td>Roughage/Fibre 6</td>
<td></td>
</tr>
</tbody>
</table>
Feeding Practices and Supplement Use Among Australian Horse Owners

30. What is the main reason for choosing this type of roughage / fibre?
   - Cost
   - Ease of feeding
   - Trusted manufacturer
   - Ready availability
   - Recommended by trainer / coach
   - Recommended by veterinarian
   - Nutritional content
   - Palatability and minimal waste
   - Visual appearance
   - Other (please specify) __________________________________________________________

31. What complete / pre-mixed feed do you feed your young horse?
(Please list the brand and variety)

<table>
<thead>
<tr>
<th>Complete/Pre-mixed feed 1</th>
<th>Amount of feed in kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete/Pre-mixed feed 2</td>
<td>Amount of feed in kg</td>
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<tr>
<td>Complete/Pre-mixed feed 3</td>
<td>Amount of feed in kg</td>
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<tr>
<td>Complete/Pre-mixed feed 4</td>
<td>Amount of feed in kg</td>
</tr>
<tr>
<td>Complete/Pre-mixed feed 5</td>
<td>Amount of feed in kg</td>
</tr>
<tr>
<td>Complete/Pre-mixed feed 6</td>
<td>Amount of feed in kg</td>
</tr>
</tbody>
</table>

32. What is the main reason for choosing this complete / pre-mixed feed?
   - Cost
   - Ease of feeding
   - Trusted manufacturer
   - Ready availability
   - Recommended by trainer / coach
   - Recommended by veterinarian
   - Nutritional content
   - Palatability and minimal waste
   - Visual appearance
   - Other (please specify)________________________________________________________________
### Feeding Practices and Supplement Use Among Australian Horse Owners

#### 33. What grains and/or concentrates do you feed your young horse?

(Please list)

<table>
<thead>
<tr>
<th>Grains and/or Concentrates</th>
<th>Amount of feed in kg</th>
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<tbody>
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</tbody>
</table>

#### 34. What is the main reason for choosing these grains and/or concentrates?

- [ ] Cost
- [ ] Ease of feeding
- [ ] Trusted manufacturer
- [ ] Ready availability
- [ ] Recommended by trainer / coach
- [ ] Recommended by veterinarian
- [ ] Nutritional content
- [ ] Palatability and minimal waste
- [ ] Visual appearance
- [ ] Other (please specify) ____________________________________________________________

#### 35. What supplements and/or feed additives do you feed your young horse?

(Please list and enter amount in grams)

<table>
<thead>
<tr>
<th>Supplement and/or Additives</th>
<th>Amount of feed in g</th>
</tr>
</thead>
<tbody>
<tr>
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</table>

195
36. What is the main reason for choosing these supplements and/or feed additives?

- I don't feed any supplements
- I believe my weanling/s need these supplement/s
- Recommended by trainer / coach
- Recommended by veterinarian
- Recommended by feed supplier
- Nutritional content
- Trusted manufacturer
- Other (please specify)______________________________________________________________
Feeding Practices and Supplement Use Among Australian Horse Owners

Pregnant Mares

If you have more than one pregnant mare, please choose one and answer the following questions for that one.

1. Do you own / manage any pregnant mares?
   - Yes
   - No

2. How many months pregnant is your mare?
   - 1 - 4 months
   - 5 months
   - 6 months
   - 7 months
   - 8 months
   - 9 months
   - 10 months
   - 11 months

3. What breed is your pregnant mare?
   - Appaloosa
   - Arab
   - Australian Stock Horse
   - Clydesdale/Shire/Percheron/Heavy Draft Horse
   - Large Cob/Pony
   - Miniature Horse
   - Paint Horse
   - Quarter Horse
   - Shetland Pony
   - Standardbred
   - Thoroughbred
   - Thoroughbred Cross
   - Waler
   - Warmblood
   - Welsh Pony
   - Other (please specify) ____________________________________________________________
Feeding Practices and Supplement Use Among Australian Horse Owners

Pregnant mare body condition

4. From the descriptions shown above, which condition score best fits your pregnant mare?
   - 0: Very poor
   - 1: Poor
   - 2: Moderate
   - 3: Good
   - 4: Fat
   - 5: Very fat

5. If you know or can estimate your pregnant mare's weight, please record _____________ kg

6. Is your pregnant mare currently stabled?
   - Yes, stabled all of the time
   - Yes, stabled some of the time
   - No, never stabled – go to question 12 on page 28

7. Do you give your stabled pregnant mare turn out time?
   - Yes
   - No- go to question 12 on page 28

8. What type of area is your pregnant mare turned out into?
   - Arena
   - Day yard
   - Pasture
   - Other (please describe)
Feeding Practices and Supplement Use Among Australian Horse Owners

9. How often is your pregnant mare turned out into this area?
   - Daily
   - A few times per week
   - Once a week
   - Less than once a week

10. For approximately what length of time are they in the turn out area?
    - 15 - 30 minutes
    - 31 - 60 minutes
    - 1 - 2 hours
    - 2 - 3 hours
    - 3 - 4 hours
    - 4 - 5 hours
    - 6 hours or more

11. Does your pregnant mare have access to pasture?
    - Yes, all the time
    - Yes, some of the time
    - No – go to question 18 on page 30

12. What is the size of the pasture paddock? (Please specify in either hectares or acres below)
    - Hectares ___________________________
    - Acres ______________________________

13. Using the above images for comparison, what is the average grass cover in the pasture?
    - Less than 25%
    - 25%
    - 50%
    - 75%
    - 100%
Feeding Practices and Supplement Use Among Australian Horse Owners

14. How would you describe the length of the pasture?
   - Even and Short - cropped close to ground
   - Even and Medium - around hoof level
   - Even and Long - taller than hoof level
   - Uneven - patches of tall and short grazed

15. Please indicate the predominant pasture species if known:
(Please indicate all that apply)
   - Biserrula
   - Bluegrass
   - Buffel grass
   - Clover (white or strawberry)
   - Couch grass
   - Fescue
   - Kangaroo grass
   - Kikuyu
   - Lucerne
   - Oats
   - Panic grass species
   - Paspalum
   - Phalaris
   - Plantain
   - Rye grass
   - Salt bush
   - Snow grass
   - Spear grass
   - Subterranean clover
   - Wallaby grass
   - Wheat grass
   - Mainly weeds
   - Don't know
   - Other (please specify) __________________________________________________________

16. Does your pregnant mare graze with other domestic stock animals (including horses)?
   - Yes, all the time
   - Yes, some of the time
   - No
17. What other domestic stock animals does your young horse graze with?  
(Please select all that apply)  
- Other horses  
- Cattle  
- Sheep  
- Goats  
- Alpacas / Llamas

Pregnant mares – Feeding

18. Do you feed your pregnant mare in addition to their access to grazing?  
- Yes  
- No – continue to next section on Lactating mares on page 34

19. How many times a day do you feed your pregnant mare?  
- 1  
- 2  
- 3  
- 4  
- 5  
- 6  
- Feed Constantly Available

20. What type of roughage / fibre do you feed your pregnant mare?  
(Please list)
Feeding Practices and Supplement Use Among Australian Horse Owners

21. What is the main reason for choosing this type of roughage / fibre?
   - Cost
   - Ease of feeding
   - Trusted manufacturer
   - Ready availability
   - Recommended by trainer / coach
   - Recommended by veterinarian
   - Nutritional content
   - Palatability and minimal waste
   - Visual appearance
   - Other (please specify) __________________________________________________________

21. What complete / pre-mixed feed do you feed your pregnant mare?
(Please list the brand and variety)

<table>
<thead>
<tr>
<th>Complete/Pre-mixed feed 1</th>
<th>Amount of feed in kg</th>
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<tbody>
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</tr>
<tr>
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<td>Amount of feed in kg</td>
</tr>
</tbody>
</table>

22. What is the main reason for choosing this complete / pre-mixed feed?
   - Cost
   - Ease of feeding
   - Trusted manufacturer
   - Ready availability
   - Recommended by trainer / coach
   - Recommended by veterinarian
   - Nutritional content
   - Palatability and minimal waste
   - Visual appearance
   - Other (please specify)_________________________________________________________
Feeding Practices and Supplement Use Among Australian Horse Owners

23. What grains and/or concentrates do you feed your pregnant mare? (Please list)

<table>
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<td>Grains and/or Concentrates 5</td>
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<tr>
<td>Grains and/or Concentrates 6</td>
<td></td>
</tr>
</tbody>
</table>

24. What is the main reason for choosing these grains and/or concentrates?

- Cost
- Ease of feeding
- Trusted manufacturer
- Ready availability
- Recommended by trainer / coach
- Recommended by veterinarian
- Nutritional content
- Palatability and minimal waste
- Visual appearance
- Other (please specify) ____________________________________________

25. What supplements and/or feed additives do you feed your pregnant mare? (Please list and enter amount in grams)

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<td></td>
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</tbody>
</table>
Feeding Practices and Supplement Use Among Australian Horse Owners

26. What is the main reason for choosing these supplements and/or feed additives?
   - I don't feed any supplements
   - I believe my weanling/s need these supplement/s
   - Recommended by trainer / coach
   - Recommended by veterinarian
   - Recommended by feed supplier
   - Nutritional content
   - Trusted manufacturer
   - Other (please specify)______________________________________________________________

Next Section
Lactating Mares
Feeding Practices and Supplement Use Among Australian Horse Owners

Lactating Mares

If you have more than one lactating mare, please choose one and answer the following questions for that one.

1. Do you own / manage any lactating mares?
   - Yes
   - No

2. How many lactating mares do you own and/or manage in total?

   __________________________________________________________________________

3. On average how many months has your mare been lactating?
   - 1 months
   - 2 months
   - 3 months
   - 4 months
   - 5 months
   - 6 months

4. What breed is your lactating mare?
   - Appaloosa
   - Arab
   - Australian Stock Horse
   - Clydesdale/ Shire /Percheron /Heavy Draft Horse
   - Large Cob/ Pony
   - Miniature Horse
   - Paint Horse
   - Quarter Horse
   - Shetland Pony
   - Standardbred
   - Thoroughbred
   - Thoroughbred Cross
   - Waler
   - Warmblood
   - Welsh Pony
   - Other (please specify)_______________________________________________________
Feeding Practices and Supplement Use Among Australian Horse Owners

Lactating mare body condition

5. From the descriptions shown above, which condition score best fits your lactating mare?
   - 0: Very poor
   - 1: Poor
   - 2: Moderate
   - 3: Good
   - 4: Fat
   - 5: Very fat

6. If you know or can estimate your lactating mare's weight, please record _______________kg

7. Is your lactating mare currently stabled?
   - Yes, stabled all of the time
   - Yes, stabled some of the time
   - No, never stabled – go to question 12 on page 36

8. Do you give your stabled lactating mare turn out time?
   - Yes
   - No- go to question 12 on page 36

9. What type of area is your lactating mare turned out into?
   - Arena
   - Day yard
   - Pasture
   - Other (please describe)
Feeding Practices and Supplement Use Among Australian Horse Owners

10. How often is your lactating mare turned out into this area?
   - Daily
   - A few times per week
   - Once a week
   - Less than once a week

11. For approximately what length of time are they in the turn out area?
   - 15 - 30 minutes
   - 31 - 60 minutes
   - 1 - 2 hours
   - 2 - 3 hours
   - 3 - 4 hours
   - 4 - 5 hours
   - 6 hours or more

12. Does your lactating mare have access to pasture?
   - Yes, all the time
   - Yes, some of the time
   - No – go to question 19 on page 38

13. What is the size of the pasture paddock?
   (Please specify in either hectares or acres below)
   - Hectares ____________________________
   - Acres ______________________________

14. Using the above images for comparison, what is the average grass cover in the pasture?
   - Less than 25%
   - 25%
   - 50%
   - 75%
   - 100%
Feeding Practices and Supplement Use Among Australian Horse Owners

15. How would you describe the length of the pasture?
   - Even and Short - cropped close to ground
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16. Please indicate the predominant pasture species if known: (Please indicate all that apply)
   - Biserrula
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   - Lucerne
   - Oats
   - Panic grass species
   - Paspalum
   - Phalaris
   - Plantain
   - Rye grass
   - Salt bush
   - Snow grass
   - Spear grass
   - Subterraneal clover
   - Wallaby grass
   - Wheat grass
   - Mainly weeds
   - Don't know
   - Other (please specify) __________________________________________________________

17. Does your lactating mare graze with other domestic stock animals (including horses)?
   - Yes, all the time
   - Yes, some of the time
   - No
18. What other domestic stock animals does your lactating mare graze with? *(Please select all that apply)*
- Other horses
- Cattle
- Sheep
- Goats
- Alpacas / Llamas

**Lactating mare/s – Feeding**

19. Do you feed your lactating mare in addition to their access to grazing?  
- Yes
- No – continue to next section on Mature Horses on page 42

20. How many times a day do you feed your lactating mare?  
- 1  
- 2  
- 3  
- 4  
- 5  
- 6  
- Feed Constantly Available

21. What type of roughage / fibre do you feed your lactating mare? *(Please list)*

<table>
<thead>
<tr>
<th>Roughage/Fibre</th>
<th>Amount of feed in kg</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
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<tr>
<td>Roughage/Fibre 5</td>
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<tr>
<td>Roughage/Fibre 6</td>
<td></td>
</tr>
</tbody>
</table>
22. What is the main reason for choosing this type of roughage / fibre?

- Cost
- Ease of feeding
- Trusted manufacturer
- Ready availability
- Recommended by trainer / coach
- Recommended by veterinarian
- Nutritional content
- Palatability and minimal waste
- Visual appearance
- Other (please specify) __________________________________________________________

23. What complete / pre-mixed feed do you feed your lactating mare? 
(Please list the brand and variety)

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<tr>
<td>Complete/Pre-mixed feed 4</td>
<td>Amount of feed in kg</td>
</tr>
<tr>
<td>Complete/Pre-mixed feed 5</td>
<td>Amount of feed in kg</td>
</tr>
<tr>
<td>Complete/Pre-mixed feed 6</td>
<td>Amount of feed in kg</td>
</tr>
</tbody>
</table>

24. What is the main reason for choosing this complete / pre-mixed feed?

- Cost
- Ease of feeding
- Trusted manufacturer
- Ready availability
- Recommended by trainer / coach
- Recommended by veterinarian
- Nutritional content
- Palatability and minimal waste
- Visual appearance
- Other (please specify) __________________________________________________________
25. What grains and/or concentrates do you feed your lactating mare?  
(Please list)

<table>
<thead>
<tr>
<th>Grains and/or Concentrates</th>
<th>Amount of feed in kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grains and/or Concentrates 1</td>
<td></td>
</tr>
<tr>
<td>Grains and/or Concentrates 2</td>
<td></td>
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<tr>
<td>Grains and/or Concentrates 3</td>
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<tr>
<td>Grains and/or Concentrates 4</td>
<td></td>
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<tr>
<td>Grains and/or Concentrates 5</td>
<td></td>
</tr>
<tr>
<td>Grains and/or Concentrates 6</td>
<td></td>
</tr>
</tbody>
</table>

26. What is the main reason for choosing these grains and/or concentrates?  
- [ ] Cost  
- [ ] Ease of feeding  
- [ ] Trusted manufacturer  
- [ ] Ready availability  
- [ ] Recommended by trainer / coach  
- [ ] Recommended by veterinarian  
- [ ] Nutritional content  
- [ ] Palatability and minimal waste  
- [ ] Visual appearance  
- [ ] Other (please specify) ____________________________________

27. What supplements and/or feed additives do you feed your lactating mare?  
(Please list and enter amount in grams)

<table>
<thead>
<tr>
<th>Supplement and/or Additives</th>
<th>Amount of feed in g</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
</tr>
<tr>
<td>Supplement and/or Additives 5</td>
<td></td>
</tr>
<tr>
<td>Supplement and/or Additives 6</td>
<td></td>
</tr>
</tbody>
</table>
26. What is the main reason for choosing these supplements and/or feed additives?

- I don't feed any supplements
- I believe my weanling/s need these supplement/s
- Recommended by trainer / coach
- Recommended by veterinarian
- Recommended by feed supplier
- Nutritional content
- Trusted manufacturer
- Other (please specify) ____________________________________________

Next Section
Mature Horses (between 2 ½ - 20 years old)
Mature Horses (Between 2½ - 20 years old)

If you have more than one mature horse (2.5 - 20 years old), please choose one and answer the following questions for that one.

1. Do you own / manage any mature horses (including non-breeding mares, geldings and stallions)?
   - Yes
   - No – continue to next section Aged Horses on page 52

2. How many mature horses of each category do you own / manage in total?
   - Non-breeding mares ____________________________
   - Stallions ____________________________
   - Geldings ____________________________

3. What gender is the mature horse that you are recording today?
   - Mare
   - Gelding
   - Stallion

4. What breed is your mature horse?
   - Appaloosa
   - Arab
   - Australian Stock Horse
   - Clydesdale/ Shire /Percheron /Heavy Draft Horse
   - Large Cob/ Pony
   - Miniature Horse
   - Paint Horse
   - Quarter Horse
   - Shetland Pony
   - Standardbred
   - Thoroughbred
   - Thoroughbred Cross
   - Waler
   - Warmblood
   - Welsh Pony
   - Other (please specify) ____________________________
Mature horses - Exercise and training

5. Is your mature horse currently in work / training?
   - Yes
   - No – continue to question 12 on page 45

6. What discipline/s are you working / training your mature horse in?
   (Please indicate all that apply)
   - Camp Drafting
   - Dressage
   - Driving
   - Endurance
   - Eventing
   - Flat Racing
   - Harness Racing
   - Jumps Racing
   - Pleasure Riding
   - Polo
   - Pony Club
   - Reining
   - School Horse
   - Show Horse
   - Show Jumping
   - Trail Riding
   - Western Pleasure
   - Other (please specify)____________________________________________________________

7. How many sessions per week do you work / train your mature horse?
   - 1
   - 2
   - 3
   - 4
   - 5
   - 6
   - 7
   - 8
   - 9
   - 10
   - 11
   - 12
Feeding Practices and Supplement Use Among Australian Horse Owners

8. How long do you walk your mature horse in a session?
- 0 minutes
- 5 minutes
- 10 minutes
- 15 minutes
- 20 minutes
- 30 minutes
- 45 minutes
- 1 hour
- 1.5 hours
- 2 hours or more

9. How long do you trot your mature horse in a session?
- 0 minutes
- 5 minutes
- 10 minutes
- 15 minutes
- 20 minutes
- 30 minutes
- 45 minutes
- 1 hour
- 1.5 hours
- 2 hours or more

10. How long do you canter your mature horse in a session?
- 0 minutes
- 5 minutes
- 10 minutes
- 15 minutes
- 20 minutes
- 30 minutes
- 45 minutes
- 1 hour or more

11. How long do you gallop your mature horse in a session?
- 0 minutes
- 2 minutes
- 5 minutes
- 10 minutes
- 15 minutes
- 20 minutes
- 30 minutes
Feeding Practices and Supplement Use Among Australian Horse Owners

Mature horses – Body Condition

12. From the descriptions shown above, which condition score best fits your mature horse?

- 0: Very poor
- 1: Poor
- 2: Moderate
- 3: Good
- 4: Fat
- 5: Very fat

Mature horses - Stabling, agistment and pasture management

13. If you know or can estimate your mature horse’s weight please record ________________kg

14. Is your mature horse currently stabled?

- Yes, stabled all of the time
- Yes, stabled some of the time
- No, never stabled – please go to question 19 on page 46

15. Do you give your stabled mature horse turn out time?

- Yes
- No - please go to question 19 on page 46

16. What type of area is your mature horse turned out into?

- Arena
- Day yard
- Pasture
- Other (please describe) ________________________________________________
Feeding Practices and Supplement Use Among Australian Horse Owners

17. How often is your mature horse turned out into this area?
   - Daily
   - A few times per week
   - Once a week
   - Less than once a week

18. For approximately what length of time are they in the turn out area?
   - 15 - 30 minutes
   - 31 - 60 minutes
   - 1 - 2 hours
   - 2 - 3 hours
   - 3 - 4 hours
   - 4 - 5 hours
   - 6 hours or more

19. Does your mature horse have access to pasture?
   - Yes, all the time
   - Yes, some of the time
   - No – please go to question 26 on page 48

20. What is the size of the pasture paddock?
    (Please specify in either hectares or acres below)
    - Hectares ________________________________
    - Acres _________________________________

21. Using the above images for comparison, what is the average grass cover in the pasture?
   - Less than 25%
   - 25%
   - 50%
   - 75%
   - 100%
Feeding Practices and Supplement Use Among Australian Horse Owners

22. How would you describe the length of the pasture?
   - Even and Short - cropped close to ground
   - Even and Medium - around hoof level
   - Even and Long - taller than hoof level
   - Uneven - patches of tall and short grazed

23. Please indicate the predominant pasture species if known:
(Please indicate all that apply)
   - Biserrula
   - Bluegrass
   - Buffel grass
   - Clover (white or strawberry)
   - Couch grass
   - Fescue
   - Kangaroo grass
   - Kikuyu
   - Lucerne
   - Oats
   - Panic grass species
   - Paspalum
   - Phalaris
   - Plantain
   - Rye grass
   - Salt bush
   - Snow grass
   - Spear grass
   - Subterranean clover
   - Wallaby grass
   - Wheat grass
   - Mainly weeds
   - Don't know
   - Other (please specify) ____________________________________________________________

24. Does your mature horse graze with other domestic stock animals (including other horses)?
   - Yes, all the time
   - Yes, some of the time
   - No
Feeding Practices and Supplement Use Among Australian Horse Owners

25. What other domestic stock animals does your mature horse graze with? *(Please select all that apply)*
- Other horses
- Cattle
- Sheep
- Goats
- Alpacas / Llamas

Mature Horses – Feeding

26. Do you feed your mature horse in addition to their access to grazing?
- Yes
- No – continue to next section on Aged mares on page 52

27. How many times a day do you feed your mature horse?
- 1
- 2
- 3
- 4
- 5
- 6
- Feed Constantly Available

28. What type of roughage / fibre do you feed your mature horse? *(Please list)*

<table>
<thead>
<tr>
<th>Roughage/Fibre</th>
<th>Amount of feed in kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roughage/Fibre 1</td>
<td></td>
</tr>
<tr>
<td>Roughage/Fibre 2</td>
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<tr>
<td>Roughage/Fibre 3</td>
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<tr>
<td>Roughage/Fibre 4</td>
<td></td>
</tr>
<tr>
<td>Roughage/Fibre 5</td>
<td></td>
</tr>
<tr>
<td>Roughage/Fibre 6</td>
<td></td>
</tr>
</tbody>
</table>
Feeding Practices and Supplement Use Among Australian Horse Owners

29. What is the main reason for choosing this type of roughage / fibre?
   - Cost
   - Ease of feeding
   - Trusted manufacturer
   - Ready availability
   - Recommended by trainer / coach
   - Recommended by veterinarian
   - Nutritional content
   - Palatability and minimal waste
   - Visual appearance
   - Other (please specify) __________________________________________________________

30. What complete / pre-mixed feed do you feed your mature horse?  
   *(Please list the brand and variety)*

<table>
<thead>
<tr>
<th>Complete/Pre-mixed feed 1</th>
<th>Amount of feed in kg</th>
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<tbody>
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<table>
<thead>
<tr>
<th>Complete/Pre-mixed feed 2</th>
<th>Amount of feed in kg</th>
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<table>
<thead>
<tr>
<th>Complete/Pre-mixed feed 3</th>
<th>Amount of feed in kg</th>
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<table>
<thead>
<tr>
<th>Complete/Pre-mixed feed 4</th>
<th>Amount of feed in kg</th>
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<table>
<thead>
<tr>
<th>Complete/Pre-mixed feed 5</th>
<th>Amount of feed in kg</th>
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</table>

<table>
<thead>
<tr>
<th>Complete/Pre-mixed feed 6</th>
<th>Amount of feed in kg</th>
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</tbody>
</table>

31. What is the main reason for choosing this complete / pre-mixed feed?
   - Cost
   - Ease of feeding
   - Trusted manufacturer
   - Ready availability
   - Recommended by trainer / coach
   - Recommended by veterinarian
   - Nutritional content
   - Palatability and minimal waste
   - Visual appearance
   - Other (please specify)________________________________________________________
Feeding Practices and Supplement Use Among Australian Horse Owners

32. What grains and/or concentrates do you feed your mature horse? *(Please list)*

<table>
<thead>
<tr>
<th>Grains and/or Concentrates</th>
<th>Amount of feed in kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
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<td>2</td>
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<td>3</td>
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<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

33. What is the main reason for choosing these grains and/or concentrates?  
- Cost  
- Ease of feeding  
- Trusted manufacturer  
- Ready availability  
- Recommended by trainer / coach  
- Recommended by veterinarian  
- Nutritional content  
- Palatability and minimal waste  
- Visual appearance  
- Other (please specify) ____________________________________________

34. What supplements and/or feed additives do you feed your mature horse? *(Please list and enter amount in grams)*

<table>
<thead>
<tr>
<th>Supplement and/or Additives</th>
<th>Amount of feed in g</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
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<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
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<td>4</td>
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</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

221
35. What is the main reason for choosing these supplements and/or feed additives?
- I don't feed any supplements
- I believe my weanling/s need these supplement/s
- Recommended by trainer / coach
- Recommended by veterinarian
- Recommended by feed supplier
- Nutritional content
- Trusted manufacturer
- Other (please specify)______________________________________________________________
Feeding Practices and Supplement Use Among Australian Horse Owners

Aged Horses (Over 20 years old)

If you have more than one aged horse (over 20 years old), please choose one and answer the following questions for that one.

1. Do you own or manage any aged horses (over 20 years old)?
   - Yes – continue
   - No – end of survey

2. How many aged horses do you own and/or manage in total?

3. What gender the aged horse you are recording today?
   - Mare
   - Gelding
   - Stallion

4. What breed are most of your aged horses?
   - Appaloosa
   - Arab
   - Australian Stock Horse
   - Clydesdale/ Shire /Percheron /Heavy Draft Horse
   - Large Cob/ Pony
   - Miniature Horse
   - Paint Horse
   - Quarter Horse
   - Shetland Pony
   - Standardbred
   - Thoroughbred
   - Thoroughbred Cross
   - Waler
   - Warmblood
   - Welsh Pony
   - Other (please specify) ________________________________
Feeding Practices and Supplement Use Among Australian Horse Owners

Aged horses - Exercise and training

5. Is your aged horse currently in work / training?
   - Yes
   - No – continue to question 12 on page 55

6. What discipline/s are you working / training your aged horse in? (Please indicate all that apply)
   - Camp Drafting
   - Dressage
   - Driving
   - Endurance
   - Eventing
   - Flat Racing
   - Harness Racing
   - Jumps Racing
   - Pleasure Riding
   - Polo
   - Pony Club
   - Reining
   - School Horse
   - Show Horse
   - Show Jumping
   - Trail Riding
   - Western Pleasure
   - Other (please specify)____________________________________________________________

7. How many sessions per week do you work / train your aged horse?
   - 1
   - 2
   - 3
   - 4
   - 5
   - 6
   - 7
   - 8
   - 9
   - 10
   - 11
   - 12
### Feeding Practices and Supplement Use Among Australian Horse Owners

8. **How long do you walk your aged horse in a session?**
   - 0 minutes
   - 5 minutes
   - 10 minutes
   - 15 minutes
   - 20 minutes
   - 30 minutes
   - 45 minutes
   - 1 hour
   - 1.5 hours
   - 2 hours or more

9. **How long do you trot your aged horse in a session?**
   - 0 minutes
   - 5 minutes
   - 10 minutes
   - 15 minutes
   - 20 minutes
   - 30 minutes
   - 45 minutes
   - 1 hour
   - 1.5 hours
   - 2 hours or more

10. **How long do you canter your aged horse in a session?**
    - 0 minutes
    - 5 minutes
    - 10 minutes
    - 15 minutes
    - 20 minutes
    - 30 minutes
    - 45 minutes
    - 1 hour or more

11. **How long do you gallop your aged horse in a session?**
    - 0 minutes
    - 2 minutes
    - 5 minutes
    - 10 minutes
    - 15 minutes
    - 20 minutes
    - 30 minutes
Feeding Practices and Supplement Use Among Australian Horse Owners

Aged horses – Body Condition

12. From the descriptions shown above, which condition score best fits your aged horse/s?
   - 0: Very poor
   - 1: Poor
   - 2: Moderate
   - 3: Good
   - 4: Fat
   - 5: Very fat

13. If you know or can estimate your aged horse’s weight, please record ______________kg

Aged horses - Stabling, agistment and pasture management

14. Is your aged horse currently stabled?
   - Yes, stabled all of the time
   - Yes, stabled some of the time
   - No, never stabled – please go to question 19 on page 56

15. Do you give your stabled aged horse turn out time?
   - Yes
   - No- please go to question 19 on page 56

16. What type of area is your aged horse turned out into?
   - Arena
   - Day yard
   - Pasture
   - Other (please describe) _______________________________________________
17. How often is your aged horse turned out into this area?
   - Daily
   - A few times per week
   - Once a week
   - Less than once a week

18. For approximately what length of time are they in the turn out area?
   - 15 - 30 minutes
   - 31 - 60 minutes
   - 1 - 2 hours
   - 2 - 3 hours
   - 3 - 4 hours
   - 4 - 5 hours
   - 6 hours or more

19. Does your aged horse have access to pasture?
   - Yes, all the time
   - Yes, some of the time
   - No – please go to question 26 on page 58

20. What is the size of the pasture paddock?
    (Please specify in either hectares or acres below)
   - Hectares ________________________________
   - Acers ________________________________

21. Using the above images for comparison, what is the average grass cover in the pasture?
   - Less than 25%
   - 25%
   - 50%
   - 75%
   - 100%
Feeding Practices and Supplement Use Among Australian Horse Owners

22. How would you describe the length of the pasture?
   - Even and Short - cropped close to ground
   - Even and Medium - around hoof level
   - Even and Long - taller than hoof level
   - Uneven - patches of tall and short grazed

23. Please indicate the predominant pasture species if known:
   (Please indicate all that apply)
   - Biserrula
   - Bluegrass
   - Buffel grass
   - Clover (white or strawberry)
   - Couch grass
   - Fescue
   - Kangaroo grass
   - Kikuyu
   - Lucerne
   - Oats
   - Panic grass species
   - Paspalum
   - Phalaris
   - Plantain
   - Rye grass
   - Salt bush
   - Snow grass
   - Spear grass
   - Subterranean clover
   - Wallaby grass
   - Wheat grass
   - Mainly weeds
   - Don't know
   - Other (please specify) __________________________________________________________

24. Does your aged horse graze with other domestic stock animals (including other horses)?
   - Yes, all the time
   - Yes, some of the time
   - No
Feeding Practices and Supplement Use Among Australian Horse Owners

25. What other domestic stock animals does your aged horse graze with?  
(Please select all that apply)
- Other horses
- Cattle
- Sheep
- Goats
- Alpacas / Llamas

Aged Horses – Feeding

26. Do you feed your aged horse in addition to their access to grazing?
- Yes
- No – end of survey

27. How many times a day do you feed your aged horse?
- 1
- 2
- 3
- 4
- 5
- 6
- Feed Constantly Available

28. What type of roughage / fibre do you feed your aged horse?  
(Please list)

<table>
<thead>
<tr>
<th>Roughage/Fibre 1</th>
<th>Amount of feed in kg</th>
</tr>
</thead>
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</tr>
<tr>
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<td>Amount of feed in kg</td>
</tr>
<tr>
<td>Roughage/Fibre 6</td>
<td>Amount of feed in kg</td>
</tr>
</tbody>
</table>
Feeding Practices and Supplement Use Among Australian Horse Owners

29. What is the main reason for choosing this type of roughage / fibre?
   - Cost
   - Ease of feeding
   - Trusted manufacturer
   - Ready availability
   - Recommended by trainer / coach
   - Recommended by veterinarian
   - Nutritional content
   - Palatability and minimal waste
   - Visual appearance
   - Other (please specify) __________________________________________________________

30. What complete / pre-mixed feed do you feed your aged horse?
(Please list the brand and variety)

   | Complete/Pre-mixed feed 1 | Amount of feed in kg |
   | Complete/Pre-mixed feed 2 | Amount of feed in kg |
   | Complete/Pre-mixed feed 3 | Amount of feed in kg |
   | Complete/Pre-mixed feed 4 | Amount of feed in kg |
   | Complete/Pre-mixed feed 5 | Amount of feed in kg |
   | Complete/Pre-mixed feed 6 | Amount of feed in kg |

31. What is the main reason for choosing this complete / pre-mixed feed?
   - Cost
   - Ease of feeding
   - Trusted manufacturer
   - Ready availability
   - Recommended by trainer / coach
   - Recommended by veterinarian
   - Nutritional content
   - Palatability and minimal waste
   - Visual appearance
   - Other (please specify)________________________________________________________________
### Feeding Practices and Supplement Use Among Australian Horse Owners

32. What grains and/or concentrates do you feed your aged horse?
*(Please list)*

<table>
<thead>
<tr>
<th>Grains and/or Concentrates</th>
<th>Amount of feed in kg</th>
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<tbody>
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<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

33. What is the main reason for choosing these grains and/or concentrates?

- [ ] Cost
- [ ] Ease of feeding
- [ ] Trusted manufacturer
- [ ] Ready availability
- [ ] Recommended by trainer / coach
- [ ] Recommended by veterinarian
- [ ] Nutritional content
- [ ] Palatability and minimal waste
- [ ] Visual appearance
- [ ] Other (please specify) __________________________________________________

34. What supplements and/or feed additives do you feed your aged horse?
*(Please list and enter amount in grams)*

<table>
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<tr>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>
35. What is the main reason for choosing these supplements and/or feed additives?
- I don't feed any supplements
- I believe my weanling/s need these supplement/s
- Recommended by trainer / coach
- Recommended by veterinarian
- Recommended by feed supplier
- Nutritional content
- Trusted manufacturer
- Other (please specify)______________________________________________________________

End of Survey

Thank you very much for your participation and supplying this information about your feeding practices and supplement use with your horse/s.